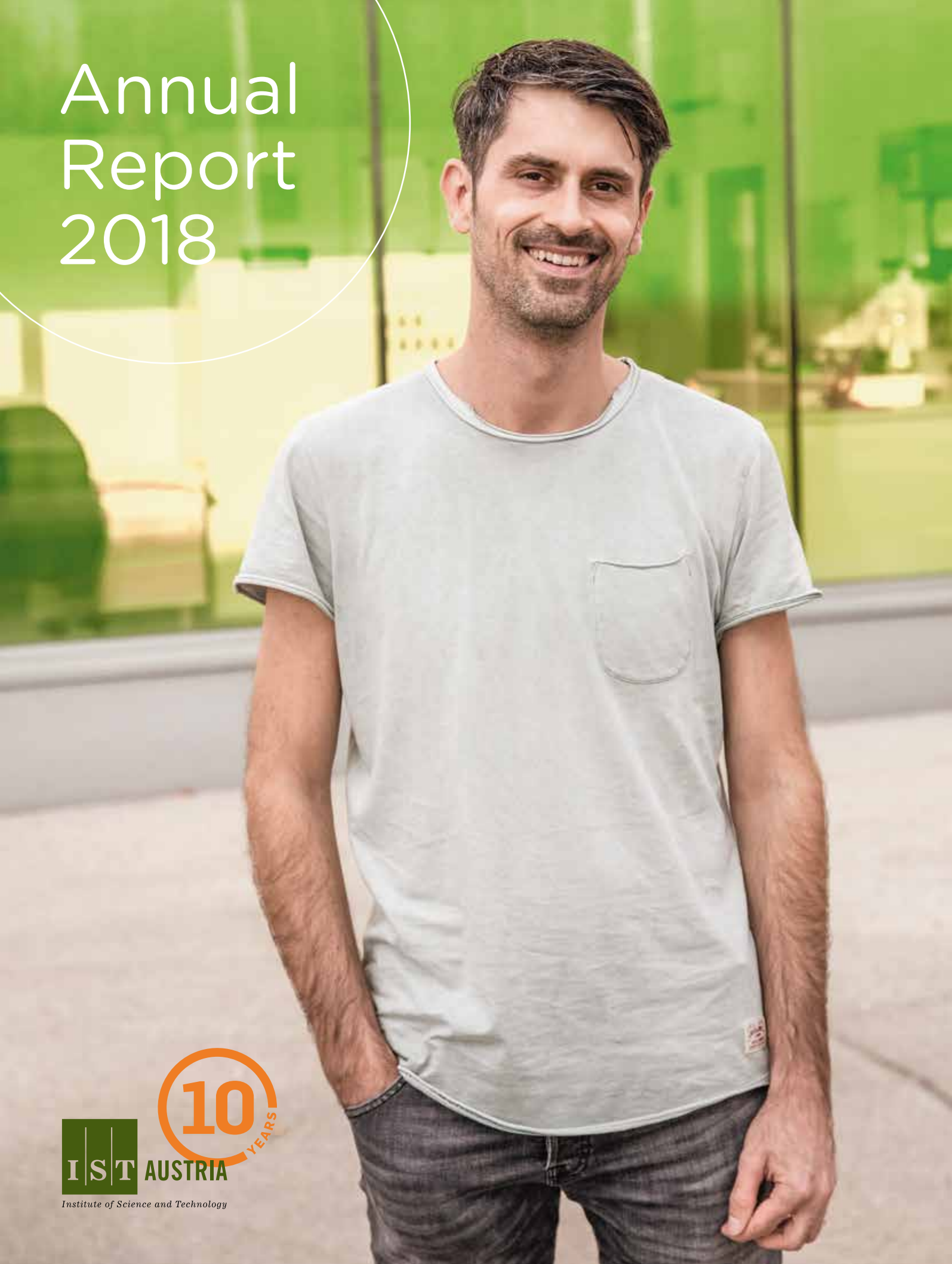
Annual Report 2018



IST AUSTRIA
Institute of Science and Technology

10 YEARS

The Scientists of IST Austria

Scientists come from all over the world to conduct research at IST Austria. This map provides an overview of the nationalities on campus.

IST Austria scientists by country of previous institution

Austria	15.6%
Germany	13.8%
USA	11.1%
UK	7.2%
Spain	4.5%
France	4.5%
Italy	4.2%
Switzerland	3.6%
Czech Republic	3.3%
China	3.0%
Russia	2.7%
India	2.4%
Other	24.1%

IST Austria scientists by nationality

Austria	15.6%
Germany	11.1%
Italy	5.7%
Russia	5.1%
China	4.8%
Slovakia	4.5%
Hungary	4.2%
India	4.2%
Poland	3.3%
Czech Republic	3.3%
France	3.0%
Spain	2.7%
UK	2.4%
United States	2.4%
Other	27.7%

North America

Canada
Mexico
USA

South America

Argentina
Bolivia
Brazil
Chile
Colombia

Europe

Austria
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Italy
Lithuania
Netherlands
Poland
Portugal
Romania
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
UK
Ukraine

Asia

Afghanistan
China
India
Iran
Israel
Japan
Jordan
Nepal
Palestine
Russia
Turkey
Vietnam

Oceania

Australia

Content

Foreword

Thomas A. Henzinger
President, IST Austria

Almost ten years ago, in June 2009, our campus in Klosterneuburg was officially inaugurated and opened its doors to welcome the first staff and scientists, embarking on a path towards the ambitious goal of becoming a beacon for scientific excellence in Austria and worldwide. 2019 will be a year of celebration for us, as well as a year of reflection and planning, as we enter the next phase of the Institute's development.

The past decade has seen the campus grow into a productive, vibrant center for basic research of the highest quality, as evidenced by the very encouraging figures in this year's annual *Nature Index* survey. Of all research institutions established within the last 30 years, IST Austria is ranked eighth among the "rising stars" of the world, the only institution outside of Asia to appear in the top ten. Another positive sign is our faculty's continuing success in acquiring funding from the European Research Council (ERC), the premier funding source for basic research in the EU. With 50% of the grant applications awarded, IST Austria has by far the highest success rate in Europe among all research institutions hosting more than 30 ERC grantees. Currently, about two thirds of our faculty have obtained at least one ERC grant, including two Starting Grants awarded in 2018 to computer scientist Dan Alistarh and physicist Mikhail Lemeshko. With Herbert Edelsbrunner, the Institute hosts already the third Wittgenstein Award—the highest honor of the Austrian Science Fund (FWF)—in its first ten years.

The campus community continues to grow: around 700 scientists and staff are currently employed, among them four new faculty members. These new group leaders strengthen the Institute's research profile in number theory, neurobiology, quantum physics, and soft-matter physics. The past year also saw two successful tenure evaluations: biologist Călin Guet and mathematician Uli Wagner were promoted to full professors.

In June, we celebrated the achievements of 18 new PhDs. In the past decade, a total of 60 students have obtained their doctoral degrees and left the Institute to pursue their next career steps. Our growing network of alumni have taken on positions in over 30 different countries, from Australia to Poland, and at organizations including Harvard University and Google.

Remaining at the forefront of science requires cutting-edge equipment and services. One of our largest investments so far, the Nobel prize-winning technology of cryo-electron microscopy, will be available for use on campus in early 2019.

Construction on campus is progressing as planned. In October, IST Austria held the groundbreaking ceremony for Lab Building Five, the future home of chemistry laboratories, the Graduate School, and the Institute's library. Also, the winning projects for the sixth science building and a campus visitor center were selected this year. The latter will be the future home of the Institute's outreach and educational activities; these will comprise a broad program including the hosting of school visits and the organization of regular events such as the Science Education Day, which took place for the first time in 2018. Our technology transfer activities are also ramping up: the construction of the IST Technology Park is progressing rapidly, and the Institute's incubator fund is supporting its first two start-up companies.

This year has given us many reasons to be confident about the future of IST Austria. At the same time, we continue to depend on the strong support of our public and private partners. We are grateful to all donors, supporters, and friends of IST Austria, especially the Federal Minister of Science, Education, and Research, Heinz Faßmann, and the Governor of Lower Austria, Johanna Mikl-Leitner, who have shown their steadfast commitment to our ambitious plans and to the Institute's founding principles of excellence, internationality, and independence. The coming decade will present new milestones to reach and new challenges to overcome, and achieving our aspirations will also depend on engaging new partners. With supporters both old and new, we are eager to take on these challenges and continue to work towards becoming a globally recognized institution for basic science and doctoral education in Austria.

Haim Harari

Chair of the Executive Committee of the Board of Trustees, IST Austria, since 2006
Former President, Weizmann Institute of Science, Rehovot, Israel

More than fifty years ago, I began my studies towards an MSc degree at the Weizmann Institute in Israel. I have been associated with that institute as a PhD student, a young professor, department head, dean, president for 13 years, founder of several new enterprises in and around it, and now as a partly retired, partly active "institute professor". During those years, I have sampled numerous European and American research organizations, serving in many different capacities and activities. I committed endless errors, learned many lessons, and even took some successful steps and decisions. Among other countries, I became familiar with the basic research landscape of Austria, and family reasons attached me further to the country. When, at the beginning of the new millennium, Anton Zeilinger started campaigning for the creation of a new outstanding basic research institute in Austria, I was not surprised that the planning team consulted me. However, when the project nearly collapsed, for administrative and political reasons, I was amazed to find myself as the chair of the new international team that had to redesign and restart the project, and later as an active member of its Board of Trustees.

So, you want to create an outstanding new institute for basic research. What are the "must" components? First, absolute top quality, defining a high threshold below which no scientist can join the institute. Second, a commitment to allow and enable each outstanding researcher to pursue his or her preferred research program and goals, using the best facilities and instrumentation. Third, a broad mélange of scientific fields, covering many areas of science, including, but not only, multidisciplinary and interdisciplinary endeavors. Fourth, an international atmosphere, collaborations, guest and travel programs, and a dominant working language. Fifth, ample, but not exaggerated, operating and construction budgets, with diversified sources of funding. Sixth, permission to train students and grant degrees in PhD and MSc programs. Seventh, no external political or business interference in the science and management of the organization. Eighth, an optimal rate of growth, allowing the creation of a critical mass in one new area after another, without compromising quality for the sake of rapid growth. Ninth, contributing to the national and international economy and to human development, by exploiting intellectual property created by the institute scientists, without allowing it to redirect research programs away from basic science. Tenth, contributing to society in a variety of other ways, primarily by advancing science education for young and old and bringing an awareness of science to every mind.

In many ways, this blueprint is an approximate description of the Weizmann Institute, an outstanding multidisciplinary basic research institute (but not at all the best in the world), with its own graduate degree programs, international flavor, and highly diversified sources of funding. It is also an absolute world leader in contributing to science education and in creating jobs with, and benefitting from its own intellectual property. IST Austria is, in some aspects, an approximate replica of that success story, and in important other respects, a brand new model for others.

The above ten-course menu is a tall order, but that is what IST Austria was supposed to do, and happily, that is exactly what it has already partly done, with a few items in the above list still works in progress. In 2019, we are 17 years after conception, 13 years after the creation of the blueprint, and 10 years after inaugurating the first research buildings and facilities. It has been a real success story, but the road ahead is still long, winding, and treacherous. It is a story with many heroes, far too numerous to be counted here by name, and very few villains, and it has the clear potential of establishing a true new European lighthouse of basic research, for the benefit of humanity.

Catherine Cesarsky

Member of the Board of Trustees, IST Austria, since 2006;
member of the Scientific Board, IST Austria, 2007–2009
Chief Scientific Advisor, Former High Commissioner for Atomic Energy, CEA-Saclay, Gif-sur-Yvette, France

I was invited to participate in the Board of IST Austria very early on, in 2006. I received the visionary report by Haim Harari, Olaf Kübler, and Hubert Markl, and was tremendously impressed with it. The report took inspiration from the best proven practices of institutions from around the world—hiring practices like those at ETH Zurich, career paths similar to the US university system, technology transfer and fundraising as pursued by the Weizmann Institute of Science, and so on—and used them to shape a beautifully coherent proposal. Another essential ingredient was the independence of the Institute. I had been involved in many advisory committees of university departments and research centers, but this was the first time I had a chance to see an ambitious science institute born *ex nihilo*. I was intrigued and excited by the prospect, and I accepted. The Board, run with skill and determination by Claus Raidl, and comprising top scientists from Austria and the world, was always congenial and effective. I was particularly pleased to see that the role of basic research in shaping the future always was taken for granted here.

At the beginning, there was no Institute, so we met in various places in Vienna and visited the site just before the work on the grounds and buildings started. We spent time discussing topics such as the name and logo, the choice of disciplines… When the search for professors was launched, I was part of the first Scientific Board involved in this endeavor. From the very start, the standards were incredibly high, only stellar researchers had a chance of joining the Institute. Later on, the big topic, of course, was the search for the first president.

There again, a remarkable personality, Thomas Henzinger, was found and accepted the responsibility for developing the Institute; this again was a most felicitous selection. At the beginning, the intention was to first hire a set of established professors and let them build up their groups and play a role in the hiring of junior scientists. Soon, we realized that it took time and persuasion to convince senior professors to leave their institutions and move to the IST Austria campus, and thus the pace of growth of the Institute could be compromised. We decided to proceed faster than originally planned with the hiring of junior scientists, still keeping the original very high standards and betting on their promise as future leaders. In the end, it worked out. Now that the faculty of the Institute comprises more than 50 professors and assistant professors, it has become much easier to continue expanding the faculty. The excellence of the hiring, at all levels, is reflected in the fact that IST Austria is the institute with the highest proportion of ERC grantees, and by far, the highest rate of acceptance of ERC proposals, among those institutes with over 30 ERC grants. The Graduate School is also thriving, and has granted more than 60 PhD degrees.

Ten years after its creation, IST Austria is an undisputed success. All the original goals have been achieved and surpassed; the scientific output is of the utmost quality. Austria as a nation and Lower Austria in particular can legitimately boast about hosting a world-class institute in fundamental research, whose visibility will only continue to grow. As for me, I have been fascinated all along by the development of the Institute. I am glad to have been able to take part in this exciting endeavor.

10 YEARS

IST AUSTRIA

Institute of Science and Technology

“The path from curiosity-driven research to practical inventions, which change the world, is often unpredictable.

But all such results emerge from the work of outstanding individuals, who lead research teams and are allowed and encouraged to pursue their own self-defined scientific goals.”

Excerpt from the founding document of IST Austria, written by Haim Harari, Olaf Kübler, and Hubert Markl

Excerpts from the founding document of IST Austria,
written by Haim Harari, Olaf Kübler, and Hubert Markl

“Scientific research has always been a rewarding intellectual activity. But in the last few decades, scientific knowledge has also become a leading economic asset. Today, sustainable human development depends on a successful research program, starting with a top quality effort in basic science.”

“Today, the successful pursuit of scientific knowledge is not only an exciting intellectual endeavor. It is also an absolute necessity for any country wishing to achieve economic success and a sustainable advanced way of life.”

“High quality research will inevitably lead to usable practical results, but we can predict neither the time scale, nor the direction, in which this will happen. In addition to direct consequences such as patents, new technologies and new applications of old processes, one may encounter the creation of entire new ‘schools of thought’, local ‘dynasties’ of excellent scientists in a given field and industrial areas based on newly acquired scientific and technological excellence.”


Anlieferung
Warenannahme

Guest Commentaries

Claus J. Raidl

Chair of the Board of Trustees, IST Austria, since 2006
President, Österreichische Nationalbank, Vienna (until August 2018)

The idea to create a new academic institution for basic research in Austria, originally introduced by Anton Zeilinger, was widely discussed in politics and academia, drawing both intrigue and fascination. I was similarly drawn to it early on and made my endorsement clear from the beginning, speaking with some of the main players in both politics and industry. Once the visionary blueprint document outlining the necessary steps in establishing such an institution (later aptly referred to as the "road map" for IST Austria) was published—authored by Haim Harari, Olaf Kübler, and Hubert Markl—I was excited and honored to be asked to chair its Board of Trustees.

The most important factors of success for the Institute—then, now, and in the future—are complete institutional freedom without external encroachment of any kind, along with long-term financing. The Institute's main role on a global scale is to conduct excellent curiosity-driven basic research and educate the next generation of scientists, which in turn gives back to society on a national and local level. The Austrian economy and international scientific community will profit from its output and alumni. Giving back locally also means reaching out to the Austrian public by communicating results and acting as a role model in science management.

I have always been proud to be involved in such a courageous and visionary project—though its steep trajectory towards success has surprised even me. The fact that so much has been achieved in a mere decade—measured for instance by the number of ERC grantees among faculty—is nothing short of astounding. Ten years ago, nobody would have thought that IST Austria would already rank among the world's leading centers for basic research. The progress of the Institute has far exceeded my expectations and I am humbled to play a small part in its success story.

Alice Dautry

Member of the Board of Trustees, IST Austria, since 2006
Former President, Institut Pasteur, Paris

IST Austria has had the rare chance of starting a really new institute, one based on the vision of its founders, which sets forth that quality and talent guide all decisions, and one that has had the strong support of the governments of Austria and Lower Austria. What seemed a dream ten years ago has become a success beyond this dream: a beautiful institute, full of talents from all over the world, who work in a supportive and encouraging environment and benefit from cutting-edge technology. An institute with energy, and with governing rules based on the best practices of research institutions worldwide. Congratulations—keep developing and becoming one of the top research institutions in the world!

Helga Nowotny

Former President, European Research Council

IST Austria has become the premier league place for science in Austria with the highest density of ERC grantees in a European host institution. With admirable consistency it continues the planned expansion and consolidation, attracting some of the world's best talents. Its success is due to the unwavering commitment to scientific excellence and the firm belief in, as Abram Flexner put it, "the usefulness of useless knowledge". Congratulations!

Anton Zeilinger

Vice Chair of the Board of Trustees, IST Austria, 2006-2016; member of the Executive Committee of the Board of Trustees, IST Austria, 2006-2013
Professor of Physics Emeritus, University of Vienna; President, Austrian Academy of Sciences; Senior Group Leader, Institute of Quantum Optics and Quantum Information, Austrian Academy of Sciences

In only 10 years, IST Austria has established itself as one of the top new institutions worldwide in its field of activity. The idea to found IST Austria as a postgraduate research institute proved to be the right concept. Moreover, the accomplishments of IST Austria confirm once again that hiring the very best and giving them the opportunity to realize their ideas and visions is an age-old rule for success. It is a pleasure to visit the lively campus full of enthusiastic young people.

The founding of IST Austria was not without conflict. When Anton Zeilinger called for the creation of an "elite university" in 2002, heated discussions began. In 2005, however, Chancellor Schüssel and Finance Minister Grasser pledged the financial resources and charged me with the implementation of this project. The Province of Lower Austria offered the Gugging area in Klosterneuburg, the City of Vienna also offered two locations. The decision in favour of the current campus in Klosterneuburg was made in 2006 owing to the possibility of developing a large campus and the pledged financial support from the Province of Lower Austria.

As a result of this decision, three members left the planning group. But Claus Raidl of the IV and President Harari got involved in the planning and were committed to the project's realization.
I am very pleased that despite all initial quarrels, IST Austria has developed excellently and that the critics are on board again. I wish you all the best for your research activities, conducted together with highly motivated young scientists.

Elisabeth Gehrer
Federal Minister of Education, Science, and Culture 1995–2007

When IST Austria was founded, I had no experience whatsoever with such an institute. But why shouldn't it work out? The idea to establish such an institute in a region where four countries —Hungary, Slovakia, Czech Republic, and Austria— meet was fascinating, but time was of the essence, if Austria wanted to be the one founding such an institute, which could legitimately expect to receive support from the EU. The implementation of the concept would not have been possible without the help of the Weizmann Institute, and without Wolfgang Schüssel, his curiosity, and his strength in implementation, Austria would be poorer by one success story. Today, the whole of Austria, not only the scientific community, can be proud of this project.

Veit Sorger
Chairman, Supervisory Board Mondi AG
President, Federation of Austrian Industries 2004-2012

I followed Austria's bold endeavor to establish a world-class institution for basic science right from the beginning and must say that I was deeply impressed during my recent visit about what had been achieved in such a short time. All ingredients to further develop this remarkable success story are there: creative, international researchers of exceptional quality—unambiguously shown by the success rate at the European Research Council—, state-of-the art infrastructure, and a beautiful campus providing a vibrant environment for scientific creativity at world-class level. Tom Henzinger and his team are now in a unique position to enter the next stage of their fascinating journey.

Otmar D. Wiestler
President, Helmholtz Association
Director, German Cancer Research Centre 2004-2015

The idea behind IST Austria was to establish cutting-edge research in Austria. As rather unusual "ingredients"—for Austria—this recipe included long-term financial planning, public and private financing, as well as complete independence and freedom for the Institute. IST Austria has more than fulfilled my expectations: it is not a given to be established within the "global top league" after only 10 years in operation.

To succeed in the global competition, Austria and Europe need massive efforts and investment in research, development, and innovation. The model of IST Austria is a shining example and should be positioned in the European community.

Wilhelm Molterer
Managing Director, European Fund for Strategic Investments
Vice Chancellor of Austria and Minister of Finance 2007-2008

IST Austria is quite an extraordinary story of success. The idea to establish such a research institute was not generated "at the top", i.e. within the government or the universities, but came from science and industry representatives who saw the need for an additional—and badly needed—impetus to the Austrian research landscape. It was an easy task to convince Elisabeth Gehrer, Martin Bartenstein and Karlheinz Grasser, then Federal Ministers of Education, Science and Culture, Economic Affairs, and Finance, respectively. In addition, with the Federation of Austrian Industries, who showed impressive effort and lobbying work, the idea had soon gained support from within the private sector as well. As then Head of the Government, I would not have dared to follow this concept without this strong commitment from the industry sector. It was clear, however, that the liaison of basic research and applied technology would play a crucial role in the shaping of our future. The question remained, where such an institute could be located. Various Federal States—among them Styria, Vienna and Lower Austria—had expressed their interest. Erwin Pröll, then Governor of Lower Austria, turned out to be the most courageous and determined. Not only did he present a beautiful location for the new campus, he also offered to co-finance the project.

Several years later, I can confidently say that our visions and expectations have not only been fully met, but exceeded. IST Austria's management around Thomas Henzinger appears outstanding, the members of the Board of Trustees—among others, Haim Harari, Claus Raidl, Eric Kandel, Alice Dautry, and Catherine Cesarsky—have been excellent advisors and mentors. Several hundred world-class scientists conduct research and work at IST Austria, the resulting publications are well-recognized, the establishment of a technology park for start-ups is in process, and long-term funding is secured. I hereby would like to express my gratitude, congratulations and best wishes for the future.

Wolfgang Schüssel
Federal Chancellor of Austria 2000–2007

A Decade of Growth

In the ten years since the opening of the campus, the Institute has reached many milestones—in research, in recruitment, in construction, and concerning grants and fundraising. Much has already been achieved and IST Austria continues to have big visions for the future, embarking on the next decade with a steadfast commitment to creating an institute of world-class science, facilities, and training.

Looking back…
On June 1, 2009, the IST Austria campus opened with 37 employees and great ambitions. The campus comprised the Central Building, intended for the theoretical sciences, and the Raiffeisen Lecture Hall, an architectural landmark that would provide a platform for scientific exchange, as well as the voestalpine Building, home to the Institute's administration. The four faculty members consisted of three computer scientists and one evolutionary biologist, and three more biologists were expected over the course of 2010. Over the years, infrastructure has expanded to include three additional laboratory and office buildings, two scientific facility buildings, and a second administration building, as well as structures dedicated to improving campus life and community—a cafeteria, more than 100 apartments, and a kindergarten, among others. The faculty has increased from four to 52 professors under contract. The research landscape has also broadened: currently, 16 professors conduct research in mathematics and computer science, 26 focus on the life sciences, including biology and neuroscience, and 10 work in physics and chemistry.

...and looking forward
The first decade of IST Austria has been marked by rapid growth, and the second decade promises to continue this trend. In October of 2018, the Institute held the groundbreaking ceremony for the fifth laboratory building. Lab Building Five, as it is currently known, will be the home of the chemistry labs, the Graduate School, and the Library. A sixth laboratory building is in the planning stage; the winning architectural design was selected in 2018.

The Institute has a mission to engage the public with science through outreach and educational programs. The hub for these activities will be the future Visitor Center, which will also serve as a central meeting and information point for everyone who comes to campus. Architect and design for this project were also selected during 2018.

Another key point in the founding document of the Institute is the importance of technology transfer. To facilitate interaction between scientists and companies, the IST Park, located across the street from the main campus, is being constructed. In the future, several buildings providing offices, lab space, and advanced technical infrastructure will be available to research-intensive enterprises.

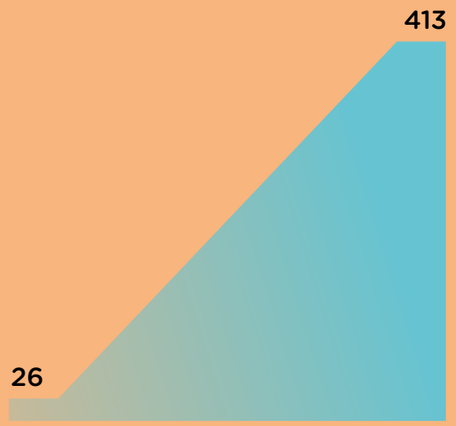
The growth in campus infrastructure reflects the expected growth in the number of scientists and staff at IST Austria: by 2026, the number of employees will exceed 1000, including about 90 research groups, which are expected to cover the research fields of mathematics and computer science, life sciences, and physical sciences.

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
37 employees	>100 employees		>200 employees	>300 employees	>400 employees	>500 employees		>600 employees	
4 professors	>10 professors		> 20 professors		>30 professors			>40 professors	
	first PhD students admitted			>50 PhD students		>100 PhD students		>200 PhD students	
	first PhD awarded (to a transfer student)				>10 PhDs awarded		>20 PhDs awarded	>40 PhDs awarded	>60 PhDs awarded
		>100 publications	>200 publications		>500 publications		>1'000 publications		>2'000 publications
				>10 ERC grants			>20 ERC grants	>30 ERC grants	
>€10 million in donations						>€50 million in third-party funds		>€100 million in third-party funds	
Raiffeisen Lecture Hall opened & start of theoretical research	Bertalanffy Foundation Building opened & start of experimental research		Lab Building East opened			Lab and Office Building West opened			groundbreaking of Lab Building 5
	Bioimaging Facility & Machine Shop opened	Preclinical Facility opened		Electron Microscopy opened				Nanofabrication Facility opened	
					first patent filed	first TWIST fellow			first investment by IST Cube & groundbreaking of IST Park
first public IST Lecture & first Open Campus Day	first Science Industry Talk							first Science Industry Day	first Science Education Day

A Decade of Science

Brilliant minds are the foundation of a graduate institute with the goal of becoming one of the top research institutions for basic science worldwide. IST Austria has therefore put great effort into recruiting the best scientists from all over the world—with proven success. The following gives an overview of the many high-quality contributions as well as a few research snapshots from IST Austria scientists.

Number of scientists per year
(under contract as of December 31 of the respective year)



Publications per year

Number of professors per year
(under contract as of December 31 of the respective year)

IST Austria was created to provide an environment for excellent scientists to conduct outstanding research. The Institute has no set research agenda; it chooses its scientific fields based on the availability of top scientists in various fields and provides them with the resources to follow their curiosity into the unknown, the unexpected, and the unconventional. The first decade of science at IST Austria has demonstrated the value and great potential of this founding policy: the faculty consists of 52 exceptional scientists, who, with their groups, the Scientific Service Units, and external collaborators, have pushed boundaries, made breakthroughs, and collectively published over 2'000 works.

The group leaders for the research snapshots presented here—Eva Benková, Gašper Tkačik, and Chris Wojtan—are three of the 11 professors who have undergone successful tenure evaluations at the Institute.

Hormonal cross-talk in plants
Benková group

While animals can depart for friendlier terrain when an environment turns hostile, plants are literally rooted to the ground, and must therefore adapt to changing conditions. In particular, they change their development, for instance by growing in a different direction, or putting out new roots and leaves. Plants regulate their development using hormones, which allow them to adjust rapidly to cues such as light, temperature, and nutrition. The two primary hormones regulating plant development have been identified—auxin and cytokinin—, but they do not act separately, and the network of interactions connecting them is extremely complex. Eva Benková and her group seek to understand how these hormonal networks are established, maintained, and modulated. Recently, they were able to locate several key points at which hormonal signaling pathways converge to control plant growth and development. As Earth's climate undergoes rapid changes, plants must be able to better adapt. The group's research helps identify mechanisms for better adaptation, with possible applications in agriculture and conservation.

Moving disc video reconstructed from rat retinal neuron signals
Tkačik group

Neurons in the mammalian retina transform light patterns into electrical signals that are transmitted to the brain. Reconstructing light patterns from neuronal signals, a process known as decoding, can help reveal what kind of information these signals carry. However, most decoding efforts to date have used simple stimuli and have relied on small numbers (fewer than 50) of retinal neurons. In a new study, scientists in the Tkačik group and their collaborators examined a small patch of about 100 neurons taken from the retina of a rat. They recorded the electrical signals produced by each neuron in response to short movies of small discs moving in a complex, random pattern. Then, using machine-learning techniques, they were able to reconstruct the movie from the signals. Not only could their work pave the way to improved decoding methods and a better understanding of what different types of retinal neurons do and why they are needed, it showcases how modern statistical and machine learning methods can be employed to gain new insights and testable hypotheses about biological systems.

Making waves
Wojtan group

How can we simulate natural phenomena not only realistically, but also time- and cost-effectively? Professor Chris Wojtan has spent much of his research career doing exactly that, and his work has resulted in fundamental new algorithms that allow for convincing visualizations while reducing memory usage and computing time. One of his particular focuses is water waves: current water wave simulations are based on one of two available methods. "Spectral" methods are efficient, but cannot model complicated interactions, whereas "finite difference" methods can simulate a wide range of such effects, but are much more expensive computationally. As a result, scenes with details at the level of tiny waves and with environmental interactions at the level of kilometer-long islands were either impossible or completely impractical. Recently, Wojtan and his collaborators developed a simulation method that bridges the gap between these methods, and makes that breadth of scale and range possible—in real time. Their method, which required a deep understanding of the underlying physics to develop, also allows graphic designers to easily create a variety of artistic effects that were previously unattainable or extremely expensive computationally, such as objects landing realistically in water, or water reflecting off the sides of a moving boat.

Pioneering Spirits

Evolutionary biologist Nick Barton and mathematician Herbert Edelsbrunner were two of the first faculty members to join IST Austria. Here, they talk about their motivations for coming to IST Austria, their experiences during the first decade of the Institute's existence, and potential next steps and challenges.

Why did you decide to join the Institute?
Barton: In 2008, I was looking for opportunities to come to Vienna, as it is extremely strong in evolutionary biology. By chance, I found out about IST Austria—which, at the time, hadn't opened yet—, applied, and was hired as the first professor. What particularly drew me to the Institute was the founding document, which laid out the importance of curiosity-driven research, something refreshing and inspiring at a time when the UK research councils were becoming ever more bureaucratic.
Edelsbrunner: I myself am Austrian, and was interested in returning to Europe from the US. After talking to local universities, I wasn't sure what opportunities Austria could offer, but then Haim Harari contacted me about IST Austria. Everything about it, how it was planned, what it was striving for, was attractive. Like Nick, the emphasis on fundamental research particularly resonated with me. In my own career, I've found that the more theoretical my work became, the more applicable it was, the more useful in industry and other situations.

What do you think are the key aspects that have shaped the development of IST Austria?
Edelsbrunner: The existence of the Graduate School has played a significant role—at one point, we even discussed whether or not we would teach. Now, it seems obvious that we should: we wanted to be able to take students without a master's, and allow them to switch disciplines, and for that, you need courses. Now, we are able to give young scientists a chance, if we think they're bright enough and willing to work for it.
Barton: Moreover, the way we recruit young scientists builds communication between groups. Postdocs may come with the aim of working with multiple groups, whilst through their required rotations, graduate students spread their ideas and knowledge throughout the Institute, stimulating interdisciplinarity. The campus of the Institute also plays a role: I came to do evolutionary biology, and Vienna has top people in this field. But I ended up talking far more to people at IST Austria, because you discover not only interesting research, but other research cultures as well. This only happened because we were all put together at this new institute—and it continues today, through the constant exposure to other fields and ideas. Our internal funding structure has also played a big role in the development. We receive a core budget, which allows for continuity—you can hire people without the uncertainty of dependence on a specific grant.

What role does risk-taking play at the Institute, especially in recruitment and research?
Barton: I think it's something we should be doing: we should give chances to people we think can do great things. It was certainly easier to do this at the beginning, when the Institute was smaller—it will be a challenge to maintain the ability to take risks as we grow larger.
Edelsbrunner: We should take risks, but not randomly. I think of us as being in a very high-dimensional space, of which we can only see a very low-dimensional part. Taking risks means going off in a direction we can't see and don't know or understand yet. You may not reach anything, but taking these risks is rational in the sense that there is an enormous amount of potential out there, and I think we are building up the expertise on campus to take risks responsibly.

In what ways do you see the Institute as having an impact?
Barton: In general, the Institute provides a model for how one can organize research. For instance, we have a tenure-track system, which is rare in Austria, and could serve as an example for other institutes and universities. Also, the graduate school and the postdoc program bring people from all over the world—often, they choose to stay in Austria, which enriches and strengthens the whole system. Then, we make an impact by sending people who have lived and researched in this environment out into the world. It's not just the research that is produced at the Institute, but the people that are "produced" here.
Edelsbrunner: In the general education system, students are trained in a particular field, and then it takes effort to go outside that field. Our students and postdocs experience a very mixed environment, however, which facilitates such transitions: these opportunities are open to them.

What are you looking forward to in the next ten years? What do you see as the challenges ahead?
Edelsbrunner: IST Austria has big dreams and big ideas—and a short timeline in which to achieve them. We're still a small institution in a sea of universities, but the Institute is unique, and I believe that it will greatly impact industry and science because of original scientific ideas that would be difficult to develop elsewhere. In particular, as education becomes more unified, it cuts off connections that are visible at IST Austria.
Barton: As we nearly double in size over the next eight to ten years, we will need to maintain the balance between getting things done quickly and efficiently, which requires delegation, and flexibility, which means avoiding artificial divisions between different groups. Practices that were successful when we were small may no longer work, or will work in a different way. However, a lot of the structures we put into place at the beginning have continued to function, and I think we can build on and adapt what we've already created.
Edelsbrunner: I've been surprised at how well everything has worked out so far. I think that's fairly unusual, and I'm crossing my fingers that it continues like this—but we should not take it for granted.
Barton: Yes, complacency is something to watch out for. We have to keep thinking about how we're developing, and how we should continue.
Edelsbrunner: In fact, many things are uncertain and fluctuating—politics in particular comes to mind—so I think it important that the Institute remains strong in its direction and its values.

Building an Environment for Creative Ideas

IST Austria at a Glance

The Institute of Science and Technology Austria (IST Austria) is a PhD-granting research institution dedicated to cutting-edge research in the physical, mathematical, computer, and life sciences.

Student admissions in 2018

Applications	1'407
Student offers made	89
Student offers accepted	56

Faculty recruiting in 2018

Applications	1'353
Faculty offers made	8
Faculty offers accepted	4

416 scientists
(as of December 31, 2018)

PhD students	185
Postdocs	158
Professors	52
Scientific interns	16
Staff scientists	5

Total research grant funding acquired
(rounded; as of December 31, 2018)

ERC European Research Council	€65'689'000
FWF Austrian Science Fund	€23'498'000
EU other	€18'898'000
HFSP Human Frontier Science Program	€2'754'000
ÖAW Austrian Academy of Sciences	€2'072'000
DFG German Research Foundation	€1'469'000
NOMIS Foundation	€1'400'000
EMBO European Molecular Biology Organization	€986'000
NFB NÖ Forschung und Bildung	€519'000
WWTF Vienna Science and Technology Fund	€434'000
Microsoft Research	€359'000
ONR Office of Naval Research	€326'000
SNF Swiss National Science Foundation	€283'000
Simons Foundation	€267'000
BAYER	€150'000
NSF National Science Foundation	€119'000
FFG Austrian Research Promotion Agency	€96'000
Others	€1'766'000
Total	**€121'084'000**

Founding Principles

IST Austria was established in 2006 by the Federal Government of Austria and the Government of Lower Austria. The campus opened in 2009 in the city of Klosterneuburg, on the outskirts of Vienna. The Institute was founded based on a set of eight principles, which were first formulated by Haim Harari, Olaf Kübler, and Hubert Markl, who distilled them from the most successful systems and ideas for research institutes worldwide.

Curiosity-driven basic research
Scientists pursue their interests without limits or predefined research topics.

International
IST Austria brings together scientists and staff from all over the world; employees use English as their working language.

Interdisciplinary
Research on campus is not divided by departments or boundaries; communication and collaboration are encouraged across scientific fields.

PhD-granting
IST Austria pioneers a new kind of graduate education with one Institute-wide PhD program.

Career support and development
Scientists at all levels grow intellectually and professionally. Professors hired early in their careers are on a tenure-track system.

Independent boards
Trustees oversee the Institute; more than half are international scientists. Guidance and advice are also provided by the Scientific Board.

Exploiting results
Excellent basic research leads to unforeseen but useful discoveries, and intellectual property and technology transfer are important objectives.

Diverse funding sources
The Institute is publicly and privately financed. Scientists acquire third-party funds, donations to the Institute are transferred to an endowment, and revenue from technology transfer is a long-term goal.

Core Missions

IST Austria is performance-oriented and only uses practices that have have proven successful elsewhere. The Institute's founding principles remain relevant today and continue to guide the growth and development of IST Austria as it works towards its core missions:

- **perform world-class basic research**
- **train the next generation of scientific leaders**
- **implement best practices for management in science**
- **support science education and technology transfer**

Campus Life

IST Austria is not only committed to excellence in research, it applies this high standard to its services for employees and visitors to campus alike. The Institute provides a range of amenities and facilities to create not only an outstanding place to conduct research, but also an outstanding place to work and live.

Work and Family

The balance between work and family life is a challenge for both employees and employers. In order to support this balance, IST Austria participates in “workandfamily” audits with the Austrian Federal Ministry of Women, Family, and Youth, which evaluates companies on their family-friendliness and helps them define and plan improvements. To support staff and scientists with children, IST Austria has an on-campus childcare center. Children as young as three months and up to elementary school age can be enrolled in the “Froschkönig” childcare center, and enjoy educational activities, field trips, a science club, and more.

Diversity and Inclusion

In view of the international mobility of scientists, measures for integration are important for the scientific success of the Institute and its staff. Currently, about 65 nationalities work and conduct research at IST Austria, both in the scientific and administrative fields. With the motto “diversity is a reality, inclusion is a choice”, IST Austria is proud to be striving for a barrier-free campus, focusing on structural measures, establishing a welcome culture, and increasing awareness of interculturality and implicit bias.

Nature and Recreation

With the beautiful Vienna woods at the Institute’s doorstep, staff and scientists can enjoy the scenery, hiking trails, the fresh air, and the quiet of an oasis away from the bustle of a big city. The campus is home to several sports grounds, including tennis courts and a soccer field, and also provides equipment for bowling, table tennis, and other recreational activities.

Housing

Many employees choose to live on campus in the Institute-owned and -operated apartments. Surrounded by nature, and just steps away from the lab and office buildings, these comprise over 100 residences, for both families and individuals. For short-term visitors, IST Austria also has a guesthouse located in the Central Building, where individuals, couples, or families can reside for brief periods.

Shuttle Bus

Many employees also choose to live in Klosterneuburg or Vienna. For the ease of their commute, an Institute shuttle bus travels from the U4 metro station Heiligenstadt via Klosterneuburg to IST Austria in only 22 minutes.

Cafeteria and Coffee Pub

Cafeteria and coffee pub are not only places to have a meal or a drink, they also serve as gathering points for exchange and places where scientists and administrative employees can meet. The “Crazy Duck” coffee pub, which is open in the evenings, also hosts numerous events, from science talks to game nights.

Lifelong Learning

There are many opportunities for further development both on and off campus; these are available to both staff and scientists. People Services organizes skills trainings throughout the year and is also responsible for the Erasmus+ program, which helps to fund employees who travel to organizations in other countries for training purposes. Also, free on-campus German and English language courses are available to all and contribute to the successful integration of employees. Partners of employees or visiting scientists may join the German courses for a small fee.

Institute-wide Events

In order to bring the campus community closer together, IST Austria organizes several Institute-wide events throughout the year. These include a summer barbecue, at which families and friends are also welcome, the Institute Retreat, where employees have a chance to get to learn about each other’s work, and the Winter Bash, the Institute’s annual holiday party.

Career Options at IST Austria

Career opportunities at IST Austria resemble the widely established stages of an international scientific career. However, not all these levels can be passed through in-house at IST Austria: PhD students and postdocs will pursue their next steps outside IST Austria. Employees in the Scientific Service Units and Administration are committed to creating the best possible environment for world-class research.

Next career step outside IST Austria

Internships for Undergraduates

Current bachelor's and master's students have the chance to explore research through an internship at IST Austria, which are offered year-round as well as in the form of the summer ISTernship program.

→ www.ist.ac.at/education/internships

Next career step outside IST Austria

PhD Positions

Students with a bachelor's or master's seeking a PhD program that offers breadth and depth can apply to the Graduate School of IST Austria during the annual call.

Application deadline is in January for a start in September of the same year.

→ www.ist.ac.at/education/graduate-school

Next career step outside IST Austria

Postdoc Positions

Young researchers with a doctorate can enhance their careers and their CVs with a postdoc position at IST Austria.

Interested scientists can apply by contacting professors directly, or by applying for an ISTplus grant.

→ www.ist.ac.at/education/postdocs

Career evaluation

Staff Scientist Positions

Staff scientists provide expertise not available within the research groups.

Scientists with doctorates and relevant experience can apply to open positions listed here:

→ www.ist.ac.at/jobs/open-positions

Tenure evaluation

Assistant Professorships

Early-career scientists seeking a tenure-track position with the freedom and resources to prove themselves can apply for an assistant professorship.

Applications are accepted year-round, but processed primarily after the end of the annual call in early November.

→ www.ist.ac.at/jobs/open-positions

Tenured Professorships

Advanced researchers interested in a tenured position in an outstanding work environment can apply for a tenured professorship.

Applications are accepted year-round, but processed primarily after the end of the annual call in early November.

→ www.ist.ac.at/jobs/open-positions

Administrative Positions

Professionals in a variety of administrative areas—from accounting to outreach to technology transfer—support scientists and further the mission of the Institute.

→ www.ist.ac.at/jobs/open-positions

Scientific and Technical Support Positions

Supporting experts provide research groups with scientific and technical assistance.

→ www.ist.ac.at/jobs/open-positions

Training the Next Generation

Educating PhD students is a core mission of IST Austria. Its Graduate School offers a multidisciplinary PhD program that supports students in becoming experts in their fields while fostering communication and collaboration across research groups and disciplines.

World-class Education

Now in its eighth year, the IST Austria Graduate School provides training, support, and a shared experience for the 201 graduate students on campus. The past eight years have seen an expansion of the program in all its aspects, and the 56 new students who arrived in fall 2018—the largest cohort so far—will have a significantly different experience than the seven who made up the original class.

The Institute was founded with the legal right and the intention to train young scientists and grant doctoral degrees. In 2010, faculty and management decided to establish the IST Austria Graduate School to fulfill the core mission by recruiting gifted students from all over the world who will benefit from the scientific environment and state-of-the-art infrastructure the Institute has to offer. Since then, a rigorous curriculum has been developed and implemented for the PhD program, providing the structure for a world-class educational system.

Six tracks
PhD students at IST Austria can choose from six different tracks of study: biology, computer science, data science and scientific computing, mathematics, neuroscience, and physics. Many faculty members are associated with multiple tracks, reflecting the interdisciplinary nature of the research groups on campus, and allowing students to approach topics of interest from a variety of angles. Each track has a set of mandatory courses that ensure that students gain the background they need to succeed in their area of choice. Designated track representatives are responsible for the curriculum as well as advising the PhD students associated with each track.

Core course
Regardless of their track, all PhD students take the Institute's signature core course. This course is designed to encourage communication between fields and to teach an understanding of how to gain knowledge from data. During the 2018 course, students were working in multidisciplinary groups to tackle a problem related to large biological datasets. They brought together concepts from molecular biology, neuroscience, and bioinformatics, as well as elements of computer and data science, and learned the language and terminology of the various fields along the way. The communication and collaboration skills developed during the course will help students to work across disciplines and communicate their work to a wider audience, as well as increase their ability to effectively take on open-ended questions.

Rotations
Three required rotations—short research projects completed with different professors—give students the opportunity to explore several areas, broaden their knowledge, try out a variety of research styles, and get to know potential doctoral supervisors. The students' freedom to tailor their rotations to fit their backgrounds and research interests—whether this entails a focus within one area or an open-minded exploration of different fields—is one part of what makes the IST Austria PhD program unique and valuable.

Mentoring and support
Even after PhD students affiliate, the Graduate School continues to be a source of support and mentoring. In 2018, the "graduate student portfolio" was introduced: students maintain a document that accumulates details about their activities during the year, such as papers published, talks given, external research stays, conferences attended, and courses passed. In addition, the Graduate School coordinates several faculty mentors. These professors are available to all students to discuss any topic of concern or interest.

GRADUATE STUDENTS

How to apply

IST Austria is looking for highly motivated, exceptional students who are passionate about scientific research and have a drive to succeed. Students who have or will complete a bachelor's or master's degree by the time they begin their studies at IST Austria are invited to apply. The application deadline is in January for a start in September of the same year.
https://phd.ist.ac.at

Scientific Excellence

Continual growth and improvement
As the number of graduate students continues to grow—in the future, the Institute expects to admit annual cohorts of around 100 students—the Graduate School continues to expand and refine its structures as well as its course offerings, to ensure that IST Austria PhD students receive the best possible support and training.

Specific measures include additional mathematics and programming courses for students in the life sciences, a general skills curriculum, and coordination with local universities. Moreover, the Graduate School works to maintain a sense of community and the willingness to communicate across disciplines while keeping to the high standards set by the Institute's educational mission.

Independent research
Once students decide on their topic of research, they take a qualifying exam and then affiliate with one or more research groups. They spend the next three to four years pursuing independent research and working towards their PhD theses. Students are encouraged to disseminate their work by presenting at conferences and by publishing papers. So far, IST Austria graduate students have (co-)authored nearly 250 original works.

Two students and their research projects are presented here; more student profiles can be found on the Graduate School website: https://phd.ist.ac.at

Funding and grants for PhD students
Every PhD student is a full-time employee of IST Austria for the duration of his/her studies. The ISTscholar PhD program is co-funded by the European Union's Horizon 2020 research and innovation program through a Marie Skłodowska-Curie grant. Although the 2018 PhD open call was the last call within the €4.4 million grant supplementing the costs of each student's first two years, the PhD program will continue following the same layout. Thereafter, the doctoral supervisors support their students until the completion of their degrees.

External funding schemes also have positive effects on promising early-career researchers. Planning a multi-year research project and presenting it in a proposal are crucial skills for a scientist. As a highlight of 2018, seven PhD students received highly competitive DOC stipends from the Austrian Academy of Sciences. The award, which is worth €38'500 per year per stipend, will fund their PhD research for up to three years. The 2018 awardees were Catarina Alcarva, Georg Arnold, Christina Artner, Rok Grah, Amir Goharshady, Katarzyna Kuzmicz, and Rouven Schulz.

Scientific integrity and ethics
Ethics considerations are important in scientific research. All PhD students must fill out a self-assessment form to ensure that the highest ethical standards in research are adhered to. Specific trainings, including a course addressing proper scientific conduct, are offered during the PhD program.

Bor Kavčič

PhD student, Tkačik group

Bor Kavčič first realized his love for basic research during his master's studies at the University of Ljubljana, where he investigated the biophysics of confined lipid vesicles. As his project there had been highly interdisciplinary, Kavčič was eager to do his PhD at a research institution that would enable him to explore science outside of the strict limits often imposed by educational background. IST Austria offered such an opportunity, and here, he was given a chance to work in a molecular biology lab—something completely outside of his previous experience. In the Tkačik group, he employs the modeling and data analysis skills he had developed during his undergraduate studies, as well as newly acquired experimental techniques, to study combined antibiotic action. Moreover, he works to identify the different "knobs" of the protein synthesis machinery inside bacterial cells. Kavčič credits much of his progress so far to the supportive and interdisciplinary environment at IST Austria: "It is through discussions with professors and my peers that I have learned the most; talking to experienced people is of paramount importance to my daily work."

Elena Redchenko

PhD student, Fink group

Elena Redchenko completed her undergraduate degree at the Moscow Institute of Science and Technology, where she studied, from a theoretical perspective, the formation and decay of collective states in ensembles of two-level systems. Selecting IST Austria for her doctoral studies was not straightforward: Would such a new institution be the best choice? The research conditions on campus and the quality of research being done at the Institute, as well as what she could hope to accomplish here, were the aspects to guide her decision. After her rotations, she affiliated with the Fink group, which investigates quantum effects in electrical, mechanical, and optical chip-based devices. Redchenko continues to focus on collective states, but from the experimental side, and now in systems of superconducting qubit ensembles.
She is very happy with her decision to join the Fink group: "Within the group, I can work on a project I love, and I have a unique opportunity to participate in *all* stages of scientific research—theory, fabrication, and experimentation. We have an excellent work environment, and it is a pleasure to work with the other people in the group."

The ISTScholar PhD program has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 665385.

Julia Michalska

PhD student, Danzl group

Julia Michalska is a second-year PhD student working in the Danzl group. There, she develops and uses high-resolution microscopy and molecular tools to investigate biological questions and is particularly interested in how communication between neurons is regulated by their synapses. Michalska is also interested in communication of another sort: outreach. This year, she helped with several activities centered around making science accessible and interesting to the public, including presenting the research of several groups at the Long Night of Research, as well as giving an interactive lecture and workshop for the Children's University of Vienna, which covered "Microscopy – our small building blocks in focus!". In addition to activities for the general public, she is also part of the group of PhD students and postdocs organizing next year's Young Scientist Symposium. Finding the time for outreach is not always easy, but for Michalska, it is important—and enjoyable. "By sharing my fascination for my work and research, I hope to pass on the magic and mystery of science. Teaching children is especially rewarding, because I love sparking their interest, and seeing their drive to understand the world and make things work. I also want to help people overcome their fear of innovation and technology in our everyday life; it is our responsibility to educate the public, and make people aware of our work and how it can benefit society."

Georg Osang

PhD student, Edelsbrunner group

Though a lot of his time is taken up by researching and implementing algorithms for topological data analysis, Georg Osang, a fourth-year PhD student in the Edelsbrunner group, is an active contributor to science education and outreach activities on and off campus. During his time at IST Austria, he has worked with groups ranging from kindergarteners to high school students to classes of his peers. At the Institute's annual Sommercampus, he designed and ran a full-day activity using Scratch, a click-and-drag programming application, with which students created their own computer games. He was also one of the volunteers who traveled to Africa to help with math camps there; this summer in Ethiopia, he managed the international logistics of the program in addition to teaching. Osang further taught an interactive programming course on campus, which helped PhD students gain skills they could apply in their research. His motivation for taking on these projects has several bases: "Every time I gain new insights into how people learn and what works and what doesn't, I myself am learning. Plus, when students have that 'aha!' moment, it's extremely rewarding—even more so if they've discovered something on their own. Designing a learning experience that challenges students in this way is difficult, but I feel that by conveying skills relevant for students' futures, I have the chance to do something useful, be it through teaching programming, problem solving, or scientific thinking."

Diverse Experiences of Graduate Students

Graduate students not only make up the largest group on campus, they are one of the most diverse, both in terms of nationality and background, and in terms of their experiences during their time at the Institute and their contributions as part of the IST Austria community. The Graduate School strives to support students as they follow their many different paths, and to help them gain the skills they need to succeed in their next steps.

Internships and mobility
Graduate students have the opportunity to take short-term internships in industry and at other research institutions, rounding off their PhD experiences as well as their CVs. A number of graduate students completed internships during 2018, including time spent at companies such as Weta Digital, the New Zealand-based special effects company that worked on *Lord of the Rings*, universities, for instance Caltech, and research institutes, like the Max Planck Institute in Dortmund.

Graduate student involvement
PhD students are also encouraged to organize events and engage with the campus in a variety of ways. In 2018, graduate students organized the Young Scientist Symposium for the seventh year in a row. The theme was "GAME ON! Designs, Strategies, and Rewards Across Science", and the six keynote speakers approached the topic from various angles, including physics, evolutionary and plant cell biology, and mathematics.

All PhD students are represented by the Graduate Student Association (GSA). The GSA serves as a platform for exchanging opinions and fostering communication between students and constitutes an interface between the graduate students of IST Austria and the rest of the Institute. Two elected student representatives communicate students' ideas, feedback, and criticism to the management and faculty, and organize regular meetings to discuss issues and promote networking. Graduate students also serve in numerous campus committees, helping to improve the PhD program, recognize teaching achievements, organize activities, and more.

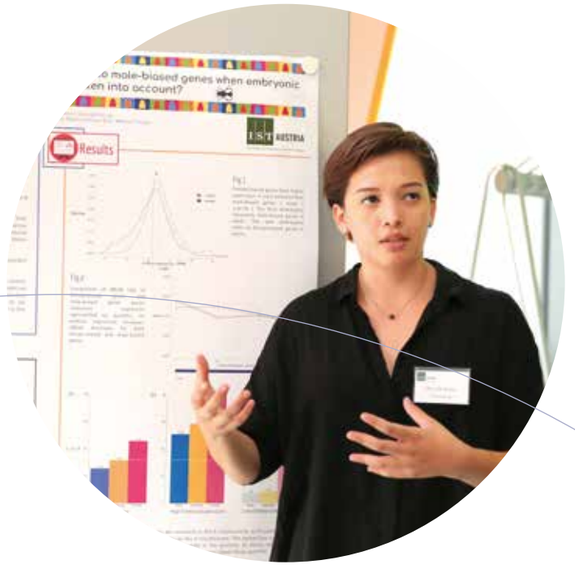
Outreach and teaching
Communication is a key skill for any scientist as well as for any other profession. Graduate students develop their communication skills in many ways; one important aspect of this is teaching. Every PhD student must spend at least one semester as a teaching assistant, and many take on additional teaching responsibilities. Some even design and teach their own courses, for instance programming classes or math review sessions. In 2018, Rok Grah, a PhD student in the Tkačik group, received the Institute's "Golden Sponge" Best Teaching Assistant Award, and Georg Osang, a PhD student in the Edelsbrunner group (profiled to the left), received the "Golden Chalk" Best Lecturer Award.

Graduate students also take time to reach out to the public: Many help with the research stations at the Institute's annual Open Campus, where they present their group's work and encourage visitors to explore. Several students also created their own projects for "Sommercampus", a week-long research camp for 7- to 10-year olds. Further afield, several IST Austria PhD students spent two weeks designing and running mathematics camps in Africa.

Career development
The Career Services team at IST Austria works to support and enable PhD students (as well as postdocs) to make well-informed decisions that result in meaningful and successful careers in and outside of academia. Their work has two main focuses: first, to create an environment where early career scientists have easy access to career inspiration and role models. As part of this, the team organizes various events throughout the year, such as company visits, a "Young Founders" afternoon at the Institute's Science Industry Day, and alumni talks. They also maintain an online career portal that provides information on career options and job hunting. Second, to help students and postdocs optimize their working habits, strengthen their CVs, and develop transferable skills, numerous workshops are organized, covering topics such as time and self-management, leadership, presentation skills, interview training, and teaching didactics. As of this year, the team also offers one-on-one meetings, where scientists can get feedback on job applications, discuss career options, and develop strategies to achieve their career goals.

Opportunities at Every Level

Interns at IST Austria



Training the next generation applies not only to graduate students: IST Austria offers year-round opportunities for bachelor's and master's students from other institutions to intern in a laboratory or with a research group.

An internship is a valuable opportunity offering students the chance to explore and broaden their interests in science, to learn about the process of conducting research, and to build connections within academia and among their scientific peers. There are two types of internships available at IST Austria:

ISTernship program
Every year, for 8–12 weeks between May 15 and September 15, students from all over the world come to IST Austria to work closely with a faculty or laboratory member on a short research project. In 2018, 39 ISTerns—selected from over 1'580 applicants—spent their summers researching topics like the topology of simplicial complexes, drag reduction effects of fish gill outflow, or discrete bidding games. Their research experiences were rounded off with lectures given by faculty members and postdocs, and culminated in a poster session where ISTerns presented their projects to the campus community.

Though their time at the Institute is short, the ISTerns' work often results in scientific papers. Besides the core mission of training future researchers, the Institute has an additional interest in hosting these young scientists: several former ISTerns have joined IST Austria to pursue their doctorates.

The ISTernship program is run in collaboration with the OeAD, the Austrian agency for international mobility and cooperation in education, science, and research.

Year-round scientific internships
Interns can also join IST Austria throughout the year, collaborating with a particular research group for up to one year. During 2018, the Institute hosted 50 scientific interns in 25 different research groups. These students worked on a variety of projects, ranging from running field experiments in the Pyrenees to proving hardness of finding *Nash equilibria*.

INTERNSHIPS

How to apply

All active bachelor's and master's students in the physical, mathematical, computer, and life sciences are eligible to apply—and the professors at IST Austria look forward to welcoming qualified and passionate interns into their research groups.
www.ist.ac.at/education/internships

What ISTerns say about their summer 2018 experiences:

"I really enjoyed my stay at IST Austria. It is an experience that enriched me both academically and personally."

"A fantastic three months."

"My internship was a great experience and I enjoyed it a lot. Thank you, IST Austria!"

Marta Gorecka

2018 intern, Cremer group

Currently a bachelor's student at the University of Natural Resources and Life Sciences in Vienna, Marta Gorecka has spent most of her life in Lower Austria. She watched the Institute grow and—impressed by its diversity and rapid evolution—was eager to spend time on campus, where she could work in an international environment and gain new skills, as well as share her own knowledge and enthusiasm. For three months this year, she worked with the Cremer group as a scientific intern. In this capacity, she assisted in experimental work, studying the individual and collective anti-pathogen defenses in the ant *Cardiocondyla obscurior.* The focuses of her work were the effect of pathogen exposure on male-male competition, social and transgenerational immunization, and the recovery of colonies after fungal infection. Through the internship, her enthusiasm for research has only grown: once she has completed her bachelor's, Gorecka plans to pursue a master's in medical and pharmaceutical biotechnology.

Mikhail Maslov

2018 ISTern, Lemeshko group

In 2018, Mikhail Maslov graduated from the Moscow Institute of Physics and Technology with his bachelor's, then spent the summer as an ISTern with the Lemeshko group. He had heard about IST Austria from colleagues and was eager to be a part of the young, dynamic, interdisciplinary environment that the Institute offered. Research with the Lemeshko group was particularly appealing: Maslov's project related to the theoretical examination of moving angulons, a quasiparticle previously defined by Lemeshko. In particular, he worked to derive the energy dispersion relation and investigate several other important characteristics of the system. Following his internship, Maslov joined IST Austria as one of the Institute's new graduates in the fall of 2018. Though he has previously focused on simulations of physical effects, he is eager to dive into the theoretical side of things during his doctorate, and is looking forward to his rotations, courses, and discussions with other scientists as avenues to explore the different ways he could do this at IST Austria.

A Chance to Grow

Postdocs at IST Austria

The years following the completion of a PhD are important for early career scientists. IST Austria provides postdoctoral fellows with a world-class multidisciplinary research environment, giving them the resources and opportunity to broaden their scientific horizons and deepen their expertise.

Climbing the career ladder
After the completion of a PhD, a postdoc position at IST Austria with a duration of up to five years gives early career scientists the chance to grow professionally, while not yet shouldering the responsibilities of a research group leader. IST Austria brings together the faculty, facilities, and support to help postdocs develop the skills necessary for their next career steps elsewhere. Already at the beginning of their stay, postdocs assess their professional profiles and skill sets together with a career counselor. During their time at IST Austria, postdocs interact closely with colleagues from different fields through shared infrastructure, joint projects, and events.

Over the course of 2018, 197 postdocs were part of the campus community, designing and executing projects, building connections in academia and industry, writing papers, and attending conferences.

Sharing knowledge and building community
Developing a solid network of peers has benefits at every career level, especially for postdocs, who are under pressure to be scientifically productive, to communicate their results, and start new collaborations. This fall, the Postdoc Association organized an event at the Institute where postdocs from institutions in and around Vienna were invited to campus to take tours of the labs, network, and meet professors. Also during fall 2018, IST Austria postdocs went on a retreat near Semmering. The weekend included career development trainings and short science talks, as well as team-building activities.

Postdocs at IST Austria also take the time to work with younger generations of scientists. Several courses on campus were taught by postdocs in 2018, including programming, mathematics for life scientists, and turbulence theory. Also during 2018, a variety of outreach programs were designed and carried out by IST Austria postdocs. These initiatives included designing and running a DNA-reading activity at the Institute's annual summer research camp, organizing a two-day research camp for high-school-aged evolutionary biology enthusiasts, and creating informational posters and games about the Abelian sandpile model.

Funding postdoctoral fellows
In order to attract outstanding postdoctoral researchers, IST Austria submitted a proposal for a Marie Skłodowska-Curie COFUND scheme of the EU. Received in 2017, the scheme now provides funds for an interdisciplinary, international, and intersectoral postdoc program. Known as ISTplus, the program supports postdocs at the interface between science and other sectors, such as industry and policy. Postdocs funded by the ISTplus COFUND scheme have the opportunity to take short-term (up to six months) internships with external partners. With a total award amount of almost €4.6 million, this is the single largest grant obtained so far by IST Austria. Calls for ISTplus applications open biannually; in 2018, 33 offers were made, and 28 were accepted. So far, 38 postdocs have joined the Institute under the COFUND scheme. In total, the ISTplus program will support 60 postdocs for up to two and a half years each. The ISTplus program complements the opportunity to apply for a postdoc position directly by contacting IST Austria faculty.

POSTDOCS

How to apply

Scientists interested in conducting postdoctoral research at IST Austria can apply by contacting professors directly, or by applying for an ISTplus grant.
www.ist.ac.at/education/postdocs

Christian Hilbe

Postdoc, Chatterjee group

Christian Hilbe completed his PhD in mathematics at the University of Vienna and already at this time had a keen interest in game theory, his current area of research. His interest only deepened during his two postdoc positions abroad, one at the Max Planck Institute for Evolutionary Biology in Germany, and one with Professor Martin Nowak in the Program for Evolutionary Dynamics at Harvard University. At Harvard, Hilbe heard about the Chatterjee group from a colleague, and jumped at the chance to come back to Austria and start new projects while continuing to collaborate with Nowak. The move paid off: in 2018 alone, he published five papers in the journals *Nature, Nature Communications, Nature Human Behavior,* and *PNAS*. These papers have covered a range of topics in game theory, including how cooperation is affected by noise and incomplete information, why modesty pays off, and how changing payoffs can lead to increased cooperation. "In general," Hilbe says, "I'm interested in how reciprocity works, and how we use buried and subtle signals. The Institute has been a good place to pursue my research—the campus community, the resources available, and being able to collaborate with the Chatterjee group have all contributed to a great experience."

Melinda Pickup

Postdoc, Barton group

Melinda Pickup joined the Institute as a postdoc in 2011, eager to work with Professor Nick Barton, a world leader in her area of research. Prior to this, she earned her PhD at the Australian National University in Canberra, Australia, where she specialized in evolutionary biology, genetics, and ecology. After her PhD, she worked for a year at a non-profit conservation organization as a field ecologist, then moved to Toronto for a two-year postdoc. Her research at IST Austria focuses on understanding how plant sex can influence hybridization between species. In particular, Pickup is interested in how plant systems that prevent self-fertilization may actually facilitate gene exchange (hybridization) between species. To accomplish this, she works on the snapdragon (*Antirrhinum*) system using a combination of theory, genomics, population genetics, and ecology. The mix of these techniques and areas is only possible through collaboration with theoreticians, mathematicians, molecular biologists, ecologists and population geneticists. The interdisciplinary nature of IST Austria, as well as of the Barton research group in particular, facilitates this—and is significantly different from her previous research lab experience. "Through this environment," says Pickup, "I have developed new skills and knowledge, and there is no doubt that I will leave the Institute a better scientist than when I arrived."

These projects have received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme (FP7/2007-2013) under REA grant agreement No 291734 and from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 754411.

Out into the World

IST Austria Alumni

As diverse as IST Austria's campus community is its alumni network, which has spread to over 30 countries in the years since the first alumni left the campus. When they left the Institute, 85 percent of postdocs and PhD students also left Austria. The largest group—15 percent—has gone to the US, where they have joined major universities, such as Harvard, Stanford, and MIT, or large companies, including Google and Microsoft. Alumni in Europe have taken similar paths and joined top universities, research institutes, and companies, for instance the Max Planck Institutes and TU Munich in Germany, the University of Cambridge and the Francis Crick Institute in the UK, as well as ETH Zurich, Roche, and Google Brain in Switzerland. However, IST Austria does not just observe the success of its alumni from afar: the Alumni Relations Team works to maintain an active relationship with the 264 alumni, inviting them back to campus to share their experiences, and reaching out to them with opportunities and news.

Christine Mieck

Associate Editor,
Nature Communications, London, UK

Christine Mieck had been a postdoc in the Loose group until 2017, before she moved to London to take up her current position as an editor for Springer Nature. She obtained her PhD from IMP Vienna, where she studied kinesin motors using *in vitro* reconstitution and methods from structural biology. In her postdoctoral work at IST Austria, she continued to explore the biochemical and biophysical bases of cellular polarity. Her background as a scientist plays an important role in her position as an associate editor at Nature Communications: Mieck handles submissions related to the biochemistry and structural biology of membrane proteins, computational structural biology, and general and single molecule biophysics.

"My time at IST Austria was extremely useful and productive," Mieck says. "We had an excellent lab dynamic—the group was such an incredible mixture of talented, funny, warm-hearted people that I looked forward to going to the lab every morning! I have fond memories of lunches in the sun, and champagne and ice cream parties."

Mieck returned to campus in spring 2018 for a special "Think and Drink", where she shared insights into her job and career path, as well as the publishing system in general.

Michal Rolínek

Researcher,
Max Planck Institute for Intelligent Systems, Tübingen, Germany

Michal Rolínek joined IST Austria with a bachelor's in general mathematics and a master's in mathematical analysis from the Charles University in Prague. After his rotations, he affiliated with the Kolmogorov group and started work towards his PhD. During his time at the Institute, Rolínek focused on the complexity of constraint satisfaction problems. After graduating, he moved to Tübingen, Germany, to join the Max Planck Institute for Intelligent Systems, where he expanded his scope to work on reinforcement learning, computer vision, and optimization in the context of artificial intelligence. Not only is Rolínek an enthusiastic researcher, he is passionate about teaching mathematical problem solving to high school students around the world. His current focus is on Africa; he spent the last two summers volunteering in Ethiopia.

Before committing to a full-time position at MPI, Rolínek also worked as a cryptographer for wickr, a US-based software company. Rolínek feels that his time at IST Austria had a big impact on how his life has progressed: "IST Austria played a massive role in my career. The opportunities that have come my way are more than I could ever have imagined."

Rolínek returned to campus in fall 2018 for Science Industry Day, where he was part of the expert panel during the Young Scientists' and Founders' Afternoon.

Christine Moussion

Researcher,
Genentech, San Francisco, USA

Christine Moussion trained as a bioengineer in biotechnology, then joined the Sixt group after her PhD and a postdoc at the CNRS-University of Toulouse, France. At IST Austria, she worked on the migration of leucocytes, and also developed a new bioimaging technique. Her goal was to gain a deeper understanding of immune cell recruitment in tumors and how to stimulate this recruitment, which could lead to improvements in cancer immunotherapy. In 2016, she moved to San Francisco to work for Genentech. There, she leads a research team in basic science and is also involved with the discovery and development of new drugs.

Moussion's time at IST Austria was particularly fruitful, and helped her gain valuable expertise that she applies in her current position. "IST Austria gave me the freedom to explore the edges of what is currently known in my field, the interface of immunology and bioimaging. Here, I was also able to connect with different cultures and different areas of science—I interacted with mathematicians and physicists as well as with biologists."

Moussion joined the expert panel at Science-Industry Day in fall 2018 to share her experiences working at a large pharmaceutical company.

New Professors in 2019

This year, two new Professors and two new Assistant Professors signed a contract and will strengthen the research profile of IST Austria in physics, mathematics, and the life sciences. Tim Browning has already joined the campus community; more details on his research program and background can be found in the "Facts & Figures" section of this report. The three scientists presented here will join the Institute in the course of 2019.

Mario de Bono

How are neural networks assembled? How do they function and evolve to regulate behavior and physiology? These questions are the primary focus of neuroscientist Mario de Bono. De Bono received his PhD from the University of Cambridge, UK, in 1995 for studies of sex determination mechanisms. He continued his research as a postdoc at the University of California in San Francisco, USA, investigating neural mechanisms that control group foraging. He returned to Cambridge in 1999 as a group leader at the MRC Laboratory of Molecular Biology. There, de Bono combined genetics, molecular and cell biology, and neural imaging to study neural circuits, with a particular focus on the model organism *C. elegans*. At IST Austria, he will combine genetics and biochemistry to discover functions for the neural unknome—genes as yet mysterious—and genomics and proteomics to elucidate molecular mechanisms of circuit plasticity. His work will involve both *C. elegans* and mammalian models.

Mario de Bono joins IST Austria in March 2019.

Andrew Higginbotham

Quantum physicist Andrew Higginbotham develops innovative methods to explore condensed-matter systems at low temperature. He began his research career early on, investigating laser-driven nuclear fusion and fluid mechanics as an undergraduate at Harvey Mudd College, USA. After receiving his BSc, he spent a year at the University of Cambridge, UK, for his master's, before entering the PhD program at Harvard University, USA. There, he conducted research on singlet-triplet spin qubits, quantum dots, and topological superconductivity, for which he received his PhD in 2015. Since then, he has been a researcher at both the Joint Institute for Laboratory Astrophysics in Boulder, USA, and Microsoft Station Q in Copenhagen, Denmark. At IST Austria, his work will focus on using microwave circuits and nanomechanical resonators as tools to probe condensed-matter systems. In particular, he hopes to shed light on puzzling phases in superconductor-semiconductor heterostructures, where interactions, superconducting fluctuations, and spin-orbit coupling can give rise to glassy insulators, anomalous metals, and topological superconductivity.

Andrew Higginbotham joins IST Austria in March 2019.

Scott Waitukaitis

Scott Waitukaitis is an experimental physicist investigating the complex phenomena that arise when solids and liquids interact in exotic ways. After completing his bachelor's in physics at the University of Arizona, USA, he joined the University of Chicago for his PhD in physics, which he received in 2013. He then moved to the University of Leiden, the Netherlands, to conduct research on origami-based mechanical metamaterials. In 2016, he moved to Amsterdam, the Netherlands, to continue this work at the NWO Institute for Atomic and Molecular Physics (AMOLF), where he spearheaded experiments in strongly coupled fluid-solid-gas systems. His group will explore complex phenomena in a broad spectrum of disciplines ranging from soft matter physics and materials science to complex fluids and chemistry. Two specific goals on the horizon include cracking the mechanism behind the mysterious phenomenon of tribocharging and engineering and designing non-Newtonian metafluids—liquids whose material properties can be altered spatially and temporally at will.

Scott Waitukaitis joins IST Austria in July 2019.

Opening Spaces
Crossing Borders

Biology

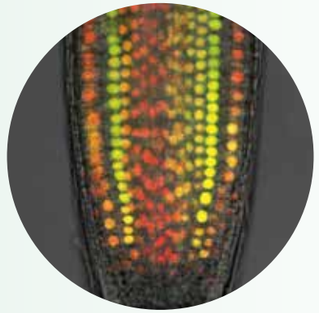
Biology, the study of life and living organisms, encompasses a range of topics—from cell biology to evolution, from genetics to development. Similarly, biology research at IST Austria covers a wide range of research areas.

In 2018, biologists at IST Austria explored questions including: How do plant mating systems evolve while preventing self-fertilization? How can cells squeeze through tight tissue barriers? What role do mechanical forces play during zebrafish development? And how does the plant hormone auxin regulate processes from seed patterning to root growth?

Cooperative Disease Defense in Social Insects

Cremer group

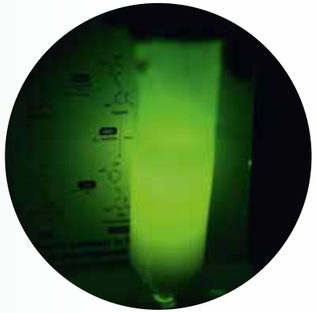
Diseases can easily spread in social groups with intense interactions. Social insects live together in dense colonies but counteract the risk of the spread of disease with cooperative defenses, forming their “social immune system”. This year, the work by Sylvia Cremer and her group revealed that ants can prevent outbreaks of epidemics using several different defense layers. First, they prophylactically disinfect their nests with toxic poison, which is possible because colony members in the sensitive brood stages are protected from the side effects of these harsh chemicals. When infections arise despite the disinfection process, the poison treatment is also applied to fatally infected colony members to prevent pathogen multiplication and spread. Disease spread is further reduced by a change in the social interaction network towards a stronger subclustering of the colony into cliques, resulting in fewer sick, but more immunized individuals. In turn, this change in immune status affects how the ants then care for exposed colony members.



New Roles for Plant Hormone Auxin

Friml group

Auxin is a plant hormone that essentially controls all plant developmental processes, from shaping the embryo to the branching of growing plants. In a series of publications in 2018, Jiří Friml and his group uncovered new mechanisms and roles for auxin. While auxin was previously thought to act mainly by regulating gene transcription, Friml and his team showed that a rapid perception mechanism of auxin is necessary for the roots’ response to gravity. Auxin is also a great communicator: plant mothers talk to their embryos in the seeds and pattern them, in part, using auxin as a signal. In other publications, Friml and his group found that plant cells inherit their knowledge of where is up and where is down from the mother cell. The team also uncovered the signals used by cells at the root tip to communicate with each other in order to protect the fragile root as it grows through the ground.



Set of Enzymes to Create Glowing Organisms

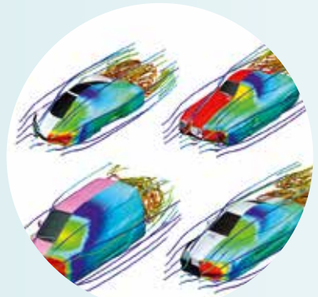
Kondrashov group

In daylight, *Neonothopanus nambi* is a rather unremarkable brown fungus. But a surprise hides behind the drab façade: at night, the fungus glows a ghostly green. *N. nambi* is one of over 100 species of mushrooms that emit light. In 2018, Fyodor Kondrashov and his team were part of a collaboration that, for the first time, identified the biochemical pathway that allows bioluminescent fungi to light up. But they went even further: by putting the three genes necessary to generate luminescence into a non-glowing yeast, they created an artificially luminescent eukaryote. This discovery could find widespread application, from tissues that report changes in their physiology by lighting up to creating glowing animals and plants.

Faculty Mathematical Models of Evolution NICK BARTON | Hormonal Cross-Talk in Plants EVA BENKOVÁ | RNA-based Gene Regulation CARRIE BERNECKY | Collective Disease Defense in Insect Societies SYLVIA CREMER | High-Resolution Optical Imaging for Biology JOHANN DANZL | Developmental and Cell Biology of Plants JIŘÍ FRIML | Systems and Synthetic Biology of Genetic Networks CĂLIN GUET | Physical Principles in Biological Systems EDOUARD HANNEZO | Morphogenesis in Development CARL-PHILIPP HEISENBERG | Tissue Growth and Developmental Pattern Formation ANNA KICHEVA | Evolutionary Genomics FYODOR KONDRASHOV | Self-Organization of the Cell MARTIN LOOSE | Structural Biology of Membrane Protein Complexes LEONID SAZANOV | Structural Biology of Cell Migration and Viral Infection FLORIAN SCHUR | Neuroimmunology in Health and Disease SANDRA SIEGERT | Invasive Migration of Immune Cells DARIA SIEKHAUS | Morphodynamics of Immune Cells MICHAEL SIXT | Biophysics and Neuroscience GAŠPER TKAČIK | Sex Chromosome Biology and Evolution BEATRIZ VICOSO

Computer Science

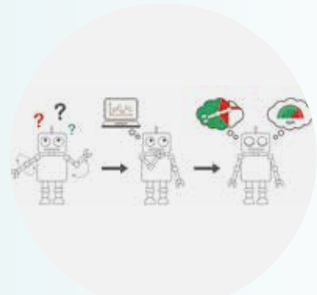
Computer science at IST Austria stands out among similar departments at other institution in two particular ways. First, all computer science groups share an appreciation for foundational thinking and base their research on a mathematically rigorous foundation. New insights are made and new algorithms and formalisms developed, based on mathematical concepts and computational thinking. Second, the groups work to foster interdisciplinarity, strengthening the ties between life sciences, physics, mathematics, and computer science—one of IST Austria's signature characteristics. This year, scientists asked questions such as: What is the logic behind modesty? Can robots learn to think "outside the box"? How can we optimize efficiently some complex loss functions that measure the accuracy of information retrieval systems?



Interactive Machine Learning Tool for Aerodynamic Car Designs

Bickel group

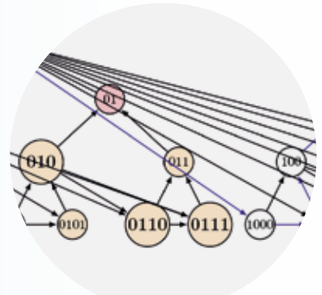
When engineers or designers want to test the aerodynamic properties of the newly designed shape of a car, airplane, or other object, they would normally model the flow of air around the object by having a computer solve a complex set of equations—a procedure that usually takes hours or even an entire day. This year, Bernd Bickel, together with his collaborator Nobuyuki Umetani from Autodesk Research (now at the University of Tokyo), significantly sped up this process, making streamlines and parameters available in real-time. Their method, which is the first to use machine learning to model flow around continuously editable 3D objects, was presented at this year's prestigious SIGGRAPH conference in Vancouver.



First Machine Learning Method Capable of Accurate Extrapolation

Lampert group

Understanding how a robot will react under different conditions is essential to guaranteeing its safe operation. But how do you know what will break a robot without actually damaging it? In the past, machine learning was only capable of making predictions about situations that are "between" other, known situations. It was incapable of making predictions about situations *outside* of the known, as the robot learns to fit the known data as closely as possible locally, regardless of how it performs outside of these situations. However, a new method developed by Christoph Lampert, together with collaborators at the Max Planck Institute for Intelligent Systems, can use observations made under safe conditions to make accurate predictions for all possible conditions governed by the same physical dynamics—the first machine learning method to do so. Especially designed for real-life situations, this method provides simple, interpretable descriptions of the underlying physics. The researchers presented their findings at this year's prestigious International Conference for Machine Learning.



Towards Sustainable Blockchains

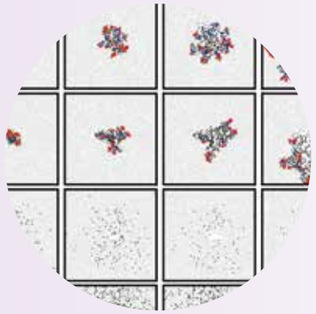
Pietrzak group

As blockchains become ever more popular and widespread, a growing concern is their sustainability: current designs, most notably the blockchain underlying the Bitcoin cryptocurrency, are secured using so-called "proofs of work", which results in the consumption of huge amounts of computational power. This is an ecological problem and brings into question the long-term viability of such cryptocurrencies. In an ongoing collaboration, Krzysztof Pietrzak and BitTorrent inventor/Chia Network CEO Bram Cohen seek to address this problem by making use of disk space rather than computational work. Their research into one of the two key components of this approach—"proofs of sequential work", also known as "verifiable delay algorithms"—received this year's Best Paper Award at EUROCRYPT, one of the world's top cryptography conferences.

Faculty Distributed Algorithms and Systems DAN ALISTARH | Computer Graphics and Digital Fabrication BERND BICKEL | Game Theory and Software Systems Theory KRISHNENDU CHATTERJEE | Algorithms, Computational Geometry and Topology HERBERT EDELSBRUNNER | Design and Analysis of Concurrent and Embedded Systems THOMAS A. HENZINGER | Computer Vision and Discrete Optimization VLADIMIR KOLMOGOROV | Computer Vision and Machine Learning CHRISTOPH LAMPERT | Cryptography KRZYSZTOF PIETRZAK | Discrete and Computational Geometry and Topology ULI WAGNER | Computer Graphics and Physics Simulation CHRIS WOJTAN

Mathematics

Mathematics allows us to distill ideas and observations, to abstract to their fundamentals, and precisely define concepts, objects, and the connections between them. It provides a language to formalize quantitative aspects of the natural sciences and a way of thinking that is useful across a wide spectrum of research fields. Mathematicians at IST Austria understand their areas deeply and combine this with the ability and openness to communicate with scientists in other disciplines. They have interests in a variety of areas, from analysis to topology, from combinatorics to mathematical physics and beyond. This year, they explored a wide range of questions, including: What can we say about the geometry of geodesics in discrete optimal transport? Under what conditions is a system of four fermions, two each of two different types, stable? Can a convex body in the plane be divided into any number of convex parts, all of equal area and perimeter?



“With a Little Help from my Friends”

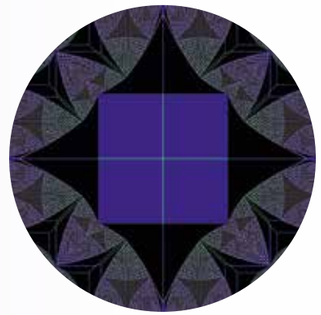
Alistarh group

Just a few *Shigella* bacteria are enough to make anyone catch gastroenteritis, while thousands to millions of *Vibrio cholerae* bacteria are necessary for a case of cholera. What causes this difference? Based on observational data, biologists proposed that this difference stems from how bacteria attack their host: for example, while *Shigella* bacteria act locally by directly injecting proteins into host cells, cholera bacteria attack from a distance, by secreting the cholera toxin. Joel Rybicki, a postdoc in the Alistarh group, with collaborators at the University of Helsinki, built a mathematical model of bacterial infections. The research results, published in *PNAS*, support the hypothesis that the scale of pathogenetic mechanisms lies behind different bacteria having different infective doses. Moreover, the researchers predict that the mechanism also influences how quickly an infection spreads in the host.

Geometry via Counting

Browning group

The first step in understanding complicated objects usually involves understanding the constituent parts. In algebraic geometry, the complicated objects are known as algebraic varieties. Their classification goes back to the 19th-century mathematician Riemann in dimension one, and to the early 20th century Italian school in dimension two. For dimensions greater than two, mathematicians hope to gain insight by studying the space of one-dimensional varieties they contain. For example, what can be said about the space of straight lines contained in a hypersurface? The geometry of these spaces is largely unknown, but Tim Browning and his collaborator Will Sawin at Columbia University recently answered some long-standing open questions about the “singular locus” of these spaces using counting arguments. This is surprising: algebraic geometry is about the *qualitative* properties of objects viewed over the complex numbers, whereas counting arguments generally describe *quantitative* properties of objects viewed over the integers.



The Abelian Sandpile Model

Guet and Hausel groups

As sand drops slowly onto a table, little mountains of grains grow and eventually become unstable, resulting in avalanches. The Abelian sandpile is an abstract mathematical model of this process. In it, the board is divided into a grid of squares, each of which can carry up to three grains of sand. If, due to the random addition of sand, one square exceeds this number, it becomes unstable and “topples”, decreasing its grain number by four and increasing the grain number of each of its neighbors by one. Certain additions of sand, known as “the identity”, return the board to its original state; when these additions are plotted, a beautiful fractal pattern emerges. Moritz Lang and Mikhail Shkolnikov, postdocs in the Guet and Hausel groups, respectively, seek to understand these fractal patterns and use them to better understand aspects of the sandpile model. Though simple, many areas of mathematics meet in the sandpile model, and their work could have implications in numerous contexts.

Faculty Mathematical Models of Evolution NICK BARTON | Analytic Number Theory and its Interfaces TIM BROWNING | Algorithms, Computational Geometry, and Computational Topology HERBERT EDELSBRUNNER | Mathematical Physics, Probability LÁSZLÓ ERDŐS | Theory of Partial Differential Equations, Applied and Numerical Analysis JULIAN FISCHER | Geometry and its Interfaces TAMÁS HAUSEL | Stochastic Analysis JAN MAAS | Mathematical Physics ROBERT SEIRINGER | Discrete and Computational Geometry and Topology ULI WAGNER

Neuroscience

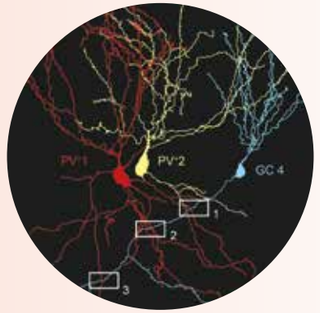
Neuroscientists study the nervous system to understand how our brains and those of other animals work. Neuroscience is a highly multidisciplinary field of science, combining physiology, molecular biology, developmental biology, and cognitive science with links to mathematics, computer science, and physics. Accordingly, the research backgrounds of neuroscientists at IST Austria are diverse.

In 2018, neuroscientists at IST Austria investigated questions such as: What is the molecular basis of neurodevelopmental disorders, such as epilepsy and autism? How is the production of nerve cells controlled? How can the brain distinguish between very similar memories? What is the neuronal basis of innate behaviors?

Reading Rats' Minds

Csicsvari group

Scientists can usually infer a rat's location based on which place cell—found in a brain region called hippocampus—sends signals. However, signaling sometimes does not correspond to the rat's location, giving the researchers an insight into how the animal thinks about space. In a study published this year in *Neuron*, Jozsef Csicsvari and his group sent rats through an eight-armed maze to find food rewards. The sequence of place cells that fire when a rat is at the maze's center corresponds either to the last arm the rat visited, or to the arm it is going to run down next. In tasks testing reference memory, the place cells fire corresponding to the next arm the rat will visit—making it possible for the researchers to predict where the rat will go next.



Lateral Inhibition Keeps Similar Memories Apart

Jonas group

When you park in the office car park, you have no problem finding your car again. The next day, you might park a few spots further away. But you still find your car, even though the memories of both days are very similar—and (also) because our brains are able to store memories of very similar events as distinct memories in a process called pattern separation. Peter Jonas and his group deciphered how a brain region, called the dentate gyrus, is wired to compute this pattern separation. They found that parvalbumin-expressing interneurons inhibit the activity of nearby neurons in a process called lateral inhibition, but this pattern only occurs in the dentate gyrus. In other brain regions, they are not connected in this manner. These connectivity rules in the dentate gyrus may represent an adaptation of the neuronal wiring to allow for pattern separation.

Mutation that Causes Autism and Intellectual Disability Makes Brain Less Flexible

Novarino group

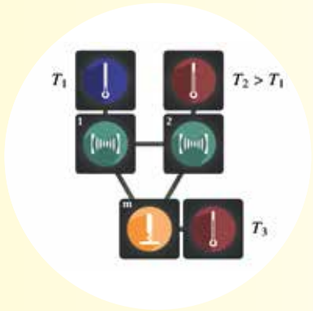
Gaia Novarino and her group study the genetic basis of neurodevelopmental disorders such as autism and epilepsy. In 2014, they found that mutations in the gene SETD5 cause intellectual disabilities and autism in about one percent of patients. In a follow-up study published in 2018 in *Nature Neuroscience*, Novarino and her team studied what happens on a molecular and behavioral level when the SETD5 gene is mutated in mice. They found that SETD5 regulates gene transcription when signals are integrated during learning and memory formation. The SETD5 mice make more stable memories, which could make the brain inflexible. Therefore, the mice cannot easily make new memories or adapt to new situations. The brain structure of mice with a SETD5 mutation is unchanged, giving hope that, eventually, researchers may understand how to treat the cognitive issues of patients with SETD5 mutations.

Faculty Systems Neuroscience JOZSEF CSICSVARI | High-resolution Optical Imaging for Biology JOHANN DANZL | Genetic Dissection of Cerebral Cortex Development SIMON HIPPENMEYER | Cellular Neuroscience PETER JONAS | Neuroethology MAX JÖSCH | Genetic and Molecular Basis of Neurodevelopmental Disorders GAIA NOVARINO | Molecular Neuroscience RYUICHI SHIGEMOTO | Neuroimmunology in Health and Disease SANDRA SIEGERT | Biophysics and Neuroscience GAŠPER TKAČIK

Physics

Physics is one of the oldest and most fundamental disciplines, and at IST Austria, scientists have approached questions in and inspired by this field from many different perspectives, using both experimental and theoretical methods. The diverse interests of the physics groups have led to questions such as: How can qubits be shielded from noise? How can one describe the rotation of molecules in fluids? Why do some quantum systems stay out of equilibrium much longer than predicted?

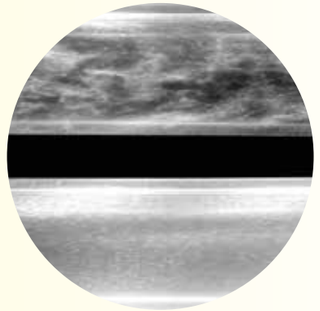
Research in physics often leads to technological advances, as scientists design new materials and machines to test their ideas and discoveries lead to novel applications. Physicists at IST Austria push boundaries in both aspects, and their research has led to developments in optical imaging, physical principles in biological systems, nanoelectronics, and more.



Cooling Quantum Devices with Interference

Fink group

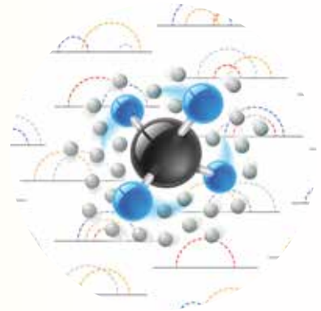
Quantum computer parts are sensitive and need to be cooled to very low temperatures. Unfortunately, their tiny size makes them particularly susceptible to temperature increases caused by the thermal noise produced by the environment and other nearby devices. Together with colleagues from Malta, Shabir Barzanjeh, a postdoc in the Fink group, has proposed a novel method to keep quantum devices cool. The approach, which they have proven to work theoretically, relies on quantum interference. The secret lies in an additional heat bath, which is connected to the other devices. The researchers showed that it is possible to use special quantum interference to control the heat flow of the bath in such a way that it cancels the heat coming from a warm object to a cool one.



Turning Turbulence into Energy-saving Laminar Flow

Hof group

From water to oil to natural gas, an enormous amount of fluid is transported across the globe through pipes. The amount of energy used to pump these fluids is considerable and corresponds to approximately ten percent of the global electricity consumption. The majority—95 percent—of these energy losses is caused by turbulence, which leads to a drastic increase in frictional drag. Previously, it was assumed that, once the flow of a fluid becomes turbulent, turbulence would persist. But the research group of Björn Hof demonstrated that this is not correct: by changing the velocity profile across the pipe, the researchers managed to destabilize the turbulence so that the flow automatically became laminar. This discovery, once transferred to applications, has the potential to dramatically decrease global energy consumption.



Description of Rotating Molecules Made Easy

Lemeshko group

Feynman diagrams are a powerful technique in condensed matter physics. By turning highly complex equations into sets of simple diagrams, the method has established itself as one of the most effective tools in a theoretical physicist's toolbox. The Lemeshko group has now extended the Feynman diagram technique: originally devised for subatomic particles, the simplest objects imaginable, the technique can now work with molecules, far more complex objects. The new formalism that the group developed is expected to drastically simplify the description of molecular rotations in solvents. This brings science one step closer to the long-term goal of understanding chemical reactions in solvents at the microscopic level and, potentially, controlling them.

Faculty Non-linear and Time-resolved Optical Spectroscopy of Strongly Correlated Electron Systems ZHANYBEK ALPICHSHEV | High-resolution Optical Imaging for Biology JOHANN DANZL | Mathematics of Disordered Quantum Systems and Matrices LÁSZLÓ ERDŐS | Quantum Integrated Devices JOHANNES FINK | Physical Principles in Biological Systems EDOUARD HANNEZO | Condensed Matter and Quantum Circuits ANDREW HIGGINBOTHAM | Nonlinear Dynamics and Turbulence BJÖRN HOF | Quantum Sensing with Atoms and Light ONUR HOSTEN | Functional Nanomaterials MARIA IBÁÑEZ | Nanoelectronics GEORGIOS KATSAROS | Theoretical Atomic, Molecular, and Optical Physics MIKHAIL LEMESHKO | Quantum Statistical Mechanics, Mathematical Physics ROBERT SEIRINGER | Condensed Matter Theory and Quantum Dynamics MAKSYM SERBYN | Biophysics and Neuroscience GAŠPER TKAČIK | Soft and Complex Materials SCOTT WAITUKAITIS

Providing Perspectives
Supporting Careers

Scientific Service Units

At an institution like IST Austria, different research groups often have the same needs. Microscopes, 3D printing, computing resources, and access to publications are just a few examples of the equipment and services that many scientists will require for their work, no matter which group or field they work in. To avoid unnecessary redundancies and to guarantee professional operation and maintenance of the equipment, IST Austria centrally runs and manages such facilities as Scientific Service Units (SSUs).
Each SSU is led by a manager and staffed by a team of experts that maintains the equipment and supports scientists with know-how, customized development, and training. Scientists use a central platform to book the available cutting-edge equipment. External users can also book the facilities at market-compliant prices, provided slots are available. The SSU system not only guarantees well-maintained equipment, it avoids unused and idle machines, fosters collaboration and communication between groups, and makes it easy for research groups to enter into new technologies.

IST Austria's Eight SSUs

Bioimaging Facility: The Bioimaging Facility supports researchers with state-of the art microscopes, flow cytometry equipment, advanced user trainings, assay development, and image analysis.
Electron Microscopy Facility: The Electron Microscopy Facility provides electron microscopes as well as sample preparation and image analysis facilities for the life sciences, physics, and chemistry. In 2018, the Electron Microscopy Facility expanded its portfolio to include cryo-EM infrastructure. More details about this addition can be found in the highlight on the right.
Nanofabrication Facility: The Nanofabrication Facility develops, optimizes, and maintains micro- and nanofabrication processes. Its staff works constantly to remain at the cutting-edge of technology and provide IST Austria researchers with the possibility to explore new materials and new devices of dimensions down to the nanometer scale.
Library: The mainly electronic Library supplies access to all types of scientific information, including eJournals, eBooks, and databases. Furthermore, it supports open scientific communication by providing digital infrastructure and consulting services.
Life Science Facility: The Life Science Facility supports experimental biologists by providing laboratory infrastructure for the biological sciences such as refrigerators and centrifuges. In addition, the Facility provides a wide spectrum of supplies for experiments, from liquid nitrogen to agar plates, and runs the fish and plant facilities.
Miba Machine Shop: The Miba Machine Shop produces and provides custom-tailored mechanical and electronic equipment and setups for all experimental research groups.
Preclinical Facility: The Preclinical Facility provides the infrastructure for research groups using laboratory animals for scientific experiments. Its main duties include breeding, documentation, and genetic identification of transgenic mouse and rat strains, as well as hygienic sanitation of mouse strains.
Scientific Computing Facility: Scientific Computing supports theoretical and experimental researchers in all their scientific computing needs, primarily by providing a high-performance computing cluster.

IST Austria's New Cryo-Electron Microscopes

2018 saw the arrival of an entirely new technology on campus: three state-of-the art cryo-electron microscopes (cryo-EMs) were purchased, delivered, and installed at IST Austria as part of the existing Electron Microscopy Facility, allowing scientists to observe biological structures at near-atomic scales.

This technology, which earned its inventors the 2017 Nobel Prize in chemistry, has led to a series of breakthrough discoveries in the life sciences in recent years. Using cryo-EM, biological samples, such as proteins, can be observed in their natural state, rendering this method indispensable in structural biology. The primary users of the new machines will be Leonid Sazanov, Carrie Bernecky, and Florian Schur—IST Austria professors specializing in structural biology—and their research groups.

IST Austria's cryo-EM facility consists of one 300 kV, one 200 kV, and one cryo-dedicated focused ion beam (FIB) microscope. The 300 kV microscope is particularly noteworthy: "This machine is unique in Austria," says Ludek Lovicar, the manager of the facility. "Currently, no other institution has a state-of-the-art 300 kV electron microscope under cryo conditions, and we expect an increase in requests from external users once the fine-tuning of the procedures and parameters has been completed."

The 200 kV machine was the first to arrive on campus. Delivered in July, the system started normal operations in November. The FIB microscope arrived in September. The last and largest machine to be delivered was the 300 kV microscope, which arrived in October. Now, the facility is busy testing and fine-tuning the machines, and training scientists in the operation of the microscopes. "I am delighted by how smoothly the installation went," adds Lovicar. "So far, the microscopes have passed all tests to our satisfaction and the installation is on schedule. I am looking forward to seeing the first scientific results coming out of our facility."

Staff Scientists

Staff scientists are fully trained researchers who work closely with various research groups on campus. They provide domain-specific skills, expertise and experience not usually present within research groups and assist in the development of the scientific service units (SSUs). They provide advanced training in sample preparation, imaging and data analysis. Each staff scientist is administratively associated with a specific SSU. Staff scientist positions are not unique to IST Austria, but in contrast to others, the Institute's staff scientists are independent of a particular research group, and thus are free and encouraged to work with any research group and SSU on campus. Their support and collaboration is critical to the success of numerous projects at IST Austria, because of their ability to devise innovative solutions to research questions. In addition, their continued presence prevents the loss of knowledge as other scientists leave the Institute and sustains the stability of institutional structures.

Similar to the professors on campus, staff scientists receive a fixed-length contract at the beginning of their employment and are evaluated after five years. If successful, staff scientists receive permanent contracts. The Institute currently employs five staff scientists, who share their time in collaborations with research groups, assisting SSUs, and advancing their own projects. These scientists have diverse backgrounds and focus on different research topics, but are united in their curiosity and creativity, their openness to collaboration, and their desire to find effective solutions to technical problems.

Robert Hauschild

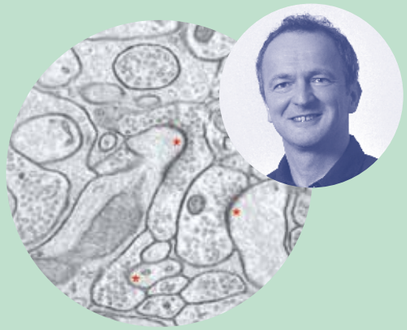
Bioimaging Facility

The startling beauty of the microscopic is what attracted Robert Hauschild to the field. As the first staff scientist on campus, he brings expertise in imaging, optical engineering, automation, and image analysis to IST Austria.

After finishing his PhD, Hauschild took on a postdoc position—both at the Institute for Applied Physics in Karlsruhe, Germany. He then moved to industry, where he worked as a system engineer developing laser scanning microscopes for several years, before joining IST Austria, where he helped establish the Bioimaging Facility. Hauschild, who greatly enjoys the cooperative spirit and the interdisciplinary nature of his work, collaborates with scientists from different fields to develop innovative solutions for unique microscopy problems, including designing and building new equipment and software.

In one recent project, the Friml and Benková groups needed live images of growing roots—a challenging task, since plants orient their root growth in the direction of gravity, but in commercially available microscopes, samples are positioned horizontally. An additional difficulty arises from the root growth that continuously displaces the area to be imaged out of the field of view. Working with scientists from both groups, Hauschild developed a microscope setup with vertical sample mounting that included a grow light to keep the plants healthy. Moreover, he wrote custom software to automatically track moving samples, enabling the observation of root tips over prolonged periods.

Another one of his projects was a micro ablation system that has found numerous applications in studies of cell migration, wound healing, tension measurement, and the quantitative patterning of proteins. "At the end of the day," says Hauschild, "if the equipment I build and software I write enables other scientists to do something they could not have done before, I'm happy. That is how I define my success."



Walter Kaufmann

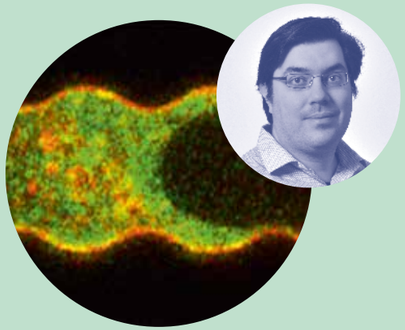
Electron Microscopy Facility

When scientists at IST Austria are interested in applying electron microscopy in their work, but are unsure how to go about it—for instance, what techniques to use or which analysis to employ—they talk to Walter Kaufmann, a staff scientist with the Electron Microscopy Facility on campus. Before joining the Institute in 2013, Kaufmann specialized in neuroscience and neurobiology for his PhD from the Leopold Franzens University in Innsbruck. He then held positions as a postdoc at the Innsbruck Medical University and the University of Oslo, before returning to Innsbruck as a senior scientist and habilitating in neuroscience.

Helping scientists plan a project is just one part of his regular work, however: Kaufmann also takes care of sample preparation for various projects, imaging and analysis of these samples, as well as initiating discussions about the resulting data. He works with numerous groups on campus. In one completed project with the Shigemoto group, he worked with a visiting scientist to combine innovative electron microscopy techniques with physiological approaches.

The goal was to reveal the number of vesicle docking sites in a central nervous system synapse and the localization of P/Q-type voltage-gated calcium channels in relation to them. Kaufmann's primary contribution was applying a technique that had only recently been established at IST Austria—freeze-fracture replica labeling. His internationally recognized work provided a proof of principle, and led to several other projects in the field of synaptic ion channel localization.

Currently ongoing are investigations into the role of actin in clathrin-mediated endocytosis of plant progenitor cells. Initiated by a PhD student in the Friml group, the project aims to understand the presence of a clathrin coat on endocytic vesicles, as well as establish the location and function of actin at the endocytic spot. While the questions are not new, many scientists have been unable to answer them due to challenges in sample preparation and electron-microscopy imaging. Kaufmann and the Friml group have already provided proof of a clathrin coat by replica analysis—a step forward that has gained widespread attention.



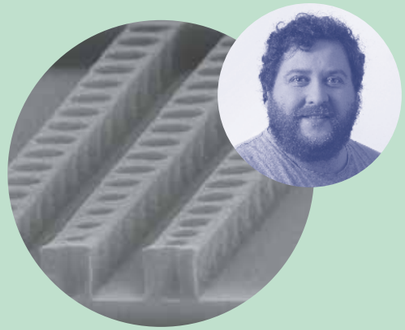
Jack Merrin

Nanofabrication Facility

Microfluidics, the manipulation of fluids on small length scales, is widely applicable in interdisciplinary fields. Jack Merrin, a staff scientist in the Nanofabrication Facility, is an expert in this area and conducts research with diverse groups on campus. His most extensive running collaboration is with the Sixt group, where he constructs many different microchips for experiments on immune cell motility and chemotaxis. Scientists generally think that cells use proteins that adhere to surfaces to pull themselves along. Using microchannels with wavy patterns, however, the team was able to show that T-cells can also move by pushing off the walls without adhesive proteins.

With the Friml group, Merrin constructed a microfluidic root chip to probe growing roots and rapidly test the effects of removing and applying chemicals. This device resulted in a breakthrough discovery that root growth rate responds instantaneously to the hormone auxin. A device that lets two different chemical environments flow over different sides of a root is currently under development. Dual flow root chips allow explorations of how cells respond to local or asymmetric environments. Finally, in collaboration with the Hof group, Merrin explores bouncing silicone oil droplets in corrals. The droplet orbital motions exhibit properties similar to quantum particles and also have chaotic features.

Merrin became interested in microfluidics during his physics PhD at Princeton University, and he gained further experience during his five years as a postdoc. Since joining IST Austria, he keeps his knowledge and skills up to date by teaching courses such as microfluidics and differential equations, attending microfluidics conferences, and taking on innovative projects. Merrin says, "Being a staff scientist gives me an opportunity to short-circuit the learning curve on a lot of projects, and I enjoy training and supporting students and postdocs."



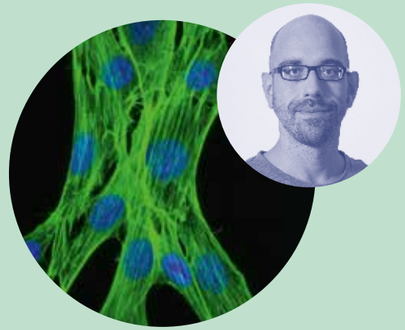
Ivan Prieto

Nanofabrication Facility

The Institute's newest staff scientist, Ivan Prieto, is an expert in nanofabrication, material science, and optoelectronics. He received his PhD in Madrid, then moved to Zurich for a postdoc at ETH. Still in Switzerland, he moved to industry, and worked as a process development manager for one year. Eager to focus again on research, he joined IST Austria in May 2018. His work here is centered on the fabrication of nanoscale structures, developing new fabrication routines, and improving the existing ones, primarily with the Fink and Katsaros groups. With the Fink group, for example, he has focused on silicon photonic cavities: essentially, light is coupled to an integrated waveguide that excites the mode of a set of a type of photonic cavity.

These cavities are designed to confine the light by coupling to a mode with high quality factor (Q), which is very sensitive to fabrication imperfections such as uncontrolled shapes or sidewall roughness. The fabrication process was initiated by PhD student Georg Arnold, whose structures already performed remarkably well. However, the group believed they could further improve Q, and Prieto dedicated himself to optimizing the fabrication procedure. Their joint efforts so far have resulted in a two- to three-fold increase of Q, improving the overall quality of the device. In the future, the scope of this position will expand to include design, simulations, and characterization. Prieto will also conduct his own research in the field of strained spintronics.

"I believe that, in the future, scientific projects will become increasingly interdisciplinary, and the way IST Austria has been conceived fosters this interdisciplinarity. The combination of this environment and the brilliant scientists we have here can only lead to success—it is just a question of time. It is my pleasure to be part of the team and to provide the support that enables this progress."



Christoph Sommer

Bioimaging Facility

Given an image, how can we transform it into numbers that answer the question we posed? And how can we automate that process? These are two of the questions underlying much of Christoph Sommer's work. A computer scientist by training, Sommer is an expert in image analysis and has significant experience creating software to automate analysis, with a focus on deep learning applications.

Already as a graduate student at the University of Heidelberg, he developed software for image classification and segmentation, which is still used by scientists at many research institutes—including IST Austria. He developed high-content screening analysis software as a postdoc at ETH Zurich and IMBA Vienna; then, seeking new challenges, Sommer joined the Institute as a staff scientist in 2017. He already carries out projects with the bio-imaging facility, other staff scientists, and several different labs. With the Danzl lab, he is working on a project involving expansion microscopy—a way around the diffraction limit of normal light microscopy, essentially by taking the sample and increasing its size by swelling it isotropically. For their analysis, the lab needed to quantify the local distortions that appear during this expansion process. Since the protocol resulted in the sample being divided into pieces, each of which swells individually, they also needed a way to match the rotated, expanded pieces at the end with the pre-expansion image. Sommer contributed with a program that analyzed the images and correlated the pieces with the original, putting numbers to the expected expansion artifacts.

A second project is conducted together with the Cremer group. The group has collected videos of ants engaged in various activities, and wanted to automatically analyze the videos and tag specific activities. Sommer used a deep learning approach for this problem and achieved excellent recognition rates; it is planned to use this approach in additional scenarios. The range of scales is one aspect of what makes Sommer's position exciting: "From electron micrographs to cells, to ants, to flowers—there is always a new domain to explore," he says. "And because there needs to be regular communication between the scientists and me, I'm always learning." Though his projects so far have mainly focused on biology-related questions, he plans to work with the Lampert group in the future to improve deep learning techniques and increase their use in the labs on campus.

Administration

Creating the best possible environment for world-class research is the central task of all administrative employees at IST Austria. Staffed with dedicated experts, the administration provides high-quality support in the areas listed on the right.

Georg Schneider

Managing Director, IST Austria

IST Austria was founded with the goals of performing world-class basic research and training the next generation of scientific leaders. Setting examples in science and education, however, requires setting an example in science management, and the administration of IST Austria strives for professionalism, efficiency, and above all, excellent support for science and scientists.

The opening of the new administration building is a testament to the growth and development of the administration at IST Austria. Over the nine years the campus has existed, administration and scientific support has grown from 11 to 235 employees, and this growth in size has been paralleled by the growth and development of the capabilities and services provided. For instance, Academic Affairs established a career development program to support scientists in their next steps. At the same time, we have built up a rigorous system of internal controls to minimize risks and maximize efficiency. The administration moreover provides structure and continuity in a place where many of the scientific employees spend just a few years; as part of this, they create and refine the organizational processes and development. In optimizing our processes, the efficient use of our budget is very important to us. As an institute funded largely from public sources, we seek to ensure the best possible use of those funds.

The Institute is also committed to supporting its administrative staff: in 2018, IST Austria continued its participation in the Erasmus+ program, sending employees to conferences, workshops, and trainings across Europe, including Belgium, Spain, and the UK.

The Institute will continue to grow in the coming ten years and the size of the administration will increase to ensure continued full support, while keeping an emphasis on streamlined, unbureaucratic service.

Academic Affairs is responsible for administrating all academic matters. Its team coordinates the quality control of research at the Institute and organizes the recruitment process for professors and staff scientists. Academic Affairs moreover supports postdocs and scientific visitors during their time at the Institute, and deals with topics such as research ethics, alumni tracking, and career development for scientists.

The Graduate School Office within the division organizes the PhD program and academic courses and manages the admissions and progress-monitoring processes for students. In addition to these tasks, this division supports scientists with funding schemes, assists in preparing research proposals, and administers approved grants through the Grant Office.

Communications & Events support the managing team, scientists, and administration in public relation and public affairs. The Communications team provides services in media relations, science writing, web and social media management, alumni relations, content management, and internal communications. The Event team organizes conferences, workshops and meetings as well as public outreach events, and develops materials and activities for science education.

Construction & Maintenance prepares the space for new research groups and facilities and operates the buildings on campus. Responsibilities include electricity, heating, ventilation, and air-conditioning, as well as providing non-scientific equipment and furnishings. The division also includes Environment, Health & Safety, which ensures the well-being of everyone on and around campus, and Campus Services, which takes care of childcare, housing, food, transportation, sports facilities, and other non-scientific services on campus.

Campus IT Services assists scientists and administrative staff with all their IT issues, provides basic infrastructure for all IT services and takes care of all application development and customization.

People & Financial Services comprises both the classical human resources unit of the Institute and teams responsible for all aspects of accounting, controlling, and procurement. Its staff members moreover handle questions related to diversity and inclusion and support international scientists. The division also includes the Institute's team of assistants to professors, who support the research groups with a variety of administrative tasks.

The **Technology Transfer Office** takes care of all matters related to intellectual property developed at IST Austria, such as patent protection, licensing technology to companies, and supporting the creation of spin-off companies. The office supports aspiring entrepreneurs among IST Austria's young scientists and facilitates collaboration agreements with industry.

Two units work closely with the management and are responsible for building up and maintaining support structures to accommodate the continued growth of the Institute and the ongoing adaptation of its organizational structures and processes:

Executive Affairs supports the Managing Director and includes Legal Affairs, Internal Audit, and Organization, Processes & Project Management.

The **Office of the President** supports the President and includes Faculty Affairs and Stakeholder Relations, in addition to being responsible for the administration of board meetings.

Encouraging Collaborations Across Scientific Fields

Outreach and Science Education

A key role of research institutions is to share the wonder, excitement, and methods of scientific research as well as the resulting discoveries with their local, national, and global communities. Within its missions of outreach and education, IST Austria seeks to foster public engagement with basic science by making resources and information available on campus accessible to the public. The Institute organizes events and develops communication materials to engage children, teenagers, and adults not actively involved in science and to create an open dialogue between the public and the academic world.

2018 saw the implementation of a comprehensive outreach strategy based on four pillars: the development of tools, exhibits, and innovative formats for outreach activities and education, the improvement of science education in Austria, providing public access to a vibrant research campus, and increasing the visibility of the Institute. The strategy focuses on science education, activity modules, and scalability to form the basis of the programs for the coming Visitor Center, the future home of the Institute's outreach activities. In order to expand current programs and develop new projects and partnerships in science education, the Institute held several events designed to connect teachers and researchers. Chief among these was the first Science Education Day, which will be held annually in the future. In addition to the events described here, a list of outreach events can be found in the "Facts & Figures" section.

Science Education Day

How can we engage and excite students for science? How can we support teachers in developing science activities?

Providing a forum to exchange ideas and answer these questions was the primary motivation for the first Science Education Day organized by IST Austria on May 24, 2018. Scientists, teachers and prospective teachers, policy makers and administrators as well as the public audience discussed possibilities and new pathways in the field of science education. Highlights included the keynote address by Liat Ben David, director-general of the Weizmann Institute's Davidson Institute of Science Education, who emphasized the importance of science education to society and people's ability to make information-based choices. The day also included panel discussions on knowledge-transfer campaigns and an afternoon workshop for young researchers to improve their ability to communicate their work.

In the future, the Science Education Day will be an annual event focusing on national and international perspectives and exchange on topics in science education, as well as on designing materials and activities for students of all ages.

Open Campus

At the Open Campus, taking place in spring each year, IST Austria opens its doors to the public.

Everyone interested in science is invited to explore a research exhibition, attend a general science lecture, and tour the laboratories, as well as to relax and enjoy the campus. This year, nearly 2'000 visitors experimented with probability using a giant Galton board, tried their hands at crypto-graphic pebbling problems, took a moment to ponder questions about evolution and the brain that are still baffling researchers, and much more. Professor Johann Danzl demonstrated how new approaches in light microscopy enable the investigation of the tiniest details in cells during the family science lecture, and schoolchildren who had taken part in a regional contest to submit "ideas of today for the world of tomorrow" were honored and the winners announced.

New this year was a digital scavenger hunt: teams of up to three people solved a series of tricky puzzles. The three winning teams received a helicopter flight, an indoor skydiving tour, and a VR racing challenge.

Summer Science Camps

IST Austria organizes and hosts research camps for elementary, middle, and high school children during the summer. One of these, the "Sommercampus", was held this year for the fifth time in a row. Sixty children between the ages of seven and ten came to campus to spend a week carrying out exciting experiments. Guided by students at the Lower Austrian University of Education (PH NÖ), as well as IST Austria staff and scientists, the children discussed bacteria in extreme habitats, the evolutionary family tree, as well as the colors of light and experimented with the trajectory of Robin Hood's arrows, launched vinegar-powered rockets, built robots, and programmed computer games. The following week, 15 teenagers came to campus for "Top Models in Science", a three-day research camp about scientific models and how scientists use these models to describe and understand nature and natural phenomena.

During the camp, participants tested the models for free-fall and projectile trajectories in experiments, then analyzed their data and computed statistics. Game theory challenged the teenagers to think logically and strategically, and during a session on engineering, they simulated collisions, computed the carrying capacity of bridges, and even built their own computers. The days were rounded off with lab tours and lectures, during which students learned about chaos theory, fluid mechanics, and quantum bits.

Science and Schools

IST Austria seeks to make science, scientists, and the campus accessible to the general public, in particular to schools. This year, over 300 students aged nine to 19 from five different countries came to IST Austria to tour the labs, see scientists at work, meet graduate students, and more. Some younger classes had the opportunity to participate in a multi-session research project, "How do plants dance?". In this project, schoolchildren ran experiments and prepared microscope samples to learn about plant development and observation.

In the future, high school students will also have the opportunity to complete their "pre-scientific work" ("vorwissenschaftliche Arbeit") under the supervision of IST Austria scientists—including the chance to work in the Institute's laboratories. But the schools do not just come to IST Austria—the Institute also goes to them: During 2018, scientists visited schools to talk about their careers, intrigue students with mathematical problems, and present their research. One IST Austria professor, Simon Hippenmeyer, gave three lectures as part of the program called "Science goes School". During his talks, students learned about groundbreaking achievements in brain research, as well as answers to questions such as: How does the brain perceive itself and the environment, and how does the thinking process work? What are the consequences if mistakes occur during brain development or if the brain is damaged in an accident?

Scientific Discourse

Over the course of 2018, IST Austria organized and hosted numerous events in and around science. Ranging from colloquium lectures given by renowned scientists to conferences on selected topics, these events brought science supporters and enthusiasts—members of the general public as well as top researchers and science administrators—to campus to exchange ideas and discuss the latest scientific trends and discoveries. The Institute also hosted other public events, which focused on discussions of issues in and around science, research, and policy. Four types of events are highlighted here; a list of major talks and conferences can be found in the "Facts & Figures" section.

Conferences, Symposia, and Workshops

The Institute is proud to host and organize events that provide platforms for scientific exchange. Two highlights this year were the Frontiers of Circuit QED and Optomechanics (FCQO18) Conference and the 8th annual Algebraic Topology: Methods, Computation, and Science Conference (AMTCS18). FCQO18 addressed topics from reservoir engineering to hybrid quantum devices and quantum error correction. Speakers discussed the challenges in connecting superconducting quantum computers to large-scale quantum networks. AMTCS18 brought over one hundred mathematicians to campus with the goals of developing new topological techniques for use in applications and coming up with new ways and areas in which to apply their research.

Public Lectures

IST Austria (co)organizes several lecture series, which take place on and off campus. IST Lectures are given by eminent scientists who are invited to present their research to the general public and the scientific community. In his IST Lecture, quantum physicist Anton Zeilinger gave an overview of the current state of quantum communication, focusing on communication with individual photons. Another highlight this year was the IST Science and Society Lecture given by Jeffrey D. Sachs, one of the world's leading economists. He talked about the global growth of both economy and population hitting the limits of the resources available on earth, with a particular focus on the importance of education and the role that universities and research institutes can and will have to play in solving global problems.

Colloquia

The Institute Colloquium is IST Austria's main weekly seminar, and the talks are open to the general public, both on and off campus. The colloquium talks address a broad range of topics in the research areas represented at IST Austria, and are designed to engage scientists from all fields. Among the many international experts who gave colloquium talks at IST Austria in 2018 were Nobel Laureate John O'Keefe, who discussed how rats navigate using spatial cells in the hippocampus, and Orna Kupferman of the Hebrew University of Jerusalem, who examined classical graph theory problems using formal verification methods.

Other Public Events

In 2018, Austria held the Presidency of the Council of the European Union, and in connection with this, IST Austria hosted a high-profile public event together with the Federal Ministry of Education, Science, and Research. During the event, speakers from all over Europe discussed the role of competitive research funding in science. The program included both keynote speeches and panel discussions, and addressed questions such as: What are the key factors to consider when designing, implementing, and evaluating a competitive research grant program? How does competitive research funding affect research institutions? And does competitive funding help to develop and support Europe's research talent in full, or does it perpetuate the participation gap between old and new membership countries?

Pursuing Scientific Interests
Exploiting Results

Feeding the Entrepreneurial Bug

TWIST – Technology Transfer Office

twist
Tech Transfer at IST Austria

The Technology Transfer Office is the one-stop shop for all matters related to intellectual property, industry liaison, and entrepreneurship at IST Austria. It is responsible for patent protection and licensing, and supports the creation of spin-off companies and cooperation with industry. A range of measures is available to help translate research results into product ideas that the Institute can commercialize through licensing and the support of start-ups. TWIST facilitates exchanges with industry, works with founders, and helps researchers interested in joining industry or start-ups make career decisions.

As part of its ambition to develop technology transfer projects, IST Austria has continued to file patents on inventions with commercial potential. In total, IST Austria now owns twelve patent families in such diverse areas as modeling systems for biological networks, photopatterning research tools, potential treatments for diabetes, and algorithms to generate flexible casting molds.

IST Austria also holds equity positions in two start-ups based on research by the Institute's faculty: Chia Network is building a more sustainable blockchain for a new cryptocurrency; Neuralmagic is developing a systems platform specifically designed for machine learning. The Institute also actively pursues collaborative projects with industry partners—in 2018, a cooperative research project on quantum computing with Microsoft was initiated.

IST cube

While business angel activity has grown over recent years and a range of government grants are now available, institutional equity investors addressing academic spin-offs are still rare in Austria. IST Austria and a subsidiary of Lansdowne Partners took a significant step towards closing this gap and improving the situation for young tech-based founders who plan to host their ventures in Austria: they partnered to set up IST Cube, a new investment fund that supports the creation and development of tech and science-based start-ups. IST Cube invests in advanced technology companies, many of which are derived from academic research, and will help successful founders to generate viable business models, form strong teams, and develop their ventures, all with the goal of becoming global leaders in their fields.

IST PARK

The project to build a science and technology park for research-intensive enterprises adjacent to the IST Austria campus is moving ahead. The joint development company between ecoplus—the business agency of Lower Austria—and IST Austria has secured sufficient commitments to pursue construction of the first phase, comprising two buildings offering lab and office space and scheduled to be completed in summer 2019.

Supporting IST Austria's Science and Future

In the past decade, IST Austria has established itself among Europe's top research institutions. Through their philanthropic contributions, IST Austria's supporters have played—and continue to play—a key role in the Institute's success story.

The Institute of Science and Technology Austria has received a great deal of support over the past year, which has helped make IST Austria's mission to conduct excellent basic research possible. IST Austria is extremely grateful to its private and corporate patrons for their continued dedication and significant contributions.

October 2018 saw the implementation of a new fund-raising concept in the form of the first "WISTA" dinner. Organized jointly by the Israel-based Weizmann Institute of Science and IST Austria, the exclusive event celebrated the fruitful scientific discourse between Israel and Austria in general and the Weizmann Institute and IST Austria in particular. To give the attendees a glimpse of the possibilities of fundamental research, Professors Gašper Tkačik (IST Austria) and Elad Schneidmann (Weizmann Institute) presented results from their long-standing and award-winning collaborative research on neural coding. Proceeds from the evening will be directed towards further scientific collaborations between both research institutes.

With its 10th anniversary celebrations coming up in 2019, IST Austria is looking forward to further increasing its network of supporters and connecting the Institute with society.

More information: www.ist.ac.at/donors

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Facts & Figures

Professors at IST Austria

(Under contract as of December 31, 2018)

Dan Alistarh Distributed Algorithms and Systems
Zhanybek Alpichshev Non-linear and Time-resolved Optical Spectroscopy of Strongly Correlated Electron Systems
Nick Barton Mathematical Models of Evolution
Eva Benková Plant Developmental Biology
Carrie Bernecky RNA-based Gene Regulation
Bernd Bickel Computer Graphics and Digital Fabrication
Tim Browning Analytic Number Theory and its Interfaces
Krishnendu Chatterjee Computer-aided Verification, Game Theory
Sylvia Cremer Collective Disease Defense in Insect Societies
Jozsef Csicsvari Systems Neuroscience
Johann Danzl High-resolution Optical Imaging for Biology
Mario de Bono Genes, Circuits and Behavior
Herbert Edelsbrunner Algorithms, Computational Geometry, and Computational Topology
László Erdős Mathematics of Disordered Quantum Systems and Matrices
Johannes Fink Quantum Integrated Devices
Julian Fischer Theory of Partial Differential Equations, Applied and Numerical Analysis
Jiří Friml Developmental and Cell Biology of Plants
Călin Guet Systems and Synthetic Biology of Genetic Networks
Edouard Hannezo Physical Principles in Biological Systems
Tamás Hausel Geometry and its Interfaces
Carl-Philipp Heisenberg Morphogenesis in Development
Thomas A. Henzinger Design and Analysis of Concurrent and Embedded Systems
Andrew Higginbotham Condensed Matter and Quantum Circuits
Simon Hippenmeyer Genetic Dissection of Cerebral Cortex Development
Björn Hof Nonlinear Dynamics and Turbulence
Onur Hosten Quantum Sensing with Atoms and Light
Maria Ibáñez Functional Nanomaterials
Peter Jonas Synaptic Communication in Hippocampal Microcircuits
Maximilian Jösch Neuroethology
Georgios Katsaros Nanoelectronics
Anna Kicheva Tissue Growth and Developmental Pattern Formation
Vladimir Kolmogorov Discrete Optimization
Fyodor Kondrashov Evolutionary Genomics
Christoph Lampert Computer Vision and Machine Learning
Mikhail Lemeshko Theoretical Atomic, Molecular, and Optical Physics
Martin Loose Self-organization of the Cell
Jan Maas Stochastic Analysis
Gaia Novarino Genetic and Molecular Basis of Neurodevelopmental Disorders
Krzysztof Pietrzak Cryptography
Leonid Sazanov Structural Biology of Membrane Protein Complexes
Florian Schur Structural Biology of Cell Migration and Viral Infection
Robert Seiringer Mathematical Physics
Maksym Serbyn Condensed Matter Theory and Quantum Dynamics
Ryuichi Shigemoto Molecular Neuroscience
Sandra Siegert Neuroimmunology in Health and Disease
Daria Siekhaus Invasive Migration
Michael Sixt Morphodynamics of Immune Cells
Gašper Tkačik Theoretical Biophysics and Neuroscience
Beatriz Vicoso Sex Chromosome Biology and Evolution
Uli Wagner Discrete and Computational Geometry and Topology
Scott Waitukaitis Soft and Complex Materials
Chris Wojtan Computer Graphics and Physics Simulation

Total number of Professors (under contract): 52

Gender among Professors*

Country of nationality*

Germany	20.4%
Austria	16.3%
USA	8.2%
Hungary	6.1%
Russia	6.1%
Romania	4.1%
UK	4.1%
Other (17**)	34.7%

Country of PhD Institution*

Germany	26.5%
USA	26.5%
Switzerland	16.3%
UK	10.2%
Austria	8.2%
Other (6**)	12.3%

Country of previous institution*

USA	34.7%
Germany	22.4%
UK	18.4%
Switzerland	10.2%
Belgium	4.1%
Other (5**)	10.2%

* Data refer to 49 Professors on campus as of December 31, 2018

** Number of countries

Research Groups on Campus

Dan Alistarh

Distributed Algorithms and Systems

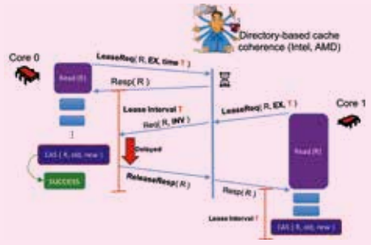
Distribution has been a major trend in computing over the last decade, which affects the way we compute in several ways: Microprocessor architectures are now multi-core, offering several parallel threads of computation, while large-scale systems distribute storage and computation across several processors, machines, or data centers. The Alistarh group works to create algorithms that take advantage of these developments by creating software that scales—in other words, it improves its performance when more computation is available.

This fundamental change in the way computation is performed puts forward exciting open questions. How do we design algorithms to extract every last bit of performance from the current generation of architectures? How do we design future architectures to support more scalable algorithms? Are there clean abstractions to render high-performance distribution accessible to programmers? The Alistarh group's research is focused on answering these questions. In particular, they are interested in designing efficient, practical algorithms for fundamental problems in distributed computing, in understanding the inherent limitations of distributed systems, and in developing new ways to overcome these limitations.

Current Projects Distributed machine learning | Concurrent data structures and applications | Molecular computation
Team Members 2018 Trevor Brown (postdoc), Bapi Chatterjee (ISTplus postdoc), Ekaterina Goltsova (ISTern), Arnab Kar (scientific intern), Ilia Markov (scientific intern), Giorgi Nadiradze (PhD student), Joel Rybicki (ISTplus postdoc), Aditya Sharma (scientific intern), Nandini Singhal (scientific intern)

Career
- since 2017 Assistant Professor, IST Austria
- 2016 – 2017 Visiting Researcher, Computer Science Department, ETH Zurich
- 2014 – 2016 Researcher, Microsoft Research, Cambridge, UK
- 2014 – 2016 Morgan Fellow, Downing College, University of Cambridge, UK
- 2012 – 2013 Postdoc, Massachusetts Institute of Technology, Cambridge, USA
- 2012 PhD, EPFL, Lausanne, Switzerland

Selected Distinctions
- 2018 ERC Starting Grant
- 2015 Awarded Swiss National Foundation "Ambizione" Fellowship
- 2014 Elected Morgan Fellow at Downing College, University of Cambridge
- 2012 Postdoctoral Fellowship of the Swiss National Foundation
- 2011 Best Paper Award at the International Conference on Distributed Computing and Networking



Intuitive diagram of a timing-aware cache-coherence protocol developed by the Alistarh lab. Cores are allowed to process extra timing information about the workload, which can provide order-of-magnitude performance improvements.

Zhanybek Alpichshev

Non-linear and Time-resolved Optical Spectroscopy of Strongly Correlated Electron Systems

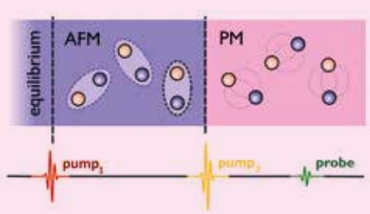
To understand a complex system, it is often useful to bring it out of equilibrium; the recovery dynamics will reveal a great deal about its inner workings. The Alpichshev group uses ultra-fast optical methods to understand the physical mechanisms underlying some of the extremely complicated phenomena in many-body physics.

One of the most important problems in modern physics is to understand the behavior of a large number of strongly interacting particles. Such systems often feature unique properties such as high-temperature superconductivity or colossal magnetoresistance. The exact origins of such behavior is still unclear, which hinders our ability to control and increase the effects of these phenomena. The main difficulty facing researchers in this area is that these "strongly correlated" properties invariably arise in the context of a large number of competing phases, which makes it difficult to determine the individual role of each factor. The Alpichshev group circumvents this problem by using ultra-short laser pulses to selectively perturb and probe the individual degrees of freedom in a strongly correlated material and study the system in the resulting transient state. The resulting information can be used to reconstruct the microscopic mechanisms behind complex phenomena with genetic data to estimate population structure and fitness variation over multiple scales.

Current Projects Determining the role of rattling modes of organic cations on the transport of photo-carriers in hybrid lead halide perovskites | Exciton dynamics in frustrated Mott insulators | Ultrafast dissipative processes in correlated electron systems below Planckian level
Team Members 2018 Dusan Lorenc (postdoc)

Career
- since 2018 Assistant Professor, IST Austria
- 2017 – 2018 Visiting Scientist, Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany
- 2012 – 2017 Postdoctoral Associate, Massachusetts Institute of Technology, Cambridge, MA, USA
- 2012 PhD, Stanford University, Stanford, CA, USA

Selected Distinctions
- 2008 – 2010 Albion W. Hewlett Stanford Graduate Fellowship
- 2005 "Dynasty Foundation" Fellowship
- 2002 Landau Fellowship, Landau Institute for Theoretical Physics



Three step pump-probe measurement in a Mott insulator. Comparing the difference in relaxation dynamics of Hubbard excitons (generated by the first pump pulse) with and without magnetic order (switched by the second pump pulse) gives information about the microscopic mechanisms behind the effective characteristics of quasiparticles in strongly correlated systems.

Nick Barton

Mathematical Models of Evolution

The Barton group develops mathematical models to probe fundamental issues in evolution: For example, how do new species form, what limits adaptation, and what shapes the genetic system?

Nick Barton and his group study diverse topics in evolutionary genetics. The main focus of their work is the effects of natural selection on many genes, and the evolution of populations that are distributed across space. They develop statistical models for the evolution of complex traits, which depend on the combined effects of very many genes. Working with other groups at IST Austria, they study the evolution of gene regulation, using a thermodynamic model of transcription factor binding. A substantial component of the group's work is a long-term study of the hybrid zone between two populations of snapdragons (*Antirrhinum*) that differ in flower color. This combines detailed field observation with genetic data to estimate population structure and fitness variation over multiple scales and serves as a test-bed for developing ways to infer selection and demography from genetic data.

Current Projects Evolutionary computation | Evolution of complex traits | Analysis of selection experiments | Understanding genealogies in space and at multiple loci | Inference from DNA sequence | Speciation and hybridization in *Antirrhinum*
Team Members 2018 Louise Arathoon (PhD student), Carina Baskett (ISTplus postdoc), Stefanie Belohlavy (PhD student), Ioana Bouros (ISTern), Eva Cereghetti (scientific intern), Christelle Fraisse (FWF Lise Meitner postdoc, joint with Vicoso group), Michal Hledik (PhD student), Lenka Matejovičová (PhD student), Maria Melo Hurtado (postdoc), Ahina Nandy (ISTern), Melinda Pickup (postdoc), Gemma Puixeu Sala (PhD student, joint with Vicoso group), Harald Ringbauer (PhD student), Natalia Ruzickova (scientific intern), Himani Sachdeva (postdoc), Srdjan Sarikas (postdoc), Daria Shipilina (postdoc), Enikő Szép (PhD student), Barbora Trubenová (Marie Curie postdoctoral fellow), Anja Westram (ISTplus postdoc, Marie Curie postdoctoral fellow)

Career
- since 2008 Professor, IST Austria
- 1990 – 2008 Reader and Professor, University of Edinburgh, UK
- 1982 – 1990 Lecturer and Reader, University College London, UK
- 1980 – 1982 Demonstrator, Cambridge University, UK
- 1979 PhD, University of East Anglia, Norwich, UK

Selected Distinctions
- ISI Highly Cited Researcher
- 2016 Schrödinger Lecture, Dublin
- 2013 Erwin Schrödinger Prize, Austrian Academy of Sciences (ÖAW)
- 2013 Mendel Medal, German National Academy of Sciences Leopoldina
- 2009 Linnean Society Darwin-Wallace Medal
- 2009 ERC Advanced Grant
- 2006 Royal Society Darwin Medal
- 2001 President, Society for the Study of Evolution
- 1998 American Society of Naturalists President's Award
- 1994 Fellow, Royal Society of London
- 1994 David Starr Jordan Prize

Studies of hybridization between red- and yellow-flowered *Antirrhinum* in the Pyrenees tell us about the process of speciation.

Eva Benková

Plant Developmental Biology

True to their name's Greek roots, plant hormones "set in motion" a myriad of physiological processes. Influencing and modulating each other, an intricate network of interactions arises. The Benková group seeks to untangle this network and understand its molecular basis.

Post-embryonic formation of new organs, a major determinant of the plant body architecture, is responsive to a myriad of environmental inputs such as light, temperature, and nutrition. Plant hormones allow plants to rapidly adjust their development to these external cues. Physiological and genetic studies have investigated the signaling components of the individual hormonal pathways. However, over the last years it became clear that hormones are interconnected by a complex network of interactions. How these hormonal networks are established, maintained, and modulated to control specific developmental outputs is the focus of the Benková group. Recently, the group has located several convergence points that integrate different hormonal inputs. Importantly, some of these identified components exceed their function in the hormonal crosstalk and provide functional links with pathways mediating perception of environmental stimuli.

Current Projects Convergence of hormonal pathways on transport-dependent auxin distribution | Identification of hormonal cross-talk components by genetic approaches | Hormonal cross-talk driven nutrient-dependent root development
Team Members 2018 Rashed Abualia (PhD student), Christina Artner (ÖAW DOC-funded PhD student), Nivola Cavallari (postdoc), David Domjan (scientific intern), Marcas Gallemi Rovira (postdoc), Corinna Hartinger (scientific intern), Mónika Hrtyan (laboratory technician), Syamala Inumella (scientific intern), Karolina Kubiasova (academic visitor), Juan Montesinos López (EMBO-funded postdoc), Krisztina Ötvös (postdoc), Thomas Rauter (scientific intern), Willi Riber (academic visitor), Arseny Savin (academic visitor), Hana Semeradova (ÖAW DOC-funded PhD student), Berokh Shojaie Flowerjani (academic visitor), Kaori Tabata (academic visitor), Petr Valosek (laboratory technician)

Career
- since 2016 Professor, IST Austria
- 2013 – 2016 Assistant Professor, IST Austria
- 2011 – 2013 Group Leader, Central European Institute of Technology (CEITEC), Brno, Czech Republic
- 2007 – 2013 Group Leader, Flanders Institute for Biotechnology, Ghent, Belgium
- 2003 – 2007 Habilitation position, University of Tübingen, Germany
- 2001 – 2003 Postdoc, Centre for Plant Molecular Biology, Tübingen, Germany
- 1998 – 2001 Postdoc, Max Planck Institute for Plant Breeding, Cologne, Germany
- 1998 PhD, Institute of Biophysics of the Academy of Sciences of the Czech Republic, Brno, Czech Republic

Selected Distinctions
- Highly Cited Scientist
- 2017 Member, EMBO
- 2014 FWF-ANR Bilateral Grant
- 2011 FWO Grants
- 2008 ERC Starting Grant
- 2003 – 2007 Margarete von Wrangell Habilitation Program

Plants in the plant growth chamber.

Carrie Bernecky

RNA-based Gene Regulation

The regulated expression of genetic material is one of the most basic processes of a cell, affecting everything from organism development to environmental response. Through structural studies of the involved complexes, the Bernecky group works to unravel the gene expression regulatory networks that employ RNA as an intermediate.

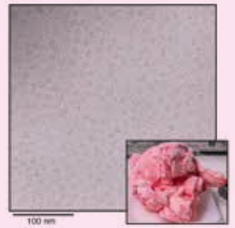
RNA is an important focal point for the regulation of gene expression. Both protein-coding and noncoding RNAs are integral components of diverse regulatory pathways and often act together with protein cofactors. Despite their importance, an understanding of the mechanisms of action of the involved RNA-protein complexes is lacking. Many of these RNA-containing complexes are flexible, modular, and lowly abundant. For such challenging targets, cryo-electron microscopy (cryo-EM) has emerged as a particularly powerful tool for the determination of near-atomic structures while simultaneously providing insight into their dynamics. Using this and related methods, the Bernecky group aims to understand how RNA-protein complexes assemble and regulate cellular RNA metabolism.

Current Projects Molecular basis of transcriptional regulation | Transcriptional inhibition by noncoding RNA | Substrate recognition by RNA modifying enzymes
Team Members 2018 Narkhyun Bae (ISTFELLOW postdoc, joint with Novarino group), Edwine Lehner (scientific intern), Anita Testa Salmazo (project technician), Katarina Tluckova (postdoc)

Career
- since 2018 Assistant Professor, IST Austria
- 2011 – 2017 Postdoc, LMU Munich and MPI for Biophysical Chemistry, Göttingen, Germany
- 2010 – 2011 Postdoc, University of Colorado Boulder, USA
- 2010 PhD, University of Colorado Boulder, USA

Selected Distinctions
- 2012 – 2014 Humboldt Research Fellowship
- 2005 – 2007 NIH Molecular Biophysics Training Grant
- 2002 Hughes Undergraduate Research Scholar (Cornell-HHMI)

Cryo-electron micrograph of single RNA polymerase II transcription complexes purified from animal tissue. Inset: calf thymus from which the protein was purified.



Bernd Bickel

Computer Graphics and Digital Fabrication

We are currently witnessing the emergence of novel, computer-controlled output devices that provide revolutionary possibilities for fabricating complex, functional, multi-material objects and meta-materials with stunning optical and mechanical properties. Leveraging the potential of advanced 3D printing technology is tightly coupled to efficient methods for content creation.

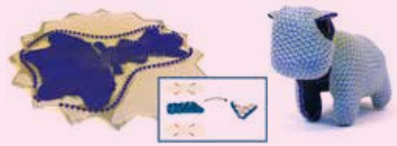
Bernd Bickel is a computer scientist interested in computer graphics and its overlap into animation, biomechanics, material science, and digital fabrication. The main objective of his research group is to push the boundaries of how functional digital models can be efficiently created, simulated, and reproduced. Given the digital nature of the process, three factors play a central role: computational models and efficient representations that facilitate intuitive design, accurate and fast simulation techniques, and intuitive authoring tools for physically realizable objects and materials. Accordingly, the work of the Bickel group focuses on two closely related challenges: (1) developing novel modeling and simulation methods, and (2) investigating efficient representation and editing algorithms for materials and functional objects.

Current Projects Computational synthesis of metamaterials | Soft robotics | Interactive design systems | Design of cyber-physical systems
Team Members 2018 Thomas Auzinger (postdoc), Donald Degraen (academic visitor), Zudong Feng (predoctoral visiting scientist), Ruslan Guseinov (PhD student), Christian Hafner (PhD student), Jesus Perez Rodriguez (ISTplus postdoc), Mikhail Tsaritsyn (ISTern), Ran Zhang (PhD student)

Career
- since 2015 Assistant Professor, IST Austria
- 2012 – 2014 Research Scientist and Research Group Leader, Disney Research Zurich, Switzerland
- 2011 – 2012 Visiting Professor, TU Berlin, Germany
- 2011 – 2012 Postdoc, Disney Research Zurich, Switzerland
- 2010 PhD, ETH Zurich, Switzerland

Selected Distinctions
- 2017 ACM SIGGRAPH Significant New Researcher Award
- 2016 ERC Starting Grant
- 2015 Microsoft Visual Computing Award
- 2012 EUROGRAPHICS Best PhD Thesis
- 2011 ETH Medal for Outstanding Doctoral Thesis

A self-transforming structure: fabricated as a flat object, once released it deforms into a predefined surface through a process controlled locally by the assemblage of small-scale structures.



Tim Browning

Analytic Number Theory and its Interfaces

What is the precise connection between adding and multiplying whole numbers? This is a surprisingly deep question that can be thought about in many different lights. One natural extension studies the sequence of integers that arise as solutions to a polynomial equation with integer coefficients, viz. a Diophantine equation. The Browning group works on understanding such sequences using a blend of analytic, geometric and algebraic methods.

Low-dimensional Diophantine equations have been heavily exploited in cryptography, but the properties of higher-dimensional Diophantine equations remain largely mysterious. Hilbert's 10th problem asks for an algorithm to decide if a given Diophantine equation has integer solutions or not. Methods of mathematical logic have revealed this to be an impossible dream, but we would still like to know if such a procedure exists when we merely ask for solutions in rational numbers. Moreover, when solutions are known to exist, there are deep conjectures that connect their spacing to the intrinsic geometry of the equation. In recent years quantitative methods have been found to be remarkably effective at resolving these fundamental questions. The Browning group is involved in actively expanding the available toolkit for studying these problems and their generalizations.

Current Projects Moduli space of rational curves on hypersurfaces of low degree | Hasse principle for random Fano hypersurfaces | Manin's conjecture for orbifolds | Distribution of number fields with given Galois group via Manin's conjecture
Team Members 2018 Kevin Destagnol (postdoc), Maria-Adelina Manzateanu (predoctoral visiting scientist)

Career
- since 2018 Professor, IST Austria
- 2012 – 2019 Professor, University of Bristol, UK
- 2008 – 2012 Reader, University of Bristol, UK
- 2005 – 2008 Lecturer, University of Bristol, UK
- 2002 – 2005 Postdoctoral Research Fellow, University of Oxford, UK
- 2001 – 2002 Postdoctoral Research Fellow, Université de Paris-Sud, Orsay, France
- 2002 PhD, Magdalen College, University of Oxford, UK

Selected Distinctions
- 2017 Simons Visiting Professorship (MSRI)
- 2017 EPSRC Standard Grant
- 2012 ERC Starting Grant
- 2010 Phillip Leverhulme Prize
- 2009 Ferran Sunyer i Balaguer Prize
- 2008 Whitehead Prize
- 2007 EPSRC Advanced Research Fellowship

Krishnendu Chatterjee

Computer-aided Verification, Game Theory

Life is a game—at least in theory. Game theory has implications for the verification of correctness of computer hardware and software, but also in biological applications, such as evolutionary game theory. The Chatterjee group works on the theoretical foundations of game theory, addressing central questions in computer science.

Game theory studies the interactive problems in decision making. It can be used to study problems in logic, automata theory, economics, evolutionary biology, and the design of the internet. The Chatterjee group is interested in the theoretical foundations of game theory, its application in formal verification, and evolutionary game theory. Game theory in formal verification involves the algorithmic analysis of various forms of games played on graphs, where the graph models a reactive system. This broad framework allows for the effective analysis of many important questions in computer science and helps to develop robust systems. The Chatterjee group also works on algorithmic aspects of evolutionary game theory on graphs, where the graph models a population structure. The goals of this research are to better understand games and to develop new algorithms.

Current Projects Quantitative verification | Stochastic game theory | Modern graph algorithms for verification problems | Evolutionary game theory
Team Members 2018 Sriram Balasubramanian (scientific intern), Amir Goharshady (ÖAW DOC-funded PhD student, IBM doctoral fellow), Christian Hilbe (ISTFELLOW postdoc), Rasmus Ibsen-Jensen (postdoc), Deep Karkhanis (scientific intern), Petr Novotny (ISTFELLOW postdoc), Arash Pourdamghani (ISTern), Nico Schaumberger (predoctoral visiting scientist), Laura Schmid (PhD student), Pouya Shati (ISTern), Jakub Svoboda (scientific intern), Josef Tkadlec (PhD student), Viktor Toman (PhD student)

Career
- since 2014 Professor, IST Austria
- 2009 – 2014 Assistant Professor, IST Austria
- 2008 – 2009 Postdoc, University of California, Santa Cruz, USA
- 2007 PhD, University of California, Berkeley, USA

Selected Distinctions
- 2011 Microsoft Research Faculty Fellowship
- 2011 ERC Starting Grant
- 2008 Ackerman Award, best thesis worldwide in Computer Science Logic
- 2007 David J. Sakrison Prize, best thesis in EECS, University of California, Berkeley, USA
- 2001 President of India Gold Medal, best IIT student of the year

The asymmetric distribution of rational solutions on a Châtelet surface. Image by Emmanuel Peyre (Institut Fourier).

Sylvia Cremer

Collective Disease Defense in Insect Societies

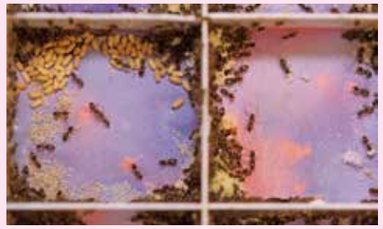
Social insects fight disease as a collective. Together, they perform nest hygiene and mutual sanitary care, effectively reducing the risk of infection and disease transmission through the colony. The Cremer group studies how collective protection arises at the colony level from individual behaviors and social interactions in ants.

Just like an individual immune response, collective disease defense of the colony must effectively balance the attack of pathogens and prevent self-harm to the host. The Cremer group showed that, similar to the way healthy host tissue is protected from collateral damage by the toxins used to fight pathogens, healthy members of social insect colonies are protected from "social immunopathology". Ants disinfect their colonies constantly by spraying toxic poison over the brood—including the sensitive pupae, which would die from this treatment if not protected by a silk cocoon. Hence, similar to humans using protective gear like gloves when using harmful chemicals to clean their homes, ants that use formic acid as a disinfectant in the colony retain the practice to produce silk cocoons that protect their pupae, even though the production is costly.

Current Projects Collective hygiene in ant societies | Social interaction networks and epidemiology | Disease resistance and tolerance | Costs and benefits of social immunization
Team Members 2018 Barbara Casillas Perez (PhD student), Erika Dawson (postdoc), Anna Franschitz (PhD student), Matthias Fürst (FWF Lise Meitner postdoc), Marta Gorecka (scientific intern), Anna Grasse (senior laboratory technician, on maternity leave), Elina Hanhimäki (scientific intern), Niklas Kampleitner (project technician), Megan Kutzer (ISTFELLOW postdoc), Sina Metzler (PhD student), Barbara Milutinović (postdoc), Elisabeth Naderlinger (project technician)

Career
- since 2015 Professor, IST Austria
- 2010 – 2015 Assistant Professor, IST Austria
- 2010 Habilitation, University of Regensburg, Germany
- 2006 – 2010 Group Leader, University of Regensburg, Germany
- 2006 Junior Fellow, Institute of Advanced Studies, Berlin, Germany
- 2002 – 2006 Postdoc, University of Copenhagen, Denmark
- 2002 PhD, University of Regensburg, Germany

Selected Distinctions
- 2017 ERC Consolidator Grant
- 2015 Elisabeth Lutz Prize, Austrian Academy of Sciences (ÖAW)
- 2013 Walther Arndt Prize of the German Zoological Society (DZG)
- 2012 Research Award Lower Austria: Anerkennungspreis des Landes Niederösterreich
- 2011 Elected Member of the Young Academy of the Austrian Academy of Sciences (ÖAW)
- 2009 ERC Starting Grant
- 2008 Member of the Young Academy of the German National Academy of Sciences Leopoldina and the Berlin-Brandenburg Academy of Sciences and Humanities; Alumna since 2013



Poison spraying in ant colonies: Garden ants disinfect their colony by spraying their formic acid-rich poison in the nest and over the brood piles. The nest lined with pH-sensitive paper turns from blue to pink in the presence of acid. Picture by Chris D. Pull.

Jozsef Csicsvari

Systems Neuroscience

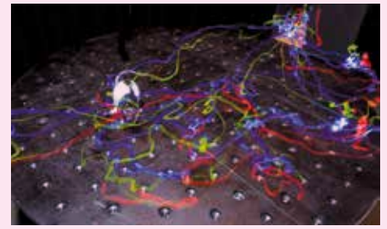
Memory formation is crucial for learning new facts and skills. This process of encoding, storing, and ultimately recalling memories involves complex interactions between various brain regions and neurons in embedded circuits that form complex codes to encode these memory traces. The Csicsvari group studies how learning is implemented in the brain.

During learning, new memories are acquired and subsequently consolidated to ensure their successful later recall. The Csicsvari group focuses on understanding how learning leads to memory formation in neuronal circuits by investigating the neuronal system mechanisms of memory formation and stabilization. They also investigate the mnemonic role of neuronal populations and their interactions in brain areas involved in spatial memory processing. The group seeks to understand how neuronal circuits process information and form spatial memories by recording the activity of many neurons in different brain regions during spatial learning tasks and sleep. In their research, the group uses optogenetic methods to selectively manipulate neuronal activity in different brain areas.

Current Projects Oscillatory interactions in working memory | Role of hippocampal formation in spatial learning | Activation of brain structures using light sensitive channels to study memory formation
Team Members 2018 Yosman Bapatdhar (PhD student), Peter Baracskay (postdoc), Uladzislau Barayeu (ISTern), Igor Gridchyn (PhD student), Karola Käfer (PhD student), Sarah Krückel (scientific intern), Michele Nardin (PhD student), Juan Ramirez Villegas (ISTplus postdoc), Dámaris Rangel Guerrero (PhD student), Federico Stella (postdoc), Jago Wallenschus (senior laboratory technician), Haibing Xu (postdoc)

Career
- since 2011 Professor, IST Austria
- 2008 – 2011 MRC Senior Scientist (tenured), MRC Anatomical Neuropharmacology Unit, University of Oxford, UK
- 2003 – 2008 MRC Senior Scientist (tenure-track), MRC Anatomical Neuropharmacology Unit, University of Oxford, UK
- 2001 – 2002 Research Associate, Center for Behavioral and Molecular Neuroscience, Rutgers University, New Brunswick, USA
- 1999 – 2001 Postdoctoral Fellow, Center for Behavioral and Molecular Neuroscience, Rutgers University, New Brunswick, USA
- 1999 PhD, Rutgers University, New Brunswick, USA

Selected Distinctions
- 2011 ERC Starting Grant
- 2010 Title of Ad Hominem Professor in Neuroscience at the University of Oxford



Ultra slow exposure image of a learning experiment on the "cheeseboard" maze.

Johann Danzl

High-resolution Optical Imaging for Biology

How can we decode the molecular architecture of biological systems? How can we analyze living cells and tissues at the required nanoscale spatial resolution? The central aim of the Danzl lab, an interdisciplinary team of physicists, biologists, and neuroscientists, is to shed light on problems of biological and ultimately also medical relevance by developing and using a set of advanced light microscopy tools.

In conventional light microscopy, spatial resolution is limited by diffraction of light waves to about half the wavelength of light, or 200 nm. The Danzl group thus explores and extends the possibilities of diffraction-unlimited methods. These enable resolution of tens of nanometers, allowing them to capture a wealth of details of biological specimens. Analyzing living cells and tissues at high spatial and temporal resolution in a minimally perturbative way poses additional challenges. To this end, the group works toward the development of novel imaging approaches, building on their expertise both in fundamental physics and in high-resolution imaging. They integrate the imaging with state-of-the-art technologies to manipulate cells and tissues, and also to label them.

Current Projects Deep-tissue nanoscale imaging | Minimally perturbing high-resolution imaging | Decoding of synapse nano-architecture | High-content analysis of tissue microarchitecture
Team Members 2018 Giulio Abagnale (postdoc), Wiebke Jahr (postdoc), Mia Juracic (scientific intern), Caroline Kreuzinger (laboratory technician), Julia Michalska (PhD student), Mojtaba Tavakoli (PhD student), Sai Punuganti (ISTern), Shiva Safari (scientific intern), Sven Truckenbrodt (postdoc), Philipp Velicky (postdoc), Jakob Vorlaufer (scientific intern)

Career
- since 2017 Assistant Professor, IST Austria
- 2012 – 2016 Postdoc, Department of NanoBiophotonics, Max Planck Institute for Biophysical Chemistry, Göttingen, Germany
- 2010 – 2011 Postdoc, Institute for Experimental Physics, University of Innsbruck, Austria
- 2010 PhD, University of Innsbruck, Austria
- 2005 MD, Medical University of Innsbruck, Austria

Selected Distinctions
- 2018 Otto-Kraupp Prize for the best medical habilitation of 2017 in Austria, Society of Physicians in Vienna
- 2012 – 2014 Marie Curie Intra-European Fellowship
- 2011 PhD thesis selected as one of the four best in the years 2009 and 2010 by the AMO (Atomic, Molecular, Optical) section of the German Physical Society
- 2009 Liechtenstein Prize
- 2006 Scholarship for Intellectually Highly Gifted Persons, Rotary Club Innsbruck

The group develops new optical imaging approaches and applies them to biological questions. Top: Close-up of an optics module in one of the group's super-resolution microscopes. Bottom: Nerve cell processes of living cultured neurons imaged with both super-resolution STED and conventional diffraction-limited (confocal) microscopy. STED reveals considerably more detail.

Herbert Edelsbrunner

Algorithms, Computational Geometry, and Computational Topology

Understanding the world in terms of patterns and relations is the undercurrent in computational geometry and topology, the broad research area of the Edelsbrunner group.

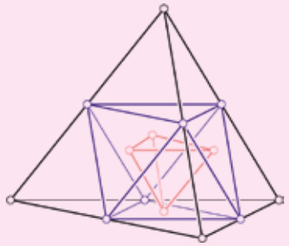
While geometry measures shapes, topology focuses its attention on how the shapes are connected. These shapes may be three-dimensional (an artistic sculpture or a cave in a mountain), it may be four-dimensional (a galloping horse or a flexing protein), or it may even have many more than four dimensions (the configuration space of a robot or the expression pattern of a cancer). The Edelsbrunner group approaches the two related subjects of geometry and topology from a computational point of view. The computer aids in this study and it is used to make the insights useful in applications and workable for non-specialists. The group believes in a broad approach that does not sacrifice depth, including the development of new mathematics, the design of new algorithms and software, and the application in industry and other areas of science. Candidate areas for fruitful collaborations include 3D printing, structural molecular biology, neuroscience, and, more generally, data analysis.

Current Projects Discretization in geometry and dynamics | Topological data analysis in information space
Team Members 2018 Arseniy Akopyan (postdoc), Ranita Biswas (postdoc), Mabel Iglesias Ham (PhD student), Teresa Heiss (PhD student), Grzegorz Jablonski (postdoc), Zuzana Masárová (PhD student), Anton Nikitenko (postdoc), Katharina Ölsböck (PhD student), Georg Osang (PhD student), Morteza Saghafian (predoctoral visiting scientist), Tiow Seng Tan (academic visitor), Wei Tian (predoctoral visiting scientist), Hubert Wagner (postdoc)

Career
- since 2009 Professor, IST Austria
- 2004 – 2012 Professor of Mathematics, Duke University, Durham, USA
- 1999 – 2012 Arts and Sciences Professor for Computer Science, Duke University, Durham, USA
- 1996 – 2013 Founder, Principal, and Director, Raindrop Geomagic
- 1985 – 1999 Assistant, Associate, and Full Professor, University of Illinois, Urbana-Champaign, USA
- 1981 – 1985 Assistant, Graz University of Technology, Austria
- 1982 PhD, Graz University of Technology, Austria

Selected Distinctions
- ISI Highly Cited Researcher
- 2018 Wittgenstein Award
- 2018 ERC Advanced Grant
- 2014 Fellow of the European Association for Theoretical Computer Science
- 2014 Member, Austrian Academy of Sciences (ÖAW)
- 2012 Corresponding Member of the Austrian Academy of Sciences (ÖAW)
- 2008 Member, German Academy of Sciences Leopoldina
- 2006 Honorary Doctorate, Graz University of Technology
- 2005 Member, American Academy of Arts and Sciences
- 1991 Alan T. Waterman Award, National Science Foundation

The three nested barycenter polytopes in three dimensions.



László Erdős

Mathematics of Disordered Quantum Systems and Matrices

How do energy levels of large quantum systems behave? What do the eigenvalues of a typical large matrix look like? Surprisingly, these two very different questions have the same answer!

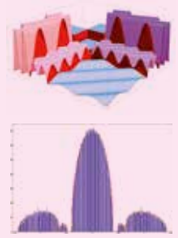
Large complex systems tend to develop universal patterns that often represent their essential characteristics. A pioneering vision of Eugene Wigner was that the distribution of the gaps between energy levels of complicated quantum systems depends only on the basic symmetry of the model and is otherwise independent of the physical details. This thesis has never been rigorously proved for any realistic physical system, but experimental data and extensive numerics leave no doubt as to its correctness. Erdős' group took up the challenge to verify Wigner's vision with full mathematical rigor as well as to understand the underlying mechanism. Starting from the simplest model, a large random matrix with independent identically distributed entries, the group is now able to deal with arbitrary distributions and even matrices with correlated entries. The mathematical ideas and tools developed along the way will extend the scope of random matrix theory and are likely to be used in their many applications beyond quantum physics such as wireless communications and statistics.

Current Projects Self-consistent resolvent equation and application in random matrices | Next order correction in the form factor for Wigner matrices | Local spectral universality for random band matrices | Spectral statistics of random matrices with correlated entries | Quantum spin glasses
Team Members 2018 Johannes Alt (PhD student), Giorgio Cipollini (PhD student), Adrian Dietlein (ISTplus postdoc), Tibor Döme (scientific intern), Sofiia Dubova (ISTern), Peter Mühlbacher (scientific intern), Peter Nejjar (postdoc, joint with Maas group), Yuriy Nemish (postdoc), David Renfrew (FWF Lise Meitner postdoc), Dominik Schröder (PhD student), Dániel Viosztek (ISTFELLOW postdoc), Ben Wallace (postdoc)

Career
- since 2013 Professor, IST Austria
- 2003 – 2013 Chair of Applied Mathematics (C4/W3), Ludwig Maximilian University of Munich, Germany
- 1998 – 2003 Assistant, Associate, Full Professor, Georgia Institute of Technology, Atlanta, USA
- 1995 – 1998 Courant Instructor/ Assistant Professor, Courant Institute, New York University, USA
- 1994 – 1995 Postdoc, ETH Zurich, Switzerland
- 1994 PhD, Princeton University, USA

Selected Distinctions
- ISI Highly Cited Researcher
- 2017 Leonard Eisenbud Prize
- 2016 Foreign Member, Hungarian Academy of Sciences
- 2015 Corresponding Member, Austrian Academy of Sciences (ÖAW)
- 2015 Member, Academia Europaea
- 2014 Invited Speaker, ICM
- 2013 ERC Advanced Grant
- 2007 – 2016 Participant of SFB TR12, Symmetries and Universality
- 1999 – 2005 NSF Grants
- 1993 – 1994 Alfred P. Sloan Foundation Dissertation Fellowship

Variance profile of an inhomogeneous random matrix H (top). Eigenvalue distribution of H and its limiting density (bottom).



Johannes Fink

Quantum Integrated Devices

The Fink group's research is positioned between quantum optics and mesoscopic condensed matter physics. The team studies quantum physics in electrical, mechanical, and optical chip-based devices with the goal to advance and integrate quantum technology for simulation, communication, metrology, and sensing.

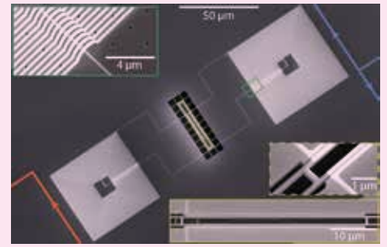
One of Fink's goals is to develop a microchip-based router that will be able to convert a microwave signal to an optical signal with near unity efficiency. With such devices, the Fink group seeks to perform quantum communication with superconducting circuits and telecom wavelength photons. In one project, the group uses a qubit to create a single photon state. With the router, this microwave photon is converted into an optical photon, which can then be transmitted over long distances using low-loss optical fiber. The Fink group will also use this technique to entangle microwave and optical photons—an important step toward realizing worldwide quantum networks. Another direction is to develop higher quality qubits by using new electrical circuit elements called geometric superinductors which help suppress charge fluctuations that can wash out the quantum information stored on-chip.

Current Projects Quantum electro-mechanics | Quantum microwave photonics | Ultra-high impedance physics for hardware protected qubits | Quantum phononics | Multi-qubit quantum electrodynamics
Team Members 2018 Georg Arnold (ÖAW DOC-funded PhD student), Shabir Barzanjeh (Marie Curie postdoctoral fellow), Farid Hassani (PhD student), William Hease (ISTplus postdoc), Mariia Labendik (ISTern), Moritz Laber (scientific intern), Alexander McKeehan (ISTern), Matilda Peruzzo (PhD student), Elena Redchenko (PhD student), Alfredo Rueda Sanchez (postdoc), Matthias Wulf (postdoc), Martin Zemlicka (postdoc)

Career
- since 2016 Assistant Professor, IST Austria
- 2015 – 2016 Senior Staff Scientist, California Institute of Technology, Pasadena, USA
- 2012 – 2015 IQIM Postdoctoral Research Scholar, California Institute of Technology, Pasadena, USA
- 2011 – 2012 Postdoctoral Research Fellow, ETH Zurich, Switzerland
- 2010 PhD, ETH Zurich, Switzerland

Selected Distinctions
- 2018 Fritz Kohlrausch Award
- 2017 ERC Starting Grant
- 2012 IQIM Postdoctoral Prize Fellowship
- 2010 ETH Medal for Outstanding Dissertation
- 2009 CSF Award at the QSIT Conference on Quantum Engineering

Two thin film aluminum spiral resonators are suspended on a 220 nm thick silicon membrane and capacitively coupled to a micro-machined nanostring mechanical oscillator in the center. In the presence of two frequency detuned pump fields this microchip device outputs a continuous stream of entangled microwave photons at its two ports.



Julian Fischer

Theory of Partial Differential Equations, Applied and Numerical Analysis

Diverse phenomena such as the motion of fluids or elastic objects, the evolution of interfaces, or the physics of quantum-mechanical particles are described accurately by partial differential equations. The Fischer group works on the mathematical analysis of partial differential equations that arise in the sciences, connecting also to areas like numerical analysis or probability.

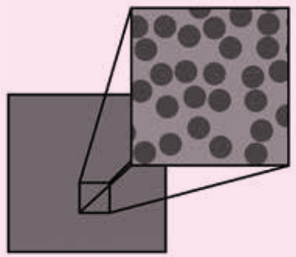
Partial differential equations are a fundamental tool for the description of many phenomena in the sciences, ranging from the physics of continua like fluids or elastic solids over quantum mechanics to population biology. Julian Fischer and his group work on the mathematical aspects of partial differential equations. One of the group's main themes is the mathematical justification of model simplifications. For example, an elastic material with a highly heterogeneous small-scale structure may in many cases be approximated as a homogeneous material. Likewise, a fluid with low compressibility may in many cases be approximated as ideally incompressible. To justify such approximations, the group derives rigorous estimates for the approximation error. The techniques they employ connect the analysis of PDEs with adjacent mathematical areas like numerical analysis and probability.

Current Projects Effective behavior of random materials | Evolution of interfaces in fluid mechanics | Structure of fluctuations in stochastic homogenization | Entropy-dissipative PDEs
Team Members 2018 Nicola De Nitti (ISTern), Sebastian Hensel (PhD student), Michael Kniely (postdoc)

Career
- since 2017 Assistant Professor, IST Austria
- 2014 – 2016 Postdoc, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
- 2013 – 2014 Postdoc, University of Zurich, Switzerland
- 2013 PhD, University of Erlangen-Nürnberg, Germany

Selected Distinctions
- 2015 Dr.-Klaus-Körper Prize, PhD Award of the GAMM

A schematic picture of upscaling for a material with a heterogeneous small-scale structure.



Jiří Friml

Developmental and Cell Biology of Plants

When conditions get tough, animals typically fight or flee, but plants are rooted in their environment, and, as a result, have become remarkably adaptable. The Friml group investigates the mechanisms underlying plants' adaptability during embryonic and postembryonic development.

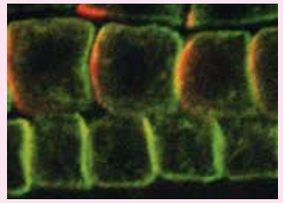
Plants and animals have different life strategies. Plants are highly adaptive, and able to modify development and physiology to environmental changes; they can easily regulate growth, initiate new organs or regenerate tissues. Many of these developmental events are mediated by the plant hormone auxin. The Friml group investigates the unique properties of auxin signaling, which can integrate both environmental and endogenous signals. Employing methods spanning molecular physiology, developmental and cell biology, genetics, biochemistry, and mathematical modeling, the group focuses on auxin transport, cell polarity, endocytic recycling, as well as non-transcriptional mechanisms of signaling. In their work, the Friml group gains insights into the mechanisms governing plant development, and has shown how signals from the environment are integrated into plant signaling and result in changes to plant growth and development.

Current Projects Polar auxin transport | Cell polarity and polar targeting | Endocytosis and recycling | Non-transcriptional mechanisms of signaling
Team Members 2018 Maciek Adamowski (postdoc), Philip Brewer (academic visitor), Anton Dubenko (ISTern), Zuzana Gelova (predoctoral visiting scientist), Matous Glanc (predoctoral visiting scientist), Jakub Hajny (PhD student), Huibin Han (PhD student), Lukas Hörmayer (PhD student), Alexander Johnson (postdoc), Ivan Kulik (scientific intern), Lanxin Li (PhD student), Gergely Molnar (postdoc), Madhumitha Narasimhan (PhD student), Lesia Rodriguez Solovey (EMBO-funded, ISTFELLOW postdoc), Yuliya Salanenka (postdoc), Scott Sinclair (postdoc), Shutang Tan (EMBO-funded postdoc), Mina Vasileva (PhD student), Inge Verstaeten (postdoc), XiXi Zhang (predoctoral visiting scientist), Yuzhou Zhang (ISTFELLOW postdoc)

Career
- since 2013 Professor, IST Austria
- 2007 – 2012 Full Professor, University of Ghent, Belgium
- 2006 Full Professor, University of Göttingen, Germany
- 2002 – 2005 Group Leader, Habilitation, University of Tübingen, Germany
- 2002 PhD, Masaryk University, Brno, Czech Republic
- 2000 PhD, University of Cologne, Germany

Selected Distinctions
- 2017 ERC Advanced Grant
- 2016 Charles Albert Shull Award, ASPB
- 2015 Selected to 2015 World's Most Influential Scientific Minds
- 2015 Erwin Schrödinger Prize, Austrian Academy of Sciences (ÖAW)
- 2014 Běhounek Prize, Czech Ministry of Education
- 2012 EMBO Gold Medal
- 2011 Elected Fellow of the American Association for the Advancement of Science (AAAS)
- 2010 Member, EMBO
- 2010 Körber European Science Award
- 2010 Olchemim Scientific Award
- 2005 Heinz Maier-Leibnitz Prize
- 2004 EMBO Young Investigator Award
- 2000 Max Planck Society Award: The Otto Hahn Medal

Polarity in *Arabidopsis* cells.



Călin Guet

Systems and Synthetic Biology of Genetic Networks

Living systems are characterized by connections and interactions across many scales—from genes to organelles, to cells, to organs, to ecologies—as parts of networks. Which basic rules, if any, do these networks follow? The Guet group studies the molecular biology and evolution of gene regulatory networks by analyzing both natural and synthetic networks.

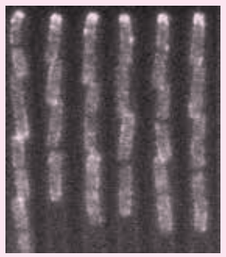
Genes and proteins constitute themselves into bio-molecular networks in cells. These genetic networks are engaged in a constant process of decision-making and computation over time scales of a few seconds to the time it takes a cell to divide, and beyond. By studying existing networks and constructing synthetic networks in living cells, the group works to understand how molecular mechanisms interact with evolutionary forces that ultimately shape each other. They use a variety of classical and modern experimental techniques that, in combination, enable them to construct any imaginable network in living bacteria and thus to study the network dynamics from the single-cell level all the way to the level of small ecologies, in which bacteria interact with bacteriophages.

Current Projects Information processing and evolution of complex promoters | Single-cell biology of multi-drug resistance | Biology, ecology, and evolutionary dynamics of restriction-modification systems
Team Members 2018 Remy Chait (postdoc, joint with Tkačik group), Ivana Glatzova (scientific intern), Rok Grah (ÖAW DOC-funded PhD student, joint with Tkačik group), Katharina Hönig (scientific intern), Claudia Igler (ÖAW DOC-funded PhD student), Kirti Jain (ISTFELLOW postdoc), Stephanie Kainrath (PhD student), Mato Lagator (postdoc), Moritz Lang (postdoc), Anna Nagy-Staron (postdoc), Nela Nikolic (ISTFELLOW postdoc), Dorothea Pittrich (scientific intern), Magdalena Steinrück (PhD student), David Toledo Aparicio (ISTern), Isabella Tomanek (PhD student), Kathrin Tomasek (PhD student, joint with Sixt group)

Career
- since 2018 Professor, IST Austria
- 2011 – 2018 Assistant Professor, IST Austria
- 2009 Postdoc, Harvard University, USA
- 2005 – 2008 Postdoc, University of Chicago, USA
- 2004 PhD, Princeton University, USA

Selected Distinctions
- 2017 ESPCI Chair, Paris
- 2015 ETAPS EASST Best Paper Award
- 2011 HFSP Young Investigator Grant
- 2005 Yen Fellow, The University of Chicago

Fluorescent microscopy images of *Escherichia coli* cells grown in a 'mother-machine', express AcrB-GFP to visualize the AcrAB-TolC trans-membrane complex, the main multi-drug resistance determinant of Gram negative bacteria, which undergoes biased partitioning at cell division (Bergmiller et al Science 356, 311-15, 2017).



Edouard Hannezo

Physical Principles in Biological Systems

During embryo development, cells must "know" how to behave at the right place and at the right time. The Hannezo group applies methods from theoretical physics to understand how these robust choices occur.

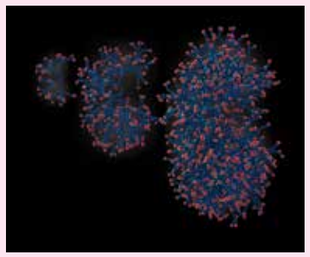
The Hannezo group is particularly interested in design principles and processes of self-organization in biology, at various scales, in close collaboration with cell and developmental biologists. Their methods include tools from solid and fluid mechanics, statistical physics as well as soft matter approaches. Examples of problems that the group is working on—at three different scales—include:
(1) How do cytoskeletal elements, which generate forces within cells, self-organize to produce complex spatio-temporal patterns?
(2) How do cells concomitantly acquire identities and shape a tissue during development?, and (3) How does complex tissue architecture derive from simple self-organizing principles, for instance during branching morphogenesis (in organs such as the kidneys, mammary glands, pancreas, and prostate) as a prototypical example.

Current Projects Stochastic branching in mammalian organs | Active fluids and cell cytoskeleton | Models of fate choices of stem cells during homeostasis and embryo development
Team Members 2018 Daniel Boocock (PhD student), Bernat Corominas-Murtra (postdoc), Shilei Xue (postdoc)

Career
- since 2017 Assistant Professor, IST Austria
- 2015 – 2017 Sir Henry Wellcome Postdoctoral Fellow, Gurdon Institute, Cambridge, UK
- 2015 – 2017 Junior Research Fellow, Trinity College, University of Cambridge, UK
- 2014 Postdoc, Institut Curie, Paris, France
- 2014 PhD, Institut Curie and Université Pierre et Marie Curie, Paris, France

Selected Distinctions
- 2015 Wellcome Trust Fellowship
- 2014 Young Researcher Prize of the Bettencourt-Schuller Foundation
- 2014 Trinity College Junior Research Fellowship
- 2010 PhD grant from the French Ministry of Research

Successive snapshots from a numerical simulation of branching morphogenesis in the mouse kidney.



Tamás Hausel

Geometry and its Interfaces

How can we understand spaces too large for traditional analysis? Combining ideas from representation theory and combinatorics, the Hausel group develops tools to study the topology of spaces arising from string theory and quantum field theory.

Suppose you have many particles, and consider the space made up of all the ways each particle can move between two points. Now, play the same game with more complicated objects, such as vector fields. The resulting spaces are too large to analyze, but it is possible to simplify them along structural symmetries, giving rise to moduli spaces that are finite-dimensional, but non-compact—again, defying traditional methods. The Hausel group studies the topology, geometry, and arithmetic of these moduli spaces, which include the moduli spaces of Yang-Mills instantons in four dimensions, and Higgs bundles in two dimensions, among others. One question is the number of high-dimensional holes of the spaces. Using methods from representation theory and combinatorics, Hausel and his team are able to give results and conjectures that have previously been described by physicists and number theorists in other terms, thus connecting a wide variety of fields and ideas.

Current Projects Geometry, topology, and arithmetic of moduli spaces arising in supersymmetric quantum field theories | Representation theory of quivers, finite groups, Lie and Hecke algebras
Team Members 2018 Johannes Droschl (ISTern), Jan Friedmann (PhD student), Iordan Ganev (postdoc), Quoc Ho (postdoc), Penghui Li (postdoc), Sasha Minets (postdoc), András Sándor (PhD student), Mikhail Shkolnikov (ISTFELLOW postdoc), Tanya Srivastava (ISTplus postdoc), Hongjie Yu (ISTplus postdoc), Gufang Zhao (postdoc)

Career
- since 2016 Professor, IST Austria
- 2012 – 2016 Professor and Chair of Geometry, EPFL, Lausanne, Switzerland
- 2007 – 2012 Tutorial Fellow, Wadham College, Oxford, UK
- 2007 – 2012 University Lecturer, University of Oxford, UK
- 2005 – 2012 Royal Society University Research Fellow, University of Oxford, UK
- 2002 – 2010 Assistant, Associate Professor, University of Texas, Austin, USA
- 1999 – 2002 Miller Research Fellow, Miller Institute for Basic Research in Science, University of California, Berkeley, USA
- 1998 – 1999 Member, Institute for Advanced Study, Princeton, USA
- 1998 PhD, Trinity College, University of Cambridge, UK

Selected Distinctions
- 2013 ERC Advanced Grant
- 2009 EPSRC First Grant
- 2008 Whitehead Prize
- 2005 Sloan Research Fellow

Carl-Philipp Heisenberg

Morphogenesis in Development

The most elaborate shapes of multicellular organisms—the elephant's trunk, the orchid blossom, the lobster's claw—all start off from a simple bunch of cells. This transformation of a seemingly unstructured cluster of cells into highly elaborate shapes is a common and fundamental principle in cell and developmental biology and the focus of the Heisenberg group's work.

To gain insights into critical processes by which the developing organism takes shape, the Heisenberg group focuses on gastrulation in zebrafish and ascidians, a highly conserved process in which a seemingly unstructured blastula is transformed into an organized embryo. The group has chosen a transdisciplinary approach, employing a combination of genetic, cell biological, biochemical, and biophysical tools. Using these tools, the group is addressing how the interplay between the physical processes driving cell and tissue morphogenesis and the gene regulatory pathways determining cell fate specification control gastrulation. Insights derived from this work may ultimately have implications for the study of wound healing and cancer biology, as immune and cancer cells share many morphogenetic properties of embryonic cells.

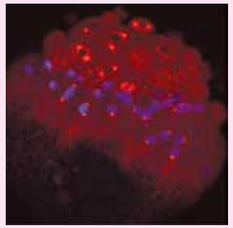
Current Projects Cell adhesion | Actomyosin contraction | Cell and tissue morphogenesis | Cell polarization and migration
Team Members 2018 Feyza Arslan (PhD student), Silvia Caballero Mancebo (PhD student), Daniel Capek (PhD student, postdoc), Alba Diz-Muñoz (academic visitor), Benoit Godard (postdoc), Karla Huljev (PhD student), Roland Kardos (ISTFELLOW postdoc), Joana Leitao Pinheiro Almeida Enes (project technician), Yuuta Moriyama (academic visitor), Diana Nunes Pinheiro (EMBO-, HFSP-funded postdoc), Nicoletta Petridou (EMBO-funded postdoc), Kornelija Pranjic-Ferscha (laboratory technician), Eduardo Pulgar (academic visitor), Guillaume (academic visitor), Alexandra Schauer (PhD student), Cornelia Schwayer (PhD student), Jana Slovakova (postdoc), Zoltan Spiro (ISTFELLOW postdoc), Ste Tavano (postdoc), Peng Xia (postdoc)

Career
- since 2010 Professor, IST Austria
- 2001 – 2010 Group Leader, Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany
- 1997 – 2000 Postdoc, University College London, UK
- 1996 PhD, Max Planck Institute of Developmental Biology, Tübingen, Germany

Selected Distinctions
- 2017 ERC Advanced Grant
- 2017 Lower Austrian Science Award
- 2015 Member, EMBO
- 2015 Member, German Academy of Sciences Leopoldina
- 2000 Emmy Noether Junior Professorship

Hitchin fibration on the real points of the toy model Higgs moduli space.

Zebrafish embryo at the onset of gastrulation, stained for nuclei (blue), microtubules (red) and microtubule organizing centers (white).



Thomas A. Henzinger

Design and Analysis of Concurrent and Embedded Systems

Humans and computers are surprisingly similar: While the interaction between two actors may be simple, every additional actor complicates matters. The Henzinger group builds the mathematical foundations for designing complex hardware and software systems.

Over 90% of today's worldwide computing power is found in unexpected places like cell phones or kitchen appliances. Software has become one of the most complicated man-made artifacts, making software bugs unavoidable. The Henzinger group addresses the challenge of reducing software bugs in concurrent and embedded systems. The former consist of parallel processes that interact with one another, whether in a global network or on a tiny chip. Because of the large number of possible interactions between parallel processes, concurrent software is particularly error-prone, and sometimes bugs show up after years of flawless operation. Embedded systems interact with the physical world; an additional challenge for this kind of safety-critical software is to react sufficiently quickly. The Henzinger group invents mathematical methods and develops computational tools for improving the reliability of software in concurrent and embedded systems.

Current Projects Analysis and synthesis of concurrent software | Quantitative modeling and verification of reactive systems | Predictability and robustness for real-time and embedded systems | Model checking biochemical reaction networks
Team Members 2018 Milad Aghajohari (ISTern), Guy Avni (FWF Lise Meitner postdoc), Adrian Elgyütt (PhD student), Thomas Ferrere (postdoc), Miriam Garcia Soto (postdoc), Mirco Giacobbe (PhD student), Hui Kong (postdoc), Bernhard Kragl (PhD student), Alexander Scharinger (scientific intern), Christian Schilling (ISTplus postdoc), Luka Zeleznik (PhD student)

Career
- since 2009 Professor, IST Austria
- 2004 – 2009 Professor, EPFL, Lausanne, Switzerland
- 1999 – 2000 Director, Max Planck Institute for Computer Science, Saarbrücken, Germany
- 1998 – 2004 Professor, University of California, Berkeley, USA
- 1997 – 1998 Associate Professor, University of California, Berkeley, USA
- 1996 – 1997 Assistant Professor, University of California, Berkeley, USA
- 1992 – 1995 Assistant Professor, Cornell University, Ithaca, USA
- 1991 Postdoc, University Joseph Fourier, Grenoble, France
- 1991 PhD, Stanford University, Palo Alto, USA

Selected Distinctions
- ISI Highly Cited Researcher
- 2015 Royal Society Milner Award
- 2015 EATCS Fellow
- 2015 Honorary Doctorate, Masaryk University, Brno, Czech Republic
- 2014 Most Influential 2004 POPL Paper Award
- 2013 AAAS Fellow
- 2012 Wittgenstein Award
- 2012 Honorary Doctorate, University Joseph Fourier, Grenoble, France
- 2012 Logic in Computer Science Test-of-Time Award
- 2011 Member, Austrian Academy of Sciences (ÖAW)
- 2011 ACM SIGSOFT Impact Paper Award
- 2010 ERC Advanced Grant
- 2006 ACM Fellow
- 2006 IEEE Fellow
- 2006 Member, Academia Europaea
- 2005 Member, German Academy of Sciences Leopoldina
- 1995 ONR Young Investigator Award
- 1995 NSF Faculty Early Career Development Award

Simon Hippenmeyer

Genetic Dissection of Cerebral Cortex Development

The human cerebral cortex, the seat of our cognitive abilities, is composed of an enormous number and diversity of neurons and glia cells. How the cortex arises from neural stem cells is an unsolved but fundamental question in neuroscience. In the pursuit of mechanistic insights, the Hippenmeyer group genetically dissects corticogenesis at unprecedented single cell resolution using the unique MADM (Mosaic Analysis with Double Markers) technology.

The Hippenmeyer group's current objectives are (1) to establish a definitive quantitative and mechanistic model of cortical neural stem cell lineage progression; (2) to dissect the cellular and molecular mechanisms generating cell-type diversity; (3) to determine the role of genomic imprinting, an epigenetic phenomenon, in cortex development. In a broader context, the group's research has the ultimate goal to advance the general understanding of brain function and why human brain development is so sensitive to disruption of particular signaling pathways in pathological neurodevelopmental diseases and psychiatric disorders.

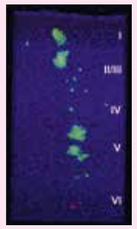
Current Projects Determine neuronal lineages by clonal analysis | Mechanisms generating cell-type diversity | Probing genomic imprinting in cortex development
Team Members 2018 Nicole Amberg (FWF Hertha-Firnberg postdoc), Robert Beattie (FWF Lise Meitner postdoc), Giselle Cheung (ISTplus postdoc), Ximena Contreras Paniagua (PhD student), Amarbayasgalan Davaatseren (scientific intern), Andi Hansen (ÖAW DOC-funded PhD student), Susanne Laukoter (PhD student), Florian Pauler (senior laboratory technician), Jonas Rybnicek (ISTern), Olivia Slepecka (scientific intern), Johanna Sonntag (laboratory technician), Melissa Stouffer (ISTplus postdoc), Carmen Streicher (laboratory technician)

Career
- since 2012 Assistant Professor, IST Austria*
- 2011 – 2012 Research Associate, Stanford University, Palo Alto, USA
- 2006 – 2011 Postdoctoral Fellow, Stanford University, Palo Alto, USA
- 2004 – 2006 Postdoctoral Associate, University of Basel and Friedrich Miescher Institute for Biomedical Research, Basel, Switzerland
- 2004 PhD, University of Basel, Switzerland

* tenure evaluation meanwhile successfully concluded

Selected Distinctions
- 2016 ERC Consolidator Grant
- 2014 HFSP Program Grant
- 2013 Marie Curie Career Integration Grant
- 2009 – 2011 Fellowship for Advanced Researchers, Swiss National Science Foundation, Bern, Switzerland
- 2007 – 2009 HFSP Long-term Fellowship
- 2006 EMBO Long-term Fellowship
- 2005 Natural Sciences Faculty Prize for the best PhD thesis of the year 2004, University of Basel, Switzerland
- 2005 Edmond H. Fischer Prize

MADM-labeled clonally related neurons and glia cells distributed across the six layers in the cerebral cortex.



Björn Hof

Nonlinear Dynamics and Turbulence

Most fluid flows of practical interest are turbulent, yet our understanding of this phenomenon is very limited. The Hof group seeks to gain insight into the nature of turbulence and the dynamics of complex fluids.

Flows in oceans, around vehicles, and through pipelines are all highly turbulent. Turbulence governs friction losses and transport and mixing properties. Despite its ubiquity, insights into the nature of turbulence are very limited. To obtain a fundamental understanding of the origin and the principles underlying this phenomenon, the Hof group investigates turbulence when it first arises from smooth, laminar flow. The group combines detailed laboratory experiments with highly resolved computer simulations and applies methods from nonlinear dynamics and statistical physics, enabling them to decipher key aspects of the transition from smooth to turbulent flow and identify universal features shared with disordered systems in other areas of physics. Some of these insights can be used to control turbulent flow, and the group actively develops such methods. In addition, the group investigates instabilities in fluids with more complex properties, such as dense suspensions of particles and polymer solutions.

Current Projects Transition from laminar to turbulent flow | Dynamics of complex fluids | Control of fully turbulent flows | Cytoplasmic streaming | Instabilities in cardiovascular flows
Team Members 2018 Nishchal Agrawal (PhD student), Nazmi Budanur (postdoc), George Choueiri (ISTFELLOW postdoc), Mike Hennessey-Wesen (PhD student), Lukasz Klotz (ISTplus postdoc), Jakob Kühnen (postdoc), Grégoire Lemoult (postdoc), Jun Liu (ISTern), José Lopez Alonso (ISTFELLOW postdoc), Xingyu Ma (postdoc), Chaitanya Paranjape (PhD student), Michael Riedl (PhD student), Davide Scarselli (PhD student), Shayan Shamipour (PhD student), Balachandra Suri (ISTFELLOW postdoc), Atul Varshney (ISTplus postdoc), Mukund Vasudevan (laboratory technician)

Career
- since 2013 Professor, IST Austria
- 2007 – 2013 Research Group Leader, Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany
- 2005 – 2007 Lecturer, University of Manchester, UK
- 2003 – 2005 Research Associate, Delft University of Technology, The Netherlands
- 2001 PhD, University of Manchester, UK

Selected Distinctions
- 2012 ERC Consolidator Grant
- 2011 Dr. Meyer Struckmann Science Prize
- 2005 RCUK Fellowship

Onur Hosten

Quantum Sensing with Atoms and Light

The first quantum revolution yielded lasers and transistors more than half a century ago. These days, a second quantum revolution is unraveling, yielding new quantum-enhanced technologies for information processing, communications and sensing. The Hosten group is interested in developing new protocols and techniques in the sensing branch of these developments using cold atoms and light.

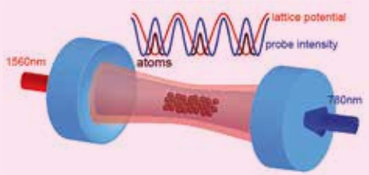
Onur Hosten is an experimental atomic and optical physicist. His group develops innovative techniques to control the quantum properties of atomic and optical systems. The experimental platform is many-atom cavity-quantum-electrodynamics (cQED), where large ensembles of atoms are laser-cooled, trapped inside of an optical cavity and made to interact strongly with light resonating inside the cavity. The focus of the Hosten group is investigating the concepts of quantum entanglement, quantum measurement, and light-assisted atomic interactions to develop new sensing techniques, e.g., for force or acceleration sensing, or for making ultra-precise clocks. In the long term, the Hosten group is interested in applying the precision sensors they develop to explore challenging experimental questions such as the precise interplay between quantum mechanics and gravity, or the nature of dark matter.

Current Projects Design and construction of a traveling wave optical cavity with intra-cavity trapped cold atoms | Generation of spin-squeezed states of atomic ensembles | Mapping atomic spin correlations into motional degrees of freedom | Squeezed-state atom interferometry
Team Members 2018 Fritz Diorico (postdoc), Ilango Maran (scientific intern)

Career
- since 2018 Assistant Professor, IST Austria
- 2015 – 2017 Research Associate, Stanford University, Palo Alto, USA
- 2010 – 2015 Postdoctoral Scholar, Stanford University, Palo Alto, USA
- 2010 PhD, University of Illinois at Urbana-Champaign, USA

Selected Distinctions
- 2011 Outstanding Doctoral Theses in AMO Physics (top four), American Physical Society
- 2010 Karl van Bibber Postdoctoral Research Fellowship, Stanford University
- 2010 Pappalardo Postdoctoral Fellowship (offered), Massachusetts Institute of Technology
- 2008 Ross J. Martin Award for Outstanding Research Achievement, University of Illinois at Urbana-Champaign

Cold atoms interacting with light inside of an optical cavity



Maria Ibáñez

Functional Nanomaterials

Understanding structure-property relationships, as well as the development of materials for target applications, is limited by our ability to control the nanostructure of solid state materials. One potential solution is through the use of nanocrystals, which can be used as artificial atoms to build up materials. By using colloidal synthetic routes, it is possible to "grow" nanocrystals while precisely controlling their size, shape, crystalline phase, and composition, thus making it possible to engineer these artificial atoms according to certain specifications. In this way, we are able to create a new generation of complex materials in which components and functionalities can be defined in a predictable way.

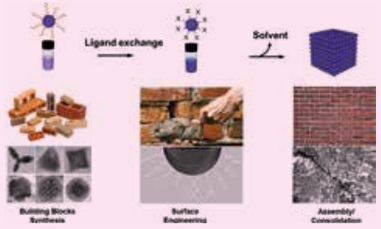
The Ibáñez group works to develop novel functional nanomaterials using cost-efficient synthetic methods. The group employs nanoparticle and hybrid solution-nanoparticle precursors to investigate the properties and applications of these nanomaterials as functions of their finely tunable nano-features. In particular, the team synthesizes colloidal nanoparticles and focuses on understanding their chemical and physical properties, with the eventual goal of using these nanoparticles as functional building blocks for diverse applications, primarily thermoelectrics and the electrocatalytic reduction of CO_2.

Current Projects Syntheses of novel metal and semiconductor nanocrystals | Unravelling of nanocrystal surface chemistry | Nanocrystals assembly and consolidation | Transport properties of nanocrystal-based solids | Electrocatalytic CO_2 conversion | Bottom-up processed thermoelectric nanomaterials
Team Members 2018 Dogukan Apaydin (postdoc), Yu Liu (ISTplus postdoc)

Career
- since 2018 Assistant Professor, IST Austria
- 2014 – 2018 Research Fellow, ETH Zurich, Switzerland
- 2013 – 2014 Research Fellow, Catalonia Institute of Energy Research (IREC), Barcelona, Spain
- 2013 Visiting Researcher, Northwestern University, Evanston, USA
- 2013 PhD, University of Barcelona, Spain

Selected Distinctions
- 2017 Ružička Prize
- 2017 ETH Career Seed Grant
- 2014 Beatriu de Pinós Postdoctoral Grant
- 2013 PhD Extraordinary Award, University of Barcelona
- 2009 Training Program for Academic Staff (FPU)

An analogy of how the Ibáñez group builds materials from the bottom up, assembling nanoparticles into macroscopic, multi-compound materials. This strategy has no competing technology that can match the nanometer-scale control over crystal domain size, shape, crystal phase, and 3D-composition distribution.



Peter Jonas

Synaptic Communication in Hippocampal Microcircuits

Synapses enable communication between neurons in the brain. The Jonas group investigates how signals pass through these vital interfaces—a major undertaking in the field of neuroscience.

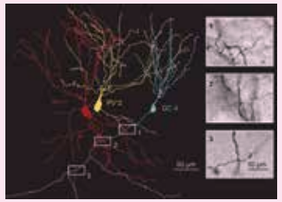
Understanding the function of the brain is a major challenge in the 21st century. The human brain comprises ~10 billion neurons, which communicate through ~10'000 synapses per cell. Excitatory synapses use glutamate as a transmitter, whereas inhibitory synapses release Gamma-Aminobutyric acid (GABA). The group addresses two major questions: (1) What are the biophysical signaling and plasticity mechanisms at glutamatergic and GABAergic synapses in the cortex? (2) How do specific synaptic properties generate higher network functions? In their work, the group combines nanophysiology, presynaptic patch-clamp and multi-cell recording, two-photon Ca^{2+} imaging, optogenetics, *in vivo* recording, and modeling. One focus is hippocampal mossy fiber synapses and output synapses of parvalbumin-expressing GABAergic interneurons.

Current Projects Nanophysiology of fast-spiking, parvalbumin-expressing GABAergic interneurons | Biophysics and circuit function of hippocampal mossy fiber synapses | Analysis of neuronal coding *in vivo* and in realistic network models
Team Members 2018 Christina Altmutter (laboratory technician), Yoav Ben Simon (ISTFELLOW postdoc), Carolina Borges-Merjane (Marie Curie postdoctoral fellow), Chong Chen (PhD student), JingJing Chen (PhD student), Claudia Espinoza Martinez (PhD student), Olena Kim (PhD student), Florian Marr (senior laboratory technician), Yuji Okamoto (postdoc), Magdalena Picher (postdoc), Benjamin Suter (Marie Curie postdoctoral fellow), David Vandael (postdoc), Victor Vargas Barroso (ISTplus postdoc), Xiaomin Zhang (postdoc)

Career
- since 2010 Professor, IST Austria
- 1995 – 2010 Professor of Physiology and Department Head, University of Freiburg, Germany
- 1994 – 1995 Associate Professor, Technical University of Munich, Germany
- 1990 – 1994 Research Assistant, Max Planck Institute for Medical Research, Heidelberg, Germany
- 1988 – 1989 Postdoc, University of Giessen, Germany
- 1987 MD / PhD, University of Giessen, Germany

Selected Distinctions
- 2018 Erwin Schrödinger Prize, Austrian Academy of Sciences (ÖAW)
- 2016 FWF Wittgenstein Award
- 2016 ERC Advanced Grant GIANTSYN
- 2016 Elected Member Editorial Board, Neuron
- 2015 Member, Academia Europaea
- 2011 ERC Advanced Grant NANOPHYS
- 2009 Adolf Fick Award, Physical-Medical Society, Würzburg, Germany
- 2008 Member, Academy of Sciences, Heidelberg, Germany
- 2007 Member of the Board of Reviewing Editors, Science
- 2007 Tsungming Tu Award, National Science Council Taiwan
- 2006 DFG Gottfried Wilhelm Leibniz Award
- 2002 Member, German Academy of Sciences Leopoldina
- 1998 Max Planck Research Award
- 1997 Medinfar European Prize in Physiology, President of Portugal
- 1994 BMBF Heinz Maier Leibnitz Award
- 1992 DFG Heisenberg Fellowship

Ensemble of eight reconstructed neurons in the hippocampal dentate gyrus. The synapses between these neurons are believed to play a critical role in pattern separation (Espinoza et al., Nature Communications, 2018).



Maximilian Jösch

Neuroethology

Maximilian Jösch and his team study the neuronal basis of innate behaviors, i.e. the processes implemented by neuronal circuits to transform sensory information into motor commands. Using a combination of molecular and physiological approaches, they monitor brain activity during animal behavior to reveal the principles and motifs of neuronal computation.

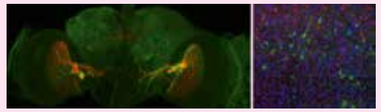
Two different model organisms, the mouse and the fruit fly (*Drosophila melanogaster*), are being used in parallel to take advantage of their unique strengths and gather a general, cross-phyla understanding of computational principles. Experiments in the mouse will allow the group to study the mechanisms used by the nervous system to send behaviorally relevant information from the eye to the brain, e.g., to easily detect a red apple in the green foliage. By conducting experiments in the fly, the group intends to obtain comprehensive understanding of the molecular, anatomical, and physiological instructions conveyed by a highly defined circuit involved in course control. This is possible because neuronal circuits in the fly brain are highly stereotyped, allowing high-throughput screenings of the behavioral role of identified cells.

Current Projects Comprehensive mapping of the behavioral repertoire instructed by defined neuronal circuitries | Role of electrical synapses in sensory transformations | Mechanisms of visual saliency and attention | State dependent modulation of sensory information | Sensorimotor transformation in the superior colliculus
Team Members 2018 Laura Burnett (PhD student), Arka Pal (scientific intern), Victoria Pokusaeva (PhD student), Roshan Satapathy (PhD student), Kieran Sharma (ISTern), Anton Sumser (EMBO-, HFSP-funded postdoc), Olga Symonova (project technician), Tomas Vega Zuniga (postdoc)

Career
- since 2017 Assistant Professor, IST Austria
- 2010 – 2016 Postdoc and Research Associate, Harvard University, Cambridge, USA
- 2009 Postdoc, Max Planck Institute of Neurobiology, Martinsried, Germany
- 2009 PhD, Max Planck Institute of Neurobiology, Martinsried, Germany and Ludwig Maximilian University, Munich, Germany

Selected Distinctions
- 2017 ERC Starting Grant
- 2016 Article Recommendation by F1000
- 2014 Best Poster Award, Retina FASEB Meeting
- 2011 Otto Hahn Medal, Max Planck Society
- 2011 Best Neuroscience Article, Neuroforum
- 2010 HFSP Long-term Fellowship
- 2009 Summa Cum Laude, PhD thesis

On the left, a fly brain showing a randomized expression of different genetic tools (green and red) in neurons involved in course control. On the right, a close-up to neurons in a circuit of the mouse brain that are known to modulate innate visual-driven behaviors.



Georgios Katsaros

Nanoelectronics

Computers are becoming ever more powerful due to the continuous miniaturization of transistors. In his research, Georgios Katsaros uses low-dimensional semiconductor materials for the fabrication of nanodevices. With these nanodevices, the solid-state physicist investigates the fundamental physical concepts on which quantum computing could be based in the future.

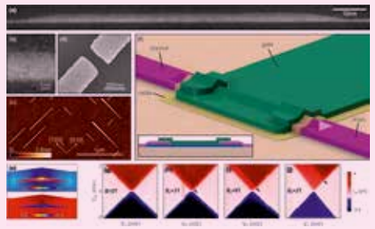
Georgios Katsaros develops semiconductor nanodevices and studies the quantum effects that appear when these nanotransistors are cooled down. One quantum mechanical property of a charge carrier is its spin. The spin of a charge carrier can be used in order to create a quantum bit. Katsaros investigates such quantum bits, or qubits, by manipulating them with microwave signals. In classic computers, a bit can be in only one of two states, zero or one. In quantum computers, a qubit can be both zero and one at the same time. By combining semiconductor nanodevices with superconductors, the Katsaros group is also aiming to study Majorana fermions. These have been suggested as building blocks for a topological quantum computer in which quantum information would be protected from environmental perturbations.

Current Projects Towards hole spin qubits and Majorana fermions in Germanium | Hybrid semiconductor-superconductor quantum devices | Hole spin orbit qubits in Ge quantum wells
Team Members 2018 Maksim Borovkov (scientific intern), Matthias Brauns (postdoc), Luka Drmic (project technician), Andrea Hofmann (postdoc), Daniel Jirovec (PhD student), Jason Jung (laboratory technician), Josip Kukucka (PhD student), Joshua Milem (PhD student), Konrad Prikoszovich (ISTern), Marco Valentini (ISTern), Lada Vukušić (PhD student, postdoc), Hannes Watzinger (PhD student, postdoc)

Career
- since 2016 Assistant Professor, IST Austria
- 2012 – 2016 Group Leader, Johannes Kepler University, Linz, Austria
- 2011 – 2012 Group Leader, Leibniz Institute for Solid State and Materials Research, Dresden, Germany
- 2006 – 2010 Postdoc, CEA, Grenoble, France
- 2006 PhD, Max Planck Institute for Solid State Research, Stuttgart, Germany
- 2001 – 2002 Research Assistant, National Center for Scientific Research “Demokritos”, Athens, Greece

Selected Distinctions
- 2015 Member, Young Academy of the Austrian Academy of Sciences (ÖAW)
- 2013 ERC Starting Grant
- 2013 FWF START Award
- 2012 FWF Lise Meitner Fellowship
- 2011 Marie Curie Carrier Integration Grant

(a) Scanning transmission electron microscope image along a hut wire embedded in epitaxial silicon. (b) Wire cross section at higher resolution. (c) Atomic force microscopy image of uncapped Ge HWs. (d) Scanning electron micrograph of a HW contacted by Pd source and drain electrodes. (e) COMSOL simulations of the out-of-plane (top) and the in-plane (bottom) strain distribution of a capped HW. (f) Schematic representation of a processed three-terminal device studied in this work. (g)-(j) Magnetotransport measurements around a charge degeneracy points taken for magnetic fields applied at different directions.



Anna Kicheva

Tissue Growth and Developmental Pattern Formation

Individuals of the same species can differ widely in size, but their organs have reproducible proportions and patterns of cell types. This requires the coordination of tissue growth with the generation of diverse cell types during development. The Kicheva group studies how this coordination is achieved in the vertebrate neural tube, the embryonic precursor of the spinal cord and brain.

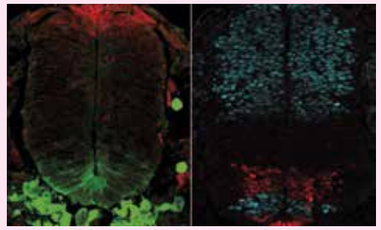
Neural tube development is controlled by signaling molecules called morphogens. Morphogens determine what type of neuron a neural progenitor cell will become. They also control tissue growth by influencing the decisions of cells to divide or exit the cell cycle. The goal of the Kicheva group is to better understand how morphogen signaling is controlled and interpreted by cells to determine cell fate and cell cycle progression. One of the main projects in the lab investigates the role of the morphogen sonic hedgehog in controlling the size of the mouse neural tube. The group uses diverse quantitative experimental approaches. This includes collection of high-resolution spatiotemporal datasets of signaling and gene expression in mouse and chick neural tube development, imaging, and *ex vivo* assays. The group collaborates with biophysicists to relate their experiments to theoretical frameworks.

Current Projects Integration of opposing morphogen gradients | Morphogen control of tissue growth | Morphogen gradient formation
Team Members 2018 Laura Bocanegra (PhD student), Martina Greunz (laboratory technician), Kasumi Kishi (PhD student), Katarzyna Kuzmicz (ÖAW DOC-funded PhD student), Marcin Zagórski (postdoc)

Career
- since 2015 Assistant Professor, IST Austria
- 2008 – 2015 Postdoc, National Institute for Medical Research (The Francis Crick Institute), UK
- 2008 PhD, University of Geneva, Switzerland and Max Planck Institute of Cell Biology and Genetics, Dresden, Germany

Selected Distinctions
- 2015 ERC Starting Grant
- 2009 Marie-Curie Intra-European Fellowship
- 2008 FEBS Long-term Fellowship

The opposing Shh (green) and BMP (red) morphogen signaling gradients (left) and the striped pattern of target gene expression (right) in the mouse neural tube.



Vladimir Kolmogorov

Discrete Optimization

When we step out into the street, we automatically judge the distance and speed of cars. For computers, estimating the depth of objects in an image requires complex computations. A popular approach for tackling this problem is to use discrete optimization algorithms—the research focus of the Kolmogorov group.

The work of Vladimir Kolmogorov’s group can be divided into three topics. The first is the development of efficient algorithms for inference in graphical models and combinatorial optimization problems. Some of the group's techniques are widely used in computer vision and other areas, for example the “Boykov-Kolmogorov” maximum flow algorithm and the “TRW-S” algorithm for MAP inference in pairwise graphical models. Kolmogorov’s “Blossom V” algorithm is currently the fastest technique in practice for computing a minimum cost perfect matching in a graph. The second focus is the theoretical investigation of the complexity of discrete optimization, in particular using the framework of valued constraint satisfaction problems and their variants. Finally, the Kolmogorov group has worked on applications of discrete optimization in computer vision, such as image segmentation and stereo reconstruction.

Current Projects Inference in graphical models | Combinatorial optimization problems | Theory of discrete optimization
Team Members 2018 Seyed Gatmiry (scientific intern), Paul Swoboda (postdoc)

Career
- since 2014 Professor, IST Austria
- 2011 – 2014 Assistant Professor, IST Austria
- 2005 – 2011 Lecturer, University College London, UK
- 2003 – 2005 Assistant Researcher, Microsoft Research, Cambridge, UK
- 2003 PhD, Cornell University, Ithaca, USA

Selected Distinctions
- 2018 Best Paper Award – Honorable Mention at IEEE/CVF Conference on Computer Vision and Pattern Recognition
- 2013 ERC Consolidator Grant
- 2012 Koenderink Prize at the European Conference on Computer Vision for fundamental contributions to computer vision
- 2007 Honorable mention, outstanding student paper award (to M. Pawan Kumar) at Neural Information Processing Systems Conference
- 2006 – 2011 Royal Academy of Engineering/EPSRC Research Fellowship
- 2005 Best Paper Award – Honorable Mention at IEEE Conference on Computer Vision and Pattern Recognition
- 2002 Best Paper Award at the European Conference on Computer Vision

Example of the “Grabcut” interactive image segmentation algorithm based on graph cuts, which has been incorporated in Microsoft Office 2010.

Fyodor Kondrashov

Evolutionary Genomics

How did living organisms become the way we know them today? The Kondrashov lab is focused on understanding the natural world in an evolutionary context, typically focusing on studying genetic information due the abundance of DNA and protein sequence data.

Kondrashov and his group do not restrict themselves to studying specific functions or phenotypes; instead, a staple feature of their research is a focus on how functions and phenotypes change over time. Therefore, their research is inherently interdisciplinary, grounded in classical evolutionary fields of population genetics and molecular evolution while drawing from other fields, such as cell and molecular biology, bioinformatics, and biophysics. Recently, the group has become increasingly interested in the experimental assay of fitness landscapes. Combining experiments, theory, and computational biology, they query how changes in the genotype affect fitness or specific phenotypes. In the near future, they hope to expand their experimental capabilities in order to query a wider range of interesting phenotypes in a high-throughput manner.

Current Projects Empirical fitness landscapes | Protein evolution in the context of epistasis | Population genomics of the spoon-billed sandpiper

Team Members 2018 Polina Avdiunina (scientific intern), Pilar Baldominos Flores (laboratory technician), Liliia Fakhranurova (postdoc), Ana Gutierrez Franco (postdoc), Dmitrii Ivankov (postdoc), Nastia Lyulina (laboratory technician), Mariya Minkevich (scientific intern), Aygul Minnegalieva (ISTern), Iro Pierides (project technician), Daniil Poliakov (ISTern), Katya Putintseva (postdoc), Karen Sarkisyan (EMBO-funded postdoc), Petr Vlasov (postdoc)

Career
- since 2017 Professor, IST Austria
- since 2012 Scientific Director, School of Molecular and Theoretical Biology
- 2011 – 2017 ICREA Research Professor, Centre for Genomic Regulation, Barcelona, Spain
- 2008 – 2017 Junior Group Leader, Centre for Genomic Regulation, Barcelona, Spain
- 2008 PhD, University of California, San Diego, USA

Selected Distinctions
- 2017 ERC Consolidator Grant
- 2016 Plan Estatal, Spanish Ministry of Economics and Competitiveness
- 2016 Zimin Foundation Grant for School of Molecular and Theoretical Biology
- 2014 ERC Starting Grant
- 2013 Plan Nacional Grant, Spanish Ministry of Economics and Competitiveness
- 2012 Howard Hughes Medical Institute International Early Career Scientist Award
- 2011 EMBO Young Investigator Award
- 2010 Theodosius Dobzhansky Prize from Society for the Study of Evolution
- 2010 Plan Nacional Grant, Spanish Ministry of Science and Innovation
- 2005 National Science Foundation Graduate Research Fellow

Christoph Lampert

Computer Vision and Machine Learning

Today's computer programs are "idiots savant": Software that is extremely good at a certain task, such as playing chess, is completely useless for most other tasks like searching a database, and vice versa. The Lampert group works on methods for computers to break out of this limitation by sharing information between different tasks.

Modern computer software adapts to its users, e.g. voice recognition software learns to understand its speaker better over time, and email programs learn which of all incoming emails are spam and should therefore be suppressed. However, this learning process happens independently for each task that the computer is meant to solve. The Lampert group develops and analyzes algorithms that allow computers to learn new tasks while making use of the knowledge acquired from previous tasks. A particular application area is automatic image understanding, whereby the goal of the software is to analyze the contents of a natural image and automatically answer questions such as: What objects are visible in the image? Where are they located? How do they interact?

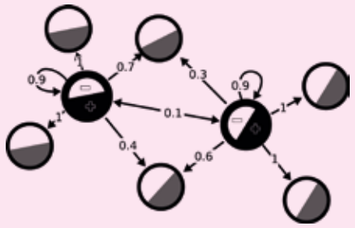
Current Projects Life-long visual learning | Transfer learning | Image understanding with weak supervision | Structured prediction and learning

Team Members 2018 Phuong Bui Thi Mai (PhD student), Hung Hoang (scientific intern), Alexander Kolesnikov (PhD student), Nikola Konstantinov (PhD student), Ehsan Pajouheshgar (scientific intern), Marian Poljak (scientific intern), Bernd Prach (scientific intern), Amélie Royer (PhD student), Alexander Zimin (PhD student)

Career
- since 2015 Professor, IST Austria
- 2010 – 2015 Assistant Professor, IST Austria
- 2007 – 2010 Senior Research Scientist, Max Planck Institute for Biological Cybernetics, Tübingen, Germany
- 2004 – 2007 Senior Researcher, German Research Center for Artificial Intelligence, Kaiserslautern, Germany
- 2003 PhD, University of Bonn, Germany

Selected Distinctions
- since 2015 Associate Editor in Chief of the IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI)
- 2012 ERC Starting Grant
- 2008 Best Paper Award, IEEE Conference for Computer Vision and Pattern Recognition (CVPR)
- 2008 Best Student Paper Award, European Conference for Computer Vision (ECCV)
- 2008 Main Prize, German Society for Pattern Recognition (DAGM)

Lowland coastal tundra in the Chukotka region, seen here from a helicopter, is the breeding habitat of the spoon-billed sandpiper, a model species of migrating waders.



Schematic illustration of multi-task learning: Information is transferred between different learning tasks through a suitably weighted sharing of annotated training examples. As a consequence, the number of necessary training examples per task is reduced and the prediction quality improved.

Mikhail Lemeshko

Theoretical Atomic, Molecular, and Optical Physics

"The whole is greater than the sum of its parts." Aristotle's saying also holds true in many systems studied in quantum physics. Mikhail Lemeshko investigates how macroscopic quantum phenomena emerge in ensembles of atoms and molecules.

Most polyatomic systems in physics, chemistry, and biology are strongly correlated: Their complex behavior cannot be deduced from the properties of their individual components. Despite considerable effort, understanding strongly correlated, many-body systems still presents a formidable challenge. For instance, given a single atom of a certain kind, it is hard to predict whether the resulting bulk material will be solid, gaseous or liquid, crystalline or amorphous, magnetic or non-magnetic, conductive or insulating. The Lemeshko group studies how many-particle quantum phenomena emerge in ensembles of atoms and molecules, and in so doing, answers questions such as: How many particles are sufficient for a given property to emerge? How does an external environment modify the properties of quantum systems? Their theoretical efforts aim to explain experiments on cold molecules and ultra-cold quantum gases, as well as predict novel, previously unobserved phenomena.

Current Projects Understanding angular momentum properties of quantum many-particle systems | Studying open quantum systems and understanding how dissipation acts at the microscopic scale | Many-body physics of ultra-cold quantum gases | Developing techniques to manipulate atoms, molecules, and interactions between them with electromagnetic fields
Team Members 2018 Giacomo Bighin (postdoc), Igor Cherepanov (PhD student), Areg Ghazaryan (ISTplus postdoc), Xiang Li (PhD student), Mikhail Maslov (ISTern, PhD student), Wojciech Rzadkowski (PhD student), Enderalp Yakaboylu (ISTFELLOW postdoc)

Career
- since 2014 Assistant Professor, IST Austria
- 2011 – 2014 ITAMP Postdoctoral Fellow, Harvard University, Cambridge, USA
- 2011 PhD, Fritz Haber Institute of the Max Planck Society, Berlin, Germany

Selected Distinctions
- 2018 ERC Starting Grant
- 2017 Ludwig Boltzmann Prize, Austrian Physical Society
- 2012 One of four finalists, worldwide Thesis Prize competition, AMO division of the American Physical Society
- 2011 ITAMP Postdoctoral Fellowship

Martin Loose

Self-organization of the Cell

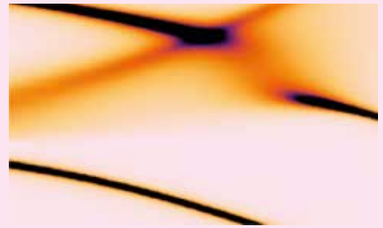
How are nanometer-sized proteins able to perform complex functions on a cellular scale? The Loose group studies the molecular mechanisms of intracellular self-organization by using purified components and advanced fluorescence in a bottom-up approach.

Although most individual players required for specific cellular processes have been identified, how they act together to accomplish their specific task is not yet understood. Instead of looking at complex phenomena in an intact cell, the Loose group aims to rebuild cellular functions from purified components. This bottom-up approach allows for a better control of the experimental conditions and a quantitative characterization of the underlying molecular processes. Ultimately, this helps to identify the mechanistic principles that allow to give rise to living systems. The interdisciplinary approach of the Loose group combines biochemical reconstitution experiments with advanced fluorescence microscopy, biomimetic membrane systems, and image analysis. They currently focus on two research questions: (1) What is the mechanism of bacterial cell division?, and (2) What are the emergent properties of small GTPase networks involved in membrane identity formation and vesicle transport?

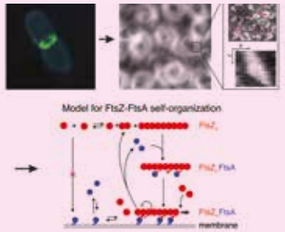
Current Projects Identifying biochemical networks that determine intracellular organization | Studying the mechanism of polarity establishment and cell division
Team Members 2018 Natalia Baranova (HFSP-funded postdoc), Urban Bezeljak (PhD student), Paulo Dos Santos Caldas (BIF-funded PhD student), Christian Düllberg (ISTFELLOW postdoc), Victoria Faas (ISTern), Larysa Ivashko (ISTern), Katrin Loibl (laboratory technician), Maria Lopez Pelegrin (laboratory technician)

Career
- since 2015 Assistant Professor, IST Austria
- 2011 – 2014 Departmental Fellow, Harvard Medical School, Boston, USA
- 2010 – 2011 Postdoc, TU Dresden and Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany
- 2010 PhD, TU Dresden and Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany

Selected Distinctions
- 2015 HFSP Young Investigator Grant
- 2015 ERC Starting Grant
- 2012 – 2014 HSFP Long-term Fellowship
- 2011 – 2012 EMBO Long-term Fellowship
- 2010 Dr. Walter Seipp Award for best dissertation at TU Dresden
- 2001 – 2009 Student and PhD Fellowship of the German National Scholarship Foundation



Fine structure appearing in the rotational spectrum of a molecule due to the interaction with a quantum many-body environment.



Using *in vitro* reconstitution of minimal biochemical systems to understand self-organized processes in the living cell.

Jan Maas

Stochastic Analysis

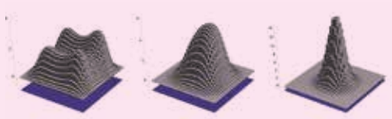
Airplane turbulence, stock rate fluctuations, and epidemic spreading are examples of highly irregular real-world phenomena subject to randomness, noise, or uncertainty. Mathematician Jan Maas develops new methods for the study of such random processes in science and engineering.

Random processes are often so irregular that existing mathematical methods are insufficient to describe them accurately. The Maas group combines ideas from probability theory, mathematical analysis, and geometry to gain new insights into the complex behavior of these processes. Their recent work has been inspired by ideas from optimal transport, a subject originating in economics and engineering that deals with the optimal allocation of resources. The Maas group applies these techniques to diverse problems involving complex networks, chemical reaction systems, and quantum mechanics. Another research focus is stochastic partial differential equations. These equations are commonly used to model high-dimensional random systems in science and engineering, ranging from bacteria colony growth to weather forecasting. The Maas group develops robust mathematical methods to study these equations, which is expected to lead to new insights into the underlying models.

Current Projects Homogenization of discrete optimal transport | Curvature-dimension criteria for Markov processes | Gradient flow structures in dissipative quantum systems
Team Members 2018 Dario Feliciangeli (PhD student), Dominik Forkert (PhD student), Mate Gerencser (FWF Lise Meitner, ISTFELLOW postdoc), David Hornshaw (academic visitor), Lorenzo Portinale (PhD student), Peter Nejjar (postdoc, joint with Erdős group), Dominic Wynter (ISTern), Giovanni Zanco (postdoc)

Career
- since 2014 Assistant Professor, IST Austria
- 2009 – 2014 Postdoc, University of Bonn, Germany
- 2009 Postdoc, University of Warwick, UK
- 2009 PhD, Delft University of Technology, The Netherlands

Selected Distinctions
- 2016 ERC Starting Grant
- 2013 – 2014 Project Leader in Collaborative Research Centre “The mathematics of emergent effects”
- 2009 – 2011 NWO Rubicon Fellowship



Gradient flow discretization of a fourth-order diffusion equation.

Gaia Novarino

Genetic and Molecular Basis of Neurodevelopmental Disorders

Gaia Novarino’s research aims to study genes underlying inherited forms of neurodevelopmental disorders such as epilepsy, intellectual disability, and autism. Neurodevelopmental disorders affect millions of people and are often refractory to treatments. Her group employs many different techniques—from molecular biology to behavior—to identify common pathophysiological mechanisms underlying this group of disorders.

Neurodevelopmental disorders are caused by mutations in a plethora of genes, whose role in the brain is mostly unknown. Identifying the molecular mechanisms underlying these genetic forms of seizure, autism syndromes, and intellectual disability may retain the key to develop therapeutic strategies for this group of conditions. The Novarino group studies the function of epilepsy, intellectual disability, and autism-causing genes at the system, cellular, and molecular levels with the goal of providing a framework for the development of effective pharmacological therapies and the background for the identification of new pathological genetic variants. Their work in understanding the underlying mechanisms will moreover advance the overall understanding of the human brain.

Current Projects Molecular mechanisms underlying autism spectrum disorders | SETD5 gene in intellectual disability | Modeling epileptic encephalopathies and autism spectrum disorders in human brain organoids | Role of the autism-associated gene CHD8 in cortical development | The role of branched amino acid-dependent pathways in neurodevelopmental disorders
Team Members 2018 Narkhyun Bae (ISTplus postdoc), Isabel Chew (ISTern), Ilaria Chiaradia (academic visitor), Alberto Coll Manzano (laboratory technician), Federica Danti (PhD student), Barbara de Sousa Oliveira (ISTplus postdoc), Elena Deliu (postdoc), Zoe Dobler (academic visitor), Christoph Dotter (PhD student), Farnaz Freeman (laboratory technician), Luis Garcia Rabaneda (postdoc), Jasmin Morandell (PhD student), Eva Reinthaler (postdoc), Roberto Sacco (postdoc), Hanna Schön (scientific intern), Margit Szigeti (ISTplus postdoc), Dora-Clara Tarlungeanu (PhD student), Aysan Yahya (PhD student)

Career
- since 2014 Assistant Professor, IST Austria*
- 2010 – 2013 Postdoc, UCSD (Joseph Gleeson Lab), La Jolla, USA
- 2006 – 2010 Postdoc, Center for Molecular Neurobiology, Hamburg, Germany and MDC/FMP (Thomas Jentsch Lab), Berlin, Germany
- 2006 PhD, University La Sapienza, Rome, Italy

* tenure evaluation meanwhile successfully concluded

Selected Distinctions
- 2017 Knight Grand Cross, Order of Merit of the Italian Republic
- 2016 Simons Foundation Autism Research Initiative (SFARI) Investigator
- 2016 ERC Starting Grant
- 2016 FENS-Kavli Scholar
- 2015 Boehringer Ingelheim FENS Research Award 2016
- 2014 Citizens United for Research in Epilepsy (CURE) Taking Flight Award
- 2012 Citizens United for Research in Epilepsy (CURE) Young Investigator Travel Award
- 2011 DFG 2-year Fellowship

Analysis of neuronal morphology in autism spectrum disorder mouse models.

Krzysztof Pietrzak

Cryptography

Cryptography, the science of information security, is often relegated to the realm of spies and secret agents. However, we all rely on cryptography on a daily basis, for example when using internet banking or a wireless car key.

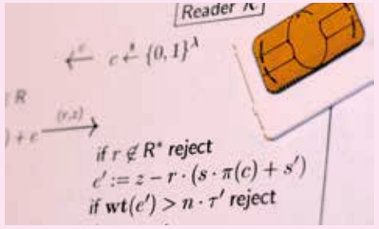
The cryptography group at IST Austria works on theoretical and practical aspects of cryptography, including:
Crypto for light-weight devices. The team works towards provably secure cryptographic schemes for light-weight devices such as RFID tags, which are too constrained to run existing cryptographic schemes.
Leakage-resilient cryptography. This project aims to construct schemes that are provably secure against “side-channel attacks”. These are attacks in which an attacker exploits information leaked during computation from a cryptographic device like a smart card.
Sustainable Cryptocurrencies. Bitcoin is the first successful digital currency. Its popularity comes from the fact that it is decentralized, so no central authority controls it. To achieve security despite decentralization, a huge amount of computing power is constantly wasted towards generating “proofs of work”. This is economically and ecologically problematic. The Pietrzak group works towards more sustainable cryptocurrencies.

Current Projects Leakage-resilient cryptography | Cryptosystems for light-weight devices | Computational entropy | Memory-hard functions | Cryptocurrencies
Team Members 2018 Hamza Abusalah (PhD student), Joël Alwen (postdoc), Arka Choudhuri (predoctoral visiting scientist), Chethan Kamath Hosdurg (PhD student), Karen Klein (PhD student), Oleksandra Lapiha (ISTern), Maciej Skorski (predoctoral visiting scientist), Samarth Tiwari (ISTern), Michael Walter (postdoc)

Career
- since 2016 Professor, IST Austria
- 2011 – 2016 Assistant Professor, IST Austria
- 2005 – 2011 Scientific Staff Member, Centrum Wiskunde & Informatica, Amsterdam, The Netherlands
- 2006 Postdoc, École Normale Supérieure, Paris, France
- 2005 PhD, ETH Zurich, Switzerland

Selected Distinctions
- 2015 ERC Consolidator Grant
- 2010 ERC Starting Grant

Light-weight devices require simple and efficient cryptographic schemes.



Leonid Sazanov

Structural Biology of Membrane Protein Complexes

Membrane proteins are responsible for many fundamental cellular processes including the transport of ions and metabolites, energy conversion, and signal transduction. They are the target of about two thirds of modern drugs. However, membrane proteins, especially large complexes, are challenging for structural studies and so are underrepresented in structural databases.

The Sazanov group has long been interested in the structural biology of membrane proteins. The main emphasis has been on complex I of the respiratory chain, a huge (~1 MDa) enzyme central to cellular energy production. So far, they have determined all the first atomic structures of complex I, from bacterial to the more elaborate mammalian version. The structures suggest a unique mechanism of proton translocation, which they are studying using both X-ray crystallography and cryo-electron microscopy. They are also investigating other related membrane protein complexes, such as antiporters. Their studies will help to understand the molecular design of some of the most intricate biological machines. Medical implications are multifaceted and the Sazanov group is interested in developing potential drug candidates.

Current Projects Mechanism of coupling between electron transfer and proton translocation in complex I | Structure and function of mitochondrial respiratory supercomplexes | Structure and function of other membrane protein complexes relevant to bioenergetics
Team Members 2018 Alexej Charnagalov (laboratory technician), Arianna Cocco (postdoc), Mikel García Alija (ISTern), Javier Gutiérrez-Fernandez (postdoc), Domen Kampjut (PhD student), Karol Kaszuba (FWF Lise Meitner postdoc), James Letts (Marie Curie postdoctoral fellow), Kristina Lukic (PhD student), Julia Steiner (ÖAW DOC-funded PhD student), Irene Vercellino (ISTplus postdoc), Long Zhou (postdoc)

Career
- since 2015 Professor, IST Austria
- 2006 – 2015 Program Leader, MRC Mitochondrial Biology Unit, Cambridge, UK
- 2000 – 2006 Group Leader, MRC Mitochondrial Biology Unit, Cambridge, UK
- 1997 – 2000 Research Associate, MRC Laboratory of Molecular Biology, Cambridge, UK
- 1994 – 1997 Research Fellow, Imperial College, London, UK
- 1992 – 1994 Postdoc, University of Birmingham, UK
- 1990 – 1992 Postdoc, Belozersky Institute of Physico-Chemical Biology, Moscow State University, Russia
- 1990 PhD, Moscow State University, Russia

Selected Distinctions
- 2018 Member, EMBO
- 2016 Academic Editor, Cell Stress
- 2013 Member of Faculty of 1000
- 2012 EMBO Grant
- 2004 Royal Society Grant
- 2002 Royal Society Grant
- 1992 Wellcome Trust Fellowship

Structure of the entire mitochondrial respiratory complex I (mammalian enzyme from *Ovis aries*, solved by cryo-EM). Each of 45 protein subunits is colored differently. Approximate location of the mitochondrial membrane is indicated in grey.

Florian Schur

Structural Biology of Cell Migration and Viral Infection

Structural plasticity and movement play fundamental roles in life, from the level of whole organisms down to cells, viruses and individual molecules. The Schur group uses advanced cryo-electron microscopy and image processing methods to study the structure and function of protein complexes in situ, where they can adopt different conformations or are continuously remodeled.

The Schur group focuses on the dynamic actin cytoskeleton, the key player in the ability of cells to move. Actin-mediated cell migration is important in physiological events as embryonic development or wound healing, but deregulation of these processes leads to pathologies including tumor cell metastasis and pathogen infection. The team thus aims to understand the underlying structural principles that control these complex mechanisms. In addition, they are studying complex and irregular viruses, including retroviruses and selected DNA-viruses, where the latter are also important model organisms to understand actin-mediated pathogen propulsion. Viruses are useful tools for electron microscopy method development, but deciphering their structure is also crucial for understanding features of the viral lifecycle, as assembly and infection.

Current Projects *In situ* structural biology of actin-mediated processes in cell migration | Structure and function of filopodia across scales | Structural conservation and diversity of retroviral capsid
Team Members 2018 Darya Chernikova (scientific intern), Georgi Dimchev (FWF Lise Meitner postdoc), Florian Fäßler (postdoc), Marco Kuslar (scientific intern), Martin Obr (postdoc), Andreas Thader (project technician), Bettina Zens (PhD student), Yuanmin Zhou (scientific intern)

Career
- since 2017 Assistant Professor, IST Austria
- 2016 – 2017 Postdoc, European Molecular Biology Laboratory, Heidelberg, Germany
- 2016 PhD, European Molecular Biology Laboratory, Heidelberg and University of Heidelberg, Germany

Selected Distinctions
- 2016 Paper of the Year Award, Journal of Structural Biology
- 2011 Poster Prize, 26th Annual European Cytoskeleton Forum

Robert Seiringer

Mathematical Physics

The Seiringer group develops new mathematical tools for the rigorous analysis of many-particle systems in quantum mechanics, with a special focus on exotic phenomena in quantum gases, like Bose-Einstein condensation and superfluidity.

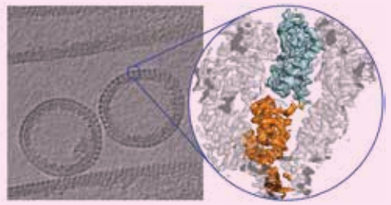
A basic problem in statistical mechanics is to understand how the same equations on a microscopic level lead to a variety of very different manifestations on a macroscopic level. Due to the intrinsic mathematical complexity of this problem, one typically has to resort to perturbation theory or other uncontrolled approximations, whose justification remains open. It therefore remains a challenge to derive non-perturbative results and to obtain precise conditions under which the various approximations can or cannot be justified. For this purpose it is necessary to develop new mathematical techniques and methods. These new methods lead to different points of view and thus increase our understanding of physical systems. Concrete problems under current investigation include the spin-wave approximation in magnetism, the validity of the Bogoliubov approximation for the excitation spectrum of dilute Bose gases, and pattern formation in Ising models with competing interactions.

Current Projects Stability of many-body systems with point interactions | The Heisenberg ferromagnet at low temperature and the spin-wave approximation | Excitation spectrum and superfluidity for weakly interacting Bose gases
Team Members 2018 Niels Benedikter (postdoc), Chiara Boccato (postdoc), Andreas Deuchert (postdoc), Nikolai Leopold (postdoc), Simon Mayer (PhD student), Thomas Moser (PhD student)

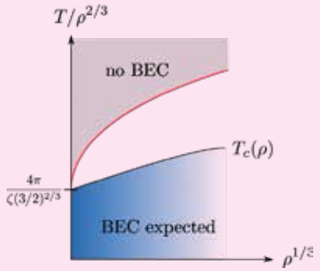
Career
- since 2013 Professor, IST Austria
- 2010 – 2013 Associate Professor, McGill University, Montreal, Canada
- 2005 Habilitation, University of Vienna, Austria
- 2003 – 2010 Assistant Professor, Princeton University, USA
- 2001 – 2003 Postdoc, Princeton University, USA
- 2000 – 2001 Assistant, University of Vienna, Austria
- 2000 PhD, University of Vienna, Austria

Selected Distinctions
- 2016 ERC Advanced Grant
- 2012 – 2017 William Dawson Scholarship
- 2012 – 2014 NSERC E.W.R. Steacie Memorial Fellowship
- 2009 – 2010 U.S. National Science Foundation CAREER Grant
- 2009 Henri Poincaré Prize of the International Association of Mathematical Physics
- 2004 – 2006 Alfred P. Sloan Fellow
- 2001 – 2003 Erwin Schrödinger Fellow

Near-atomic resolution structure of retroviral assemblies by cryo-electron tomography reveals important features in viral assembly and maturation.



Phase diagram of a dilute Bose gas.



Maksym Serbyn

Condensed Matter Theory and Quantum Dynamics

How do isolated quantum systems behave when prepared in a highly non-equilibrium state? How can such quantum systems avoid the ubiquitous relaxation to a thermal equilibrium? How can we gain novel insights into properties of quantum matter using modern non-equilibrium probes? These and other open questions in the field of quantum non-equilibrium matter are the focus of the Serbyn group.

The majority of isolated quantum systems thermalize, i.e., they reach thermal equilibrium when starting from non-equilibrium states. The first research direction of the Serbyn group is to understand mechanisms of thermalization breakdown. Many-body localized systems present one generic example of thermalization breakdown due to the presence of strong disorder. The Serbyn group is studying properties of many-body localized phase and phase transition into thermalizing phase. Kinetically constrained models present another class of systems with some signatures of thermalization breakdown. The Serbyn group is actively working on non-equilibrium properties of quantum models with constrained dynamics. A second area of interest to the Serbyn group is related to non-equilibrium probes in condensed matter systems.

Current Projects Many-body localization | Quantum ergodicity breaking | Non-equilibrium probes of solids | Spin-orbit coupled materials
Team Members 2018 Anya Goremykina (academic visitor), Alexios Michailidis (postdoc), Peng Rao (scientific intern), Marijana Vujadinovic (ISTern)

Career
- since 2017 Assistant Professor, IST Austria
- 2014 – 2017 Gordon and Betty Moore Postdoctoral Fellow, University of California, Berkeley, USA
- 2014 PhD, Massachusetts Institute of Technology, Cambridge, USA

Selected Distinctions
- 2013 Andrew Locket III Memorial Fund Award, Massachusetts Institute of Technology
- 2009 – 2010 Praecis Presidential Graduate Fellowship, Massachusetts Institute of Technology
- 2005 – 2006 Enrico Fermi Junior Grant

Ryuichi Shigemoto

Molecular Neuroscience

Information transmission, the formation of memory, and plasticity are all controlled by various molecules at work in the brain. Focusing on the localization and distribution of molecules in brain cells, the Shigemoto group investigates their functional roles in higher brain functions.

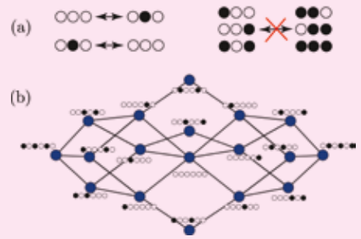
The release of neurotransmitters from a nerve cell into the synapse, where they act on receptors of the connecting nerve cell, is the primary process of information transmission and computation in the brain. The Shigemoto group studies the localization of single neurotransmitter receptors, ion channels, and other functional molecules to understand the molecular basis of neuronal information processing. The group has pioneered several methods for studying the localization of functional molecules at an unprecedented sensitivity, detecting and visualizing even single membrane proteins in nerve cells using SDS-digested freeze-fracture replica labeling. They apply these methods to investigate the mechanisms of signaling and plasticity in the brain, with questions ranging from neurotransmission to learning.

Current Projects Ultrastructural localization and function of receptors and ion channels in the brain | Mechanisms of long-term memory formation | Left-right asymmetry of hippocampal circuitry
Team Members 2018 Catarina Alcarva (ÖAW DOC-funded PhD student), Sameha Azizi (scientific intern), Pradeep Bhandari (PhD student), Matthew Case (postdoc), Kohgaku Eguchi (Marie Curie postdoctoral fellow), Felipe Fredes Tolorza (postdoc), Elena Hollergschwandtner (laboratory technician), Marijo Jevtic (PhD student), David Kleindienst (ÖAW DOC-funded PhD student), Peter Koppensteiner (postdoc), Elodie Le Monnier (laboratory technician), Jacqueline-Claire Montanaro-Punzengruber (senior laboratory technician), Diana Shevchuk (ISTern), Maria Silva Sifuentes (laboratory technician), Shigekazu Tabata (postdoc), Manuel Weninger (scientific intern)

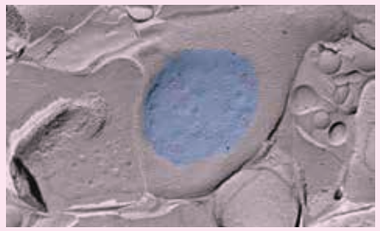
Career
- since 2013 Professor, IST Austria
- 1998 – 2014 Professor, National Institute for Physiological Sciences, Okazaki, Japan
- 1990 – 1998 Assistant Professor, Kyoto University Faculty of Medicine, Kyoto, Japan
- 1994 PhD, Kyoto University, Japan
- 1985 MD, Kyoto University Faculty of Medicine, Japan

Selected Distinctions
- ISI Highly Cited Researcher
- 2017 Member, Academia Europaea
- 2016 ERC Advanced Grant
- 2000 ISI Citation Laureate Award

(a) Local constraint disallows two occupied sites next to each other, defining a kinematically constrained model. (b) The Hilbert space and Hamiltonian of a kinematically constrained model with six sites can be conveniently represented as a graph.



Clustering of P/Q-type voltage-dependent calcium channels (red) in the presynaptic active zone (blue) of parallel fiber-Purkinje cell synapses in the rat cerebellum.



Sandra Siegert

Neuroimmunology in Health and Disease

Identifying brain function has primarily concentrated on how environmental signals are encoded within a complex neuronal network—the impact of the immune system was mostly overlooked. The Siegert group focuses on how neurons and microglia interact with each other and how malfunctions within this relationship impact neuronal circuit formation and function in health and disease.

Microglia are the CNS-resident macrophages and continually sense their neuronal environment. They switch between functional states that either promote or counteract removal of circuit elements. But how microglia decide when to alter circuit elements without inducing circuit malfunction is not known. Activated microglia are a feature of CNS pathologies such as glaucoma and Alzheimer's disease. Thus, it is important to study the contribution of these cells and to develop strategies for manipulating them in a beneficial manner. The Siegert lab addresses this using the mammalian retina, which consists of morphologically well-defined cell types that are precisely mapped in their connection and functional properties. They combine molecular biology, virology, genomics, computational, and functional imaging as well as iPS technology to translate their observations to a human-relevant perspective.

Current Projects To define microglial activation | To identify strategies to manage microglia in neuronal environment | To recapitulate microglia-neuron interaction in a human model system
Team Members 2018 Katarina Bartalska (laboratory technician), Gloria Colombo (PhD student), Evangelia Fourli (scientific intern), Verena Hübschmann (master's student), Irina Khven (ISTern), Medina Korkut (project technician), Margaret Maes (ISTFELLOW postdoc), Rajeshwari Meli (FWF-funded postdoc), Bálint Nagy (predoctoral visiting scientist), Rouven Schulz (ÖAW DOC-funded PhD student), Iris Soliman (master's student), Alessandro Venturino (laboratory technician), Gabriele Wögenstein (scientific intern)

Career
- since 2015 Assistant Professor, IST Austria
- 2011 – 2015 Postdoctoral Associate, Massachusetts Institute of Technology, Cambridge, USA
- 2010 PhD, Friedrich Miescher Institute for Biomedical Research, Basel, Switzerland

Selected Distinctions
- 2017 Liese Prokop Award
- 2016 ERC Starting Grant
- 2013 SWISS OphthAWARD
- 2012 HFSP Long-term Fellowship
- 2011 EMBO Long-term Fellowship
- 2011 SNSF Fellowship for prospective researchers

Daria Siekhaus

Invasive Migration

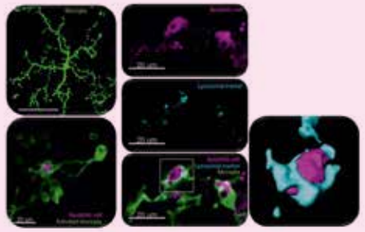
The ability of cells to migrate is crucial for their function in the immune system, the formation of the body, and the spread of cancer. The Siekhaus group investigates how cells move within the complex environment of an organism, using the genetic power of the fruit fly to interrogate this process and identify ways in which it is regulated.

Vertebrate immune and cancer cells need to squeeze between closely connected cells to disseminate in the body. Daria Siekhaus and her group study how cells penetrate such tissue barriers, using the developmental movement of macrophages in the fruit fly *Drosophila melanogaster* as a model. The Siekhaus group uses a combination of imaging, genetics, cell biology, and biophysics to identify the strategies that underlie tissue invasion. The group has recently found that a cytokine conserved in vertebrates facilitates macrophage invasion by reducing tension in surrounding tissues, acting through a previously unidentified pathway. The group is also focusing on studying the functions of novel genes required in *Drosophila* macrophages for tissue penetration that are conserved in vertebrates, and studies their roles in immune function and cancer metastasis.

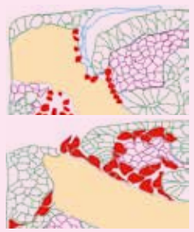
Current Projects The role of tissue tension in regulating invasive migration | A novel transporter and its effect on glycosylation, immune function and metastasis | The role of transcriptional control to tune a subpopulation of macrophages to facilitate invasion
Team Members 2018 Maria Akhmanova (FWF Lise Meitner postdoc), Vera Belyaeva (PhD student), Julia Biebl (laboratory technician), Shamsi Emtenani (PhD student), Attila György (laboratory technician), Michaela Misova (PhD student), Aparna Ratheesh (postdoc), Justine Renno (project technician), Marko Roblek (postdoc), Katarina Valosková (PhD student), Stephanie Wachner (ÖAW DOC-funded PhD student)

Career
- since 2012 Assistant Professor, IST Austria
- 2003 – 2011 Research Scientist, Skirball Institute, New York University Medical Center, USA
- 1999 – 2003 Postdoctoral Fellow, University of California, Berkeley, USA
- 1998 PhD, Stanford University, USA

Selected Distinctions
- 2016 FWF Grant
- 2012 Marie Curie Career Integration Grant
- 2003 – 2005 NIH Fellowship



Left column: top-view of a microglia in a healthy, adult neuronal environment (top); Bottom, activated microglia engulfing an apoptotic cell (magenta; bottom). Middle column: Immunostaining of an activated microglia (green) containing a lysosomal marker (cyan) and engulfing apoptotic cells (magenta). Right column: Surface rendering of one of the engulfments. Scale bar: 20 µm.



Immune cells (red) of the fruit fly *Drosophila melanogaster* before and after tissue entry. Images are tracings of primary data.

Michael Sixt

Morphodynamics of Immune Cells

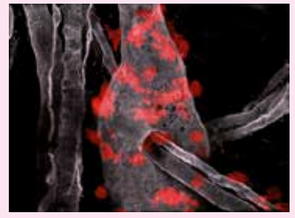
Immune cells zip through our bodies at high speeds to fight off infections and diseases. The Sixt group works at the interface of cell biology and immunology to investigate how cells are able to migrate through tissues.

Most cells in our bodies are stationary, forming solid tissues and encapsulated organs. One exception are leukocytes, immune cells essential for both the innate and adaptive immune responses to infections. Leukocytes migrate with extraordinary speed and are used by the Sixt group as a model to study cell migration. The group works at the interface of cell biology, immunology, and biophysics, and aims to identify basic mechanistic principles that are equally important for developmental processes and cancer cells. One research focus is how the cell's internal skeleton generates and transduces the force to move the cell forward. The group also investigates how cells navigate along guidance cues, specifically how they orient their polarity axis in response to chemotactic gradients. In their work, the members of the Sixt group combine genetics, pharmacology, microengineering, surface chemistry, and advanced imaging approaches, as well as *in vivo* imaging techniques.

Current Projects Environmental control of leukocyte migration | Cellular force generation and transduction | Interpretation of chemo-attractive gradients
Team Members 2018 Jonna Alanko (Stiftelsernas-funded postdoc), Frank Assen (PhD student), Markus Brown (postdoc), Nikola Canigova (PhD student), Alessandra Casano (EMBO-funded postdoc), Ingrid de Vries (senior laboratory technician), Anna Deart (academic visitor), Florian Gärtner (Marie Curie post-doctoral fellow), Tamara Girbl (postdoc), Miroslav Hons (postdoc), Alba Juanes Garcia (postdoc), Aglaja Kopf (PhD student), Alexander Leithner (postdoc), Maria Nemethova (senior laboratory technician), Jörg Renkawitz (postdoc), Anne Reversat (postdoc), Julian Stopp (PhD student), Saren Tasciyan (PhD student), Kathrin Tomasek (PhD student, shared with Guet group)

Career
- since 2013 Professor, IST Austria
- 2010 – 2013 Assistant Professor, IST Austria
- 2008 – 2010 Endowed Professor, Peter Hans Hofschneider Foundation for Experimental Biomedicine
- 2005 – 2010 Group Leader, Max Planck Institute of Biochemistry, Martinsried, Germany
- 2003 – 2005 Postdoc, Institute for Experimental Pathology, Lund, Sweden
- 2003 MD, University of Erlangen, Germany
- 2002 Approbation in human medicine

Selected Distinctions
- 2016 ERC Consolidator Grant
- 2014 EMBO Member
- 2013 European Biophysical Societies Association (EBSA) Young Investigator Medal
- 2013 Member, Young Academy of the Austrian Academy of Sciences (ÖAW)
- 2012 Ignaz L. Lieben Award
- 2011 ERC Starting Grant
- 2011 FWF START Award
- 2008 Endowed Professor of the Peter Hans Hofschneider Foundation
- 2003 Novartis Dissertation Prize



Cells entering a lymph vessel.

Gašper Tkačik

Theoretical Biophysics and Neuroscience

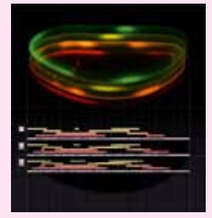
How do networks built out of biological components—neurons, signaling molecules, genes, or even cooperating organisms—process information? In contrast to engineered systems, biological networks operate under strong constraints due to noise, limited energy, or specificity, yet nevertheless perform their functions reliably. The group uses biophysics and information theory to understand the principles and mechanisms behind this remarkable phenomenon.

How can cells in a multicellular organism reproducibly decide what tissue they are going to become? How do neurons in the retina cooperate to best encode visual information into neural spikes? How does the physics at the microscopic scale, which dictates how individual regulatory molecules interact with each other, constrain the kinds of regulatory networks that are observed in real organisms today, and how can such networks evolve? These are some of the questions addressed by the Tkačik group. About half of their time is dedicated to data-driven projects performed in close collaboration with experimentalists, and half on purely theoretical projects. Their goal is to develop theoretical ideas about biological network function and connect them to high-precision data.

Current Projects Visual encoding in the retina | Genetic regulation during early embryogenesis | Collective dynamics | Evolution of gene regulation
Team Members 2018 Anna Andersson (postdoc), Sarah Cepeda Humerez (PhD student), Remy Chait (postdoc, joint with Guet group), Daniele De Martino (ISTFELLOW postdoc), James Ferrare (scientific intern), Mantas Gabrielaitis (ISTFELLOW postdoc), Rok Grah (ÖAW DOC-funded PhD student, joint with Guet group), Jan Humplik (PhD student), Bor Kavčič (PhD student), Wiktor Młynarski (ISTplus postdoc), Roshan Prizak (PhD student), Thomas Sokolowski (postdoc)

Career
- since 2017 Professor, IST Austria
- 2011 – 2016 Assistant Professor, IST Austria
- 2008 – 2010 Postdoc, University of Pennsylvania, Philadelphia, USA
- 2007 Postdoc, Princeton University, USA
- 2007 PhD, Princeton University, USA

Selected Distinctions
- 2018 HFSP Grant
- 2012 HFSP Grant
- 2003 Burroughs-Wellcome Fellowship, Princeton University
- 2002 Golden Sign of the University of Ljubljana



Analyzing positional information during fruit fly development.

Beatriz Vicoso

Sex Chromosome Biology and Evolution

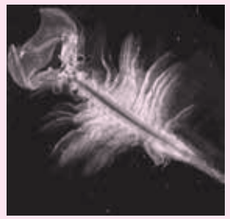
Sex chromosomes, such as the X and Y of mammals, are involved in sex-determination in many animal and plant species. Their sex-specificity leads them to evolve differently from other chromosomes, and acquire distinctive biological properties. The Vicoso group investigates how sex chromosomes evolve over time, and what biological forces are driving their patterns of differentiation.

The Vicoso group is interested in understanding several aspects of the biology of sex chromosomes, and the evolutionary processes that shape their peculiar features. By combining the use of next-generation sequencing technologies with studies in several model and non-model organisms, they can address a variety of standing questions, such as: Why do some Y chromosomes degenerate while others remain homomorphic, and how does this relate to the extent of sexual dimorphism of the species? What forces drive some species to acquire global dosage compensation of the X, while others only compensate specific genes? What are the frequency and molecular dynamics of sex chromosome turnover?

Current Projects Sex chromosome turnover and conservation | Dosage compensation in female-heterogametic species | Gene expression evolution in sexual and asexual species
Team Members 2018 Claire Fourcade (PhD student), Christelle Fraisse (ISTFELLOW postdoc, joint with Barton group), William Gammerdinger (ISTplus postdoc), Ann Kathrin Huylmans (FWF Lise Meitner postdoc), Réka Kelemen (PhD student), Ariana Macon (laboratory technician), Marion Picard (postdoc), Gemma Puixeu Sala (PhD student, joint with Barton group), Julia Raices (PhD student), Melissa Toups (postdoc)

Career
- since 2015 Assistant Professor, IST Austria
- 2009 – 2014 Postdoc, University of California, Berkeley, USA
- 2010 PhD, University of Edinburgh, Scotland, UK

Selected Distinctions
- 2017 Member of the Young Academy of the Austrian Academy of Sciences
- 2016 ERC Starting Grant
- 2016 FWF Standalone Grant
- 2011 DeLill Nasser Travel Award from the Genetics Society of America



The Vicoso group uses brine shrimp of the genus *Artemia* to investigate selection in males and females.

Uli Wagner

Discrete and Computational Geometry and Topology

How and when can a geometric shape be embedded in n-dimensional space without self-intersections? What restrictions does this place on the shape? These and other questions in combinatorial and computational geometry and topology are central to the Wagner group's research program.

A simplicial complex is a description of how to represent a geometric shape by gluing together points, edges, triangles, and their n-dimensional counterparts in a "nice" way. Simplicial complexes are a natural way to represent shapes for the purposes of computation and algorithm design, and the Wagner group explores both their topological properties, such as embeddability, as well as what can be proved about their combinatorics—e.g. bounds on the number of simplices—given a particular geometric or topological constraint. More generally, the researchers take classical topological questions and consider them from a combinatorial point of view, and conversely, they use techniques and ideas from topology to approach questions in combinatorics. They are moreover interested in the computational aspects of such problems, in particular questions of decidability (does an algorithm exist?) and complexity (if so, what are the costs in terms of time or space?).

Current Projects Embeddings of simplicial complexes | Topological Tverberg-type problems and multiple self-intersections of maps | Discrete isoperimetric inequalities and higher-dimensional expanders
Team Members 2018 Alan Arroyo Guevara (ISTplus postdoc), Sergey Avvakumov (PhD student), Illia Babiienko (ISTern), Marek Filakovský (postdoc), Peter Franek (FWF Lise Meitner postdoc), Radoslav Fulek (FWF Lise Meitner postdoc), Kristóf Huszár (PhD student), Anna Krymova (ISTern), Zuzana Masárová (PhD student), Pavel Paták (postdoc), Zuzana Patáková (ISTFELLOW postdoc), Pascal Wild (PhD student), Stephan Zhechev (PhD student)

Career
- since 2018 Professor, IST Austria
- 2013 – 2018 Assistant Professor, IST Austria
- 2012 – 2013 SNSF Research Assistant Professor, Institut de Mathématiques de Géométrie et Applications, EPFL, Lausanne, Switzerland
- 2008 – 2012 Senior Research Associate, Institute of Theoretical Computer Science, ETH Zurich, Switzerland
- 2006 – 2008 Postdoctoral Researcher, Institute of Theoretical Computer Science, ETH Zurich, Switzerland
- 2004 – 2006 Postdoc, Einstein Institute for Mathematics, The Hebrew University of Jerusalem, Israel
- 2004 Postdoc, Univerzita Karlova, Prague, Czech Republic
- 2003 Postdoc, Mathematical Sciences Research Institute, Berkeley, USA
- 2004 PhD, ETH Zurich, Switzerland

Selected Distinctions
- 2018 Best Paper Award at the Symposium on Computational Geometry (SoCG)
- 2014 Best Paper Award at the Symposium on Computational Geometry (SoCG)
- 2012 Research Assistant Professorship Grant of Swiss National Science Foundation (SNSF)
- 2012 Best Paper Award at the Symposium of Discrete Algorithms (SODA)
- 2004 Richard Rado Prize

Chris Wojtan

Computer Graphics and Physics Simulation

Computer simulations of natural phenomena are indispensable for modern scientific discoveries, modern engineering, and the digital arts. The Wojtan group uses techniques from physics, geometry, and computer science to create efficient simulations and detailed computer animations.

Natural phenomena like flowing fluids and shattering solids are both beautifully chaotic and overwhelmingly complex. This complexity makes them extremely difficult to compute without the aid of a supercomputer. The Wojtan group overcomes this complexity by combining laws of motion from physics, geometric theories from mathematics, and algorithmic optimizations from computer science to efficiently compute highly complicated natural phenomena on consumer-grade computing hardware. Their research achieves some of the world's fastest and most detailed simulations through a deeper understanding of the underlying mathematical models and inventing novel computational techniques.

Current Projects Efficient simulation of fluid and fracture dynamics | Numerical and geometric algorithms for solving partial differential equations | Algorithms for re-using simulation data | Computational physics applied to motion pictures, video games, and virtual reality
Team Members 2018 Ewa Gajda-Zagórska (postdoc), Dalila Saulebekova (ISTern), Camille Schreck (postdoc), Tomas Skrivan (PhD student), Georg Sperl (PhD student), Peter Synak (PhD student)

Career
- since 2015 Professor, IST Austria
- 2011 – 2014 Assistant Professor, IST Austria
- 2010 PhD, Georgia Institute of Technology, Atlanta, USA

Selected Distinctions
- 2016 ACM SIGGRAPH Significant New Researcher Award
- 2015 Eurographics Young Researcher Award
- 2015 Eurographics Günter Enderle Best Paper Award
- 2014 ERC Starting Grant
- 2013 Microsoft Visual Computing Award
- 2011 Georgia Institute of Technology Sigma Chi Best PhD Thesis Award
- 2005 National Science Foundation Graduate Research Fellowship

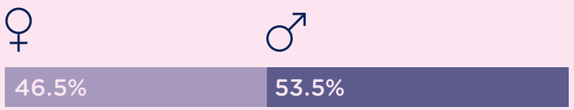
The Wojtan group redefined the state of the art in real-time ocean simulation by combining novel computer algorithms with theories from fluid dynamics and applied mathematics.

PhD Students at IST Austria

(Data as of December 31, 2018)

Total number of PhD Students: 185

Gender among PhD Students



Country of nationality

Austria	21.6%
Slovakia	7.0%
Italy	7.0%
India	7.0%
Germany	7.0%
Russia	3.8%
Czech Republic	3.2%
Other (37*)	43.4%

Country of previous (BS or MA) institution

Austria	22.7%
UK	9.7%
Germany	7.6%
India	6.0%
Czech Republic	4.9%
Italy	4.9%
Slovakia	3.2%
Russia	3.2%
Other (31*)	37.8%

Field of research

Biology	25.4%
Computer Science	11.9%
Physics	11.4%
Neuroscience	11.4%
Mathematics	5.4%
Unaffiliated**	34.5%

2018 PhD Graduates

This year, 21 students completed their PhDs, bringing the total number of graduates to 63. These students, with the names of their groups and dissertation titles, are listed below.

Johannes Alt, *Erdős group*, “Dyson equation and eigenvalue statistics of random matrices”
Vera Belyaeva, *Siekhaus group*, “Transcriptional regulation of macrophage migration in the Drosophila melanogaster embryo”
Daniel Capek, *Heisenberg group*, “Optogenetic Frizzled 7 reveals a permissive function of Wnt/PCP signaling in directed mesenchymal cell migration”
Matthew Case, *Shigemoto group*, “From the left to the right: A tale of asymmetries, environments, and hippocampal development”
Chong Chen, *Jonas group*, “Synaptotagmins ensure speed and efficiency of inhibitory neurotransmitter release”
Igor Gridchyn, *Csicsvari group*, “Reactivation content is important for consolidation of spatial memory”
Eva Gschaider-Reichhart, *Janovjak group*, “Optical and optogentic control of cell proliferation and survival”
Abusalah Hamza, *Pietrzak group*, “Proof systems for sustainable decentralized cryptocurrencies”
Andrej Hurny, *Benková group*, “Identification and characterizationof novel auxin-cytokinin cross-talk components”
Mabel Iglesias Ham, *Edelsbrunner group*, “Multiple covers with balls”
Alexander Kolesnikov, *Lampert group*, “Weakly-supervised segmentation and unsupervised modeling of natural images”
Susanne Laukoter, *Hippenmeyer group*, “Role of genomic imprinting in cerebral cortex development”
Alexander Leithner, *Sixt group*, “Branched actin networks in dendritic cell biology”
Catherine McKenzie, *Janovak group*, “Design and characterization of methods and biological components to realize synthetic neurotransmission”
Thomas Moser, *Seiringer group*, “Point interactions in systems of fermions”
Harald Ringbauer, *Barton group*, “Inferring recent demography from spatial genetic structure”
Magdalena Steinrück, *Guet group*, “The influence of sequence context on the evolution of bacterial gene expression”
Dora Tarlungeanu, *Novarino group*, “The branched chain amino acids in autism spectrum disorders”
Lada Vukusic, *Katsaros group*, “Charge sensing and spin relaxation times of holes in Ge hut wires”
Hannes Watzinger, *Katsaros group*, “Ge hut wires—from growth to hole spin resonance”
Alexander Zimin, *Lampert group*, “Learning from dependent data”

* Number of countries

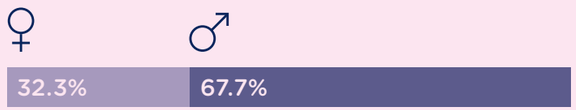
** In fall 2018, IST Austria had the biggest freshman class of 56 students, who after one year need to pass a qualifying exam to be affiliated.

Postdocs at IST Austria

(Data as of December 31, 2018)

Total number of Postdocs: 158

Gender among Postdocs



Country of nationality

Germany	12.7%
Austria	7.6%
Italy	7.0%
Spain	6.3%
China	5.7%
France	4.4%
India	4.4%
Other (36*)	51.9%

Country of PhD institution

Germany	17.1%
Austria	13.9%
USA	10.8%
Spain	8.2%
France	8.2%
UK	5.7%
Switzerland	5.1%
Other (21*)	31.0%

Field of research

Biology	39.2%
Physics	19.6%
Neuroscience	19.0%
Mathematics	12.0%
Computer Science	9.6%
Chemistry	0.6%

* Number of countries

IST Austria Alumni Network

(Data as of December 31, 2018; data are self-reported by members of the IST Austria Alumni Network, actual counts may be higher)

Total number of Alumni: 264

PhD Graduates	57
Postdocs (at least one year spent at IST Austria)	207

Country of nationality

Germany	13.3%
Austria	10.2%
China	7.6%
Czech Republic	6.8%
France	4.9%
Spain	4.5%
Italy	4.2%
Other (38*)	48.5%

Current country of employment

Austria	14.4%
USA	13.3%
Germany	12.9%
UK	6.8%
Switzerland	6.4%
France	5.3%
Czech Republic	3.8%
Other (25*)	37.1%

Alumni by employment sector

Academia	67.4%
I/P Sector**	19.3%
Public Sector	11.0%
Unknown	2.3%

* Number of countries/Unknown

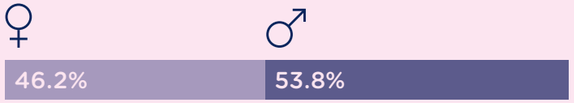
** Industry/Private Sector

Interns at IST Austria
(Data for the entirety of 2018)

ISTern Summer Interns

Total number of ISTerns: 39

Gender among ISTerns



Country of nationality

Russia	20.5%
Ukraine	17.9%
Iran	7.7%
India	7.7%
Austria	7.7%
Spain	5.1%
Italy	5.1%
Other (11*)	28.3%

Country of current institution

Russia	23.1%
UK	15.4%
Ukraine	15.4%
USA	10.3%
Austria	7.7%
Iran	7.7%
Italy	5.1%
Other (6*)	15.3%

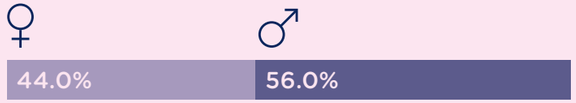
Field of research at IST Austria

Biology	30.8%
Computer Science	20.5%
Mathematics	15.4%
Neuroscience	15.4%
Physics	17.9%

Other Interns at IST Austria

Total number of other interns: 50

Gender among other interns



Country of nationality

Austria	26.0%
India	16.0%
Russia	12.0%
Slovakia	6.0%
Netherlands	4.0%
Czech Republic	4.0%
Iran	4.0%
Other (14*)	28.0%

Country of current institution

Austria	28.0%
UK	14.0%
Russia	12.0%
India	12.0%
Germany	4.0%
Switzerland	4.0%
Netherlands	4.0%
Czech Republic	4.0%
USA	4.0%
Iran	4.0%
Other (5*)	10.0%

Field of research at IST Austria

Biology	42.0%
Computer Science	24.0%
Neuroscience	18.0%
Physics	12.0%
Mathematics	4.0%

* Number of countries

Scientific Service Units at IST Austria

Scientific Service Units currently operational at IST Austria:
- Bioimaging Facility
- Electron Microscopy Facility
- Nanofabrication Facility
- Library
- Life Science Facility
- Miba Machine Shop
- Preclinical Facility
- Scientific Computing

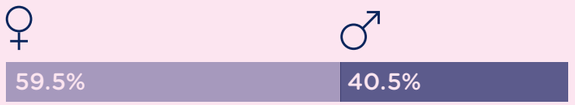
Staff Scientists at IST Austria

Robert Hauschild, *Bioimaging Facility*
Walter Kaufmann, *Electron Microscopy Facility*
Jack Merrin, *Nanofabrication Facility*
Ivan Prieto Gonzalez, *Nanofabrication Facility*
Christoph Sommer, *Bioimaging Facility*

Technical Support at IST Austria
(Comprises Scientific Service Units and laboratory technicians; data as of December 31, 2018)

Total number of Technical Support Staff: 116

Gender among Technical Support Staff



Country of nationality

Austria	51.7%
Germany	7.8%
Hungary	7.8%
Poland	3.4%
Czech Republic	2.6%
Italy	2.6%
Other (21*)	24.1%

* Number of countries

Administration at IST Austria

Administration at IST Austria comprises the following areas:
- Academic Affairs
  - Graduate School Office
  - Grant Office
- Campus IT Services
- Communications & Events
- Construction & Maintenance
  - Environment, Health & Safety
- Executive Affairs
- Office of the President
- People & Financial Services
  - People Services
- Technology Transfer Office

Administrative Staff at IST Austria
(Data as of December 31, 2018)

Total number of Administrative Staff: 158

Gender among Administrative Staff

Country of nationality

Austria	73.8%
Germany	4.2%
USA	3.0%
Romania	1.8%
UK	1.8%
Other (20*)	15.4%

Grants Active or Acquired in 2018

Alistarh Group
- Elastic Coordination for Scalable Machine Learning, H2020 ERC StG, €1'494'000, 3/2019-2/2024
- NSERC Postdoctoral fellowship, NSERC CA Postdoc fewllowship, €61'000, 10/2017-8/2018
- Algorithms for a Computational Revolution, SNF Ambizione, €67'000, 10/2018-8/2019

Barton Group
- Selected Topics in Evolutionary Biology, ESEB Outreach initiative, €2'000, 5/2017-7/2018
- Sex chromosomes and species barriers, FWF Meitner, €169'000, 6/2018-5/2020
- Theoretical and empirical approaches to understanding Parallel Adaptation, H2020 MSCA IF, €166'000, 9/2018-8/2020
- Rate of Adaptation in Changing Environment, H2020 MSCA IF, €166'000, 1/2017-6/2020

Benková Group
- Molecular mechanism of auxin-driven formative divisions delineating lateral root organogenesis in plants, EMBO LTF, €75'000, 7/2016-7/2018
- Plant endocytosis, FFG Femtech, €8'000, 10/2017-3/2018
- Molecular mechanisms of the cytokinin regulated endomembrane trafficking to coordinate plant organogenesis, ÖAW DOC, €116'000, 8/2017-7/2020

Bickel Group
- Soft-bodied intelligence for manipulation, H2020 Cooperation ICT, €261'000, 5/2015-4/2019
- Automatized Design of Injection Molds, H2020 ERC PoC, €150'000
- MATERIALIZABLE: Intelligent Fabrication-oriented Computational Design and Modeling, H2020 ERC StG, €1'498'000, 2/2017-1/2022
- Distributed 3D Object Design, H2020 MSCA ITN, €256'000, 1/2015-12/2018

Browning Group
- EPSRC ad personam fellowship - Adelina Manzateanu, EPSRC PG Scholarship, €8'000, 10/2018-3/2019

Chatterjee Group
- Game Theory, FWF NFN, €330'000, 3/2015-8/2019
- Quantitative Game-theoretic Analysis of Blockchain Applications and Smart Contracts, IBM PhD Fellowship Award, €16'000, 9/2018-5/2019
- Microsoft Research Faculty Fellowship, Microsoft Research Studio Award, €143'000, 4/2011-3/2021
- Quantitative Analysis of Probabilistic Systems with a Focus on Crypto-currencies, ÖAW DOC, €96'000, 6/2019-11/2021
- Efficient Algorithms for Computer Aided Verification, WWTF Coop. Project, €82'000, 3/2016-3/2020

Cremer Group
- Viral pathogens and social immunity in ants, FWF Meitner, €161'000, 7/2016-2/2018
- Epidemics in ant societies on a chip, H2020 ERC CoG, €1'992'000, 4/2018-3/2023

Csicsvari Group
- Interneuro Plasticity During Spatial Learning, FWF International program, €299'000, 2/2018-1/2021

Danzl Group
- UltraX – Achieving sub-nanometer resolution in light microscopy using iterative X10 microscopy in combination with nanobodies and STED, EMBO LTF, €81'000, 8/2019-8/2021
- Optical control of synaptic function via adhesion molecules, FWF International program, €287'000, 3/2018-2/2021
- High-speed 3D nanoscopy to study the role of adhesion during 3D cell migration, HFSP LTF, €144'000, 7/2018-6/2021

Edelsbrunner Group
- The Wittgenstein Prize, FWF Wittgenstein, €1'400'000
- Persistence and stability of geometric complexes, FWF International program, €154'000, 9/2016-8/2020
- Alpha Shape Theory Extended, H2020 ERC AdG, €1'678'000, 7/2018-6/2023
- Toward Computational Information Topology, ONR Grant Award, €326.000, 11/2017-10/2020
- Topological Data Analysis for a faster discovery of new materials, Royal Society International Exchanges Scheme, €11'000, 12/2017-12/2019

Erdős Group
- Random matrices, universality and disordered quantum systems, FP7 ERC AdG, €1'755'000, 3/2014-8/2019
- Structured Non-Hermitian Random Matrices, FWF Meitner, €161'000, 1/2017-1/2020

Fink Group
- Integrating superconducting quantum circuits, FWF SFB, €429'000, 3/2019-2/2023
- Hybrid Optomechanical Technologies, H2020 Cooperation FET-Proactive, €548'000, 1/2017-12/2020
- A Fiber Optic Transceiver for Superconducting Qubits, H2020 ERC StG, €1'500'000, 2/2018-1/2023
- Microwave-to-Optical Quantum Link: Quantum Teleportation and Quantum Illumination with Cavity Optomechanics SUPEREOM, H2020 MSCA IF, €178'000, 4/2016-3/2018
- Hybrid Semiconductor - Superconductor Quantum Devices, NOMIS Research Grants, €700'000, 9/2017-8/2021
- Coherent on-chip conversion of superconducting qubit signals from microwaves to optical frequencies, ÖAW DOC, €96'000, 7/2019-12/2020

Friml Group
- Long Term Fellowship, EMBO LTF, €76'000, 2/2016-2/2018
- Cell surface receptor complexes for auxin signaling in plants, EMBO LTF, €75'000, 6/2017-5/2019
- Molecular mechanisms of endocytic cargo recognition in plants, FWF International program, €339'000, 2/2018-1/2022
- RNA-directed DNA methylation in plant development, FWF Stand-alone, €352'000, 7/2017-6/2020
- Tracing Evolution of Auxin Transport and Polarity in Plants, H2020 ERC AdG, €2'410'000, 1/2018-12/2022
- Körber Prize, Körber Stiftung, €41'000, 4/2015-3/2020
- Cell surface receptor complexes for PIN polarity and auxin-mediated development, ÖAW DOC, €116'000, 3/2019-2/2022

Guet Group
- UPEC-DC interaction, FFG Femtech, €8'000, 9/2018-2/2019
- TransTerm, FFG Femtech, €8'000, 9/2017-3/2018
- CyberCircuits: Cybergenetic circuits to test composability of gene networks, FWF International program, €262'000, 4/2019-3/2022
- Bacterial toxin-antitoxin systems as antiphage defense mechanisms, FWF Richter, €230'000, 2/2019-07/2021
- Biophysically realistic genotype-phenotype maps for regulatory networks, ÖAW DOC, €77'000, 9/2018-8/2020
- Design principles underlying genetic switch architecture, ÖAW DOC, €113'000, 1/2016-12/2018

Hannezo Group
- Active mechano-chemical description of the cell cytoskeleton, FWF Stand-alone, €339'000, 10/2018-9/2021

Hausel Group
- Arithmetic and physics of Higgs moduli spaces, FP7 ERC AdG, €760'000, 9/2016-8/2018

Heisenberg Group
- Mechanosensation in cell migration: the role of friction forces in cell polarization and directed migration, EMBO LTF, €81'000, 2/2019-1/2021
- The generation and function of anisotropic tissue tension in zebrafish epiboly, EMBO LTF, €75'000, 7/2016-06/2018
- Coordination of mesendoderm cell fate specification and internalization during zebrafish gastrulation, EMBO LTF, €76'000, 2/2018-8/2018
- Nano-analytics of Cellular Systems, FWF DK, €197'000, 3/2018-2/2022
- Tissue material properties in embryonic development, FWF Richter, €184'000, 2/2019-01/2021
- Nano-analytics of Cellular Systems, FWF DK, €162'000, 3/2014-2/2018
- Control of epithelial cell layer spreading in zebrafish, FWF International program, €350'000, 2/2017-1/2020
- Control of embryonic cleavage pattern, FWF International program, €229'000, 5/2018-4/2021
- Interaction and feedback between cell mechanics and fate specification in vertebrate gastrulation, H2020 ERC AdG, €2'307'000, 7/2017-6/2022
- Coordination of mesendoderm fate specification and internalization during zebrafish gastrulation, HFSP LTF, €144'000, 9/2018-8/2021
- Hormonal regulation of plant adaptive responses to environmental signals, ÖAW DOC, €116'000, 9/2018-8/2021

Henzinger Group
- Formal Methods meets Algorithmic Game Theory, FWF Meitner, €153'000, 2/2018-1/2020
- Modern Concurrency Paradigms, FWF NFN, €490'000, 3/2015-8/2019
- Wittgenstein Prize, FWF Wittgenstein, €1'500'000, 1/2014-12/2020
- Automated Tutoring System for Automata Theory, Microsoft Research Studio Award, €7'000, 1/2011-12/2021

Hippenmeyer Group
- Role of Eed in neural stem cell lineage progression, FWF Firnberg, €234'000, 12/2018-11/2021
- Molecular Mechanisms Regulating Gliogenesis in the Cerebral Cortex, FWF Meitner, €166'000, 3/2018-2/2020
- Principles of Neural Stem Cell Lineage Progression in Cerebral Cortex Development, H2020 ERC CoG, €1'996'000, 12/2017-11/2022
- Mapping Cell-type Specificity of the Genomic Imprintome in the Brain, NFB Life Science, €245'000, 3/2015-2/2018
- Molecular Mechanisms of Radial Neuronal Migration, ÖAW DOC, €116'000, 8/2017-7/2020

Hof Group
- Eliminating turbulence in oil pipelines, H2020 ERC PoC, €150'000, 7/2017-12/2018

Janovjak Group
- Molecular Drug Targets, FWF DK, €210'000, 3/2015-8/2018
- Light-regulated ligand traps for spatio-temporal inhibition of cell signaling, ÖAW DOC, €116'000, 8/2017-7/2020

Jonas Group
- Reglas de Conectividad funcional en el hipocampo, CONACyT Postdoc fellowship, €20'000, 10/2017-08/2018
- Structural plasticity at mossy fiber-CA3 synapses, FWF Richter, €113'000, 1/2019-03/2020
- Zellkommunikation in Gesundheit und Krankheit, FWF DK, €143'000, 1/2016-6/2020
- Wittgenstein Prize, FWF Wittgenstein, €1'500'000, 10/2017-9/2022
- Biophysics and circuit function of a giant cortical glumatergic synapse, H2020 ERC AdG, €2'678'000, 3/2017-2/2022
- Is the hippocampal mossy fiber synapse a detonator in vivo?, H2020 MSCA IF, €166'000, 4/2016-3/2018
- Presynaptic calcium channels distribution and impact on coupling at the hippocampal mossy fiber synapse, H2020 MSCA IF, €166'000, 1/2017-12/2018

Jösch Group
- Connecting sensory with motor processing in the superior colliculus, EMBO LTF, €75'000, 1/2018-8/2018
- Circuits of Visual Attention, H2020 ERC StG, €1'447'000, 12/2017-11/2022
- Neuronal networks of salience and spatial detection in the murine superior colliculus, HFSP LTF, €144'000, 9/2018-8/2021

Katsaros Group
- Towards Spin qubits and Majorana fermions in Germanium selfassembled hut-wires, FP7 ERC StG, €1'388'000, 2/2016-12/2018
- Hole spin orbit qubits in Ge quantum wells, FWF Stand-alone, €400'000, 2/2018-1/2022
- Loch Spin-Qubits und Majorana-Fermionen in Germanium, FWF START, €200'000, 7/2016-10/2020
- Materials characterization of hybrid semi-super Majorana nanowires, Microsoft Project, €208'000, 7/2018-6/2019
- Hybrid Semiconductor - Superconductor Quantum Devices, NOMIS Research Grants, €700'000, 9/2017-8/2021

Kicheva Group
- Coordination of Patterning And Growth In the Spinal Cord, H2020 ERC StG, €1'499'000, 7/2016-6/2021
- Kinetics of DNA repair in neural differentiation of embryonic stem cells, OeAD WTZ, €7'000, 7/2017-6/2019
- The role of morphogens in the regulation of neural tube growth, ÖAW DOC, €116'000,10/2018-9/2021

Kolmogorov Group
- Discrete Optimization in Computer Vision: Theory and Practice, FP7 ERC CoG, €1'642'000, 6/2014-5/2019

Kondrashov Group
- Experimental exploration of global fitness landscape of a protein family, EMBO LTF, €36'000, 9/2017-7/2018
- Systematic investigation of epistasis in molecular evolution, FP7 ERC StG, €304'000, 10/2017-12/2018
- Zimin Foundation SMTB Alumni Summer Research Programme – Minkevich, Zimin Foundation Internship, €3'000, 6/2018-7/2018

Lampert Group
- Lifelong Learning of Visual Scene Understanding, FP7 ERC StG, €1'465'000, 1/2013-12/2018

Lemeshko Group
- A path-integral approach to composite impurities, FWF Meitner, €169'000, 2/2019-1/2021
- Quantum rotations in the presence of a many-body environment, FWF Stand-alone, €318'000, 2/2017-1/2020
- Angulon: Physics and applications of a new quasiparticle, H2020 ERC StG, €1'500'000, 2/2019-1/2024

Loose Group
- Self-Organization of the Bacterial Cell, H2020 ERC StG, €1'497'000, 4/2016-3/2021
- Reconstitution of bacterial cell wall sythesis, HFSP LTF, €157'000, 6/2016-5/2019
- Reconstitution of cell polarity and axis determination in a cell-free system, HFSP Young Investigator's Grant, €300'000, 10/2016-9/2020
- Reconstitution of Bacterial Cell Division Using Purified Components, BIF PhD fellowship, €46'000, 9/2017-8/2019

Maas Group
- Singular Stochastic PDEs, FWF Meitner, €169'000, 10/2018-9/2020
- Dissipation and Dispersion in Nonlinear Partial Differential Equations, FWF DK, €161'000, 3/2017-2/2021
- Taming Complexity in Partial Differential Systems, FWF SFB, €328'000, 03/2017-2/2021
- Optimal Transport and Stochastic Dynamics, H2020 ERC StG, €1'075'000, 2/2017-1/2022

Novarino Group
- Identification of Converging Molecular Pathways across Chromatinopathies as Targets for Therapy, FWF International program, €357'000, 4/2019-3/2022
- Molecular Drug Targets, FWF DK, €223'000, 3/2015-2/2019
- Transmembrane Transporters in Health and Disease, FWF SFB, €348'000, 02/2015-9/2018
- Probing the Reversibility of Autism Spectrum Disorders by Employing in vivo and in vitro Models, H2020 ERC StG, €1'498'000, 10/2017-9/2022
- Improving brain distribution of drugs targeted to the brain, NFB Life Science, €23'000, 12/2016-11/2019
- Probing development and reversibility of autism spectrum disorders, Simon Foundation Pilot, €267'000, 9/2016-8/2019

Pietrzak Group
- Teaching Old Crypto New Tricks, H2020 ERC CoG, €1'882'000, 4/2016-3/2021

Sazanov Group
- Deciphering the proton-translocation mechanism of complex I, FWF Meitner, €162'000, 6/2017-1/2019
- Atomic-Resolution Structures of Mitochondrial Respiratory Chain Supercomplexes, H2020 MSCA IF, €178'000, 9/2016-8/2018
- Revealing the functional mechanism of Mrp antiporter, an ancestor of complex I, ÖAW DOC, €116'000, 8/2017-7/2020

Schur Group
- Structural conservation and diversity in retroviral capsid, FWF Stand-alone, €381'000, 10/2018-9/2021
- Protein structure and function in filopodia across scales, FWF Meitner, €169'000, 7/2018-6/2020

Seiringer Group
- Structure of the Excitation Spectrum for Many-Body Quantum Systems, FWF Stand-alone, €315'000, 4/2015-9/2018
- Analysis of quantum many-body systems, H2020 ERC AdG, €1'498'000, 10/2016-9/2021

Shigemoto Group
- Human Brain Project Specific Grant Agreement 1 (HBP SGA 1), H2020 Cooperation FET-Flagships, €274'000, 4/2016-3/2018
- Human Brain Project Specific Grant Agreement 2 (HBP SGA 2), H2020 Cooperation FET-Flagships, €223'000, 4/2018-3/2020
- In situ analysis of single channel subunit composition in neurons: physiological implication in synaptic plasticity and behaviour, H2020 ERC AdG, €2'481'000, 7/2016-6/2021
- Ultrastructural analysis of phosphoinositides in nerve terminals: distribution, dynamics and physiological roles in synaptic transmission, H2020 MSCA IF, €178'000, 4/2018-3/2020
- Anatomical and Functional Properties of Auditory Nerve Synapses, NIH, €13'000, 3/2017-2/2018
- Plasticity in the cerebellum: Which molecular mechanisms are behind physiological learning?, ÖAW DOC, €116'000, 9/2018-8/2021
- Mechanism of formation and maintenance of input side-dependent asymmetry in the hippocampus, ÖAW DOC, €113'000, 1/2016-12/2018

Siegert Group
- The role of microglia in neuronal ceroid lipofuscionosis, FWF Firnberg, €230'000, 8/2017-12/2018
- Microglia action towards neuronal circuit formation and function in health and disease, H2020 ERC StG, €1'500'000, 5/2017-4/2022
- Modulating microglia through G protein-coupled receptor (GPCR) signaling, ÖAW DOC, €116'000, 9/2018-8/2021

Siekhaus Group
- Modeling epithelial tissue mechanics during cell invasion, FWF Meitner, €153'000, 1/2018-12/2019
- Drosophila TNFa's Funktion in Immunzellen, FWF Stand-alone, €346'000, 11/2016-10/2019
- Investigating the role of the novel major superfamily facilitator transporter family member MFSD1 in metastasis, NFB Life Science, €250'000, 8/2017-7/2020
- Tissue barrier penetration is crucial for immunity and metastasis, ÖAW DOC, €116'000, 8/2017-7/2020

Sixt Group
- Quantitative understanding of a cell-autonomous component in chemotaxis, EMBO LTF, €76'000, 7/2017-6/2019
- Spatiotemporal regulation of chemokine-induced signaling in leukocyte chemotaxis, Finnish Found PD Pool postdoctoral fellowship, € 102'000, 7/2017-7/2019
- Nano-Analytics of Cellular Systems, FWF DK, €197'000, 3/2018-2/2022 Nano-Analytics of Cellular Systems, FWF DK, €162'000, 3/2014-2/2018
- Mechanical adaptation of lamellipodial actin, FWF Stand-alone, €387'000, 3/2017-2/2020
- Cellular navigation along spatial gradients, H2020 ERC CoG, €1'985'000, 4/2017-3/2022
- Mechanical Adaptation of Lamellipodial Actin Networks in Migrating Cells, H2020 MSCA IF, €178'000, 3/2017-2/2019
- Modeling of Polarization and Motility of Leukocytes in Three-Dimensional Environments, WWTF Coop. Project, €196'000, 3/2014-2/2018

Tkačik Group
- Biophysics of information processing in gene regulation, FWF Stand-alone, €341'000, 01/2016-12/2018
- Can evolution minimize spurious signaling crosstalk to reach optimal performance?, HFSP Program Grant, €269'000, 12/2018-11/2021

Vicoso Group
- Sex Determination in Termites, FWF Meitner, €156'000, 5/2018-6/2021
- Sex chromosome evolution under male and female heterogamety, FWF Stand-alone, €224'000, 1/2016-12/2018
- Prevalence and Influence of Sexual Antagonism on Genome Evolution, H2020 ERC StG, €1'444'000, 3/2017-2/2022

Wagner Group
- Algorithms for Embeddings and Homotopy Theory, FWF Stand-alone, €396'000, 5/2018-4/2022
- Robust invariants of Nonlinear Systems, FWF Meitner, €160'000, 2/2016-1/2018
- Eliminating intersections in drawings of graphs, FWF Meitner, €162'000, 7/2017-6/2019

Wojtan Group
- Efficient Simulation of Natural Phenomena at Extremely Large Scales, H2020 ERC StG, €1'500'000, 3/2015-2/2020

Publications in 2018

Publications by IST Austria members published in 2018;
joint publications involving several groups are listed multiple times.

Alistarh Group
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- Alistarh D-A. 2018. A brief tutorial on distributed and concurrent machine learning. Proceedings of the 2018 ACM Symposium on Principles of Distributed Computing - PODC '18. PODC: Principles of Distributed Computing. 487–488.
- Alistarh D-A, Haider SK, Kübler R, Nadiradze G. 2018. The transactional conflict problem. Proceedings of the 30th Symposium on Parallelism in Algorithms and Architectures – SPAA '18. SPAA: Symposium on Parallelism in Algorithms and Architectures. 383–392.
- Alistarh D-A, De Sa C, Konstantinov NH. 2018. The convergence of stochastic gradient descent in asynchronous shared memory. Proceedings of the 2018 ACM Symposium on Principles of Distributed Computing – PODC '18. PODC: Principles of Distributed Computing. 169–178.
- Alistarh D-A, Brown TA, Kopinsky J, Nadiradze G. 2018. Relaxed schedulers can efficiently parallelize iterative algorithms. Proceedings of the 2018 ACM Symposium on Principles of Distributed Computing – PODC '18. PODC: Principles of Distributed Computing. 377–386.
- Alistarh D-A, Brown TA, Kopinsky J, Li JZ, Nadiradze G. 2018. Distributionally linearizable data structures. Proceedings of the 30th Symposium on Parallelism in Algorithms and Architectures – SPAA '18. SPAA: Symposium on Parallelism in Algorithms and Architectures. 133–142.
- Alistarh D-A, Aspnes J, King V, Saia J. 2018. Communication-efficient randomized consensus. Distributed Computing. 31(6), 489–501.
- Alistarh D-A, Leiserson W, Matveev A, Shavit N. 2018. ThreadScan: Automatic and scalable memory reclamation. ACM Transactions on Parallel Computing. 4(4), 18.
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- Gilad E, Brown TA, Oskin M, Etsion Y. 2018. Snapshot based synchronization: A fast replacement for Hand-over-Hand locking. Euro-Par: European Conference on Parallel Processing, LNCS, 11014, 465–479.
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Barton Group
- Andalo C, Burrus M, Paute S, Lauzeral C, Field D. Prevalence of legitimate pollinators and nectar robbers and the consequences for fruit set in an Antirrhinum majus hybrid zone. Botany Letters.
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Benková Group
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Bickel Group
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Chatterjee Group

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Electron Microscopy Facility

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Selected Events in 2018

Scientific conferences, workshops, and symposia

Date	Event	Description
January 26	Development and Stem Cells Regional Meeting	Organized by Anna Kicheva; 11 speakers from IST Austria, University of Vienna, IMP, and IMBA, highlighting their latest work in the fields of stem cell and developmental biology
February 12-13	Frontiers of Circuit QED and Optomechanics	Organized by Johannes Fink; 20 speakers; brought together experts to discuss theoretical and experimental aspects of Circuit QED, electro-/optomechanics, and hybrid systems
May 4	Young Scientist Symposium 2018 – Game On!	Organized by young scientists at IST Austria; 7 keynote speakers approaching the theme "Designs, Strategies, and Rewards across Science" from different perspectives
June 4-8	IST Austria Summer School in Probability and Mathematical Physics	Organized by Jan Maas, László Erdős, and Robert Seiringer; 7 keynote speakers (including Fields Medalist Martin Hairer)
June 25-29	Applied Topology: Methods, Computation, and Science	Organized by Herbert Edelsbrunner and Ulrich Wagner; 10 keynote speakers adressing the further development of topological techniques for use in applications and the creation of new areas of applications in applied topology
July 9-13	Summer School on Geometric Representation Theory	Organized by Tamás Hausel; 9 keynote speakers
September 9-13	12th European Fluid Mechanics Conference (EFMC12)	IST Austria co-organized the conference held at TU Wien, Vienna
September 17-19	New Directions in Drosophila Blood Cell Biology (NDDBCB)	Organized by Daria Siekhaus; 2 keynote speakers; gathered together experts working on immune cells in the fly

Outreach and science education events

Date	Event	Description
January 9	High school "Lycée Français", Vienna	The team performed an experiment for a project registered for "Science Fair Vienna".
January 17	"Sir Karl Popper" School, Vienna	24 high school students visited Eva Benková's lab and the plant facility.
February 1	Konrad Lorenz Gymnasium, Gänserndorf	17 high school students from the gymnasium in Gänserndorf, Lower Austria, toured and visited the Electron Microscopy Facility.
February 22	Rovereto School, Italy	20 Italian students learning how to work with people with neurological disabilities visited the Novarino research group in order to understand how advanced the research in the field is.
March 8	BRG Klosterneuburg	14 school children (14-15 years of age), accompanied by their physics teacher, visited the Wojtan and Bickel research groups.
March 9-11	ÖMO (Austrian Mathematics Olympiad team)	16 school children had an intensive training on campus, as part of their preparation for the National Mathematics Olympiad.
May 24	Science Education Day 2018	IST Austria organized the first-ever "Science Education Day", providing a forum to exchange ideas on how we can engage and excite students for science and support teachers in developing science activities. Under the motto "Exchange. Enrich. Evolve.", around 150 participants (scientists, teachers and prospective teachers, politicians, and the public) discussed possibilities and new pathways in the field of science education.
June 13	HTL Kaindorf	18 school children (16-17 years of age) learned about High Performance Computing at IST Austria.
June 20	Evolutionary Biology Contest	20 winners of the Evolutionary Biology Contest organized by the Barton group visited IST Austria as a celebration of their success.
June 21	BRG Eisenstadt	About 40 school children (16-17 years of age), accompanied by two teachers, visited the Nanofabrication Facility.
June 24-26	CPS Match	For the third year in a row, the International Mathematics Olympiad (IMO) teams from the Czech Republic, Poland, Slovakia, and Austria came to IST Austria to test their skills in a friendly competition and prepare for the IMO. Over the course of two days, students put their minds to six challenging problems under real testing conditions. Their answers were graded by IST Austria scientists—including interns, grad students, postdocs, and professors.
July 20	KinderUni Wien	Nearly 300 children's university students from Vienna and Lower Austria spent a day on the campus of IST Austria. The theme of this year's event was "Tiny cells – very big!"
August 20-24	IST Austria Sommercampus	62 children aged 7-10 spent a whole week of science camp at IST Austria.
August 27-29	Top Models in Science	15 youngsters (12-16 years of age) came to take part in "Top Models in Science: Science needs models, too!" During the three-day camp, the teenagers had the chance to dive into the exciting world of science.
August 30	National Chemistry Olympiad Winners	12 school children with exceptional results at the National Chemistry Olympiad visited the Sazanov research group and the Bioimaging Facility.
November 28	HTL Rosensteingasse, Vienna	25 students in their high school graduation year visited the Electron Microscopy Facility, the Plant Facility and the Life Science Facility.

Public lectures

Date	Speaker and affiliation	Talk series and title
March 6	**Jeffrey D. Sachs** Columbia University	IST Science and Society Lecture “Science and society in sustainable development”
March 13	**Anton Zeilinger** Vienna Center for Quantum Science and Technology; Faculty of Physics, University of Vienna and Institute of Quantum Optics and Quantum Information; Austrian Academy of Sciences (ÖAW)	IST Lecture “Quantum communication”
June 4	**Ben Feringa** University of Groningen	IST Lecture “The art of building small”
June 6	**Martin Hairer** Imperial College London	ÖAW-IST Lecture “Bridging scales”
October 3	**Eric Wieschaus** Princeton University	IST Lecture “Gene activity and the mechanics of embryonic development”

Institute colloquia

Speaker and affiliation
Kathryn Hess École Polytechnique Fédérale de Lausanne
Martin Hetzer Salk Institute for Biological Studies
Adam Summers University of Washington
Mark Pauly École Polytechnique Fédérale de Lausanne
Lieven Vandersypen Delft University of Technology
Luca Cardelli Microsoft Research
Yukiko Goda RIKEN Brain Science Institute
Jürg Fröhlich ETH Zurich
Walter Fontana Harvard University
Edvard Moser Norwegian University of Science and Technology
Alysson Muotri University of California San Diego
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Orna Kupferman The Hebrew University of Jerusalem
John O’Keefe University College London
Wolf Singer Max Planck Institute for Brain Research
Grant Jensen California Institute of Technology
Immanuel Bloch Ludwig Maximilian University of Munich
Michel Milinkovitch University of Geneva
Monika Henzinger University of Vienna
Molly Przeworski Columbia University
Arthur D. Lander University of California, Irvine

TWIST (Technology Transfer) talks

Speaker and affiliation
Peter Brabeck-Letmathe Chairman Emeritus, Nestlé S.A.
Michael Lukesch CEO and Cofounder, Valanx
Curt Carlson Founder and CEO, Practice of Innovation LLC; Former President and CEO, SRI International

IST Austria Internal Awards 2018

Outstanding PhD Thesis
Anton Nikitenko, Edelsbrunner group

Outstanding Scientific Achievement
Shabir Barzanjeh, Fink group

Outstanding Scientific Support
Dorota Jaworska, Plant growth facility

Outstanding Administrative Support
Stephanie Danzinger, A2P

Golden Chalk Award for Excellence in Teaching
Georg Osang, Edelsbrunner group

Golden Sponge Award for Excellent Teaching Assistance
Rok Grah, Tkačik group

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Boards of IST Austria

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The Board of Trustees oversees the development of the Institute, while acting as its highest authority and ensuring that it adheres to its founding principles and vision. It provides guidance to the management and—among other tasks—is responsible for approving:

- the statutes of the organization and its strategic direction,
- the budget and annual financial statements,
- the appointment of the President, the Scientific Board, and the Managing Director, and
- the procedures for academic appointments and the promotion of scientists.

The Board of Trustees consists of 15 members. Eight of them are internationally successful scientists, four are appointed by the Federal Government, and three are appointed by the Government of Lower Austria.

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Vice-Chair: **Reinhard Jahn**
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Claus J. Raidl
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The Executive Committee is a subcommittee of the Board of Trustees and has, among others, the following rights and duties:

- Act on behalf of the Board of Trustees in all matters between the meetings of the Board of Trustees.
- Hold preliminary discussions on matters to be brought for approval to the Board of Trustees, such as the annual budget.

Scientific Board

Chair: **Peter Fratzl**, Director, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany
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Petra Schwille, Director, Max Planck Institute for Biochemistry, Martinsried, Germany
Non-voting Member: **Claus J. Raidl**, President, Oesterreichische Nationalbank (until August 2018), Vienna, Austria

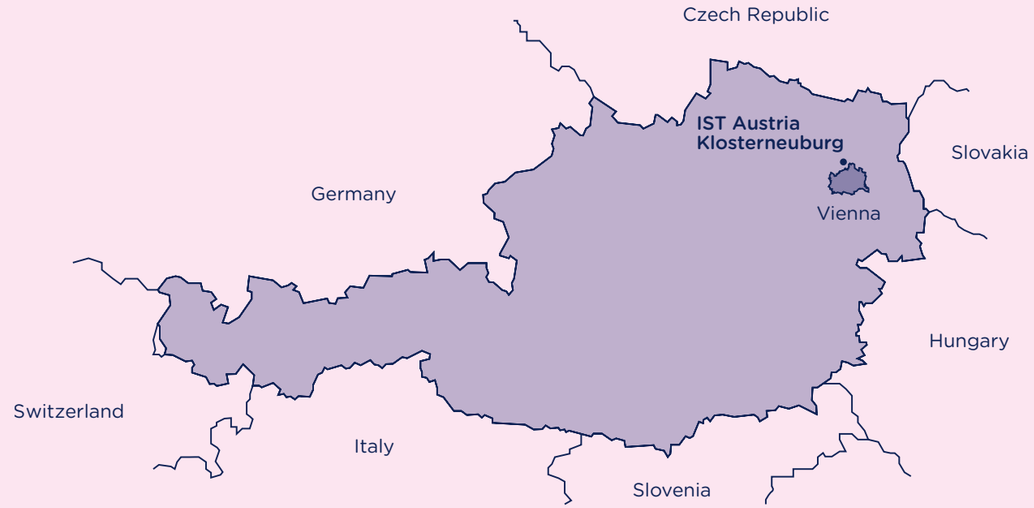
The Scientific Board prepares recommendations for the scientific direction of the Institute. It provides guidance to ensure a high degree of scientific productivity, and among other duties, it organizes internal evaluations of the various research fields. The Scientific Board consists of ten researchers who are recognized internationally at the highest levels and an additional (non-voting) member with outstanding management experience.

Leadership of IST Austria

Thomas A. Henzinger, President
Michael Sixt, Vice President
Georg Schneider, Managing Director
Nick Barton, Dean of the Graduate School

Location & Campus Map

Visiting IST Austria
The Institute is located 18 km from the center of Vienna and can easily be reached via public transportation. The IST Austria Shuttle Bus 142 leaves from the U4 Station Heiligenstadt. Additionally, a number of public buses connect IST Austria to Vienna.



01 Central Building
Science Offices, Guesthouse, Oberbank Ballroom, Mondi Seminar Center, Coffee Pub
02 Raiffeisen Lecture Hall
03 voestalpine Building
Administration
04 Bertalanffy Foundation Building
05 Preclinical Facility
06 Lab Building East
07 2nd Administration Building
08 Visitor Center (planned)
11 Facility Management
12 Heating Plant
13 Miba Machine Shop
16 Power Control
21 Lab and Office Building West
22 Cafeteria
23 Lab Building 5 (under construction)
24 Lab Building 6 (planned)
27 Kindergarten
29 Multi-purpose Experimental Facility
31–35 Apartments
37–45 Apartments
60 Tennis Courts
61 Soccer Field

y = <x,v> / |v|
<x,v> = |x|·|v|·cos(θ)
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T2(x) = b
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θ = (T1, T2)
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≠ H1

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In 2009, IST Austria welcomed the first scientists to the newly opened campus. In 2018, IST Austria was identified as an institute in the scientific fast lane and one of the top young basic research institutes in the world. Also, remarkable successes in acquiring ERC grants show the high excellence of the Institute. This is due to the outstanding work of the scientists on campus, whose achievements lay the foundation for the future viability of the Institute. The Institute's simple, but effective policy of recruiting the best minds in a few subjects has paid off; I look forward to the continued success of this project and of the scientists on campus.

Heinz Faßmann
Federal Minister of Education, Science, and Research

IST Austria was inaugurated a decade ago. In this time, it has established itself as a world-class institute of basic research. We are committed to support the Institute in its further growth and expansion, because research forms the basis of our future development here in Lower Austria, as well as in Austria and Europe as a whole. IST Austria pushes the boundaries of what is known and what is possible; we hope that the Institute continues to challenge conventions, to flourish, and to inspire and train the next generation in the years to come.

Johanna Mikl-Leitner
Governor of Lower Austria