Annual Report 2019

IST AUSTRIA
Institute of Science and Technology

10 YEARS

The people of IST Austria

Nationalities on campus

Scientists as well as administrative and technical support staff come from all over the world to conduct and back research at IST Austria. As of December 31, 2019, a total of 72 nationalities were represented on campus.

IST Austria scientists by nationality

Austria	14.7%
Germany	10.9%
Italy	7.4%
India	5.9%
Russia	4.7%
Slovakia	4.1%
China	4.1%
Hungary	3.7%
Spain	3.3%
USA	3.1%
Czech Republic	2.9%
UK	2.4%
Other	32.8%

IST Austria administrative and technical support staff by nationality

Austria	59.4%
Germany	5.6%
Hungary	3.1%
Poland	2.5%
Romania	2.5%
Italy	2.1%
Russia	1.7%
Czech Republic	1.4%
India	1.4%
Slovakia	1.4%
Spain	1.4%
UK	1.4%
Other	16.1%

North America

Canada
Cuba
El Salvador
Mexico
USA

South America

Argentina
Brazil
Chile
Colombia
Peru
Uruguay

Europe

Albania
Andorra
Armenia
Austria
Belarus
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Finland
France
Georgia
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Macedonia
Malta
Netherlands
Norway
Poland
Portugal
Romania
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
Turkey
UK
Ukraine

Africa

Egypt
Kenya
Libya
Nigeria

Asia

Afghanistan
Bangladesh
China
South Korea
India
Iran
Israel
Japan
Jordan
Kazakhstan
Lebanon
Mongolia
Philippines
Russia
Singapore
Syria
Vietnam

Oceania

Australia

Content

HAPPY BIRTHDAY!

The Open Campus 2019 was the first of a series of events to celebrate IST Austria's 10th anniversary in May and June this year.

Foreword

Thomas A. Henzinger
President, IST Austria

IST Austria celebrated its 10-year anniversary in 2019 and can look back on a very special year:

“An Austrian miracle” – A year of celebration
A series of anniversary events brought hundreds of guests from near and far to campus. Our most prominent guest of honor, the Federal President of the Republic of Austria, Alexander Van der Bellen, put the Institute’s first decade in a nutshell: “An Austrian miracle has happened.” We are truly grateful for the enormous trust and effort by everyone who has contributed to making this miracle happen, employees and supporters alike!

Reaching the podium – A year of achievements
The nicest anniversary gift came in the form of the “Nature Index” ranking, a global comparison of universities and research institutions based on their publication output. In 2019, Nature Index listed IST Austria in third place in the normalized version of their worldwide ranking, which takes the size of institutions into account. Another sign of excellence is our faculty’s continuing success with the European Research Council (ERC): in its first ten years, 37 professors of IST Austria have acquired 46 ERC grants, each worth more than 1.5 million Euro of research funding from the European Union.

Building bridges – A year of collaboration
In 2019, IST Austria joined four institutions in the UK, USA, Israel, and Japan to found the global “BRIDGE network” with the aim of promoting and strengthening the extraordinarily successful institutional model combining basic science with graduate education. 23 new PhD students joined our growing alumni network, which now encompasses 83 former students who have taken up academic and industry positions in more than 30 different countries. And the new technology and research center IST Park, which opened in 2019 adjacent to the Institute’s campus, represents a major step towards bridging the gap between basic science and commercial development.

Expanding frontiers – A year of growth
IST Austria kept expanding throughout 2019 as four new professors arrived on campus and three Assistant Professors were promoted to Professors with unlimited contracts after successfully completing their tenure evaluations. The most recent call for new faculty attracted a record number of more than 1’700 applicants. With the 61 new PhD students who arrived on campus in 2019, the total staff of IST Austria approaches 800. Community growth is accompanied by campus development: the Miba Machine Shop extension opened last year, and the construction of the next laboratory building as well as the planning for a visitor center in the center of the campus are progressing rapidly.

Getting ready for the next decade – A year of looking ahead
With the recent international evaluation panel chaired by Nobel laureate Serge Haroche praising the path taken by IST Austria, we are entering the next decade with great confidence and undiminished ambition. To reach a critical size in order to sustain global success and visibility in all major disciplines of science, the Institute needs the continuing unwavering commitment and support by our stakeholders and donors. In this regard, we especially thank the Federal Ministry of Education, Science and Research and Minister Heinz Fassmann, as well as the Province of Lower Austria and Governor Johanna Mikl-Leitner.

Welcome to the future of IST Austria!

Board member voices

Angelika Amon

Member, IST Austria Scientific Board*
Kathleen and Curtis Marble Professor of Cancer Research, Massachusetts Institute of Technology (MIT), USA

When I first heard that Austria is establishing a new Graduate School in the natural sciences, I was excited. When I learned that this university was to be built in Klosterneuburg, I was incredulous. How could a university located in the middle of nowhere succeed? The last ten years have shown that I should not have been skeptical. Today, IST Austria is one of the leading scientific institutions in Europe. What made IST Austria such a success story? Thomas Henzinger deserves a lot of credit. He identified a number of outstanding young scientists. This first batch of young scientists realized that it was on them to make this place work—and they succeeded. They built a great place to do innovative science.

The challenge for the future will be to foster this community and to expand what has been done for the computational and life sciences to other disciplines. I am not worried though, past accomplishments are the best predictor of future success. Congratulations! I cannot wait to see what happens next.

* For more about IST Austria's Scientific Board, see page 123.

Olaf Kübler

Vice-chair, IST Austria Board of Trustees & chair, IST Austria Professorial Committee**
Former President, ETH Zurich, Switzerland

Life as a member of a research institute is highly privileged, full of intellectual adventures, discoveries and insights, and exciting human interactions. By entrusting me with the chair of the Professorial Committee, IST Austria has offered me the wonderful opportunity to have a share in the most important responsibility of a research institute’s president: to find, recruit and appoint internationally outstanding faculty.

Since IST Austria’s beginnings, the Committee has counted 71 meetings in which President Henzinger asked us to review 117 professorship candidates—the cream of the crop of more than 13’000 applications! It is with deep appreciation that I acknowledge the excellent preparation of all cases by IST Austria’s Academic Affairs as well as the diligence and dedication of the Professorial Committee in appraising and adjudicating the candidates presented.

** The IST Austria Professorial Committee is a multidisciplinary academic body made up of external and internal tenured professors, tasked with reviewing all new hires and promotions. The Committee’s main tasks include authorizing the president to extend offers to new professors to join IST Austria as group leaders and to promote Assistant Professors following their tenure evaluation.

“An Austrian miracle”

A year of celebration

Since the opening of the campus in 2009, IST Austria has already reached many milestones—in the areas of research, education, construction, and fundraising. Reason enough to celebrate the Institute’s 10th anniversary with a series of festive events in summer 2019.

Celebrations kicked off with the Open Campus, IST Austria’s annual research festival, on May 26. More than 2’000 science enthusiasts of all ages gathered to explore the world of research through numerous hands-on science stations and activities. During the anniversary week in June—including an official ceremony followed by science lectures—IST Austria welcomed hundreds of interested people from near and far as well as numerous honorable guests from politics, industry and science. Renowned scientists gave inspiring talks, reflected on IST Austria’s first decade and discussed questions around the future of science in general and the Institute in particular.

Happy birthday, IST Austria!

“Science is the most revolutionary activity of human-kind.”

Sir Paul Nurse
Nobel laureate & Director,
The Francis Crick Institute, UK

“IST Austria is a unique success story that turned Lower Austria into a unique place for science.”

Johanna Mikl-Leitner
Governor of Lower Austria

“A miracle has happened. The Institute actually works.”

Alexander Van der Bellen
Federal President of the Republic of Austria

“Happy birthday! I am very impressed by IST Austria.”

Edith Heard
Director General,
European Molecular Biology Lab (EMBL),
Germany

Reaching the podium

A year of achievements

In 2019, the normalized "Nature Index" of research institutions and universities worldwide ranked IST Austria in third place—what a great anniversary gift! Alongside an impressive success rate with the European Research Council, this is a clear sign that the Institute has become a global beacon of scientific excellence.

Nature Index 2019 – Size isn't everything
In June, the renowned scientific journal *Nature* published its "Nature Index 2019", the results of the annual evaluation of publication data from 82 top-class journals. For the first time, the size of the institutions in which the publishing researchers work was also taken into account. The adjusted statistics had IST Austria show up third in the worldwide ranking—right after the Cold Spring Harbor Laboratory in New York, USA, and the Weizmann Institute of Science in Rehovot, Israel. Apart from IST Austria, only two other European institutions (EPFL in Lausanne and ETH Zurich) made it into the top 25 research institutes worldwide. To IST Austria, this announcement was a wonderful confirmation of the path the Institute chose—and clear proof that IST Austria now successfully competes with the most famous science institutions in the world.

"We have reached the Champions League of research institutes."

Thomas A. Henzinger
President, IST Austria

The European Research Council – Supporting top research at IST Austria
Another sign of excellence is our faculty's continuing success with the European Research Council (ERC), the European Union's premiere funding organization for frontier research. Every year, it selects and funds the very best and most creative researchers of any nationality and age to run projects based in Europe. With a success rate of almost 50%, IST Austria is well ahead of all other European institutions with at least 30 ERC grants when it comes to obtaining the prestigious research grants.

In its first ten years, 37 professors of IST Austria have acquired 44 Starting, Consolidator or Advanced Grants from the ERC, each worth up to 1.5, 2 and 2.5 million Euro, respectively, as well as two ERC Proof of Concept Grants.

In 2019, two Starting Grants to biophysicist Edouard Hannezo and to quantum physicist Maksym Serbyn as well as one Consolidator Grant to computer scientist Krishnendu Chatterjee were added to the list.

Krishnendu Chatterjee

ERC Consolidator Grant for
"Formal methods for stochastic models: algorithms and applications"

Stochastic models estimate the probability of potential outcomes by allowing for the random variation of one or more inputs. Some common everyday examples of where stochastic models are used include stock markets, currency exchanges, estimating wealth and inequality, and medical data such as blood pressure or temperature. Krishnendu Chatterjee's ERC project aims to develop algorithmic solutions that will help better analyze the output from stochastic models. This new approach towards reconceptualizing the algorithmic aspects for the "formal methods" used for stochastic models will inevitably benefit other scientific disciplines as well as emerging technologies such as social cooperation modelling and artificial intelligence.

Edouard Hannezo

ERC Starting Grant for
"Design principles of branching morphogenesis"

The formation of branching organs such as the lung, prostate, kidney, or mammary gland—so-called branched morphogenesis—involves fairly complex processes on various scales. The mechanisms by which molecular signals and cellular behaviors give rise to a robust macroscopic organ structure remains a fundamental and open question. In his ERC Starting Grant project, Edouard Hannezo and his research group will try to gain a broader understanding of the underlying mechanisms of branched organ formation applying state-of-the-art computational and systems biology methods. By combining systems biology with biophysical approaches at the subcellular, the cellular and the organ scale, the group expects to find out about some of the core principles of pattern formation and tissue sculpting in complex branched organs.

Maksym Serbyn

ERC Starting Grant for
"Non-ergodic quantum matter: universality, dynamics and control"

Some quantum systems fail to achieve thermal equilibrium. This can, in turn, allow these systems to exhibit a number of exotic behaviors, some of which are only possible at extremely low or absolute zero temperatures (i.e. 0 Kelvin or -273.15°C). Improving the understanding of such systems in this area has important ramifications not only for quantum physics but also quantum computing.
The ERC Starting Grant project supports Maksym Serbyn and his research group to build a unified theory of quantum systems that escape thermal equilibrium—non-ergodic quantum matter—by classifying the universal properties and phases of this quantum state of matter, along with investigating possible ways to control them. The group's overall goal for the project is to provide a foundation for a complete theory of non-equilibrium many-body systems.

European Research Council
Established by the European Commission

Building bridges

The establishment of a global network

In June 2019, five of the world's most successful scientific institutions founded the network "Basic Research Institutions Delivering Graduate Education", short BRIDGE. They share two common missions: conducting world-class research and training PhD students.

The five founding members of the BRIDGE network—the Rockefeller University, USA, The Francis Crick Institute, UK, the Weizmann Institute of Science, Israel, the Okinawa Institute of Science and Technology Graduate University, Japan, and IST Austria—are all institutions in the global "Champions League". They share being distinct from both universities with undergraduate students and pure research institutes. Their success is reflected by international rankings such as the "Nature Index" and by major awards given to their scientists, such as this year's Nobel Prize in Physiology or Medicine to Peter Ratcliffe from The Francis Crick Institute. The BRIDGE network institutions are attractive to leading researchers as they combine the best of two worlds: the freedom and availability of resources to fully concentrate on research and a steady influx of brilliant young scientists.

BRIDGE provides the basis for fruitful exchange about best practices between its members. Together, they will advocate for the conditions required for excellent science to blossom for the benefit of science and society. The network's mission and principles are detailed in the BRIDGE charter.

www.bridge.net

"Science is a global endeavor. We see the BRIDGE network as an important platform to promote the value of basic research across several continents."

Mary Collins
Provost, Okinawa Institute of Science and Technology Graduate University, Japan

"The BRIDGE network will create a unique ecosystem of institutions, all of them focused on scientific research of a fundamental nature. This is the basis of all further technological advance."

Daniel Zajfman
President, Weizmann Institute of Science, Israel

"The intimate, focused cultures of discovery that arise in our institutions bring to the fore creativity and collaboration among some of the best scientists in the world. The new BRIDGE network will help us enhance those attributes and will enable us to pursue common cause with a group of like-minded research organizations in the future."

Franklin Hoke
Associate Vice President, Communications and Public Affairs, Rockefeller University, USA

"Through the BRIDGE network, we can share best practice to make the most of our advantages and work together to solve common challenges. We hope that this will help us all to improve, benefiting our science and ultimately society."

Paul Nurse
CEO and Director, The Francis Crick Institute, UK

BRIDGE NETWORK

IST AUSTRIA Institute of Science and Technology

The Rockefeller University

THE FRANCIS CRICK INSTITUTE

מכון ויצמן למדע WEIZMANN INSTITUTE OF SCIENCE

OIST

An ecosystem for science and technology

The new IST Park

To bridge the gap between research and industry, the new technology and research center IST Park across the road from IST Austria opened on September 30, 2019.

As a cooperation between ecoplus, the business agency of Lower Austria, and IST Austria, IST Park provides state-of-the-art lab and office infrastructure, customizable to the needs of university spin-offs, deep tech startups, and R&D companies to support the translation of research findings into innovative products.

The broad scope of IST Park matches the breadth of research undertaken at IST Austria. Companies in all areas can benefit from the range of talent and scientific infrastructure available. The exchange within the IST Park community as well as interaction with the researchers of IST Austria is highly encouraged. The current community comprises companies active in software as well as in the life sciences and physical sciences, and organizations supporting innovative projects.

The IST Park construction investment volume of around 15 million Euro is co-funded by the European Regional Development Fund (EFRE) and the Province of Lower Austria. With the inauguration of IST Park's two first buildings in fall 2019, the basis is laid for further expansion—IST Park's long-term master plan foresees the construction of up to nine buildings comprising more than 20'000 m².

https://istpark.at

IST PARK

"With the new IST Park, Klosterneuburg gains even more international visibility and experiences a strong image appreciation as a city of science. The project opens up new perspectives for the people in the region."

Stefan Schmuckenschlager
Mayor, City of Klosterneuburg

Ribbon Biolabs

Founded by former IST Austria postdoc Harold de Vladar, Ribbon Biolabs introduces a new approach for the fast synthesis of long DNA molecules. The company's offer meets the expanding needs of scientists in the field of synthetic biology. Supported by the IST cube venture fund, Ribbon Biolabs tailors solutions for building genomes, high-throughput libraries, DNA-based nanotechnological devices, computing with DNA, and other innovative applications.

www.ribbonbiolabs.com

RIBBON BIOLABS

VALANX Biotech

VALANX Biotech develops a novel site-specific protein conjugation platform, which enables a fast and cost-effective creation of protein multi-conjugates as well as of peptide conjugates. The company was already located on the IST Austria campus before it moved to IST Park. Founder Michael Lukesch and his team will receive funding from the IST cube venture fund (see also page 64).

www.valanx.bio

VALANX BIOTECH

"Facilities like IST Park provide very positive impulses for a region. High-quality jobs are created and value in the region is added sustainably."

Jochen Danninger
Managing Director, ecoplus
(2019; as of February 2020, member of the Provincial Government of Lower Austria)

"A technology park in the immediate vicinity of the IST Austria campus was already included in the report on the founding of the Institute. International examples show that this is an integral part of the success for a broad innovation ecosystem around leading global research institutes."

Thomas A. Henzinger
President, IST Austria

eco plus

EFRE
Europäische Union Investitionen in Wachstum & Beschäftigung. Österreich.

IST AUSTRIA IN A NUTSHELL

A neuroscientist from the group of Sandra Siegert pipetting a cell culture to investigate neuroimmunology.

At a glance

IST Austria in numbers

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 2019

Applications	2'040
Student offers made	101
Student offers accepted	61

Faculty recruiting in 2019

Applications	1'769
Faculty offers made	13
Faculty offers accepted	9

488 scientists

(as of December 31, 2019)

PhD students	223
Postdocs	179
Professors	53
Scientific interns	29
Staff scientists	4

Research grant funding (numbers are rounded)

	2019	Total*
European Research Council (ERC)	€4'949'000	€70'638'000
Austrian Science Fund (FWF)	€4'024'000	€28'049'000
EU other	€1'785'000	€20'691'000
Human Frontier Science Program (HFSP)	-	€2'754'000
Austrian Academy of Sciences (ÖAW)	€385'000	€2'457'000
German Research Foundation (DFG)	€421'000	€1'890'000
NOMIS Foundation	-	€1'400'000
Wellcome Trust	€1'223'000	€1'223'000
European Molecular Biology Organization (EMBO)	€113'000	€1'171'000
Simons Foundation	€872'000	€1'139'000
Fondation Lopez Loreta	€1'000'000	€1'000'000
NÖ Forschung und Bildung (NFB)	€279'000	€918'000
Vienna Science and Technology Fund (WWTF)	-	€434'000
Microsoft Research	-	€359'000
Office of Naval Research (ONR)	-	€326'000
Swiss National Science Foundation (SNF)	-	€283'000
Bayer	-	€150'000
Engineering and Physical Sciences Research Council (EPSRC)	€11'000	€133'000
National Science Foundation (NSF)	-	€119'000
Austrian Research Promotion Agency (FFG)	€8'000	€104'000
Type 1 Diabetes Research Foundation (JDRF)	-	€104'000
Others	€381'000	€2'132'000
Total	**€15'451'000**	**€137'474'000**

* IST Austria grant funding ever acquired as of December 31, 2019

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 principles that were first formulated by Haim Harari, Olaf Kübler and Hubert Markl, who distilled them from the most successful systems and ideas in the world for the governance of research institutes.

Curiosity-driven research

Scientists pursue their interests without constraints or predefined research topics, supported by state-of-the-art infrastructure.

International

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

Multidisciplinary

IST Austria brings together researchers from all major scientific disciplines; communication and collaboration are encouraged across scientific fields.

PhD-granting

IST Austria awards doctoral degrees in a structured graduate program with central admissions.

Supporting careers

Professors are hired early in their careers on a tenure-track system, providing them with independence and a career perspective.

Independent boards

Trustees oversee the Institute; more than half are international scientists. Guidance is also provided by the international Scientific Board.

Exploiting results

Globally competitive basic research leads to unforeseen but useful and valuable discoveries; intellectual property and technology transfer are important objectives.

Diverse funding sources

IST Austria is publicly and privately financed. Scientists acquire third-party funds; donations to the Institute and revenues from intellectual property are transferred to an endowment fund.

Core missions

The founding principles of IST Austria remain valid today and continue to guide the growth and development of the Institute as it enters its second decade and works towards excelling in its core missions:

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

A place to work and live

Campus life at IST Austria

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

Work and family

The balance between work and family life is a challenge for both employees and employers. To support scientists as well as staff with children, children as young as three months and up to elementary school age can be enrolled in the on-campus childcare center “Froschkönig” 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, employees from 72 different countries work and conduct research at IST Austria, both in the scientific and administrative fields. Along the motto “diversity is a reality, inclusion is a choice”, IST Austria is proud to strive for a barrier-free campus, establish a welcome culture and increase awareness for interculturality and implicit bias.

Nature and recreation

With the beautiful Vienna woods at the Institute’s doorstep, scientists and staff 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, soccer and volleyball fields, as well as an outdoor fitness facility, and also provides equipment for bowling, table tennis and other recreational activities.

Cafeteria and café/pub

The on-campus cafeteria and a café/pub are not only places to have a meal or drink, they also serve as gathering points for exchange among scientists and administrative employees alike. The café/pub, which offers a range of food and beverages and hosts numerous events—from science talks to game nights—is open on both weekday and weekend afternoons as well as weekday evenings.

Campus housing

Many employees from abroad 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—individuals, couples, or families—IST Austria offers rooms in a guesthouse located in the Central Building.

Lifelong learning

IST Austria offers many opportunities for career development available to scientists and administrative staff, both on and off campus. Human Resources organizes skills trainings throughout the year. 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.

Shuttle bus

Many employees 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.

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 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. Over the whole year, weekly event series like the Institute Colloquium and the informal science session “Think & Drink” foster professional and social exchange.

A place of growth

The future of IST Austria

The first decade of IST Austria has been marked by rapid growth, while passing many milestones on the path of becoming an internationally renowned research institution. Building on what the Institute has already achieved, it continues to grow further and holds big visions for the future.

Growing community, …
In 2009, IST Austria started off with four professors and 37 employees. Over the past ten years, this number has gradually increased to reach 53 research groups on campus as of December 31, 2019, as well as a total of around 490 scientists at all career stages—PhD students, postdocs, professors, staff scientists, and scientific interns—performing world-class research in computer science, the life sciences, neuroscience, physics and chemistry, as well as mathematics. As of December 31, 2019, eight additional professors have already signed a contract to join the Institute in the course of 2020 or 2021—and following the most recent faculty call with a record number of about 1'700 applications, even more great minds will join the Institute's outstanding group of scientists in the years to come. On December 31, 2019, the multi-disciplinary group of IST Austria scientists was being supported by around 290 administrative and technical employees—a number that will naturally grow along with the number of researchers.

Reaching a critical size is vital for IST Austria to sustain global success and visibility in all major disciplines of science. International benchmarks put that size at three times the current size, or more than 150 research groups, which can be reached in the mid 2030s at the current rate of growth.

Besides strengthening basic research in the different disciplines of science, a tripling in size would allow IST Austria to invest also in technology areas that are critical to the advancement of science, and in interdisciplinary areas that can provide the "glue" necessary for the Institute to realize its full potential.

… growing campus
Reflecting the rapidly growing numbers of scientists and overall staff, new buildings and research facilities add to the high standards of basic research and education conducted at IST Austria. This year, the first two buildings of the technology and research center IST Park as well as the extension of the Miba Machine Shop plus a central storage were inaugurated; the construction of a new lab building took on full speed: the Chemistry Lab Building is scheduled to be completed in 2021 to host new research groups in chemistry as well as the Graduate School and the Institute library. A sixth lab building (Lab Building North) including a seminar center will follow soon after, along with a visitor center to serve as a central location for on-campus outreach and science education activities. Both the visitor center and the Lab Building North are in the planning stage and scheduled to open in 2022 and 2023, respectively.

2026
~ 90 research groups/
>1'000 employees

2023
Lab Building North &
seminar center**
opening

2022
Visitor center**
opening

2021
Chemistry Lab Building*
opening

2019
53 research groups/
~780 employees
IST Park opening

2017
Administration Building
opening

2015
Lab & Office Building West
opening

2012
Lab Building East
opening

2010
first PhD students
Bertalanffy Building
opening

2009
campus opening
4 research groups/
37 employees

2006
IST Austria
founded by law

* under construction
** planning stage

New professors to join IST Austria in 2020*

Kimberly Modic

Combining her expertise on different experimental methods, US-born physicist Kimberly Modic is addressing emerging questions in quantum materials research. Since 2016, she has held a postdoctoral position at the Max Planck Institute in Dresden, Germany. At IST Austria, she will combine custom-built thermodynamic probes with state-of-the-art sample preparation for the investigation of unconventional superconductors, topological materials and spin liquids.

Kimberly Modic joined IST Austria in January 2020.

Stefan Freunberger

Stefan Freunberger is an Austrian chemist working in the field of materials chemistry and electrochemistry. After stations in Switzerland, Canada, the UK, and France he had been a group leader at Graz University of Technology, Austria, since 2015. At IST Austria, he will work on new materials concepts and on the fundamental scientific understanding of processes in materials electrochemistry, such as processes underlying electrochemical energy storage in high-energy batteries.

Stefan Freunberger joined IST Austria in April 2020.

Matthew Robinson

Matthew Robinson is a British scientist working in the field of computational biology and statistical genomics. Since 2017, he has worked as Assistant Professor at the University of Lausanne. At IST Austria, he intends to continue his work on the development of theory, statistical approaches and computational algorithms, which will allow novel analyses when applied to existing datasets (big data).

Matthew Robinson will join IST Austria in May 2020.

Lora Sweeney

Lora Sweeney is an American neuroscientist working at the interface of molecular neurobiology and physiology. Since 2011, she has been a postdoctoral fellow at the Salk Institute for Biological Studies in San Diego, California, USA. At IST Austria, she aims to tackle how neurons in the spinal cord form microcircuits and how these microcircuits shape movement. Her novel approach will exploit natural variation in movement between tadpoles, frogs and mice. As a long-term goal, she aims to translate her findings from healthy to diseased motor circuits.

Lora Sweeney will join IST Austria in June 2020.

Carl Goodrich

US-native Carl Goodrich conducts research in the field of theoretical soft matter physics. Since 2015, he has worked as a postdoctoral fellow at Harvard University in Cambridge, Massachusetts, USA. His main research interests lie within the fields of theoretical condensed matter physics and biophysics. At IST Austria, he will aim to implement his interdisciplinary approach, for instance, to combine computational methods with theoretical analysis and experimental collaborations.

Carl Goodrich will join IST Austria in August 2020.

Tim Vogels

Tim Vogels is a German theoretical and computational neurobiologist who builds models of neurons and neuronal networks, ranging from describing synaptic functions from first principles to a systems and network perspective. Since 2016, he has worked as Associate Professor at the University of Oxford, UK. At IST Austria, his research will continue to focus on neuronal network dynamics and plasticity, but also branch out into ion channel functioning and machine learning.

Tim Vogels will join IST Austria in August 2020.

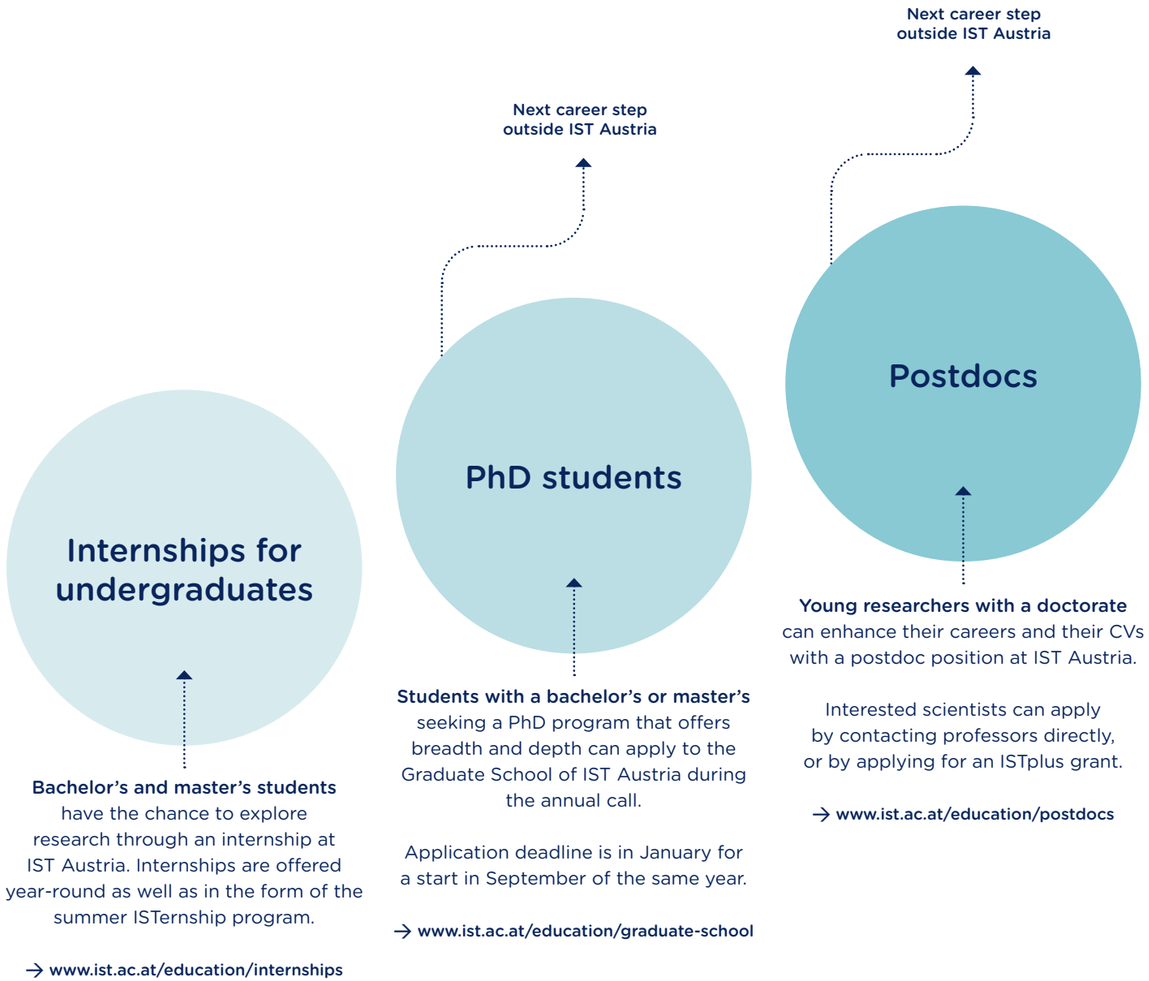
* contracts signed as of December 31, 2019

CAREER & EDUCATION

PhD students Feyza Nur Arslan and Shayan Shamipour from the Heisenberg group in IST Austria's fish facility.

Career options at IST Austria

Career opportunities at IST Austria follow the widely established stages of an international scientific career. However, there are no in-house careers at IST Austria; PhD students and postdocs alike pursue their next academic steps elsewhere.



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

→ **www.ist.ac.at/education/internships**

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.

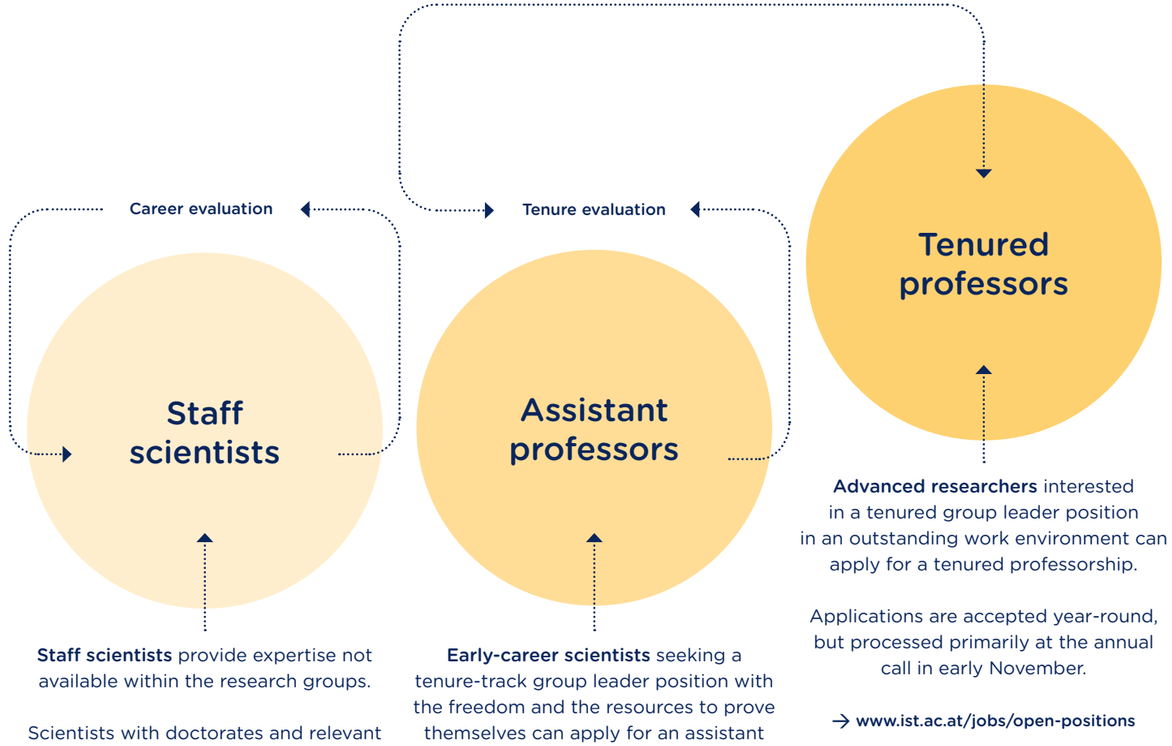
Application deadline is in January for a start in September of the same year.

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

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**



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**

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

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

→ **www.ist.ac.at/jobs/open-positions**

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

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

→ **www.ist.ac.at/jobs/open-positions**

Administrative staff

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 staff

Supporting experts provide research groups with scientific and technical assistance.

→ **www.ist.ac.at/jobs/open-positions**

Opportunities at every level

Internships at IST Austria

"The best internship of my life! Cool lab, cool people!"

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.

IST Austria offers two types of internships:

ISTernship program
Every year, for 2-3 months between May 15 and September 15, students from all over the world come to IST Austria to work on a short-term research project in close cooperation with a faculty or laboratory member. In 2019, 44 ISTerns—selected from over 3'000 applicants—spent their summers researching topics in 27 different research groups. 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 to collaborate with a particular research group for up to one year. During 2019, the Institute hosted 31 scientific interns in 20 different research groups.

INTERNSHIPS

How to apply

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

Edwine T. Lehner

2019 scientific intern, Bernecky group

During her master studies at the IMC University of Applied Sciences, Krems, Austria, Edwine chose IST Austria for her practical work because of the international environment and the opportunity to grow as a young researcher. For one year, she worked with the Bernecky group where she studied the function of a protein involved in depositing an abundant RNA modification found in mammals. "When I joined IST Austria as an intern, it became clear very quickly that this is not just a place to work", Edwine says. "Besides the international spirit I enjoyed that I can follow my passion for science while receiving great support to follow my career plans." Upon completing her degree, Edwine aims to gain experience in science education. By doing so, she hopes to inspire and motivate the next generation to become curiosity-driven and ambitious problem solvers.

Tatiana Ezubova

2019 ISTern, Edelsbrunner group

Tatiana participated in an ISTernship with the Edelsbrunner group in the last year of her bachelor's at New York University, USA. What attracted her was the opportunity to be part of the open and collaborative space at IST Austria that truly encourages scientific exploration. "My experience at IST Austria was an incredible mix of science, curiosity and great companionship. Truly the best summer!" Tatiana says. The project on Poisson-Delaunay mosaics during her ISTernship not only introduced her to a new field of computational topology, but led to the decision to extend her stay to the next year and become a scientific intern. Later on, Tatiana is planning to continue her academic career with a master's degree and a PhD.

"Being an ISTern is a unique academic opportunity and a great personal experience!"

"Absolutely amazing, transformative and memorable: working on what you love and meeting wonderful people from all over the world!"

Training the next generation

PhD students at IST Austria

Educating PhD students is a core mission of IST Austria. The Institute's 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.

Since the first student intake in 2010, IST Austria's PhD program has grown rapidly, from an initial class size of seven students admitted through the call for PhD students in 2010 to 61 students entering in 2019. As of December 31, 2019, a total of 223 people had PhD student contracts at IST Austria; 81 students had successfully graduated.

IST Austria's PhD program
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 ensuring that students gain the background they need to succeed in their area of choice.

Core project
Regardless of their track, all PhD students participate in the Institute's signature core project. During this interdisciplinary course, barriers to communication between fields are broken down to allow effective collaboration among students across disciplines. Furthermore, the course trains students to communicate their work to a wider audience and to confidently respond to open-ended questions.

Core components
To succeed in an ever more competitive world, general and transferable skills are invaluable. IST Austria PhD students receive a strong foundation through the general skills curriculum heavily focused on writing skills.

Rotations
During their first year at IST Austria, students sample research projects in different groups during three required rotations. 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.

Independent research
Once students decide on their topic of research, they affiliate with a research group and take their qualifying exam. They spend the next three to four years pursuing independent research and working towards their PhD theses. Students are also expected to serve as teaching assistants for a course in order to get valuable hands-on teaching skills, and to present their research in a larger setting outside of their research group at least once per year.

Diverse experiences
Graduate students not only make up the largest group on campus, they are also 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 opportunity to take short-term internships in industry and at other research institutions rounds off their PhD experiences as well as their CVs.

Graduate Student Association
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 the students' ideas, feedback and criticism to 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.

PHD 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 annual application deadline is in January for a start in September of the same year.
https://phd.ist.ac.at

Michelle Yeo

PhD student, Pietrzak group

Michelle Yeo studied at the University of Chicago, USA, and University College London, UK, and is now a second-year PhD student in the Pietrzak group where she is working on theoretical aspects of sustainable cryptocurrencies. She is particularly interested in this area of research as it has its origins in a theoretically fascinating question and could potentially have a huge environmental impact. At the end of her first year at IST Austria, she attended the inaugural Blockchain Summer School, where experts in the field pass on their knowledge to junior researchers. Inspired by her experience and disappointed with the scant knowledge of cryptocurrencies the everyday person has, she is keen to organize a similar event for the general public. Michelle: "For most people, blockchains are very mysterious objects. I want to debunk this myth through raising awareness and proper education."

Mike Hennessey-Wesen

PhD student, Hof group

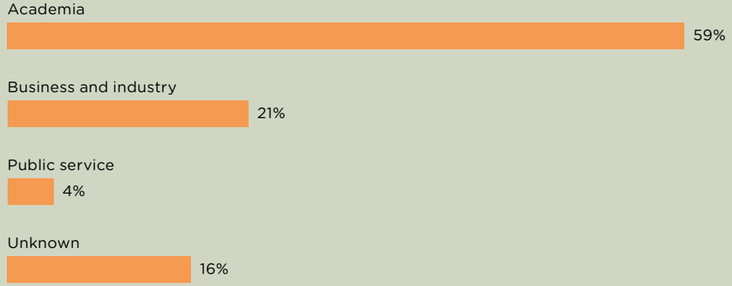
Mike Hennessey-Wesen is a fourth-year PhD student working in the Hof group. He started his education in physics, having worked in nonlinear optics and accelerator science before coming to IST Austria. After joining Björn Hof's research group, he became attracted by biology and started working on a method to precisely measure the rates of mutation in bacteria using microfluidics and fluorescence microscopy. "Over the course of my project, I hope to shine light on questions about DNA architecture and large-scale organization effect mutation", Mike says. He is also interested in education at IST Austria, having served as the physics student track representative and as a member of the working group for the improvement of the Graduate School. Additionally, he is working as a teaching assistant for the core project within IST Austria's PhD program, a first-year course meant to foster interdisciplinary communication skills among incoming students.

Career development
The value of IST Austria is not only measured by the quality of scientific research performed and the publications written, but also by the career success of its students and postdocs. The IST Austria alumni network (see also pages 38-39) actively engages with the Institute's former scientists and ensures alumni participation in IST Austria events and activities.

With regular career talks, skills training sessions as well as visits from industry leaders, the IST Austria career development program helps students prepare for a career in academia, industry, and other sectors.

As of 2019, 48 or around 60% of all PhD alumni are actively working in academia. Impressively, among these, more than 90% are engaged in basic research. This fact perfectly aligns with IST Austria's mission of training the next generation of scientists.

Careers of IST Austria PhD alumni



PhD alumni in academia

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.

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 2019, 214 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 to start new collaborations. In October 2019, IST Austria postdocs went on a retreat in Rust by Lake Neusiedl. The weekend included career development trainings, 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 2019. Postdocs also provide members of the public with tours of the research facilities during the Open Campus and help organize the Young Scientist Symposium.

Funding postdoctoral fellows
The final call for the ISTplus program, a Marie Skłodowska-Curie COFUND scheme of the EU, took place in 2019. This program focused on postdoctoral career development by offering fellows the opportunity to undertake secondments of up to six months at intersectoral partners. In total, 70 postdocs have accepted offers to join the Institute as ISTplus fellows. Succeeding ISTplus, a competitive postdoctoral fellowship program (funded by IST Austria) will launch in 2020, with the first call for applicants in fall 2020. Details on the application process to follow at **www.ist.ac.at/education/postdocs.**

POSTDOCS

How to apply

Scientists interested in conducting postdoctoral research at IST Austria can apply by contacting professors directly.
www.ist.ac.at/education/postdocs

Sven Truckenbrodt

Postdoc, Danzl group

Sven Truckenbrodt received his PhD in neuroscience from the University of Göttingen, Germany, and the International Max Planck Research School for Molecular Biology. As a postdoc at IST Austria, he develops microscopy methods in the Danzl group, an interdisciplinary team of biologists, neuroscientists and physicists working on advanced light microscopy. Sven uses a new technique called expansion microscopy, which allows scientists to get around the traditional resolution limits in microscopy. A particular version of this technique, which he developed himself, allows him to investigate how cells are organized and what is going on inside them much more easily. Sven: “In science, we uncover what nobody has ever known before. This is a thrill, a challenge and a powerful motivator at the same time.”

Tanya Kaushal Srivastava

Postdoc, Hausel group

Tanya Kaushal Srivastava holds a PhD in mathematics from the Freie Universität Berlin, Germany. As a postdoc at IST Austria, she is currently working in the area of arithmetic algebraic geometry in the Hausel group. Her research is focused on understanding so-called derived categories of K3 surfaces. Tanya has worked on counting how many K3 surfaces, over fields of positive characteristic, have the same derived categories and developed an understanding of the differences in automorphisms of K3 surfaces when seen as autoequivalences. String theorists find her work interesting as the counts of derived equivalent three-dimensional analogues of K3 surfaces also correspond to the number of multiple landscape universes in String Theory. Tanya: “My curiosity to know and understand how nature works motivates me the most to follow a career in mathematics.”

Pursuing academic careers

Professorships at IST Austria

Following the sole criteria of “person before area” and “quality before speed”, IST Austria has hired brilliant minds to become one of the top research institutions for basic science worldwide. A tenure-track system ensures long-term high-quality scientific standards.

When hiring new faculty, IST Austria does not fill pre-defined thematic slots. Instead, applicants are screened for scientific quality and promising research ideas within or even beyond the Institute’s current core areas of chemistry, computer science, life sciences, mathematics, and physics.

Most professors at IST Austria are hired early in their career to build up independent research groups at the peak of their creativity. Following the tenure-track system common in the USA, IST Austria requires junior group leaders to go through a similar procedure: they join the Institute as Assistant Professors with a limited contract and, should they successfully pass a tenure evaluation, receive an unlimited contract. The result of the tenure evaluation is solely based on the researchers’ contribution to and advancements in the respective scientific field reviewed by international peers. Scientists who have already led a research group for a minimum of six years elsewhere receive unlimited contracts and join the Institute as tenured Professors.

In 2019, the IST Austria faculty consisted of 30 Professors—including three who successfully passed their tenure evaluations this year—and 23 Assistant Professors (see also pages 70-98).

“From day one, IST Austria allowed me to independently follow my personal research goals, completely free of conventions. I also owe it to this freedom of action that I am now able to translate my ongoing academic research into products that can improve the diagnostics of children with conditions such as autism and epilepsy.”

Gaia Novarino
IST Austria Assistant Professor 2014-2019,
Professor since April 1, 2019

“The support I have received from IST Austria has surpassed my expectations. Junior faculty receive startup packages on par with large US research universities and an additional, generous annual operating budget. Further, I have been fully able to give input on institute decisions, request changes to scientific services, and participate in faculty recruiting. I have not heard of a more favorable environment for young faculty anywhere.”

Andrew Higginbotham
IST Austria Assistant Professor since 2019

Advancing methods and technology

Staff scientists at IST Austria

Staff scientists are fully trained researchers who provide special skills, expertise and experience. They aim to establish or further advance technology and methods within the Scientific Service Units on campus.

Staff scientists at IST Austria are usually associated with a Scientific Service Unit (see page 52) and work independently from a particular research group. With their skills and expertise, they contribute to the advancement of methodology and experimental set-ups. Due to their ability to develop and apply innovative solutions to all kinds of research questions, their support and collaboration with different research groups contributes to the success of numerous projects at IST Austria.

Staff scientists receive a temporary contract at the beginning of their employment and are evaluated after five years before receiving permanent contracts. Their continued presence prevents the loss of knowledge as other scientists leave the Institute and sustains stable institutional structures.

During 2019, five staff scientists were employed at IST Austria (see also pages 99-101).

Out into the world

IST Austria's alumni network

Upon graduating or finishing their research work, PhD students and postdocs leave IST Austria to pursue their careers elsewhere. But no matter how far away they go, they remain part of the IST Austria community as members of the Institute's alumni network.

A growing international network
IST Austria alumni have spread all around the world and hold a diversity of positions in various sectors, be it academia and science, business and industry, or public service: While about 20% of alumni have joined institutions in Austria like TU Vienna, the University of Vienna, TU Graz, or Med Uni Vienna, as well as companies like AIT, Bosch, Infineon, or ImageBiopsy Lab, the bigger part of them—80%—has left Austria to continue their career abroad.

The IST Austria Alumni Relations team has worked to maintain an active relationship with the ever growing network of currently more than 300 alumni, inviting them back to campus to share their experiences and reaching out to them with news and opportunities to visit IST Austria, for instance as guest lecturers.

Where IST Austria PhD students go
After graduating from IST Austria and leaving the country, PhD students have found assistant professor or postdoctoral positions at some of the top universities of the world, such as ETH Zurich or EPFL Lausanne, Switzerland, or Harvard, Stanford University, and the University of Chicago, USA.
In the industry sector, former IST Austria students are now employed with international companies like Google, Amazon or Bosch.

Where IST Austria postdocs go
Former IST Austria postdocs who left Austria have taken similar paths and joined universities, research institutes and companies at various career levels and in all corners of the earth. Some joined the ranks of full and associate professors at one of the following institutions:

University of Bonn, Germany | Jacobs University Bremen, Germany | University of Bristol, UK | Gdansk University, Poland | Hebrew University of Jerusalem, Israel | New York University, USA | Indian Institute of Technology Bombay (IITB), India | University of Science and Technology of China | University of Yamanashi, Kofu, Japan

Other former IST Austria postdocs are now assistant professors at institutions such as:

KTH Royal Institute of Technology, Sweden | University of Warwick, UK | University of California, Davis, USA | Skolkovo Institute of Science and Technology, Russia | Purdue University, USA | Hong Kong University of Science and Technology, China | Keio University, Tokyo, Japan

Others yet again are continuing their research as postdocs, for instance at:

University of Manchester, UK | Weizmann Institute of Science, Israel | Massachusetts Institute of Technology (MIT), USA | Princeton University, USA | University of Pennsylvania, USA | University of California San Diego, USA

Another group of IST Austria postdoc alumni became group or team leaders at:

Roche group, Switzerland | INRIA Saclay, France | University of Tübingen, Germany | Max Planck Institutes, Germany | Institute Curie, France | Cardiff University, UK | Institute of Photonic Sciences (ICFO), Spain

Moreover, among IST Austria postdoc alumni are senior scientists or department heads at companies and institutions such as:

BMW, Germany | Bosch Center for Artificial Intelligence, Germany | Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK), Germany | Vision Institute of Sorbonne Université, France | Genentech, USA | Wickr, USA

Catherine McKenzie

Postdoc, Institute for Interdisciplinary Neuroscience (IINS), Bordeaux, France

Catherine McKenzie completed her BSc in biology with an emphasis on neuroscience at the University of California, San Diego, USA, before joining IST Austria as a PhD student in the Janovjak group. During her time at the Institute, she focused on building biological methods to specifically address how tangible elements of the mammalian brain translate to cognitive processes and behavioral output.
She graduated in 2018. Her postdoctoral work at IINS focuses on employing 3D super-resolution microscopy, optogenetics and electrophysiology to understand the role of adhesion proteins during synaptic remodeling events in real-time by optical recruitment and reassembly of these proteins at synapses. Catherine: "IST Austria gave me a unique opportunity to flex my creative research process by being exposed to a highly interdisciplinary scientific environment. This allowed me to think outside of the box in my approach to design and implement novel biological methods, which I have been able to translate to my postdoctoral work."

Jörg Renkawitz

Professor and group leader, Ludwig-Maximilians-Universität (LMU), Munich, Germany

Jörg Renkawitz studied biochemistry at the LMU Munich and the Technical University (TU) Munich, Germany. In 2014, he joined the lab of Michael Sixt at IST Austria for his postdoctoral research. Here, he studied the principles of immune cell navigation through three-dimensional microenvironments, combining bioimaging, microfluidics and cell biology. He won the Life Science Research Awards Austria 2019 by the Austrian Association of Molecular Life Sciences and Biotechnology for his research on "Nuclear positioning facilitates amoeboid migration along the path of least resistance". In 2018, Jörg received the endowed Peter Hans Hofschneider Professorship for Molecular Medicine (Stiftung Experimentelle Biomedizin) and established his research group at the Biomedical Center Munich of LMU Munich. Jörg: "My research time at IST Austria was extremely captivating and fruitful as the Institute offers a fascinating interdisciplinary research environment, excellent scientific core facilities and the freedom to entirely focus on research."

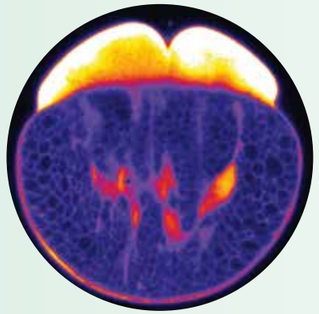
RESEARCH

Seedlings of *Arabidopsis thaliana* in IST Austria's plant facility.

Biology

Biology, the study of life and living organisms, encompasses a range of fields—from cell biology to evolution, from genetics to development. Similarly, biology research at IST Austria covers a wide range of areas and involves many collaborations both within and outside the immediate subject area.

In 2019, biologists at IST Austria explored questions including: How do the concerted actions of mechanical and biochemical signals drive key cellular processes in the zebrafish embryo? How can cells squeeze through tight tissue barriers? What does the structure of an enzyme tell us about its function? How do plants regulate their root growth, and how do they heal wounds?



Physical forces in fish embryo development

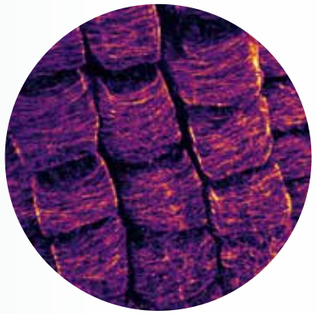
Heisenberg and Hannezo groups

A fish embryo follows a big goal: it has to divide from one into thousands of cells in a very short amount of time. To understand the physical basis of early fish embryo development, the research group of developmental biologist Carl-Philipp Heisenberg has repeatedly teamed up with the group of theoretical physicist Edouard Hannezo. In 2019, one of their multi-disciplinary studies published in *Cell* revealed that combined pulling and pushing forces involving different actin structures within the embryo facilitate the segregation of the cytoplasm from the yolk—a key process in the development of the fish larva.
Earlier this year, Heisenberg and Hannezo co-authored a study in *Nature Cell Biology* showing that zebrafish embryos partly turn liquid during their early development in a process resembling a rigidity transition. This rigidity transition had long been speculated to exist in living matter, but was described for the first time to occur in a living organism in this study.

The atomic structure of molecular machines

Sazanov group

Protein complexes play central roles in regulating metabolic processes in animals and humans alike; malfunction can lead to serious disorders. For the first time in 2019, structural biologist Leonid Sazanov and his group visualized and analyzed the near-atomic structure of the mitochondrial enzyme transhydrogenase. Parts of this study's data were the first to be published using one of three new cryo-electron microscopes installed at IST Austria in fall 2018.
Similarly, the so-called "resolution revolution" based on state-of-the-art cryo-electron microscopy also enabled the Sazanov group to identify various conformational states of a central ATP synthase representative and thus to fill in a gap in the evolutionary tree of these essential molecular machines.
The data presented in the journals *Nature* and *Science*, respectively, are highly relevant for the development of currently unavailable therapeutic options.



The effects of a plant hormone in animals

Benková and Sixt groups

The plant hormones cytokinin and auxin act as principal regulators of fundamental biological processes such as cell division and differentiation. In 2019, the team of Eva Benková in collaboration with the group of Michael Sixt identified a so far unknown function of cytokinin in the regulation of the microtubular cytoskeleton, one of the core cellular structures in both plants and animals. In plants, an increase of cytokinin activity correlated with reduced dynamics of microtubules. Intriguingly, application of this plant hormone led to rapid stabilization of microtubules also in animal cells.
This unexpected finding suggests that cytokinin targets some of the functionally conserved elements of the microtubule network in both plant and animal cells. Moreover, it opens an exciting research area on evolutionary conservation of mechanisms that control microtubule activity—and it might provide important knowledge with respect to the development of targeted therapies in diseases related to defects in cell division or differentiation, such as cancer.

Faculty Mathematical Models of Evolution NICK BARTON | Hormonal Cross-Talk in Plants EVA BENKOVÁ | RNA-based Gene Regulation CARRIE BERNECKY | Social Immunity SYLVIA CREMER | High-Resolution Optical Imaging for Biology JOHANN DANZL | Genes, Circuits, and Behavior MARIO DE BONO | 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 Protein Systems 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 DARIA SIEKHAUS | Morphodynamics of Immune Cells MICHAEL SIXT | Theoretical Biophysics and Neuroscience GAŠPER TKAČIK | Sex Chromosome Biology and Evolution BEATRIZ VICOSO

Computer science

Computer science at IST Austria stands out in two particular ways: first, all computer science groups share an appreciation for foundational thinking and build their research on a mathematically rigorous base. 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.

Among other topics, this year, IST Austria's computer scientists focused on solving scalability issues in machine learning, identifying new algorithm approaches for stochastic computer models, or developing an efficient way to animate water waves.

Scalable distributed machine learning

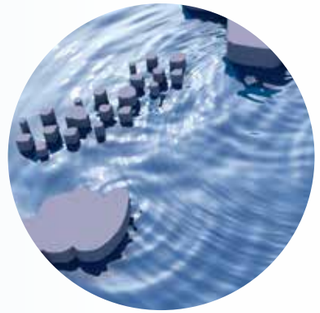
Alistarh group

The accelerated recent progress in machine learning has been enabled by the ability to distribute the training of machine learning models, and in particular deep neural networks, onto large numbers of computing nodes. As models and datasets grow larger, the communication and synchronization costs of distributed training are becoming a key bottleneck to progress in this area. Removing this scalability barrier is the focus of the Alistarh group.
This year, the group published new work describing an implementation of the Message-Passing Interface (MPI), which provides native support for efficient communication for machine learning algorithms, in the form of quantized and sparse types. The open-source framework, developed in collaboration with Torsten Hoefler's group at ETH Zurich, was presented at the 2019 Supercomputing Conference in Denver, USA. It builds on previous theoretical work published by the Alistarh group in the Proceedings of the Conference on Neural Information Processing Systems (NIPS) 2017 and 2018.

New algorithmic aspects of formal methods

Chatterjee group

Computer models, which simulate and predict real-world systems, can be broadly split up into two categories: deterministic and stochastic models. While deterministic models provide a specific mathematical output, stochastic models estimate the probability of potential outcomes by allowing for random variation of one or more inputs. Common everyday examples of stochastic models include stock markets or wealth and inequality estimations. Whilst stochastic models have been around for a long time, the algorithms used to analyze them suffer from many fundamental problems. Furthermore, the emergence of new technologies and complex data systems increase the need for algorithmic solutions that are faster, scalable and more efficient.
The Chatterjee group, together with collaborators from the University of Vienna, Austria, and Harvard University, USA, develop novel algorithmic approaches for the "formal methods" used for stochastic models. This will inevitably benefit other scientific disciplines as well as emerging technologies such as social cooperation modelling and artificial intelligence.



High-quality animations at low cost

Wojtan group

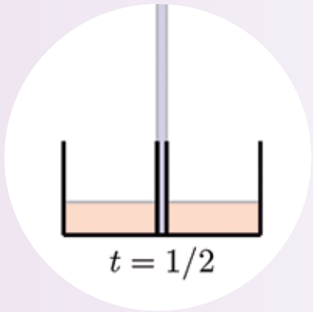
This year, the Wojtan group published a new method for animating water waves in high quality without requiring a supercomputer. While Fourier-based methods are efficient, but cannot model complicated interactions, numerical techniques can simulate a wide range of such effects, but are much more computationally expensive. As a result, detailed scenes, such as ripples forming as a wave interacts with an island or even a boat passing by, are practically impossible to animate due to the sheer processing time and computational power needed.
The publication in *ACM Transactions on Graphics*, which was also selected for presentation at the annual ACM SIGGRAPH Conference, proposed an analytical solution for efficiently animating circular ripples in closed form. Moreover, the Wojtan group was able to show how to adapt the method of fundamental solutions (MFS) to create ambient waves interacting with complex obstacles. A novel wavelet-based discretization was introduced, which outperforms the state of the art MFS approach for simulating time-varying water surface waves with moving obstacles.

Faculty Distributed Algorithms and Systems DAN ALISTARH | Computer Graphics and Digital Fabrication BERND BICKEL | Computer-aided Verification, Game Theory KRISHNENDU CHATTERJEE | Algorithms, Computational Geometry, and Computational Topology HERBERT EDELSBRUNNER | Design and Analysis of Concurrent and Embedded Systems THOMAS A. HENZINGER | Discrete Optimization VLADIMIR KOLMOGOROV | Computer Vision and Machine Learning CHRISTOPH LAMPERT | Data Science, Machine Learning, and Information Theory MARCO MONDELLI | 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 things 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.

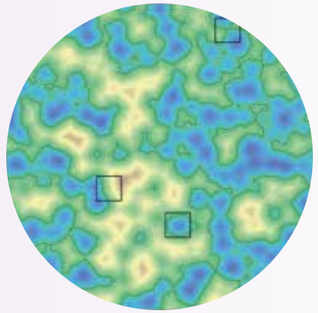
This year, questions around optimal transport in large networks or embeddability in high dimensions were answered, and the line between topology and geometry was being blurred on purpose.



Optimal transport in large networks

Maas group

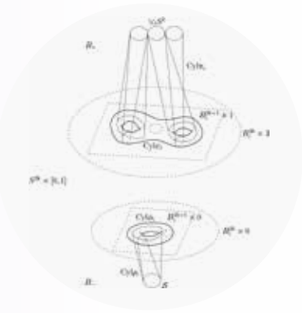
How should one transfer mass from a given initial configuration to a prescribed target configuration in such a way that the total transport cost is minimized? This optimal transport problem plays a key role in geometry and probability theory, as well as in applications to data science and engineering. An important question in the field is how optimal transport behaves on large networks. In 2019, Lorenzo Portinale and Jan Maas from IST Austria, together with collaborators from the University of Bonn, investigated the behavior of dynamical optimal transport on large discrete structures that approximate a continuous domain.
Naively, one might expect that the optimal discrete cost converges to the optimal continuous cost. Surprisingly, the research shows that the discrete transport cost is often strictly cheaper, as the transport can be arranged to exploit inhomogeneities in the network structure. In the one-dimensional periodic setting, the researchers obtained an explicit formula for the optimal transport cost in the discrete network.



How geometric is topology?

Edelsbrunner group

... or how topological is geometry? Indeed, for shapes more complicated than common designs, geometric size is conveniently measured by accumulating the topological connectivity of slices or other subsets. For example, the surface area of a solid shape in 3D is 2/π times the integral over all lines, of the number of components in which the line meets the shape. By randomly picking a few lines, we get a good estimate of the area even when conventional methods break down. This is an example of the Crofton formula of integral geometry.
More generally, the research in the Edelsbrunner group blurs the line between geometry and topology, and indeed between mathematics and computer science.
This blend of methods is a potent mix that allows for sometimes unexpected bridges between abstract mathematics and concrete applications.



Embeddability, Diophantine equations, and undecidability

Wagner group

A simplicial complex is a purely combinatorial description of a geometric shape in terms of simple building blocks—points, line segments, triangles, tetrahedra, etc.—that are glued together in a “nice” way. This is a very common way of representing shapes in computational topology and many applications. Given a simplicial complex, can it be topologically embedded (possibly bending and stretching the simplices, but without self-intersections) into d-dimensional Euclidean space? If the dimension d of the ambient space is sufficiently large compared to the dimension k of the simplicial complex, more precisely if $d \geq 3(k+1)/2$, then it is known that there is an efficient (polynomial-time) algorithm for deciding this problem.
By contrast, Uli Wagner and colleagues recently proved that the problem is algorithmically undecidable if $7 \leq d < 3(k+1)/2$ by showing that one can encode an arbitrary system of Diophantine equations (polynomial equations over the integers) into an embeddability problem. This completely settles the decidability of the embeddability problem in high dimensions and establishes a sharp dichotomy between polynomial-time solvable and undecidable cases.

Faculty Mathematical Models of Evolution NICK BARTON | Analytic Number Theory and its Interfaces TIM BROWNING | Algorithms, Computational Geometry, and Computational Topology HERBERT EDELSBRUNNER | Mathematics of Disordered Quantum Systems and Matrices 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

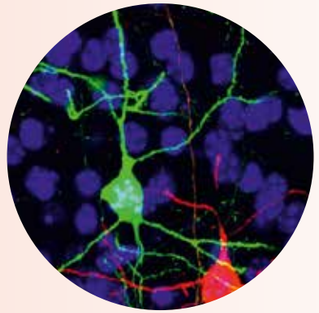
Neuroscientists study the nervous system to understand how our brain works. Neuroscience is a highly multidisciplinary field of science, combining physiology, molecular biology, developmental biology, and cognitive science, with links to mathematics, computer science and physics. Accordingly, the research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

In 2019, neuroscientists at IST Austria investigated questions such as: What is the genetic basis of inherited forms of neurodevelopmental disorders, such as epilepsy and autism? How can one and the same stem cell produce different types of nerve cells? How does our brain enable us to find our way around our environment? Which methods are suitable for detecting and visualizing functional molecules in the nerve cell—and how can these methods be optimized?

A “treasure map” in the rat’s brain

Csicsvari group

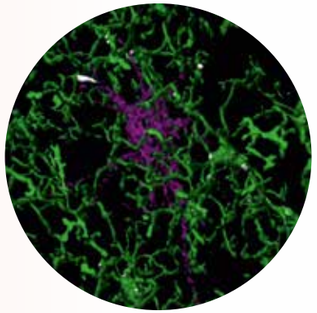
Grid cells and place cells are specialized neurons located in different brain areas that allow the brain to create a distributed map of the outside world in which one navigates. Place cells make a mental map of the environment, as each neuron is only active at specific locations. Grid cells, on the other hand, are active in many locations drawing a mosaic pattern of the whole environment. In a *Science* study published in 2019, the team around Jozsef Csicsvari showed that grid cells also carry information related to goals, deforming their activity fields to provide rats with a “treasure map” of where to reach goals, like hidden rewards. At the same time, the researchers recorded activity from place cells, and observed that their firing also shifts towards the goal location. However, while grid cells maintained the deformed pattern overnight, place cell firing reset, suggesting that grid cells are important for longer-term memory recall.



How to control brain size

Hippenmeyer group

The human cerebral cortex is the seat of our cognitive abilities and composed of an extraordinary number of neurons and glial cells. How the cortex arises from neural stem cells during embryonic development is a major unsolved question in neuroscience. The Hippenmeyer group’s recent efforts in the lab have led to several discoveries and revealed new insights into this important neurobiological problem. With the help of advanced mouse genetic technologies, the researchers deciphered a new function for epigenetic regulatory cues in the control of neural stem cell lineage progression during corticogenesis.
These new findings contribute to the basic understanding of the mechanisms instructing the generation of cell type diversity and brain size in general. Ultimately, the group’s current and future scientific program shall provide new insights into the fundamental question of why human brain development is so sensitive to the disruption of particular signaling pathways in the pathological condition.



The immune system of the brain

Siegert group

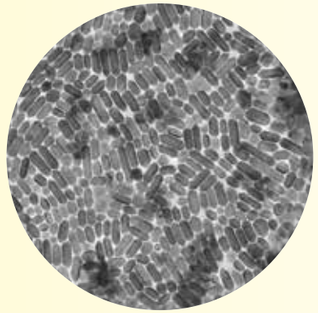
Besides neurons, special immune cells called microglia are widely distributed across the brain. Microglia are found to act directly on neurons either during neurodevelopment, where they alter neuronal synaptic connectivity, or in the course of neurodegeneration, where they remove neurons under a still unknown mechanism. In the adult brain, microglia are commonly assumed to “just” survey the neuronal environment for potential insults such as injuries or infection, and preventing the spread of the damage.
Neuroscientist Sandra Siegert and her team with lead investigator Alessandro Venturino have challenged this microglia “survey” function, showing that microglia remove neuronal plasticity-locked structures in the brain upon certain drugs, which leads to restored juvenile plasticity. This study (currently under revision) was selected by the Society for Neuroscience (SfN) as one of 100 “Hot Topics” in Neuroscience 2019—out of more than 14’000 abstracts submitted to the world’s largest neuroscience conference.

Faculty Systems Neuroscience JOZSEF CSICSVARI | High-resolution Optical Imaging for Biology JOHANN DANZL | Genes, Circuits, and Behavior MARIO DE BONO | 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 and chemistry

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. Moreover, 2019 also marked the start of tackling scientific questions related to chemistry.

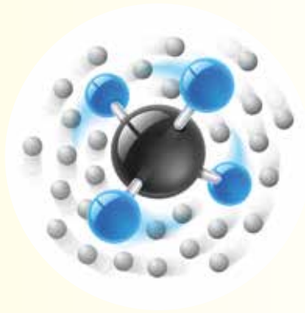
This year, the diverse interests of the physics and chemistry groups have led to questions such as: How can the surface of nanocrystals enhance thermoelectric performance? How can the interfaces between physics and chemistry be described in theory? Which insights can be gained for non-ergodic quantum matter when classical physics is applied?



Nanocrystals enhance thermoelectric performance

Ibáñez group

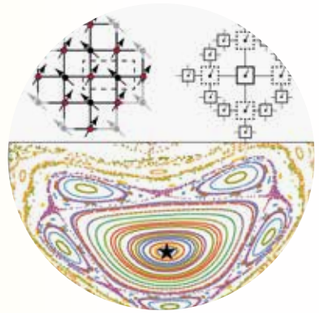
Nanocrystal-based solids have a wide range of applications including photovoltaics, field-effect transistors and thermoelectrics. To produce high-performance materials for each of these applications, the transport (electronic and thermal) properties of the semiconductor nanocrystal solid need to be properly engineered. A versatile approach to tune them is using the nanocrystal surface. Most commonly, alteration of the surface ligation has been used to modify type, concentration and/or mobility of majority carriers.
In 2019, the Ibáñez group proposed a new ligand exchange approach to simultaneously adjust the electronic band structure and introduce nanoinclusions to reduce the thermal conductivity. The work developed at IST Austria provides opportunities to develop new materials with improved thermoelectric performance.



At the interface of physics and chemistry

Lemeshko group

The Lemeshko group works at the interface of condensed-matter and chemical physics, with a particular focus on quantum processes involving molecules. One of the recently pursued directions deals with developing techniques to describe molecular rotation in the presence of a quantum “bath”, such as a solvent or a crystal. This problem—especially, far from equilibrium—pushes the limits of state-of-the-art techniques of quantum chemistry.
The Lemeshko group has shown that problems of this sort can be made tractable by introducing a new quasiparticle—the “angulon”—which consists of a rotating molecule dressed by a cloud of bath excitations carrying angular momentum.
Other projects pursued by the group deal with understanding molecular chirality and exploring the possibilities to use chiral molecules for spintronics, developing models to describe transport in hybrid organic-inorganic perovskites, and revealing the properties of strongly correlated exciton liquids in semiconductors.



Non-ergodic quantum matter

Serbyn group

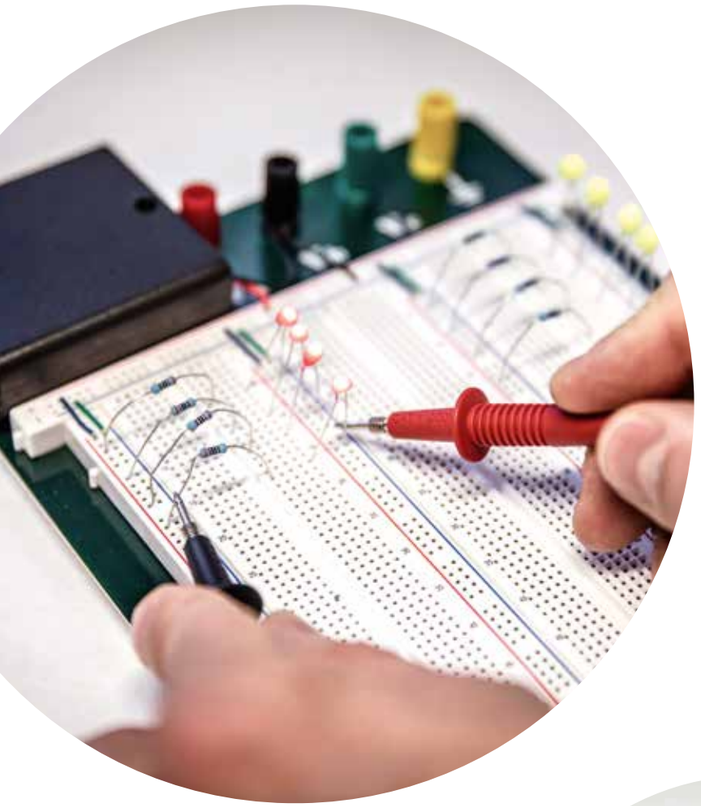
In contrast to ergodic systems, which are at the heart of statistical mechanics, non-ergodic quantum many-body systems fail to thermalize. Without reaching a thermal equilibrium, they have the potential to keep their quantum nature for extended time periods. With the EU-funded NEQuM project, the Serbyn group aims to shed further light on the dynamics and properties of these isolated quantum systems.
Exploring different routes to ergodicity breaking, including disorder, frustration, and hidden symmetries, will deepen the understanding of quantum physics.
Project results stemming from new analytical and numerical techniques aim to lay the foundations for establishing a general theory of non-equilibrium quantum systems.
In addition to advancing the fundamental understanding, describing the remaining quantum properties in non-ergodic systems on longer time-scales are also relevant for future technologies and could find application in information processing and storage.

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 | Mathematical Physics ROBERT SEIRINGER | Condensed Matter Theory and Quantum Dynamics MAKSYM SERBYN | Theoretical Biophysics and Neuroscience GAŠPER TKAČIK | Soft and Complex Materials SCOTT WAITUKAITIS

Supporting science I

Scientific Service Units at IST Austria

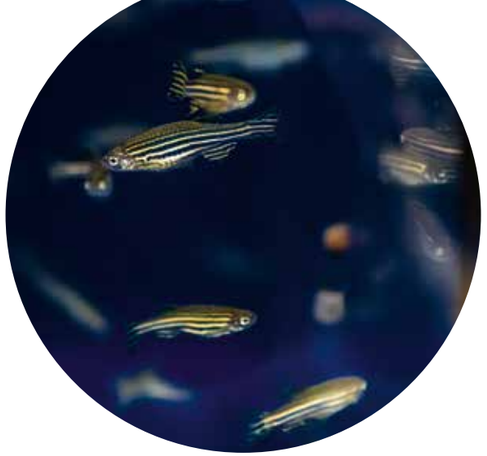
At an institution like IST Austria, different research groups often have similar needs. To guarantee professional operation and maintenance of shared equipment, IST Austria centrally runs and manages diverse facilities as Scientific Service Units (SSUs).



Microscopes, 3D printing, computing resources, and access to publications are just a few examples of equipment and services that many scientists require for their research, no matter in which group or field they work in. IST Austria's eight SSUs are each led by a manager and staffed with 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 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 also avoids idle machines, fosters collaboration and communication between groups, and makes it easy for research groups to enter into new technologies.

Over the years, the SSUs have grown up to more than 90 employees. In order to meet the needs of the research groups and to support the start-up of new faculty members, the SSUs keep striving to adapt and expand their services. Constant learning ensures that their teams provide excellent know-how for world-class research.



The **Bioimaging Facility** supports researchers with state-of the art microscopes, flow cytometry equipment, advanced user trainings, assay development, and image analysis. In 2019, the facility was extended with an additional microscopy room and three advanced microscopes that bring in new technologies and one cell sorter that allows cytometry services outside of core facility hours.

The **Electron Microscopy Facility** provides electron microscopes as well as sample preparation and image analysis facilities for the life sciences, physics and chemistry. In 2019, two recently installed state-of-the-art cryo-electron microscopes went into full operation. In August, the journal *Nature* published first research results by the Sazanov group based on work with one of the new machines. IST Austria now holds the largest and most advanced cryo-electron microscopy facility currently being operated in Austria.

The **Nanofabrication Facility** develops, optimizes and maintains micro- and nanofabrication processes. Its staff constantly works to remain at the cutting-edge of technology and to provide IST Austria researchers with the possibility to explore new materials and new devices of dimensions down to the nanometer scale. In March 2019, the facility organized the "Symposium on Direct Write, Optical, Ion and Electron Beam Lithography". Also, the characterization equipment was extended by an Atomic Force Microscope.

The Institute's mainly electronic **Library** provides access to all types of scientific information, including e-journals, e-books and databases. Furthermore, it supports open scientific communication by providing digital infrastructure, paper and data repositories, and consulting services.

The **Life Science Facility** supports experimental scientists (mainly biologists) by providing laboratory infrastructure such as refrigerators, shakers and centrifuges. In addition, the facility offers a wide spectrum of supplies for experiments, from liquid nitrogen to agar plates, and runs the fish and plant facilities. New since 2019 are a mass spectrometry and a virus preparation service.

The **Miba Machine Shop** produces and provides custom-tailored mechanical and electronic equipment and setups for all experimental research groups. To increase the available space, an extension of the Machine Shop—alongside a central storage—was opened in November 2019.

The **Preclinical Facility** provides 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.

The **Scientific Computing Facility** supports theoretical and experimental researchers in all their scientific computing needs, primarily by providing a high-performance computing cluster. In 2019, the facility acquired 64 new cluster nodes and new storage for 2 PB of data.

In 2019, five **staff scientists** were associated with the SSUs Bioimaging Facility, Nanofabrication Facility and Electron Microscopy Facility. These highly expert researchers work closely with various research groups on campus and advance their own projects. Read more about IST Austria's staff scientists on pages 37 and 99-101.

Supporting science II

Administration at IST Austria

Creating the best possible environment for world-class research is the central task of all administrative employees at IST Austria. Staffed with dedicated experts, our administration provides high-quality support in all necessary areas, from construction to event management support to technology transfer.

Georg Schneider

Managing Director, IST Austria

Ten years ago, IST Austria opened its doors with the goals of becoming a place for world-class basic research and training the next generation of scientific leaders. News like the ERC success rate and “Nature Index” rankings indicate that we are on the right track. I want to use this opportunity to thank all administrative employees for their contribution to achieving these goals.

Parallel to the growing number of scientists and the growth of the campus as a whole, the support and services offered by the administration are constantly expanding. The cryo-electron microscopy facility as well as the mass spectrometry facility are now in full operation; a Nuclear Magnetic Resonance (NMR) facility will be established in 2021. The new building extension of the Miba Machine Shop now also hosts the central storage. Opposite the campus, the research and technology center IST Park opened its doors in fall 2019 to offer spin-offs and start-ups a new home adjacent to the vibrant campus. All these services and the Institute’s high-end infrastructure can only come to life with the help of the people who establish processes, operate facilities and offer administrative support.

The administration of IST Austria will keep striving for professionalism, efficiency and excellent support for science and scientists, while following the overall goal of setting examples in science management.

If you want to learn more about IST Austria, feel free to follow us on Twitter, Facebook or Instagram, watch some videos of recent events on Youtube or visit our new website—launched in April 2019.

www.ist.ac.at

Academic Affairs is responsible for administrating all academic matters. The division 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.

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

Campus Services takes care of childcare, housing, food, transportation, sports facilities and other non-scientific services on campus.

Communications & Events provides services in media relations, science writing, web and social media management, alumni relations, content management, and internal communication. The division also supports the organization of conferences, workshops and 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.

Environment, Health & Safety provides guidance, support and legal advice in issues around environmental protection, health and occupational safety.

The division **Finance** takes care of all matters concerning accounting, controlling and procurement, including the operation of the central storage and logistics processes on campus.

The **Graduate School Office** organizes the Institute’s PhD program and academic courses and manages the admissions and progress-monitoring processes for students and scientific interns.

The **Grant Office** is responsible for endorsing and authorizing proposals to and negotiating and accepting contracts and grants for projects funded by the European Commission, federal and state agencies, companies, foundations, and other public and private sources.

Human Resources provides professional HR management including service-oriented counseling and support for scientists as well as for Scientific Service Unit and administration employees.

The **Technology Transfer Office** handles 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 and relationship agreements with industry.

The following 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.

PUBLIC ENGAGEMENT

At this year's sixth edition of the "Sommercampus", 80 schoolchildren experienced first-hand what it is like to be a scientist.

Communicating science

Outreach and science education at IST Austria

Science literacy is an invaluable 21st century skill, and scientists and their institutions can play a key role in promoting it. Through outreach and science education, IST Austria seeks to spread the fascination and impact of science to everyone, especially to young minds.

IST Austria organizes a number of events and offers an increasing number of activities for school classes and other visitors of all ages. At the heart of these activities lies the direct contact with research topics and researchers at the Institute as well as the idea of science as a process and experience. In 2019, IST Austria took up the detailed planning of its future visitor center, which will provide a permanent home to its outreach and education activities. In addition to the events highlighted here, a list of outreach events can be found in the “Facts & figures” section.

Science Education Day

Science does not belong to the scientists—it is rather a way of learning about the world around us that can be applied by learners of all ages. “Inquiry-based learning”, an internationally established teaching concept embracing this insight, was the motto of this year’s second edition of the Science Education Day on March 27. To reach out to local teachers, this event was, for the first time, primarily held in German. Hands-on workshops for teachers allowed them to experience directly how inquiry-based learning works in practice. An inspiring keynote by Haim Harari, founder of the Davidson Institute of Science Education and former president of the Weizmann Institute of Science, Israel, concluded the event.

Summer science camps

During summer, IST Austria organizes and hosts research camps for elementary, middle and high school kids. In the sixth edition of the “Sommer-campus”, 80 children from seven to twelve years of age came to campus to spend a week carrying out experiments. Guided by mixed teams of IST Austria employees and students of the University College of Teacher Education Lower Austria, they learned about topics ranging from bacteria in extreme habitats to the colors of light, the trajectory of Robin Hood’s arrows and computer game programming.
The following week, 23 teenagers participated in the third edition of “Talentesommer in Klosterneuburg”, a research camp about how scientists can use models to describe and understand nature.

Open Campus

As part of IST Austria’s 10th anniversary event series, the 2019 Open Campus celebrated the campus inauguration in 2009 together with Institute friends and the broader public. Everyone interested in science was invited to chat with IST Austria researchers and other staff as well as explore diverse research exhibitions. Campus tours to the labs and a science cabaret by Vince Ebert attracted more than 2’000 visitors. Julia Michalska and Sven Truckenbrodt, both researchers in the Danzl group, demonstrated how new approaches in light microscopy enable the investigation of the tiniest details in cells during the family science lecture. School children, who had participated in the IST Austria school contest, were honored and the winners announced in a ceremony.

Science and schools

Building up a regular school program in its future visitor center, IST Austria continuously expands its activities for schools and teachers. When visiting the campus, school groups learn that science thrives on the diversity and internationality of its people, and that the questions asked by a curious mind lie at the heart of the scientific endeavor. Whenever possible, such tours are combined with a lab visit or a meeting with a scientist. Some of the Institute’s science communication enthusiasts among the PhD students and postdocs also go out to visit schools to talk about their work or teach hands-on demonstrations. In 2019, around 21 school classes or smaller groups were involved in this kind of educational activities by IST Austria.

Scientific discourse

Academic events at IST Austria

At IST Austria's colloquia, workshops, conferences, and public lectures, all kinds of science enthusiasts—researchers and science administrators as well as the interested public—gather on campus to exchange ideas and discuss the latest scientific trends and discoveries.

Over the course of 2019, IST Austria organized and hosted numerous events in and around science, ranging from colloquium lectures given by renowned scientists to conferences on selected topics. Public events focused on topics ranging from science in the business world to history. 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 offer events that provide platforms for scientific exchange. Two highlights this year:
From March 19-22, the Conference of the Central European Section of the IUSSI (International Union for the Study of Social Insects), organized by Professor Sylvia Cremer, gathered around 100 researchers in Klosterneuburg to discuss the latest research about the ecology and evolution of social insects.
On October 18, Professors Carrie Bernecky, Leonid Sazanov and Florian Schur organized the "Cryo-EM Inauguration Symposium" in order to inaugurate IST Austria's recent investments in Austria´s largest cryo-electron microscopy facility and discuss trends and developments in this field.

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 her IST Lecture, former President of the European Research Council (ERC), Helga Nowotny, gave an insight into evolution and what it means for humans—the only species with the ability to see evolution from the inside—to live in a digital age. Another notable speaker was Gunnar Carlsson, Professor Emeritus at Stanford University, USA, who discussed different topological methods used for artificial intelligence.

Institute Colloquium

The Institute Colloquium is IST Austria's main weekly seminar, and the talks are open to the general public. 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 2019 were Paul Steinhardt from Princeton University, USA, on quasicrystals once thought to be mathematically impossible and Edward Boyden from the Massachusetts Institute of Technology (MIT), USA, on novel tools for analyzing and controlling complex biological systems.

Other public events

In 2019, the yearly Commemoration Lecture organized by IST Austria was given by Professor Philipp Ther from the University of Vienna, Austria.
This year's Science Industry Talk explored ways of "Capturing serendipity" at the interface of science and industry. Amazon Vice President Babak Parviz shared his insights into Amazon's innovation culture, and IST Austria scientists presented possible industrial applications of their research.

PARTNERSHIPS

IST Austria professor Maria Ibáñez who, along with Georgios Katsaros and Gaia Novarino, presented possible industrial applications of their research at the Science Industry Talk 2019.

Capturing serendipity

Technology transfer at IST Austria

History shows that many technological advances are based on fundamental discoveries with unforeseen consequences. Thus, one of the founding principles of IST Austria is its commitment to exploiting the results of its research for the benefit of the inventors, the Institute, industry, and society.

TWIST – Technology Transfer Office
The Technology Transfer Office is the one-stop shop for all matters related to intellectual property, industry cooperation and entrepreneurship at IST Austria. It is responsible for patent protection and licensing, and supports the creation of spin-off companies and joint projects 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 exchange 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 is actively managing a patent portfolio in such diverse areas as modeling systems for biological networks, photo-patterning research tools, algorithms to generate flexible casting molds, and engineering plants to improve resistance to pathogens.

Harold de Vladar is the first IST Austria alumnus to found a start-up company, Ribbon Biolabs, which focuses on commercializing a new technology for synthesizing long strands of DNA. Ribbon Biolabs is one of the first portfolio companies of IST cube and a tenant at IST Park, the newly opened technology park at IST Austria (see also pages 12-13).

https://twist.ist.ac.at

twist
Tech Transfer at IST Austria

IST cube
While business angel activity has grown over the 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 tech-based founders who plan to start their ventures in Austria: they partnered up 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 them derived from academic research, and helps 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. Inaugurated in 2018, IST cube has meanwhile invested in five start-ups, two of them located at IST Park.

https://ist-cube.com

IST cube

TWIST Fellowship Program

IST Austria runs the TWIST Fellowship Program as one mechanism to facilitate the development of research results towards commercial products.
The program allows the Tech Transfer Office to recruit researchers to further develop a particular technology originating from science conducted at IST Austria. In 2019, two projects focused on genetically modified plants, while another project aimed at the development of novel diagnostic assays for autism spectrum disorders.
https://twist.ist.ac.at

Enabling the future

IST Austria’s network of supporters

Playing a key role in IST Austria’s successful development, an ever-growing number of supporters has helped the growth and independence of the Institute through their philanthropic contributions. IST Austria, in turn, upholds its commitment to international best practices in research, science management and resource development.

The past year has not only marked an important point in IST Austria’s history, but has provided the Institute with manifold opportunities to engage with its supporters. IST Austria is extremely proud to have been able to welcome many donors on campus on the occasion of our anniversary celebrations.

As in the past, philanthropic contributions shaped campus life throughout 2019: With the help of two donors, it was not only able to reduce the price for tickets to IST Austria’s summer science camps for school children (“Sommercampus”), but also to offer free admission to children from families with limited financial resources. One further donor pledged 100’000 Euro towards the advancement of basic research, thus expressing their trust in fundamental research as a foundation for social prosperity and in the principles upon which IST Austria is built.

We are most grateful to our patrons who have steadily accompanied us on our path over the past decade. IST Austria is looking forward to developing further its fruitful partnerships as well as engage with and expand its network of supporters.

www.ist.ac.at/donors

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Hermann Hauser, Steven Heinz, Therese Niss, Peter Oswald, Rudolf Scholten, Veit Sorger, Franz Viehböck, Stefan Weber

Facts & figures

Professors at IST Austria

(under contract as of December 31, 2019)

Dan Alistarh Distributed Algorithms and Systems
Zhanybek Alpichshev Condensed Matter and Ultrafast Optics
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 Social Immunity
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
Stefan Freunberger* Materials Electrochemistry
Jiří Friml Developmental and Cell Biology of Plants
Carl Goodrich* Soft Matter Theory and Materials Design
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 Cellular Neuroscience
Maximilian Jösch Neuroethology
Vadim Kaloshin* Dynamical Systems, Celestial Mechanics and Spectral Rigidity
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 Protein Systems
Jan Maas Stochastic Analysis
Kimberly Modic* Thermodynamics of Quantum Materials at the Microscale
Mario Mondelli Data Science, Machine Learning, and Information Theory
Gaia Novarino Genetic and Molecular Basis of Neurodevelopmental Disorders
Krzysztof Pietrzak Cryptography
Matthew Robinson* Medical Genomics
Leonid Sazanov Structural Biology of Membrane Protein Complexes
Paul Schanda* Biomolecular Mechanisms from Integrated NMR Spectroscopy
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
Lora Sweeney* Evolution and Development of Motor Circuits
Gašper Tkačik Theoretical Biophysics and Neuroscience
Beatriz Vicoso Sex Chromosome Biology and Evolution Infection
Tim Vogels* Computational Neuroscience and Neurotheory
Uli Wagner Discrete and Computational Geometry and Topology
Scott Waitukaitis Soft and Complex Materials
Chris Wojtan Computer Graphics and Physics Simulation

* joining IST Austria during 2020 or 2021 (see also pages 20-23)

Total number of professors under contract: 61

Total number of professors on campus: 53

Gender among professors*

Country of nationality*

Germany	18.9%
Austria	15.1%
USA	11.3%
Russia	5.7%
Hungary	5.7%
Other (20**)	43.4%

Country of PhD institution*

USA	28.3%
Germany	24.5%
Switzerland	17.0%
UK	11.3%
Austria	7.6%
Other (6**)	11.3%

Country of previous institution*

USA	34.0%
Germany	20.7%
UK	18.9%
Switzerland	9.4%
Netherlands	3.8%
Belgium	3.8%
Other (5**)	9.4%

* Data refer to 53 professors on campus as of December 31, 2019; percentages are rounded
** Number of countries

Research groups at IST Austria

Dan Alistarh

Distributed Algorithms and Systems

Distribution has been one of the key trends in computing over the last decade: processor architectures are multi-core, while large-scale systems for machine learning and data processing can be distributed across several machines or even data centers. The Alistarh group works to enable these applications by creating algorithms that scale—that is, they improve their performance when more computational units are available.

This fundamental shift to distributed computing 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 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. One particular area of focus over the past few years has been distributed machine learning.

Current projects Distributed machine learning | Concurrent data structures and applications | Molecular computation
Team members 2019 Saleh Ashkboos (scientific intern), Bapi Chatterjee (ISTplus postdoc), Peter Davies (postdoc), Janne Korhonen (postdoc), Giorgi Nadiradze (PhD student), Elena-Alexandra Peste (PhD student), Joel Rybicki (ISTplus postdoc), Sidak Pal Singh (software engineer)

Career
- since 2017 Assistant Professor, IST Austria
- 2016 – 2017 "Ambizione" Fellow, Computer Science Department, ETH Zurich, Switzerland
- 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 new gradient quantization algorithm for scalable neural network training, developed by the Alistarh group and published at the Supercomputing Conference (2019)

Zhanybek Alpichshev

Condensed Matter and Ultrafast Optics

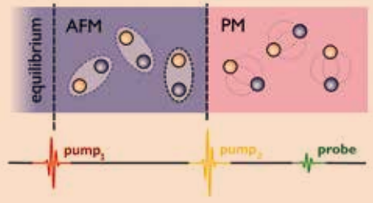
To understand a complex system, it is often useful to bring it out of equilibrium; the recovery dynamics will reveal a great deal about its inner workings. The Alpichshev group uses ultra-fast optical methods to understand the physical mechanisms underlying some of the extremely complicated phenomena 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 2019 Younes Ashourishokri (scientific intern), Vlad Dziom (postdoc), Dusan Lorenc (postdoc), Yujing Wei (ISTern)

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, Palo Alto, 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 2019 Louise Arathoon (PhD student), Carina Baskett (postdoc), Stefanie Belohlavy (PhD student), Chloe Colson (scientific intern), Louise Fouqueau (academic visitor), Christelle Fraisse (FWF Lise Meitner postdoc, joint with Vicoso group), Michal Hledik (PhD student, joint with Tkačik group), Lenka Matejovičová (PhD student), Oluwafunmilola Olusanya (PhD student), Beatriz Pablo Carmona (scientific intern), Gemma Puixeu Sala (PhD student, joint with Vicoso group), Andrea Rodriguez (scientific intern), Himani Sachdeva (postdoc), Daria Shipilina (postdoc), Parvathy Surendranadh (PhD student), 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
- 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.

Plants as sessile organisms constantly integrate varying environmental signals to flexibly adapt their growth and development. Local heterogeneities in water and nutrient availability, sudden changes in temperature, light or other stressors trigger dramatic changes in plant growth and development. Multiple hormonal signaling cascades interconnected into complex networks act as essential endogenous translators of these exogenous signals in plant adaptive responses. How the 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 crosstalk driven nutrient-dependent root development
Team members 2019 Rashed Abualia (PhD student), Christina Artner (ÖAW DOC-funded PhD student), Nicola Cavallari (postdoc), Marcal Gallemi Rovira (postdoc), Mónika Hrtyan (laboratory technician), Karla Huljev (PhD student), Juan Montesinos López (interdisciplinary project funded postdoc), Hana Semeradova (ÖAW DOC-funded PhD student)

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

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.

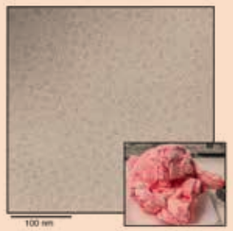
Current projects Molecular basis of transcriptional regulation | Transcriptional inhibition by noncoding RNA | Substrate recognition by RNA modifying enzymes
Team members 2019 Narkhyun Bae (ISTplus postdoc), Annamaria Hlavata (PhD student), Beata Kaczmarek (PhD student), Edwine Theresia Lehner (scientific intern), Ilaria Parenti (postdoc, joint with Novarino group), Anita Testa Salmazo (project technician), Katarina Tluckova (postdoc), Anastasiia Vasylaki (ISTern)

Career
- since 2018 Assistant Professor, IST Austria
- 2011 – 2017 Postdoc, Ludwig Maximilian University Munich and Max Planck Institute 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)

Three-day-old *Arabidopsis* seedling imaged using confocal microscopy

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 2019 Thomas Auzinger (postdoc), Xudong Feng (predoctoral visiting scientist), Dorin Gugonatu (software engineer), Ruslan Guseinov (PhD student), Christian Hafner (PhD student), Kazutaka Nakashima (academic visitor), Tobias Rittig (scientific intern), Jesus Perez Rodriguez (postdoc), Kumar Shivam (ISTern), Martin Thoresen (PhD student), 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

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, i.e. a Diophantine equation. The Browning group works on understanding such sequences, using a blend of analytic, geometric and algebraic methods.

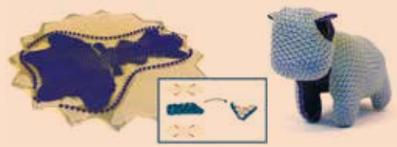
Low-dimensional Diophantine equations have been heavily exploited in cryptography, but the properties of higher-dimensional Diophantine equations remain largely mysterious. Hilbert's 10th problem asks for an algorithm to decide if a given Diophantine equation has integer solutions or not. Methods of 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 | Integral points of bounded height
Team members 2019 Francesca Balestrieri (postdoc), Dante Bonolis (postdoc), Tal Horesh (postdoc), Julian Lyczak (postdoc), Nicholas Rome (predoctoral visiting scientist), Alec Shute (PhD student), Florian Wilsch (postdoc)

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

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



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

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 2019 Ali Asadi (scientific intern), Truc Bui (scientific intern), Farbod Ekbatani (scientific intern), Tushar Gautam (scientific intern), Ehsan Goharshadi (scientific intern), Amir Goharshady (PhD student), Ismael Jecker (postdoc), Maria Kleshnina (postdoc), Seyed Mirtaheri (scientific intern), Raimundo Saona Urmeneta (scientific intern), Laura Schmid (PhD student), Jakub Svoboda (scientific intern), Pepa Tkadlec (PhD student), Viktor Toman (PhD student), Djordje Zikelic (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
- 2019 ERC Consolidator Grant 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

Sylvia Cremer

Social Immunity

Social insects fight disease as a cooperative unit. 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.

The disease defense of ants is amazingly similarly organized to the immune system within our own bodies. This is because a colony of social insects, like bees, ants and termites, is a single reproductive unit made out of thousands to millions of individual organisms. Like the cells in our body, the different individuals in the colony specialize on different tasks: the queen (germline) on reproduction and the sterile workers (soma) on colony maintenance and brood rearing. Every ant protects itself by individual hygiene and a physiological immune system that effectively fights off microbes. In addition, workers clean the nest environment by spraying their antimicrobial poison, nibbling-off pathogens from one another's body and by treating infections. Thereby, they cooperatively prevent pathogen contamination, replication and spread through the colony.

Current projects Collective hygiene in ant societies | Social interaction networks and epidemiology | Disease resistance and tolerance | Costs and benefits of social immunization
Team members 2019 Max Aubry (PhD student), Jana Buchmayr (scientific intern, BSc thesis), Barbara Casillas Perez (PhD student, postdoc), Erika Dawson (postdoc), Constance de Parseval (scientific intern), Anna Franschitz (PhD student), Anna Grasse (senior laboratory technician; on maternity leave), Niklas Kampleitner (project technician), Jessica Kirchner (scientific intern), Megan Kutzer (ISTplus postdoc), Sina Metzler (PhD student), Barbara Milutinovic (postdoc), Elisabeth Naderlinger (project technician), Linda Sartoris (PhD student), Florian Strahodinski (scientific intern, MSc thesis), Lassi Tolonen (scientific intern), Filip Turza (scientific intern), Sheetal Vepur (scientific intern)

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

Grooming ants: Garden ants groom one another to remove infectious particles from their body surface. Grooming is a combination of physical removal of the infectious particles and their disinfection using antimicrobials, such as their formic acid-rich poison. Picture by Sina Metzler & Roland Ferrigato, IST Austria

Jozsef Csicsvari

Systems Neuroscience

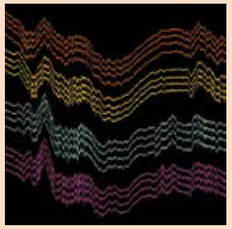
Memory formation is crucial for learning new facts and skills. This process of encoding, storing and ultimately recalling memories involves complex interactions between various brain regions and neurons in embedded circuits that form complex codes to encode these memory traces. The Csicsvari group studies 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. The researchers 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. By using optogenetic methods, the researchers 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 2019 Uladzislau Barayeu (scientific intern), Yosman Bapatdhar (PhD student), Lars Bollmann (PhD student), Heloisa Chiossi (PhD student), Andrea Cumpelik (PhD student), Igor Gridchyn (postdoc), Karola Käfer (postdoc), Michele Nardin (PhD student), Juan Ramirez Villegas (ISTplus postdoc), Dámaris Rangel Guerrero (postdoc), Chiara Roth (PhD student), Lydia Simantiraki (ISTern), Jago Wallenschus (senior laboratory technician)

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
- 2019 Member of Academia Europaea
- 2011 ERC Starting Grant
- 2010 Title of Ad Hominem Professor in Neuroscience at the University of Oxford



Electrical traces recorded from the hippocampus. Slowly changing potentials (local field potentials) are overlaid with the rapid, spike-like action potentials of individual neurons.

Johann Danzl

High-resolution Optical Imaging for Biology

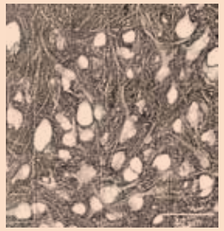
How can we decode the molecular architecture of biological systems? How can we analyze living cells and tissues across spatial and temporal scales? The central aim of the Danzl lab, an interdisciplinary team of physicists, biologists, and neuroscientists, is to shed light on problems of biological and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

The Danzl group explores and extends the possibilities of optical imaging. This includes approaches that enable resolution better than the optical diffraction limit of about half the wavelength of light or 200 nm. With resolution reaching into the nanometers range and the capability to analyze cells in their native tissue context, the group aims at extracting novel information from biological specimens. 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, to label them, and to extract the most information from the imaging data.

Current projects Deep-tissue nanoscale imaging | Minimally perturbing high-resolution imaging | Decoding of synapse nano-architecture | High-content analysis of tissue microarchitecture
Team members 2019 Giulio Abagnale (postdoc), Nathalie Agudelo Duenas (PhD student), Wiebke Jahr (postdoc), Caroline Kreuzinger (laboratory technician), Julia Lyudchik (PhD student), Hope McGovern (academic visitor), Julia Michalska (PhD student), Marek Suplata (software engineer), Mojtaba Tavakoli (PhD student), Sven Truckenbrodt (postdoc), Philipp Velicky (postdoc)

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
- 2019 Member of FWF Doctoral School
- 2018 ANR/FWF International French/ Austrian Grant
- 2018 Otto-Kraupp Prize for the best medical habilitation



Close-up view of living brain tissue imaged with super-resolution STED microscopy. Cellular structures are shown in white.

Mario de Bono

Genes, Circuits, and Behavior

The de Bono Group seeks to discover and then dissect basic molecular mechanisms that underpin the functions of neurons and neural circuits. Neurons are highly specialized cells and many fundamental questions about their organization, function and plasticity remain unaddressed.

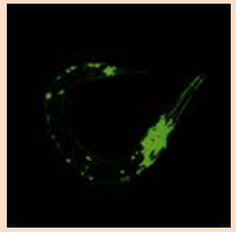
The group initiates many of their studies in *C. elegans*, because of its advantages for molecular and cellular neuroscience. Each neuron of this animal can be identified and visualized *in vivo* by selectively manipulating it using transgenes and monitoring its activity with genetically-encoded sensors. Powerful genetics and advanced genomic resources make high-throughput forward genetics and single neuron profiling possible. Genetics are complemented with biochemistry to get at molecular mechanisms that are usually conserved from the worm to man. The group aims to take discoveries made in the worm into mammalian models.

Current projects Global animal states | The neural unknome | Neuroimmune signalling
Team members 2019 Niko Amin-Wetzel (postdoc), Murat Artan (ISTplus postdoc), Ekaterina Lashmanova (project technician)

Career
- since 2019 Professor, IST Austria
- 1999 – 2019, Programme Leader, MRC Laboratory of Molecular Biology, Cambridge, UK
- 1995 – 1999, Postdoc, UCSF, San Francisco, USA
- 1990 – 1995, PhD, University of Cambridge, UK

Selected distinctions
- 2018 Wellcome Investigator Award
- 2014 Honorary Appointment, Garvan Medical Institute, Australia
- 2011 ERC Advanced Grant
- 2011 CoEN Award, Centre of Excellence in Neurodegeneration
- 2006 Human Frontiers Science Program Organization Grant
- 2007 Member, EMBO
- 2005 The Balfour Lecture, The Genetics Society, UK
- 2004 Max Perutz Prize, MRC Laboratory of Molecular Biology

C. elegans neurons highlighted using GFP



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.

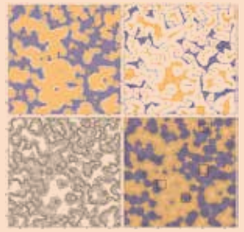
While geometry measures shapes, topology focuses its attention on how the shapes are connected. These shapes may be three-dimensional (an artistic sculpture or a cave in a mountain), it may be four-dimensional (a galloping horse or a flexing protein), or it may even have many more than four dimensions (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 2019 Arseniy Akopyan (postdoc), Ranita Biswas (postdoc), Adam Brown (postdoc), Sebastiano Cultrera di Montesano (PhD student), Ondrej Draganov (PhD student), Tatiana Ezubova (ISTern, scientific intern), Olympio Hacquard (academic visitor), Teresa Heiss (PhD student), Farid Karimipour (postdoc), Zuzka Masárová (PhD student), Alessandro Mella (academic visitor), Anton Nikitenko (postdoc), Katharina Ölsböck (PhD student), Georg Osang (PhD student), Elizabeth Stephenson (PhD student), Hubert Wagner (postdoc), Mathijs Wintraecken (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, European Association for Theoretical Computer Science
- 2014 Member, Austrian Academy of Sciences (ÖAW)
- 2012 Corresponding Member, 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 channel between complementary subcomplexes of the Voronoi tessellation and the Delaunay mosaic



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!

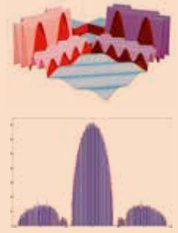
Large complex systems tend to develop universal patterns that often represent their essential characteristics. A pioneering vision of Eugene Wigner was that the distribution of the gaps between energy levels of complicated quantum systems depends only on the basic symmetry of the model and is otherwise 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. The 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 2019 Giorgio Cipolloni (PhD student), Adrian Dietlein (ISTplus postdoc), Peter Nejjar (postdoc, joint with Maas group), Yuriy Nemish (postdoc), David Renfrew (FWF Lise Meitner postdoc), Dominik Schröder (postdoc), Dániel Viosztek (ISTplus 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.

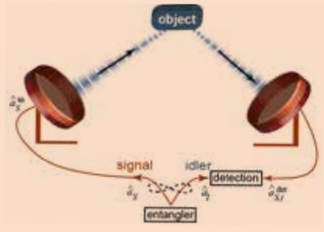
One of the Fink group's goals is to develop a microchip-based router that will be able to convert a microwave signal to an optical signal with near unity efficiency. With such devices, the researchers seek to perform quantum communication with superconducting circuits and telecom wavelength photons. 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 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- and optomechanics | Quantum microwave photonics | Ultra-high impedance physics for hardware protected qubits | Multi-qubit quantum electrodynamics | Resonant nonlinear optics
Team members 2019 Georg Arnold (ÖAW DOC-funded PhD student), Shabir Barzanjeh (postdoc), Yuan Chen (ISTplus postdoc), Francisco Martinez Checa (ISTern), Farid Hassani (PhD student), William Hease (ISTplus postdoc), Matilda Peruzzo (PhD student), Elena Redchenko (ÖAW DOC-funded PhD student), Alfredo Rueda (postdoc), Rishabh Sahu (PhD student), Riya Sett (PhD student), Andrea Trioni (PhD student), Matthias Wulf (postdoc), Maria Zelenayova (ISTern), 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

A source of entangled microwave tones (a Josephson parametric converter) can be used to detect an object in a proof-of-principle bistatic radar setup. While the entanglement is lost at room temperature, weak remaining quantum correlations between signal and idler tones allow for detecting the object with higher efficiency.



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.

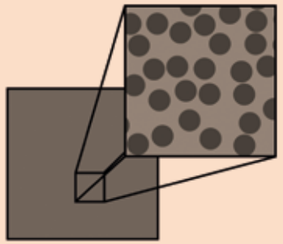
Partial differential equations are a fundamental tool for the description of many phenomena in the sciences, ranging from the physics of continua like fluids or elastic solids over quantum mechanics to population biology. Julian Fischer and his group work on the mathematical aspects of partial differential 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 and solids | Structure of fluctuations in stochastic homogenization | Entropy-dissipative PDEs
Team members 2019 Federico Cornalba (postdoc), Sebastian Hensel (PhD student), Jakob Hüpfl (ISTern), 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, Gesellschaft für Angewandte Mathematik und Mechanik (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.

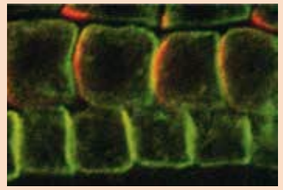
Plants and animals have different life strategies. Plants are highly adaptive and able to modify development and physiology to environmental changes; they can easily regulate growth, initiate new organs or regenerate tissues. Many of these developmental events are mediated by the plant hormone auxin. 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. The researchers gain insights into the mechanisms governing plant development and have 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 2019 Maciek Adamowski (postdoc), David Domjan (ISTern), Alberto Echevarria Poza (ISTern), Michelle Gallei (PhD student), Zuzana Gelova (postdoc), Matous Glanc (predoctoral visiting scientist), Nataliia Gnyliukh (PhD student), Corinna Hartinger (scientific intern), Jakub Hajny (PhD student), Huibin Han (PhD student), Lukas Hörmayer (PhD student), Alexander Johnson (postdoc), Lanxin Li (PhD student), Linlin Qi (postdoc), Scott Sinclair (postdoc), Lesia Rodriguez Solovey (EMBO-funded ISTplus postdoc), Shutang Tan (EMBO-funded postdoc), Mina Vasileva (PhD student), Inge Verstaeten (postdoc), Xixi Zhang (predoctoral visiting scientist), Yuzhou Zhang (ISTplus 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
- 2019 Neuron Award for Contribution to Science, Czech Republic
- 2017 ERC Advanced Grant
- 2016 Charles Albert Shull Award, ASPB
- 2015 Selected to 2015 World's Most Influential Scientific Minds
- 2015 Erwin Schrödinger Prize
- 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.

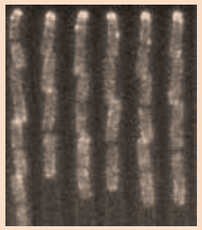
Genes and proteins constitute themselves into bio-molecular networks in cells. These genetic networks are engaged in a constant process of decision-making and computation over timescales of a few seconds to the time it takes a cell to divide, and beyond. By studying existing networks and constructing 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 2019 Vlad-Bogdan Gavra (scientific intern), Rok Grah (ÖAW DOC-funded PhD student, joint with Tkačik group), Aleksandra Greshnova (scientific intern), Maximilian Götz (academic visitor), Kirti Jain (ISTplus postdoc), Stephanie Kainrath (PhD student), Moritz Lang (postdoc), Anna Nagy-Staron (postdoc), Nela Nikolic (ISTplus postdoc), Isabella Tomanek (PhD student), Kathrin Tomasek (PhD student, joint with Sixt group), Bryan Wu (PhD student)

Career
- since 2018 Professor, IST Austria
- 2011 – 2018 Assistant Professor, IST Austria
- 2009 Postdoc, Harvard University, Cambridge, 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" that 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.

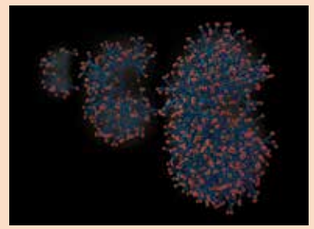
The Hannezo group is particularly interested in design principles and processes of self-organization in biology at various scales and in close collaboration with cell and developmental biologists. Their methods include tools from solid and fluid mechanics, statistical physics as well as soft matter approaches. 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 2019 Daniel Boocock (PhD student), Bernat Corominas-Murtra (postdoc), Zuzana Dunajova (PhD student), Carles Falco (ISTern), Aondoyima Ioratim-Uba (ISTern), Kasumi Kishi (PhD student, joint with Kicheva group), Suyash Naik (PhD student, joint with Heisenberg group), Oleksandr Ostrenko (ISTplus postdoc, joint with Heisenberg group), Mehmet Can Ucar (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
- 2019 EMBO Young Investigator Award
- 2019 ERC Starting Grant
- 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 2019 Jan Friedmann (PhD student), Quoc Ho (postdoc), Sasha Minets (postdoc), William Mistegaard (postdoc), Petr Pushkar (postdoc), Tanya Srivastava (ISTplus postdoc), Hongjie Yu (ISTplus 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.

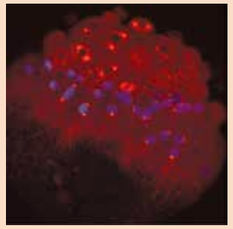
Current projects Cell adhesion | Actomyosin contraction | Cell and tissue morphogenesis | Cell polarization and migration
Team members 2019 Feyza Arslan (PhD student), Debanik Bhattacharjee (scientific intern), Silvia Caballero Mancebo (PhD student), Ehsan Ghasemian (project technician), Karla Huljev (PhD student), Roland Kardos (ISTplus postdoc), David Labrousse Arias (laboratory technician), Suyash Naik (PhD student, joint with Hannezo group), Diana Nunes Pinheiro (EMBO-, HFSP-funded postdoc), Oleksandr Ostrenko (ISTplus postdoc, joint with Hannezo group), Nicoletta Petridou (EMBO-funded postdoc), Kornelija Pranjic-Ferscha (laboratory technician), Alexandra Schauer (DOC-funded PhD student), Cornelia Schwayer (PhD student), Shayan Shamipour (PhD student, joint with Hof group), Ste Tavano (EMBO-funded 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
- 2019 Carus Medal, German Academy of Sciences Leopoldina
- 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 | Formal methods for neural networks
Team members 2019 Parand Alizadeh Alamdari (scientific intern), Guy Avni (FWF Lise Meitner postdoc), Soroush Ebadian (scientific intern), Thomas Ferrere (postdoc), Miriam Garcia Soto (postdoc), Mirco Giacobbe (PhD student), Bernhard Kragl (PhD student), Mathias Lechner (PhD student), Anna Lukina (postdoc), Fabian Mühlböck (postdoc), Christian Schilling (ISTplus postdoc)

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
- 2019 EATCS Award
- 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

Andrew Higginbotham

Condensed Matter and Quantum Circuits

Quantum systems are fragile, constantly being altered and disrupted by their environment. The Higginbotham group investigates electronic devices that are exceptions to this rule, aiming to understand the basic principles of their operations and develop future information-processing technology.

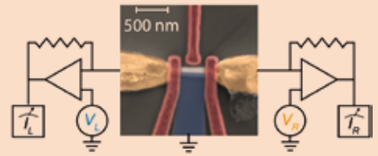
Research in the Higginbotham group experimentally explores the relationship between condensed matter systems and information processing. In practice, the group builds devices with topological superconductors, quantum dots and quantum-critical matter, and seeks to understand their behavior using electrical transport, superconducting microwave circuits and electromechanical oscillators. The central idea of their approach is that building rudimentary information-processing devices both teaches us about the physics of these interesting systems and advances technology such as quantum computing. Currently, the group is interested in using electromechanical and microwave measurement techniques to study quantities that are "invisible" to conventional electrical transport experiments. On the electromechanics side, ultra-high-Q mechanical oscillators are being built to study dynamics and quantum coherence in insulating phases of matter. On the microwave side, wide-band and low noise receiver chains are being constructed to perform fundamental studies on the electrical properties of superconductor-semiconductor heterostructures, which harbor poorly understood superconducting, metallic and—possibly—topological phases.

Current projects Understanding anomalous metallic behavior and amplification with a superconducting circuit | Electromechanics across a quantum phase transition
Team members 2019 Andras Di Giovanni (ISTern), Joshua Milm (scientific intern), Duc Thanh Phan (PhD student), Jorden Senior (predoctoral visiting scientist)

Career
- since 2019 Assistant Professor, IST Austria
- 2017-2019 Researcher, Microsoft Station Q Copenhagen, Denmark
- 2015-2017 Postdoc, JILA, USA
- 2010-2015 PhD, Harvard University, Cambridge, USA

Selected distinctions
- 2016 National Research Council Postdoctoral Fellowship
- 2010 D.O.E. Office of Science Graduate Fellowship
- 2009 A.P.S. Apker Award Finalist
- 2009 Churchill Foundation Scholarship, Cambridge, UK

Superconductor-semiconductor hybrid device embedded in a measurement circuit. Higginbotham recently used this setup to discover new conductance symmetries that arise in the presence of superconductivity.



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.

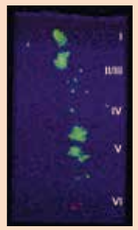
The Hippenmeyer group's current objectives are (1) to establish a definitive quantitative and mechanistic model of cortical neural stem cell lineage progression; (2) to dissect the cellular and molecular mechanisms generating cell-type diversity; (3) to determine the role of genomic imprinting, an epigenetic 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 2019 Nicole Amberg (FWF Hertha-Firnberg postdoc), Robert Beattie (FWF Lise Meitner postdoc), Giselle Cheung (ISTplus postdoc), Ximena Contreras Paniagua (PhD student), Amarbayasgalan Davaatseren (laboratory technician), Andi Hansen (ÖAW DOC-funded PhD student), Susanne Laukoter (postdoc), Florian Pauler (senior laboratory technician), Jonas Rybnicek (ISTern), Johanna Sonntag (laboratory technician), Melissa Stouffer (ISTplus postdoc), Carmen Streicher (laboratory technician), Natalie Yildiz Özgen (scientific intern)

Career
- since 2019 Professor, IST Austria
- 2012 – 2019 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

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.

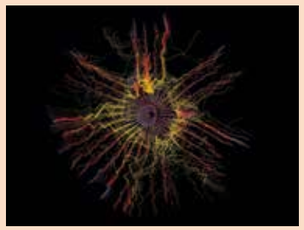
Flows in oceans, around vehicles and through pipelines are all highly turbulent. Turbulence governs friction losses and transport and mixing properties. Despite its ubiquity, insights into the nature of turbulence are very limited. To obtain a fundamental understanding of the origin and the principles 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, polymer solutions and blood flow.

Current projects Revisiting the turbulence problem using statistical mechanics | Transition from laminar to turbulent flow | Dynamics of complex fluids | Control of fully turbulent flows | Cytoplasmic streaming | Instabilities in cardiovascular flows
Team members 2019 Nishchal Agrawal (PhD student), Nazmi Burak Budanur (postdoc), George Choueiri (ISTplus postdoc), Mike Hennessey-Wesen (PhD student), Lukasz Klotz (ISTplus postdoc), Jose Lopez Alonso (postdoc), Michael Riedl (PhD student), Davide Scarselli (PhD student), Chaitanya Paranjape (PhD student), Gökhan Yalniz (intern), Arnas Volcokas (intern), Shayan Shamipour (PhD student, joint with Heisenberg group), Sarath Sankar Suresh (PhD student), Balachandra Suri (ISTplus postdoc), Atul Varshney (ISTplus postdoc), Mukund Vasudevan (laboratory technician), Yi Zhuang (postdoc)

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
- 2019 Simons Foundation Grant
- 2017 Fellow of the American Physical Society, APS
- 2012 ERC Consolidator Grant
- 2011 Dr. Meyer Struckmann Science Prize
- 2005 RCUK Fellowship

Taming turbulence: The streamlines of the initially highly turbulent pipe flow become parallel as time proceeds and turbulence collapses.



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.

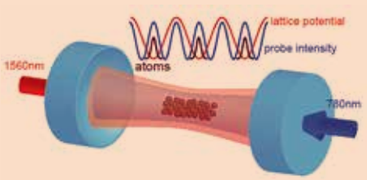
Onur Hosten is an experimental atomic and optical physicist. His group develops innovative techniques to control the quantum properties of atomic and optical systems. The experimental platform is many-atom cavity-quantum-electrodynamics (cQED), where large ensembles of atoms are laser-cooled, trapped 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 2019 Fritz Diorico (postdoc), Vyacheslav Li (PhD student), Ilango Maran (scientific intern), Yueheng Shi (ISTern), Artem Zhutov (ISTern)

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 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 create metamaterials.

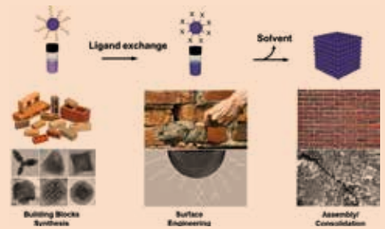
The Ibáñez group develops novel functional nanomaterials using precisely designed nanocrystals as building blocks and investigates their properties as function of their finely tunable nano-features. In this way, the researchers are able to create a new generation of complex materials in which components and functionalities can be defined in a predictable way. Beyond fundamental studies in nanocrystal synthesis, surface chemistry and assembly, the group also aims to provide high-efficiency cost-effective thermoelectric materials.

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 2019 Dogukan Apaydin (postdoc), Mariano Calcabrini (PhD student), Cheng Chang (postdoc), Yu Liu (ISTplus postdoc), Guillem Montana Mora (scientific intern), Sergi Sanchez Ribot (scientific intern), Weishan Tan (ISTern), Yu Zhang (academic visitor)

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 Zurich 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

Cellular Neuroscience

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, functional anatomy ("flash and freeze" electron microscopy), in vivo recording, and modeling. One focus is hippocampal mossy fiber synapses and output synapses of parvalbumin-expressing GABAergic interneurons.

Current projects Biophysical mechanisms of synaptic plasticity at hippocampal mossy fiber synapses | Structural changes underlying transmission and plasticity at central synapses | Analysis of neuronal coding in vivo and in realistic network models

Team members 2019 Christina Altmutter (laboratory technician), Yoav Ben Simon (postdoc), Carolina Borges-Merjane (Else Richter postdoctoral fellow), Jingjing Chen (PhD student), Claudia Espinoza Martinez (PhD student, postdoc), Olena Kim (PhD student), Eleftheria Kralli Beller (assistant), Florian Marr (senior laboratory technician), Yuji Okamoto (postdoc), Magdalena Picher (Hertha Firnberg postdoctoral fellow), Alois Schlögl (scientific computing), Benjamin Suter (postdoc), David Vandael (postdoc), Victor Vargas Barroso (ISTplus postdoctoral fellow)

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
- 2016 FWF Wittgenstein Award
- 2016 ERC Advanced Grant
- 2016 Elected Member Editorial Board, Neuron
- 2015 Member, Academia Europaea
- 2011 ERC Advanced Grant
- 2009 Adolf Fick Award
- 2008 Member, Academy of Sciences, Heidelberg, Germany
- 2007 Member, Board of Reviewing Editors, Science
- 2007 Tsungming Tu Award, National Science Council Taiwan
- 2006 Gottfried Wilhelm Leibniz Award
- 2002 Member, German Academy of Sciences Leopoldina
- 1998 Max Planck Research Award

Maximilian Jösch

Neuroethology

Maximilian Jösch and his group 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.

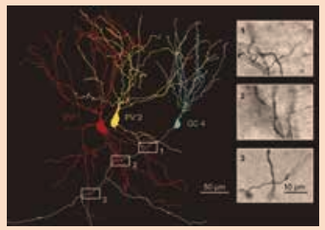
Two different model organisms, the mouse and the fruit fly (*Drosophila melanogaster*), are being used in parallel to take advantage of their unique strengths and gather a general, crossphyla understanding of computational principles. Experiments in the mouse will allow the group to study the mechanisms 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 2019 Laura Burnett (PhD student), Divyansh Gupta (PhD student), Wiktor Mlynarski (ISTplus postdoc), Victoria Pokusaeva (PhD student), Roshan Satapathy (PhD student), Anton Sumser (EMBO-, HFSP-funded postdoc), Olga Symonova (project technician), Tomas Vega Zuniga (postdoc)

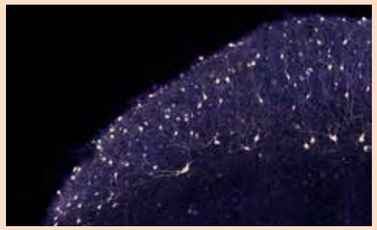
Career
- since 2017 Assistant Professor, IST Austria
- 2010 – 2016 Postdoc and Research Associate, Harvard University, Cambridge, USA
- 2009 Postdoc, Max Planck Institute of Neurobiology, Martinsried, Germany
- 2009 PhD, Max Planck Institute of Neurobiology, Martinsried, Germany and Ludwig Maximilian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

Selected distinctions
- 2018 FENS-Kavli Scholar
- 2017 ERC Starting Grant
- 2016 Article Recommendation, 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

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).



Neurons in a circuit of the mouse brain that are known to modulate innate visual-driven behaviors



Georgios Katsaros

Nanoelectronics

It is impossible to picture modern life without thinking of the vast amount of microelectronic applications that surround us. However, such development has only been made possible with the invention of the transistor in the 50s. This—back at that time—few centimeters large device and product of scientific curiosity led to a technological revolution. Until today, the size of a transistor has been shrunk to less than 14 nm and quantum physics comes into play. The Katsaros group investigates semiconductor nanodevices and studies quantum effects that appear when these devices are cooled down to -273.14 °C.

The spin degree of freedom can be used in order to create a two-level system, a quantum bit. Katsaros studies such qubits by manipulating them with high frequency signals. While in classic computers, a bit can be in only one of two states, zero or one, in the quantum world, a qubit can be both zero and one at the same time. By combining semiconductors 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 | Towards scalable hut wire devices | Topologically protected and scalable quantum bits
Team members 2019 Kushagra Aggarwal (scientific intern), Matthias Brauns (postdoc), Alessandro Crippa (postdoc), Robin Dekker (ISTern), Luka Drmic (project technician), Chaitrali Duse (ISTern), Andrea Hofmann (postdoc), Marian Janik (PhD student), Daniel Jirovec (PhD student), Josip Kukucka (PhD student), Marin Soce (scientific intern), 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

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.

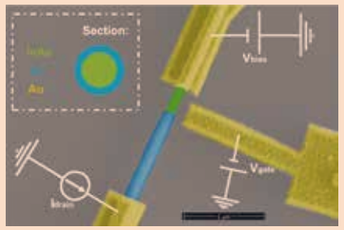
Neural tube development is controlled by signaling molecules called morphogens. Morphogens determine what type of neuron a neural progenitor cell will become. They also control tissue growth by influencing the decisions of cells to divide or exit the cell cycle. The goal of the Kicheva group is to better understand how morphogen signaling is controlled and interpreted by cells to determine cell fate and cell cycle progression. One of the group's main projects 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 2019 Laura Bocanegra (PhD student), Lucrezia Ferme (scientific intern), Catherine Gilbert (project technician), Martina Greunz (laboratory technician), Gabriela Hristova (ISTern), Aondoyima Ioratim-Uba (ISTern), Kasumi Kishi (PhD student, joint with Hannezo group), Tin Kocijan (scientific intern), Katarzyna Kuzmicz (ÖAW DOC-funded PhD student), Darya Matvijenko (ISTern), Stefanie Rus (PhD student)

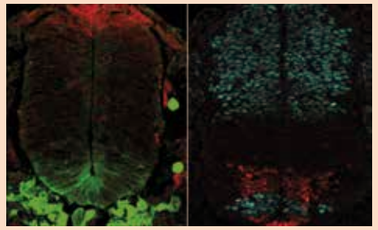
Career
- since 2015 Assistant Professor, IST Austria
- 2008 – 2015 Postdoc, National Institute for Medical Research, The Francis Crick Institute, UK
- 2008 PhD, University of Geneva, Switzerland, and Max Planck Institute of Cell Biology and Genetics, Dresden, Germany

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

A scanning electron microscope image of a nanowire used for studying the physics of hybrid semiconductor-superconductor devices via tunneling spectroscopy measurements



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 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 2019 Sharareh Alipour (postdoc), Martin Dvorak (scientific intern, PhD student), Yekini Shehu (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, IEEE/CVF Conference on Computer Vision and Pattern Recognition
- 2013 ERC Consolidator Grant
- 2012 Koenderink Prize, European Conference on 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, IEEE Conference on Computer Vision and Pattern Recognition
- 2002 Best Paper Award, European Conference on Computer Vision

Fyodor Kondrashov

Evolutionary Genomics

How did living organisms become the way we know them today? The Kondrashov group 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 2019 Olga Bochkareva (postdoc), Vera Emelianenko (scientific intern), Louisa Gonzalez Somermeyer (PhD student), Ana Gutierrez Franco (postdoc), Lada Isakova (scientific intern), Mia Juracic (project technician), Aleksandr Kolesov (ISTern), Anastasia Lyulina (laboratory technician), Nick Noel Machnik (PhD student), Ekaterina Maksimova (project technician), Rodrigo Redondo (project technician), Catalin Rusnac (PhD student), Anastasia Stolyarova (academic visitor), David Vijatovic (ISTern), 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 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, Society for the Study of Evolution
- 2010 Plan Nacional Grant, Spanish Ministry of Science and Innovation
- 2005 National Science Foundation Graduate Research Fellow

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

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.

Christoph Lampert

Computer Vision and Machine Learning

The Lampert group performs research on how to make artificial intelligence methods more trustworthy. It investigates questions such as: Can we understand not only what modern machine learning systems are doing, but also why? Can we give guarantees for their behavior? And finally, can we build systems that learn and one day might become intelligent without sacrificing our rights to data protection and privacy?

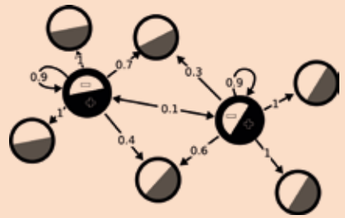
Computers are becoming more and more powerful at processing data, and they have recently learned to perform many tasks that were previously thought beyond their reach, such as making successful financial investments, diagnosing cancer from medical images, and even driving cars in traffic. So why aren't we all relying on them as financial advisors, oncologists and chauffeurs? Most likely, it is because we do not trust computers enough to let them operate important systems autonomously and completely outside of our control. Besides theoretical research, the group also applies its results to applications in computer vision, such as image understanding, where the goal is to develop automatic systems that can analyze the contents of natural images.

Current projects Trustworthy machine learning | Transfer and lifelong learning | Theory of deep learning | Generative modeling in computer vision
Team members 2019 Paul Henderson (postdoc), Nikola Konstantinov (PhD student), Alexandra Peste (PhD student), Mary Phuong (PhD student), Amélie Royer (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, 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)

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.

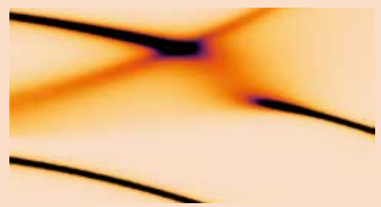
Most polyatomic systems in physics, chemistry and biology are strongly correlated: their complex behavior cannot be deduced from the properties of their individual components. Despite considerable effort, understanding strongly correlated, many-body systems still presents a formidable challenge. For 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? The group's theoretical efforts aim to explain experiments on cold molecules and ultra-cold quantum gases, as well as to 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 2019 Giacomo Bighin (postdoc), Igor Cherepanov (PhD student), Tibor Döme (scientific intern), Jiri Etrych (ISTern), Areg Ghazaryan (ISTplus postdoc), Xiang Li (PhD student), Julia Liebert (scientific intern), Mikhail Maslov (PhD student), Marjan Mirahmadi (scientific intern), Ekaterina Paerschke (postdoc), Wojciech Rzadkowski (PhD student), Artem Volosniev (postdoc), Enderalp Yakaboylu (ISTplus postdoc)

Career
- since 2019 Professor, IST Austria
- 2014 – 2019 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

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



Martin Loose

Self-organization of Protein Systems

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 rebuilding cellular functions in a bottom-up approach.

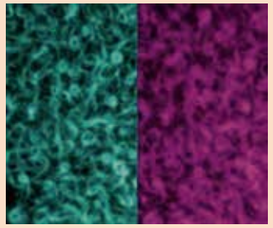
Although we often know which proteins are required for specific processes in the cell, how they act together to accomplish this task is not yet understood. Instead of looking at complex phenomena in an intact cell, the Loose group aims to rebuild cellular functions from purified components. This bottom-up 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 computer-aided 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 Self-organization of the bacterial cell division machinery | Emergent properties of small GTPase networks
Team members 2019 Albert Auer (PhD student), Natalia Baranova (postdoc), Urban Bezeljak (PhD student), Paulo Dos Santos Caldas (PhD student), Christian Düllberg (postdoc), Katrin Loibl (laboratory technician), Maria Del Mar Lopez Pelegrin (laboratory technician), Batirtze Prats Mateu (postdoc), Philipp Radler (PhD student), Veronika Szentirmai (scientific intern)

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
- 2019 EMBO Young Investigator
- 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

In vitro reconstitution of the initial stages of bacterial cell division: a minimal protein system of FtsA, FtsZ and FtsN self-organize into dynamic cytoskeletal patterns.



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.

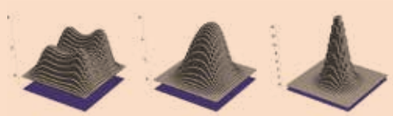
Random processes are often so irregular that existing mathematical methods are insufficient to describe them accurately. The Maas group combines ideas from probability theory, mathematical analysis and geometry to gain new insights into the complex behavior of these processes. Their recent work has been 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 2019 Dario Feliciangeli (PhD student, joint with Seiringer group), Dominik Forkert (PhD student), Mate Gerencser (FWF Lise Meitner, ISTplus postdoc), Peter Nejjar (postdoc, joint with Erdős group), Lorenzo Portinale (PhD student), Federico Sau (postdoc), Haonan Zhang (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, Collaborative Research Centre "The mathematics of emergent effects"
- 2009 – 2011 NWO Rubicon Fellowship

Gradient flow discretization of a fourth-order diffusion equation



Marco Mondelli

Data Science, Machine Learning, and Information Theory

We are at the center of a revolution in information technology, with data being the most valuable commodity. Exploiting this exploding number of data sets requires addressing complex inference problems, and the Mondelli group works to develop mathematically principled solutions.

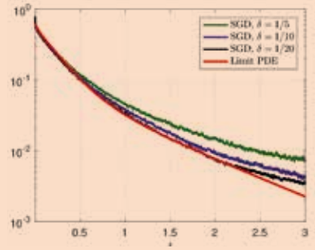
Inference problems span different fields and arise in a variety of applications coming from engineering and the natural sciences. In particular, the Mondelli group focuses on wireless communications and machine learning. In wireless communications, given a transmission channel, the goal is to send information encoded as a message while optimizing for certain metrics, such as complexity, reliability, latency, throughput, or bandwidth. In machine learning, given a model for the observations, the goal is to understand how many samples convey sufficient information to perform a certain task and to identify the optimal ways to utilize such samples. Both the vision and the toolkit adopted by the Mondelli group are inspired by information theory, which leads to the investigation of the following fundamental questions: What is the minimal amount of information necessary to solve an assigned inference problem? Given this minimal amount of information, is it possible to design a low-complexity algorithm? What are the fundamental trade-offs between the parameters at play (e.g., dimensionality of the problem, size of the data sample, complexity)?

Current projects Fundamental limits and efficient algorithms for deep learning | Non-convex optimization in high-dimensions | Optimal code design for short block lengths
Team members 2019 Alexander Shevchenko (PhD student)

Career
- since 2019 Assistant Professor, IST Austria
- 2017 – 2019 Postdoc, Stanford University, Palo Alto, USA
- 2018 Research Fellow, Simons Institute for the Theory of Computing, Berkeley, USA
- 2016 PhD, EPFL, Lausanne, Switzerland

Selected distinctions
- 2019 Lopez-Loreta Prize
- 2018 Simons-Berkeley Research Fellowship
- 2018 EPFL Doctorate Award
- 2017 Early Postdoc Mobility Fellowship, Swiss National Science Foundation
- 2016 Best Paper Award, ACM Symposium on Theory of Computing (STOC)
- 2015 Best Student Paper Award, IEEE International Symposium on Information Theory (ISIT)
- 2015 Dan David Prize Scholarship

Comparison between the performance of stochastic gradient descent (SGD) run on a two-layer neural network and the "mean field" partial differential equation (PDE). When the number of neurons is large, the dynamics of SGD is well approximated by the "mean field" PDE; and the PDE converges exponentially fast to the global optimum when it is displacement convex.



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 2019 Narkhyun Bae (ISTplus postdoc), Bernadette Basilico (postdoc), Barbara de Sousa Oliveira (ISTplus postdoc), Christoph Dotter (PhD student), Farnaz Freeman (project technician), Luis Garcia Rabaneda (postdoc), Gabriel Gonzales (academic visitor), Lisa Knaus (PhD student), Anna Kniazeva (academic visitor), Magdalena Ladrón de Guevara (laboratory technician), Annabella Liebl (FFG funded scientific intern), Jasmin Morandell (PhD student), Ilaria Parenti (postdoc), Eva Reinthaler (postdoc), Roberto Sacco (postdoc), Lena Schwarz (PhD student), Margit Katalin Szigeti (ISTplus postdoc), Benjamin-Leon Traub (scientific intern), Aysan Yahya (PhD student, project technician)

Career
- since 2019 Professor, IST Austria
- 2014 – 2019 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, Berlin, Germany
- 2006 PhD, University La Sapienza, Rome, Italy

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

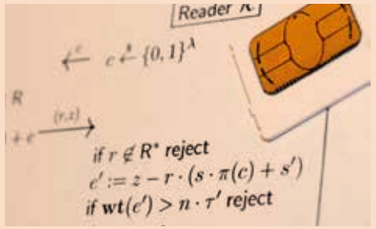
Cryptography, the science of information security, is often relegated to the realm of spies and secret agents. However, we all rely on cryptography on a daily basis, for example when using internet banking or a wireless car key. The Pietrzak group works on theoretical and practical aspects of cryptography, 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 2019 Benedikt Auerbach (postdoc), Margarita Capretto (ISTern), Chethan Kamath Hosdurg (PhD student), Karen Klein (PhD student), Miguel Cueto Noval (ISTern), Guillermo Pascual Perez (PhD student), Ahmadreza Rahimi (predoctoral visiting scientist), Michael Walter (postdoc), Michelle Yeo (PhD student)

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, the researchers 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. The group is also investigating other related membrane protein complexes, such as antiporters. These 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 2019 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
- 2019 Fellow of the Royal Society
- 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

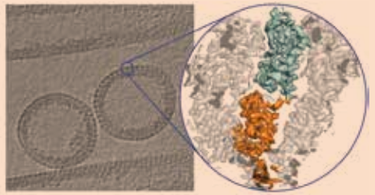
Structural plasticity and movement play fundamental roles in life, from the level of whole organisms down to cells, viruses and individual molecules. The Schur group uses advanced cryo-electron microscopy and image processing methods to study the structure and function of protein complexes in situ*, 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 group 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 2019 Robert Dick (academic visitor), Georgi Dimchev (FWF Lise Meitner postdoc), Florian Fässler (postdoc), Martin Obr (postdoc), Dario Porley (PhD student), Julia Stanger (PhD student), Andreas Thader (project technician), Bettina Zens (PhD student)

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
- 2018 FWF Standalone research grant
- 2016 Paper of the Year Award, Journal of Structural Biology
- 2016 F1000 Article recommendation
- 2013 F1000 Article recommendation



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

Robert Seiringer

Mathematical Physics

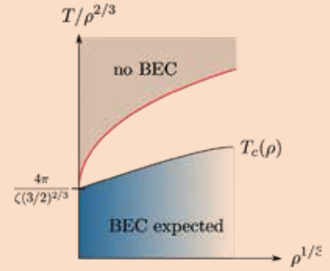
The Seiringer group develops new mathematical tools for the rigorous analysis of many-particle systems in quantum mechanics, with a special focus on exotic phenomena in quantum gases, like Bose-Einstein condensation and superfluidity.

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 poses 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 in the description of dilute Bose gases, and the behavior of polaron systems at strong coupling.

Current projects Polaron models at strong coupling | The Heisenberg ferromagnet at low temperature and the spin-wave approximation | Validity of the Bogoliubov approximation for weakly interacting Bose gases
Team members 2019 Niels Benedikter (postdoc), Chiara Boccato (postdoc), Lea Bossmann (postdoc), Andreas Deuchert (postdoc), Dario Feliciangeli (PhD student), Nikolai Leopold (postdoc), Simon Mayer (PhD student), Krzysztof Mysliwy (PhD student), Simone Rademacher (postdoc)

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
- 2019 Fellow, American Mathematical Society
- 2017 Corresponding Member, Austrian Academy of Sciences (ÖAW)
- 2016 ERC Advanced Grant
- 2012 – 2017 William Dawson Scholarship
- 2012 – 2014 NSERC E.W.R. Steacie Memorial Fellowship
- 2009 – 2010 US 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



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 2019 Pietro Brighi (PhD student), Stefano De Nicola (postdoc), Peter Gerlagh (scientific intern), Tobias Gulden (postdoc), Raimel Medina Ramos (scientific intern), Alexios Michailidis (postdoc), Barbara Roos (scientific intern)

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
- 2019 ERC Starting Grant
- 2019 Ludwig Boltzmann Prize
- 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.

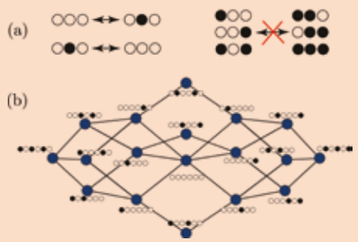
The release of neurotransmitters from a nerve cell into the synapse, where they act on receptors of the connecting nerve cell, is the primary process of information transmission and computation in the brain. The Shigemoto group studies the localization of single neurotransmitter receptors, ion channels, 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. The researchers apply these methods to investigate the mechanisms of signaling and plasticity in the brain, with questions ranging from neurotransmission to learning.

Current projects New chemical labeling methods for high resolution EM visualization of single molecules | 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 2019 Catarina Alcarva (ÖAW DOC-funded PhD student), Pradeep Bhandari (PhD student), Matthew Case (postdoc), Jessica Coelho Gaspar (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), Tsuneyuki Koga (postdoc), Peter Koppensteiner (postdoc), Hana Korinkova (scientific intern), Elodie Le Monnier (laboratory technician), Jacqueline-Claire Montanaro-Punzengruber (senior laboratory technician), Nandhini Natarajan (scientific intern), Cihan Önal (PhD student), Maria Silva Sifuentes (laboratory technician), Shigekazu Tabata (postdoc)

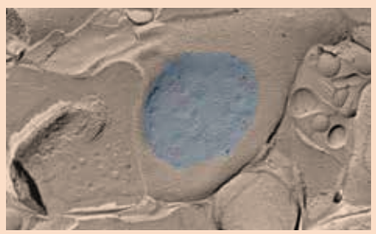
Career
- since 2013 Professor, IST Austria
- 1998 – 2014 Professor, National Institute for Physiological Sciences, Okazaki, Japan
- 1990 – 1998 Assistant Professor, Kyoto University Faculty of Medicine, Kyoto, Japan
- 1994 PhD, Kyoto University, Japan
- 1985 MD, Kyoto University Faculty of Medicine,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

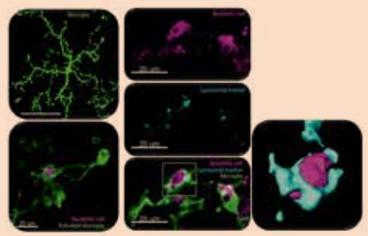
Microglia are the CNS-resident macrophages and continually sense their neuronal environment. They switch between functional states that either promote or counteract removal of circuit elements. But how microglia decide when to alter circuit elements without inducing circuit malfunction is not known. 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 group addresses this using the mammalian retina, which consists of morphologically well-defined cell types that are precisely mapped in their connection and functional properties. The researchers 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 What defines microglial reactivity and how can we manipulate it? | How do microglia impact neuronal function?
Team members 2019 Katarina Bartalska (laboratory technician), Gloria Colombo (PhD student), Ryan John Cubero (ISTplus postdoc), Verena Hübschmann (PhD student), Medina Korkut-Demirbas (project technician), Margaret Maes (postdoc), Benedetta Mendicino (scientific intern), Bálint Nagy (postdoc), Mariam Atef Othman (scientific intern), Florianne Schoot Uiterkamp (PhD student), Rouven Schulz (ÖAW DOC-funded PhD student), Alessandro Venturino (laboratory technician), Gabriele Maria Wögenstein (scientific intern, MSc thesis)

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

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



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, biophysics, and modeling to identify the strategies that underlie tissue invasion. The group has found that a cytokine conserved in vertebrates facilitates tissue entry by reducing tension in surrounding tissues. The researchers have defined a novel program acting in disseminating and invading macrophages that alters glycosylation to aid invasion; this program displays molecular conservation in metastatic cancer cells. They have also defined a conserved pioneer invader program acting in macrophages that activates transcription and translation of an mRNA subset to increase tissue entry.

Current projects The role of cell division in regulating invasive migration | A novel transporter and its effect on glycosylation, immune function and metastasis | A conserved pioneer cell program that governs invasion through transcriptional and translational shifts
Team members 2019 Maria Akhmanova (FWF Lise Meitner postdoc), Julia Biebl (laboratory technician), Shamsi Emtenani (PhD student), Attila György (laboratory technician), Michaela Misova (PhD student), 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, Palo Alto, USA

Selected distinctions
- 2019 Chosen for "Excellence in Peer Review" by Developmental Cell editors
- 2018, 2019 F1000 Prime highlighted papers
- 2016 FWF Grant
- 2012 Marie Curie Career Integration Grant
- 2003 – 2005 NIH Fellowship

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.

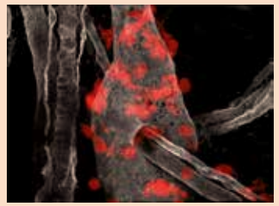
Most cells in our bodies are stationary, forming solid tissues and encapsulated organs. One exception are leukocytes, immune cells essential for both the innate and adaptive immune responses to infections. Leukocytes migrate with extraordinary speed and are used by the Sixt group as a model to study 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 change shape, move the cell body and interact with other cells. 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, micro-engineering, surface chemistry, 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 2019 Jonna Alanko (Stiftelsernas-funded postdoc), Frank Assen (postdoc), Nikola Canigova (PhD student), Alessandra Casano (EMBO-funded postdoc), Ingrid de Vries (senior laboratory technician), Anna Deart (scientific intern), Florian Gärtner (Marie Curie postdoctoral fellow), Tamara Girbl (postdoc), Alba Juanes Garcia (postdoc), Aglaja Kopf (PhD student), Alexander Leithner (postdoc), Maria Nemethova (senior laboratory technician), Patricia Rodrigues (PhD student), Julian Stopp (PhD student), Saren Tasciyan (PhD student), Kathrin Tomasek (PhD student, joint 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, 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 Tkačik group uses biophysics and information theory to understand the principles and mechanisms behind this remarkable phenomenon.

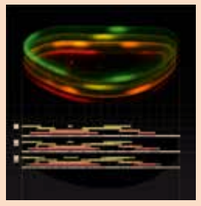
How can cells in a multicellular organism reproducibly decide what tissue they are going to become? How do neurons in the retina cooperate to best encode visual information into neural spikes? How does the physics at the microscopic scale, which dictates how individual regulatory molecules interact with 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 2019 Mantas Gabrielaitis (ISTplus postdoc), Aditya Gilra (postdoc), Rok Grah (ÖAW DOC-funded PhD student, joint with Guet group), Michal Hledik (PhD student, joint with Barton group), Jan Humplik (PhD student), Bor Kavčič (PhD student), Moritz Lang (postdoc), Fabrizio Lombardi (postdoc), Gabriel Mahuas (scientific intern), Wiktor Młynarski (ISTplus postdoc), Mark Francis Rogers (scientific intern), 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, 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, the researchers 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 speciess
Team members 2019 Christelle Fraisse (FWF Lise Meitner postdoc, joint with Barton group), William Gammerdinger (ISTplus postdoc), Ann Kathrin Huylmans (FWF Lise Meitner postdoc), Réka Kelemen (PhD student), Ariana Macon (laboratory technician), 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, Young Academy of the Austrian Academy of Sciences (ÖAW)
- 2016 ERC Starting Grant
- 2016 FWF Standalone Grant
- 2011 DeLill Nasser Travel Award, 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 2019 Sharareh Alipour (postdoc), Alan Arroyo Guevara (ISTplus postdoc), Serhii Avvakumov (PhD student), Soheil Azarpendar (ISTern), Illia Babiienko (scientific intern), Marek Filakovský (postdoc), Radoslav Fulek (FWF Lise Meitner postdoc), Ugo Giocanti (scientific intern), Kristóf Huszár (PhD student), Sergey Kudrya (ISTern), Corentin Lunel (academic visitor), Zuzana Masárová (PhD student), Pavel Paták (academic visitor), Zuzana Patáková (academic visitor), Emo Welzl (visiting professor), 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

Scott Waitukaitis

Soft and Complex Materials

The Waitukaitis group is an experimental physics lab whose research sits at the intersection of soft matter physics, materials science and chemistry. Under this umbrella, the group addresses a variety of distinct topics ranging from the nanoscale to the macroscale and involving experimental techniques ranging from atomic force microscopy to high-speed imaging.

One focus at smaller scales is tribocharging—the exchange of electrical charge between materials during contact. Although known to occur since ancient Greece, the underlying mechanism remains poorly understood. Recent results suggest adsorbed water layers could drive charging, donating hydroxide ions through minute liquid bridges. Using atomic force microscopy to characterize adsorbed water and a variety of techniques to measure charge exchange, a major goal is to validate or nullify this hypothesis. Work at larger scales will deal with the non-Newtonian dynamics that arise when colloidal-sized solid particles are suspended in liquids. A well-known example is a dense mixture of cornstarch particles in water, which behaves liquid-like when perturbed gently, but solid-like when vigorously agitated. The group will use such systems to create "metafluids" whose flow response can be tailored with high precision.

Current projects Mesoscale charging statistics with acoustic levitation | Macro-charging of oxide nanolayers on soft polymer substrates
Team members 2019 Galien Marie P. Grosjean (postdoc), Juan Carlos Sobarzo Ponce (PhD student), Sebastian Wald (PhD student)

Career
- since 2019 Assistant Professor, IST Austria
- 2016 – 2018 NWO Veni Recipient and Postdoc, AMOLF, Amsterdam, The Netherlands
- 2013 – 2016 Postdoc, Leiden University, The Netherlands
- 2007 – 2013 PhD, University of Chicago, USA

Selected distinctions
- 2018 NNV Fysica Young Speakers Award
- 2018 Block Prize for Outstanding Young Researcher
- 2016 Veni Research Grant from the Netherlands Organization for Scientific Research
- 2014 Springer Thesis Award, Springer Publishing
- 2012 Bruce Winstein Prize for Instrumentation
- 2010 – 2013 Robert A. Millikan Fellowship

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.

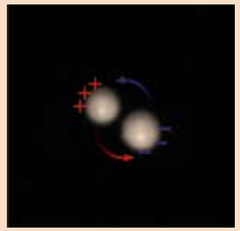
Natural phenomena like flowing fluids and shattering solids are both beautifully chaotic and overwhelmingly complex. This complexity makes them extremely difficult to compute without the aid of a supercomputer. The Wojtan group overcomes this complexity by combining laws of motion from physics, geometric 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 2019 Ewa Gajda-Zagórska (postdoc), Radhika Prasad (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

Why do insulating materials exchange electrical charge? Answering this question would explain why two same-material dust grains attract each other. In protoplanetary disks, such charging and resultant attraction may be a critical ingredient for rocky planet formation.



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.

Staff scientists at IST Austria

Robert Hauschild

Bioimaging Facility

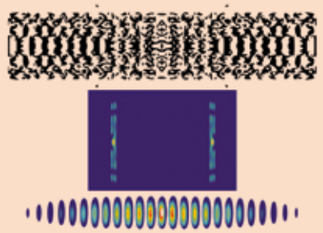
Robert Hauschild brings expertise in imaging, optical engineering, automation, and image analysis to IST Austria. Affiliated to the Bioimaging Facility, he collaborates with scientists from different fields to develop innovative solutions for unique microscopy problems, including designing and building new equipment and software.

Currently, a surge of new and diverse microscopy methodologies can be observed. State-of-the-art microscopy not only deals with the physics of imaging but incorporates automation, system control as well as an entire image analysis pipeline. Which methods provide valuable read-outs and meet the demands set by the samples under study is a difficult question to answer. Hauschild's main goal is to provide all research groups on campus with access to cutting-edge microscopy techniques. This involves the evaluation of commercially available equipment, custom modifications to hardware and software, sample feedback and control in conjunction with the implementation of complete user-friendly setups. An illustrative example for this is a UV ablation system that has been used by many researchers on campus (Heisenberg, Sixt, Siekhaus, Friml, Benkova, Schur, Guet, and Kicheva groups) and attracted several academic visitors. Originally devised to study stress in tissue, it has since found application in a diverse array of assays (wound healing, cell migration, photo patterning, 3D structuring, and laser capture). The system has spawned more specialized successor setups and led to two patent applications.

Current projects Image analysis and quantification of immune cell morphodynamics (Sixt group) | Automatic design and tuning of nanowire devices (Katsaros group) | 3D structural analysis of peripheral lymph node conduits and associated cell populations (Sixt group) | Analysis of the spatial distribution and intensity of pSMAD2/3 signaling between blastoderm explants and embryos at different developmental stages (Heisenberg group)

Career
- since 2010 Staff scientist, IST Austria
- 2007 – 2010 System engineer for laser scanning microscopes, Zeiss MicroImaging, Jena, Germany
- 2006 – 2007 Postdoc, Karlsruhe Institute of Technology, Germany
- 2006 PhD, Karlsruhe Institute of Technology, Germany

Holographic mask, diffraction pattern, and resulting light sheet (top to bottom)



Walter Kaufmann

Electron Microscopy Facility

When scientists at IST Austria are interested in applying advanced 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, staff scientist with the Electron Microscopy (EM) Facility on campus.

Kaufmann's focus is on the ultrastructural analysis of biological tissues and cells and the high-resolution localization of transmembrane proteins. He investigates their cell-type specific expression, subcellular localization and association with micro- and nanodomains, applies state-of-the-art electron microscopy techniques and develops new sample preparation procedures. Key methodologies performed are pre- and post-embedding immunogold EM, 3D serial section TEM, electron tomography (3D STEM), high-pressure freezing plus freeze-substitution, platinum-replica EM, and freeze-fracture replica labeling. Main current collaborations are within the fields of structural and molecular neurosciences (Shigemoto, Jonas, Siegert, and Danzl groups), immune cell morphodynamics (Sixt group), cell biology of plants (Friml group) and morphogenesis in development (Heisenberg group).

Current projects Ultrastructural analysis of Cav2.1 voltage-gated calcium channels in relation to vesicle fusion sites at fast and slow neuron synapses (Shigemoto and Jonas groups) | High-resolution localization of TPLATE and role of actin in clathrin-mediated endocytosis (Friml group) | 3D structural analysis of peripheral lymph node conduits and associated cell populations (Sixt group) | Electron tomography of cadherin-mediated progenitor cell-cell junctions (Heisenberg group) | Effects of KXA administration on microglia and the perineuronal net (Siegert group)

Career

- since 2013 Staff scientist, IST Austria
- 2013 Habilitation in Neurosciences, Innsbruck Medical University, Austria
- 2004 – 2013 Research Scientist, Innsbruck Medical University, Austria
- 2002 – 2004 Postdoc, Centre for Molecular Biology and Neuroscience, Oslo, Norway
- 1997 – 2002 Postdoc, Innsbruck Medical University, Austria
- 1997 PhD, Leopold-Franzens University Innsbruck, Austria

Jack Merrin

Nanofabrication Facility

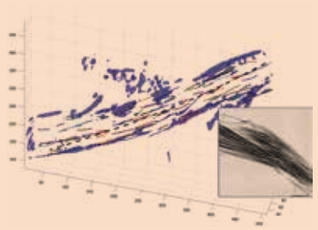
Microfluidics involves the experimental manipulation of fluids and objects such as live cells on small length scales. Nanofabrication Facility staff scientist Jack Merrin develops novel and innovative systems to study diverse biophysical phenomena together with various groups at IST Austria.

Transparent microfluidic devices are ideal for single-cell analysis, cell culture and micro-environmental control—all while performing microscopy. Hydraulic pressure and integrated valves allow the precise spatiotemporal control of flow through devices. Rapidly shifting the chemical environment in seconds reveals that the rapid growth rate response of plant roots to auxin hormone is faster than transcription. Chemotaxis studies involving dendritic cells show how cells can respond either to immobilized or diffusible gradients. Using geometries such as mazes, constrictions and serrated channels, the Sixt group found that dendritic cells move through the path of least resistance to protect the nucleus and can also move by pushing off irregular geometries in the absence of cell adhesion.

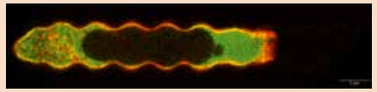
Current projects Immobilization arrays, imaging, sorting, and stimulation of *C. elegans* (de Bono group) | Fluid handling for high resolution microscopy (Danzl group) | Spatiotemporal control of *A. thaliana* root growth (Friml group) | Single-cell lineage microfluidics of *E. coli* and image analysis (Guet group) | Measurement of mutation rates and chaotic behavior in bouncing silicone oil droplets (Hof group) | Optically transparent microwells for cell-cell contact developmental studies (Heisenberg group) | Micropatterned chrome grids on glass for *in vitro* membrane biochemistry (Loose group) | Spatiotemporal control of chemotactic gradients for neutrophils and dendritic cells, cancer cell migration in post arrays, migration and chemotaxis through obstacles and mazes (Sixt group)

Career

- since 2013 Staff scientist, IST Austria
- 2012 Postdoc, Memorial Sloan Kettering Cancer Center, New York, USA
- 2009 – 2011 Postdoc, Rockefeller University, New York, USA
- 2007 – 2009 Postdoc, Joseph Fourier University, Grenoble, France
- 2006 PhD, Princeton University, New Jersey, USA



Electron tomogram of a mouse peripheral lymph node conduit, macerated and segmented for collagen fibrils (in collaboration with Sixt group). Inset: original STEM-BF image using the JEM 2800 STEM, 0° single plane



Dendritic cells adapt their shape to an irregular shaped microchannel and can push off the walls to move forward.

Ivan Prieto

Nanofabrication Facility

Ivan Prieto is an expert in nanofabrication, material science and optoelectronics. His work as staff scientist at the Nanofabrication Facility centers 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, Prieto has focused on fabrication and optimization of silicon photonic crystal cavities. Such low loss cavities are used to confine light of a certain frequency into a volume that is only of the order of the wavelength cubed. Both the waveguide coupling and the cavity quality factor (Q) are very sensitive to fabrication imperfections such as uncontrolled shape or sidewall roughness on the nanometer scale. In collaboration with the Katsaros group, Prieto has focused on improving the fabrication of devices out of Ge hole gases with the aim to create quantum dot devices as well as Josephson field effect transistors. He has also performed simulations in order to determine the strain status of semiconductor devices.

Current projects Silicon photonic electro-optomechanical transducers (Fink group) | Suspended high impedance circuits (Fink group) | Hole spin qubits in Ge quantum wells (Katsaros group)

Career

- since 2018 Staff scientist, IST Austria
- 2017 – 2018 Process Development Manager, G-ray Medical Sarl, Switzerland
- 2014 – 2017 Postdoc, ETH Zurich & Empa, Switzerland
- 2014 PhD, Instituto de Microelectrónica, Madrid, Spain

Christoph Sommer

Bioimaging Facility

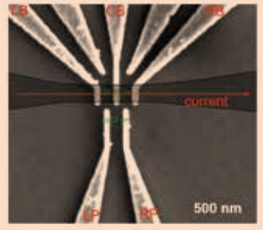
Christoph Sommer is an expert in image analysis and has significant experience in creating software to automate image analysis. His work focuses on the interface of computer science and biology, where he develops and establishes new technology for computer-aided image and video analyses in collaboration with various research groups.

In collaboration with the Danzl and Friml groups, Sommer established expansion microscopy for plants. He was able to show that super-resolution imaging of expanded plant tissue enables novel biological assays far beyond the diffraction limit. Together with the Loose group, he established a novel method for quantifying filament dynamics in *in vitro* experiments of treadmilling cytoskeletal proteins, which aids better understanding of protein (self-)organization on a molecular level. Together with the Novarino group, Sommer characterized increased actin filament disorganization in mutant neural progenitor cells, proving consistency with complementary results from proteome analysis. Ant tracking and identification of individual ants over the course of a multi-day experiment enables the study of many aspects of social immunology in ant colonies. With the Cremer group, Sommer is working on extending earlier results for ant identification based on custom color tags and deep learning.

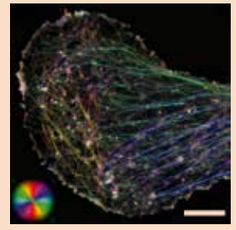
Current projects Expansion microscopy in plants (Friml and Danzl groups) | Microglia profiling (Novarino group) | Transcriptomics image analysis (Danzl group) | Treadmilling filaments (Loose group) | Ant identification (Cremer group) | Cell blebbing analysis (Heisenberg group)

Career

- since 2017 Staff scientist, IST Austria
- 2013 – 2017 Staff scientist, Institute of Molecular Biology Austria (IMBA), Vienna, Austria
- 2011 – 2013 Postdoc, ETH Zurich, Switzerland
- 2010 – 2011 Postdoc, Heidelberg Collaboratory for Image Processing (HCI), Germany
- 2010 PhD, University of Heidelberg, Germany



Double quantum dot device fabricated from a SiGe/Ge/SiGe heterostructure



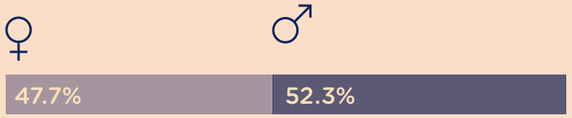
Actin filaments of a lamellipodium, color-coded by their orientation angle (scale bar: 5 µm; in collaboration with Danzl and Novarino groups)

Interns at IST Austria
(throughout 2019; percentages are rounded)

ISTerns (summer interns)

Total number of ISTerns: 44

Gender among ISTerns



Country of nationality

Russia	18.2%
Iran	13.6%
India	9.1%
Spain	9.1%
China	4.5%
Other (20*)	45.5%

Country of current institution

UK	20.5%
Russia	18.2%
Iran	13.6%
India	9.1%
Austria	6.8%
Spain	6.8%
USA	6.8%
Other (8*)	18.2%

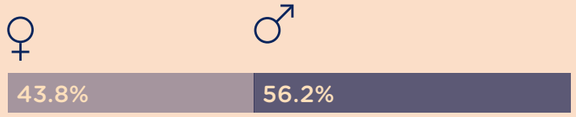
Field of research at IST Austria

Physics	25.1%
Biology	22.7%
Computer science	22.7%
Mathematics	13.6%
Neuroscience	13.6%
Chemistry	2.3%

Scientific interns at IST Austria

Total number of scientific interns: 64

Gender among scientific interns



Country of nationality

Iran	15.6%
Austria	14.0%
India	12.5%
Germany	7.8%
Russia	6.3%
Spain	6.3%
Other (15*)	37.5%

Country of current institution

Austria	21.8%
Iran	12.5%
Germany	9.3 %
India	7.8%
Russia	6.3%
UK	6.3%
France	6.3%
Other (15*)	29.7%

Field of research at IST Austria

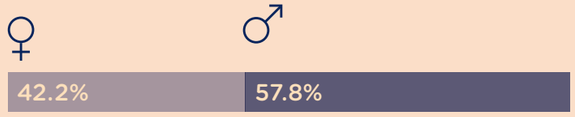
Biology	32.8%
Computer science	28.1%
Physics	18.8%
Neuroscience	12.5%
Mathematics	4.7%
Chemistry	3.1%

* Number of countries

PhD students at IST Austria
(as of December 31, 2019; percentages are rounded)

Total number of PhD students: 223

Gender among PhD students



Country of nationality

Austria	21.1%
Germany	7.2%
India	7.2%
Italy	6.7%
Slovakia	5.8%
Other (45*)	52.0%

Country of previous (BS or MA) institution

Austria	22.0%
UK	9.9%
Germany	8.5%
India	5.8%
Czech Republic	5.8%
Other (37*)	48.0%

Field of research at IST Austria

Biology	30.5%
Physics	12.6%
Neuroscience	11.2%
Computer science	10.3%
Mathematics	7.2%
Chemistry	0.4%
Unaffiliated**	27.8%

* Number of countries

** In fall 2019, a cohort of 61 PhD students joined IST Austria, who, after one year, need to pass a qualifying exam to be affiliated with at least one research group/field of research.

2019 PhD graduates

This year, 18 students completed their PhDs, bringing the total number of graduates to 81. The 2019 graduates—with their group affiliations and dissertation titles—are listed below.

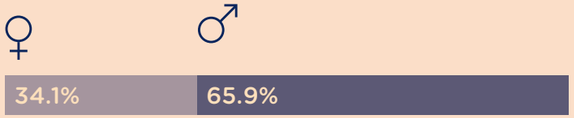
Frank Assen, *Sixt group:* "Lymph node mechanics: Deciphering the interplay between stroma contractility, morphology and lymphocyte trafficking"
Barbara Casillas Perez, *Cremer group:* "Collective defenses of garden ants against a fungal pathogen"
Sarah Cepeda Humerez, *Tkačik group:* "Estimating information flow in single cells"
Claudia Espinoza Martinez, *Jonas group:* "Parvalbumin+ interneurons enable efficient pattern separation in hippocampal microcircuits"
Mirco Giacobbe, *Henzinger group:* "Automatic time-unbounded reachability analysis of hybrid systems"
Claudia Igler, *Guet group:* "On the nature of gene regulatory design—the biophysics of transcription factor binding shapes gene regulation"
Karola Käfer, *Csicsvari group:* "The hippocampus and medial prefrontal cortex during flexible behavior"
Damaris Ketino Rangel Guerrero, *Csicsvari group:* "The role of CCK-interneurons in regulating hippocampal network dynamics"
Aglaja Kopf, *Sixt group:* "The implication of cytoskeletal dynamics on leukocyte migration"
Martin Lukačišin, *Bollenbach group:* "Quantitative investigation of gene expression principles through combinatorial drug perturbation and theory"
Marta Lukačišinová, *Bollenbach group:* "Genetic determinants of antibiotic resistance evolution"
Madhumitha Narasimhan, *Friml group:* "Clathrin-mediated endocytosis, post endocytic trafficking and their regulatory controls in plants"
Chaitanya Paranjape, *Hof group:* "Onset of turbulence in plane Poiseuille flow"
Roshan Prizak, *Tkačik group:* "Coevolution of transcription factors and their binding sites in sequence space"
Dominik Schröder, *Erdős group:* "From Dyson to Pearcey: Universal statistics in random matrix theory"
Katarina Valoskova, *Siekhaus group:* "The role of a highly conserved major facilitator superfamily member in *Drosophila* embryonic macrophage"
Mina Vasileva, *Friml group:* "Molecular mechanisms of endomembrane trafficking in *Arabidopsis thaliana*"
Stephan Zhechev, *Wagner group:* "Algorithmic aspects of homotopy theory and embeddability"

Postdocs at IST Austria

(as of December 31, 2019; percentages are rounded)

Total number of postdocs: 179

Gender among postdocs



Country of nationality

Germany	12.3%
Italy	10.0%
China	6.7%
Russia	5.6%
Austria	5.6%
Other (40*)	59.8%

Country of PhD institution

Germany	17.3%
Austria	15.1%
USA	8.9%
UK	7.3%
Switzerland	5.0%
Other (27*)	46.4%

Field of research at IST Austria

Biology	31.9%
Physics	21.8%
Neuroscience	20.1%
Mathematics	15.6%
Computer science	8.9%
Chemistry	1.7%

* Number of countries

IST Austria alumni network

(as of December 31, 2019; data are self-reported by members of the IST Austria alumni network, actual counts may be higher; percentages are rounded)

Total number of alumni: 326

PhD graduates	81
Postdocs (at least one year spent at IST Austria)	245

Country of nationality

Germany	13.5%
Austria	9.8%
China	6.8%
Czech Republic	5.5%
France	4.9%
Other (46*)	59.5%

Current country of employment

Austria	19.9%
Germany	12.6%
USA	9.5%
UK	7.7%
Switzerland	5.5%
Other (27*)	44.8%

Alumni by employment sector

Academia	65.0%
Business and industry	20.9%
Public service	2.1%
NGO/Non-profit	0.3%
Unknown	11.7%

* Number of countries/Unknown

Scientific Service Units at IST Austria

Scientific Service Units (SSUs) currently operational at IST Austria:

- Bioimaging Facility
- Electron Microscopy Facility
- Nanofabrication Facility
- Library
- Life Science Facility
- Miba Machine Shop
- Preclinical Facility
- Scientific Computing

Administration at IST Austria

Administration at IST Austria comprises the following areas:

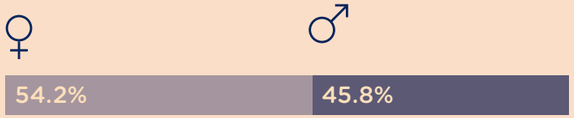
- Academic Affairs
- Campus IT Services
- Campus Services
- Communications & Events
- Construction & Maintenance
- Environment, Health & Safety
- Executive Affairs
- Finance
- Graduate School Office
- Grant Office
- Human Resources
- Office of the President
- Technology Transfer Office

Technical support at IST Austria

(Scientific Service Units and laboratory technicians; as of December 31, 2019; percentages are rounded)

Total number of technical support staff: 120

Gender among technical support staff



Country of nationality

Austria	42.5%
Germany	8.3%
Hungary	5.8%
Italy	4.2%
Poland	3.3%
Russia	3.3%
Other (24*)	32.5%

Administrative staff at IST Austria

(as of December 31, 2019; percentages are rounded)

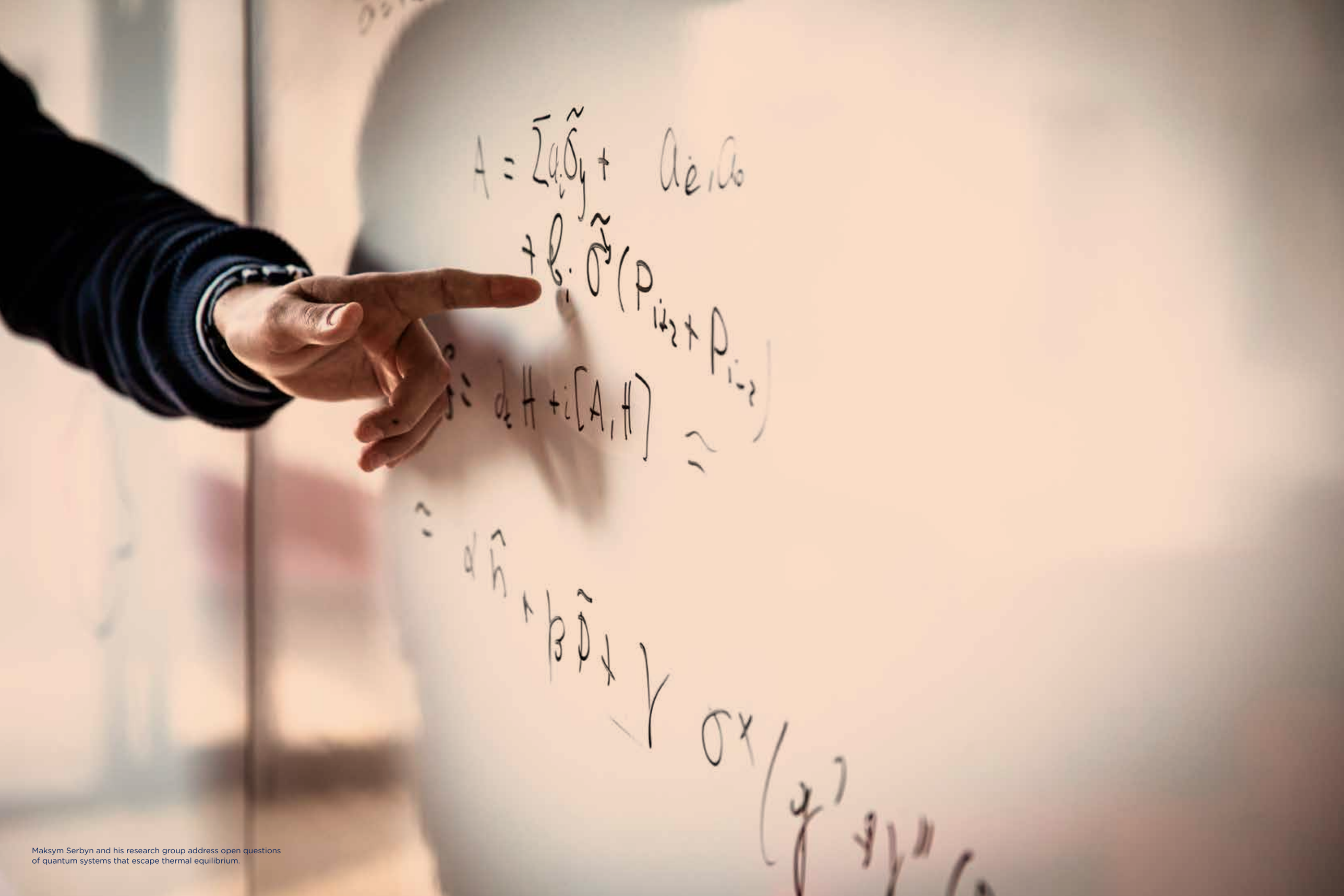
Total number of administrative staff: 166

Gender among administrative staff

Country of nationality

Austria	71.7%
Germany	3.6%
Romania	3.0%
Ireland	1.8%
Poland	1.8%
UK	1.8%
Other (23*)	16.3%

* Number of countries



Maksym Serbyn and his research group address open questions of quantum systems that escape thermal equilibrium.

Grants 2019

(active or received in 2019; funding amounts are rounded)

Alistarh group
- Coordination in constrained and natural distributed systems, H2020 MSCA IF, €174’000, 6/19-5/21
- Elastic coordination for scalable machine learning, H2020 ERC StG, €1’494’000, 3/19-2/24
- Algorithms for a computational revolution, SNF Ambizione, €67’000, 10/18-8/19

Barton group
- The maintenance of alternative adaptive peaks in snapdragons, FWF Stand-alone, €404’000, 03/20-02/23
- Theoretical and empirical approaches to understanding parallel adaptation, H2020 MSCA IF, €166’000, 9/18-11/20
- Sex chromosomes and species barriers, FWF Meitner, €169’000, 6/18-5/20
- Rate of adaptation in changing environment, H2020 MSCA IF, €166’000, 1/17-6/20

Benková group
- Plant tropisms, FFG FEMtech, €8’000, 01/20-07/20
- Hormonal regulation of plant adaptive responses to environmental signals, ÖAW DOC, €116’000, 9/18-8/21
- Molecular mechanisms of the cytokinin regulated endomembrane trafficking to coordinate plant organogenesis, ÖAW DOC, €116’000, 8/17-7/20

Bernecky group
- Roles of A-to-I editing in dsRNA recognition, FWF SFB, €244’000, 3/20-2/24

Bickel group
- Automatized design of injection molds, H2020 ERC PoC, €150’000, 6/19-11/20
- MATERIALIZABLE: Intelligent fabrication-oriented computational design and modeling, H2020 ERC StG, €1’498’000, 2/17-1/22
- Soft-bodied intelligence for manipulation, H2020 Cooperation ICT, €261’000, 5/15-4/19

Browning group
- Local-global principles and zero-cycles, H2020 MSCA IF, €174’000, 10/19-9/21
- New frontiers of the Manin conjecture, FWF Stand-alone, €362’000, 10/19-9/22
- EPSRC ad personam fellowship – Nicholas Rome, EPSRC PG scholarship, €11’000, 8/19-3/20
- EPSRC ad personam fellowship – Adelina Mânzățeanu, EPSRC PG scholarship, €8’000, 10/18-3/19
- Between rational and integral points, EPSRC Research Grant, €114’000, 9/18-11/20

Chatterjee group
- Formal methods for stochastic models: algorithms and applications, H2020 ERC CoG, €1’998’000, 10/20-09/25
- Quantitative analysis of probabilistic systems with a focus on crypto-currencies, ÖAW DOC, €96’000, 6/19-2/22
- Quantitative game-theoretic analysis of blockchain applications and smart contracts, IBM PhD Fellowship Award, €16’000, 9/18-5/19
- Efficient algorithms for computer aided verification, WWTF Cooperation project, €82’000, 3/16-6/21
- Game theory, FWF NFN, €330’000, 3/15-8/19
- Microsoft Research Faculty Fellowship, Microsoft Research Studio Award, €143’000, 4/11-3/21

Cremer group
- Epidemics in ant societies on a chip, H2020 ERC CoG, €1’992’000, 4/18-3/23

Csicsvari group
- The brainstem-hippocampus network uncovered: dynamics, reactivation and memory consolidation, H2020 MSCA IF, €174’000, 8/19-7/21
- Interneuro plasticity during spatial learning, FWF International program, €299’000, 2/18-1/21

Danzl group
- High content imaging to decode human immune cell interactions in health and allergic disease, NFB Life Science, €279’000, 12/19-11/22
- UltraX – achieving sub-nanometer resolution in light microscopy using iterative X10 microscopy in combination with nanobodies and STED, EMBO LTF, €81’000, 8/19-8/21
- Molecular drug targets, FWF DK, €193’000, 3/19-2/23
- High-speed 3D-nanoscopy to study the role of adhesion during 3D cell migration, HFSP LTF, €144’000, 7/18-6/21
- Optical control of synaptic function via adhesion molecules, FWF International program, €287’000, 3/18-2/21

de Bono group
- Control of gene expression at the endoplasmic reticulum, EMBO LTF, €83’000, 10/19-9/21
- Molecular mechanisms of neural circuit function, Wellcome Trust Investigator Award, €1’223’000, 10/19-3/23

Edelsbrunner group
- Algebraic footprints of geometric features in homology, FWF International program, €234’000, 10/19-9/22
- The Wittgenstein Prize – Herbert Edelsbrunner, FWF Wittgenstein, €1’400’000, 7/19-6/24
- Alpha shape theory extended, H2020 ERC AdG, €1’678’000, 7/18-6/23
- Topological data analysis for a faster discovery of new materials, Royal Society International Exchanges Scheme, €11’000, 12/17-12/19
- Toward computational information topology, ONR Grant Award, €326’000, 11/17-4/19
- Persistence and stability of geometric complexes, FWF International program, €154’000, 9/16-8/20

Erdös group
- Geometric study of Wasserstein spaces and free probability, H2020 MSCA IF, €186’000, 10/19-9/21
- Structured non-hermitian random matrices, FWF Meitner, €161’000, 1/17-1/20
- Random matrices, universality and disordered quantum systems, FP7 ERC AdG, €1’755’000, 3/14-8/19

Fink group
- Quantum readout techniques and technologies, H2020 Cooperation FET-Open, €388’000, 11/19-10/22
- Controllable collective states of superconducting qubit ensembles, ÖAW DOC, €77’000, 10/19-9/21
- Integrating superconducting quantum circuits, FWF SFB, €429’000, 3/19-2/23
- Coherent on-chip conversion of superconducting qubit signals from microwaves to optical frequencies, ÖAW DOC, €96’000, 7/18-12/20
- A fiber optic transceiver for superconducting qubits, H2020 ERC StG, €1’500’000, 2/18-1/23
- Hybrid semiconductor-superconductor quantum devices, NOMIS Research Grants, €700’000, 9/17-8/21
- Hybrid optomechanical technologies, H2020 Cooperation FET-Proactive, €548’000, 1/17-12/20

Friml group
- A case study of plant growth regulation: Molecular mechanism of auxin-mediated rapid growth inhibition in *Arabidopsis* root, ÖAW DOC, €77’000, 10/19-9/21
- Cell surface receptor complexes for PIN polarity and auxin-mediated development, ÖAW DOC, €116’000, 3/19-2/22
- Molecular mechanisms of endocytic cargo recognition in plants, FWF International program, €339’000, 2/18-1/22
- Tracing evolution of auxin transport and polarity in plants, H2020 ERC AdG, €2’410’000, 1/18-12/22
- RNA-directed DNA methylation in plant development, FWF Stand-alone, €352’000, 7/17-6/21
- Cell surface receptor complexes for auxin signaling in plants, EMBO LTF, €75’000, 6/17-5/19
- Körber European Science Prize, Körber Foundation, €41’000, 4/15-3/20

Guet group
- CyberCircuits: Cybergenetic circuits to test composability of gene networks, FWF International program, €262’000, 4/19-3/22
- Bacterial toxin-antitoxin systems as antiphage defense mechanisms, FWF Richter, €230’000, 2/19-7/21
- Biophysically realistic genotype-phenotype maps for regulatory networks, ÖAW DOC, €77’000, 9/18-8/20
- UPEC-DC interaction, FFG FEMtech, €8’000, 9/18-2/19
- Light-regulated ligand traps for spatio-temporal inhibition of cell signaling, ÖAW DOC, €116’000, 8/17-7/20

Hannezo group
- Design principles of branching morphogenesis, H2020 ERC StG, €1’453’000, 7/20-6/25
- EMBO Young Investigator, EMBO, €15’000, 1/20-12/23
- Active mechano-chemical description of the cell cytoskeleton, FWF Stand-alone, €339’000, 10/18-9/21

Hausel group
- Algebro-geometric applications of factorization homology, FWF Meitner, €159’000, 9/19-8/21

Heisenberg group
- Mesendoderm specification in zebrafish: The role of extraembryonic tissues, ÖAW DOC, €77’000, 6/19-5/21
- Mechanosensation in cell migration: The role of friction forces in cell polarization and directed migration, EMBO LTF, €79’000, 2/19-1/21
- Tissue material properties in embryonic development, FWF Richter, €184’000, 2/19-1/21
- Coordination of mesendoderm fate specification and internalization during zebrafish gastrulation, HFSP LTF, €144’000, 9/18-8/21
- Control of embryonic cleavage pattern, FWF International program, €229’000, 5/18-4/21
- Nano-analytics of cellular systems, FWF DK, €197’000, 3/18-2/22
- Interaction and feedback between cell mechanics and fate specification in vertebrate gastrulation, H2020 ERC AdG, €2’307’000, 7/17-6/22
- Control of epithelial cell layer spreading in zebrafish, FWF International program, €350’000, 2/17-1/20

Henzinger group
- Formal methods meets algorithmic game theory, FWF Meitner, €153’000, 2/18-1/20
- Modern concurrency paradigms, FWF NFN, €490’000, 3/15-8/19
- The Wittgenstein Prize – Thomas A. Henzinger, FWF Wittgenstein, €1’500’000, 1/14-12/20
- Automated tutoring system for automata theory, Microsoft Research Studio Award, €7’000, 1/11-12/21

Hippenmeyer group
- Molecular mechanisms of neural stem cell lineage progression, FWF SFB, €373’000, 03/20-02/24
- Role of Eed in neural stem cell lineage progression, FWF Firnberg, €234’000, 12/18-11/21
- Molecular mechanisms regulating gliogenesis in the cerebral cortex, FWF Meitner, €166’000, 3/18-2/20
- Principles of neural stem cell lineage progression in cerebral cortex development, H2020 ERC CoG, €1’996’000, 12/17-11/22
- Molecular mechanisms of radial neuronal migration, ÖAW DOC, €116’000, 8/17-7/20

Hof group
- Instabilities in pulsating pipe flow of Newtonian and complex fluids, FWF International Programme, €357’000, 1/20–12/22
- Revisiting the turbulence problem using statistical mechanics: Experimental studies on transitional and turbulent flows, Simons Foundation MPS Targeted Grants, €872’000, 9/19-8/23

Jonas group
- Development of nanodomain coupling between Ca^{2+} channels and release sensors at a central inhibitory synapse, ÖAW DOC, €77’000, 10/19-9/21
- Intracellular hippocampal attractor dynamics, FWF Firnberg, €239’000, 9/19-8/22
- Structural plasticity at mossy fiber-CA3 synapses, FWF Richter, €113’000, 1/19-3/20
- The Wittgenstein Prize – Peter Jonas, FWF Wittgenstein, €1’500’000, 10/17-9/22
- Biophysics and circuit function of a giant cortical glumatergic synapse, H2020 ERC, AdG, €2’678’000, 3/17-2/22
- Zellkommunikation in Gesundheit und Krankheit, FWF DK, €143’000, 1/16-6/20

Jösch group
- Evolution of sensorimotor transformation across diptera, DFG SPP, €187’000, runtime: 36 months
- Neuronal networks of salience and spatial detection in the murine superior colliculus, HFSP LTF, €144’000, 9/18-8/21
- Circuits of visual attention, H2020 ERC StG, €1’447’000, 12/17-11/22

Katsaros group
- Topologically protected and scalable quantum bits, H2020 Cooperation FET-Open, €504’000, 12/19-11/22
- Towards scalable hut wire quantum devices, FWF Stand-alone, €407’000, 10/19-9/23
- Majorana bound states in Ge/SiGe heterostructures, H2020 MSCA IF, €174’000, 4/19-3/21
- Materials characterization of hybrid semi-super Majorana nanowires, Microsoft Project, €208’000, 7/18-6/19
- Hole spin orbit qubits in Ge quantum wells, FWF Stand-alone, €400’000, 2/18-1/22
- Hybrid semiconductor-superconductor quantum devices, NOMIS Research Grants, €700’000, 9/17-8/21
- Loch Spin-Qubits und Majorana-Fermionen in Germanium, FWF START, €200’000, 7/16-10/20

Kicheva group
- Morphogen control of growth and pattern in the spinal cord, FWF SFB, €375’000, 03/20-02/24
- The role of morphogens in the regulation of neural tube growth, ÖAW DOC, €116’000, 10/18-11/21
- Kinetics of DNA repair in neural differentiation of embryonic stem cells, OeAD WTZ, €7’000, 7/17-6/19
- Coordination of patterning and growth in the spinal cord, H2020 ERC StG, €1’499’000, 7/16-6/21

Kolmogorov group
- Discrete optimization in computer vision: theory and practice, FP7 ERC CoG, €1’642’000, 6/14-5/20

Kondrashov group
- Characterizing the fitness landscape on population and global scales, H2020 ERC CoG, €1’998’000, 1/19-12/23

Lemeshko group
- A path-integral approach to composite impurities, FWF Meitner, €169’000, 2/19-1/21
- Angulon: physics and applications of a new quasiparticle, H2020 ERC StG, €1’500’000, 2/19-1/24
- Quantum rotations in the presence of a many-body environment, FWF Stand-alone, €318’000, 2/17-1/20

Loose group
- EMBO Young Investigator, EMBO, €15’000, 1/20-12/23
- Reconstitution of bacterial cell division using purified components, BIF PhD fellowship, €46’000, 9/17-8/19
- Reconstitution of cell polarity and axis determination in a cell-free system, HFSP Young investigators’ grant, €300’000, 10/16-9/20
- Reconstitution of bacterial cell wall synthesis, HFSP LTF, €157’000, 6/16-5/19
- Self-organization of the bacterial cell, H2020 ERC StG, €1’497’000, 4/16-3/21

Maas group
- Singular stochastic PDEs, FWF Meitner, €169’000, 10/18-2/20
- Dissipation and dispersion in nonlinear partial differential equations, FWF DK, €161’000, 3/17-2/21
- Taming complexity in partial differential systems, FWF SFB, €328’000, 3/17-2/21
- Optimal transport and stochastic dynamics, H2020 ERC StG, €1’075’000, 2/17-1/22

Mondelli group
- Prix Lopez-Loreta 2019 – Marco Mondelli, Fondation Lopez Loreta, €1’000’000, 9/20-8/25

Novarino group
- Neural stem cells in autism and epilepsy, FWF SFB, €375’000, 03/20-02/24
- Identification of converging molecular pathways across chromatinopathies as targets for therapy, FWF International program, €357’000, 4/19-3/22
- Probing the reversibility of autism spectrum disorders by employing *in vivo* and *in vitro* models, H2020 ERC StG, €1’498’000, 10/17-9/22
- Improving brain distribution of drugs targeted to the brain, NFB Life Science, €23’000, 12/16-11/19
- Probing development and reversibility of autism spectrum disorders, Simons Foundation Pilot, €267’000, 9/16-8/19
- Molecular drug targets, FWF DK, €223’000, 3/15-2/23

Pietrzak group
- Teaching old crypto new tricks, H2020 ERC CoG, €1’882’000, 4/16-3/21

Sazanov group
- Structural characterization of *E. coli* complex I: an important mechanistic model, ÖAW DOC, €77’000, 12/19-11/21
- Revealing the functional mechanism of Mrp antiporter, an ancestor of complex I, ÖAW DOC, €116’000, 8/17-7/20
- Deciphering the proton-translocation mechanism of complex I, FWF Meitner, €162’000, 6/17-1/19

Schur group
- NÖ-Fonds Preis für die Jungforscherin des Jahres am IST Austria – Bettina Zens, NÖEF, €30’000, 1/19-12/19
- Structural conservation and diversity in retroviral capsid, FWF Stand-alone, €381’000, 10/18-9/21
- Protein structure and function in filopodia across scales, FWF Meitner, €169’000, 7/18-6/20

Seiringer group
- Analysis of quantum many-body systems, H2020 ERC AdG, €1’498’000, 10/16-9/21

Serbyn group
- Non-ergodic quantum matter: universality, dynamics and control, H2020 ERC StG, €1’498’000, 2/20-1/25

Shigemoto group
- LGI1 antibody-induced pathophysiology in synapses, FWF International program, €256’000, 1/20-12/22
- Recombinant immunolabels for nanoprecise brain mapping across scales, NIH U24, €235’000, 9/18-6/24
- Plasticity in the cerebellum: Which molecular mechanisms are behind physiological learning?, ÖAW DOC €116’000, 9/18-8/21
- Human Brain Project Specific Grant Agreement 2 (HBP SGA 2), H2020 Cooperation FET-Flagships, €223’000, 4/18-3/20
- Ultrastructural analysis of phosphoinositides in nerve terminals: distribution, dynamics and physiological roles in synaptic transmission, H2020 MSCA IF, €178’000, 4/18-3/20
- *In situ* analysis of single channel subunit composition in neurons: physiological implication in synaptic plasticity and behavior, H2020 ERC AdG, €2’481’000, 7/16-6/21

Siegert group
- Modulating microglia through G protein-coupled receptor (GPCR) signaling, ÖAW DOC, €116’000, 9/18-8/21
- Microglia action towards neuronal circuit formation and function in health and disease, H2020 ERC StG, €1’500’000, 5/17-4/22

Siekhaus group
- Modeling epithelial tissue mechanics during cell invasion, FWF Meitner, €153’000, 1/18-12/19
- Investigating the role of the novel major superfamily facilitator transporter family member MFSD1 in metastasis, NFB Life Science, €251’000, 8/17-7/20
- Tissue barrier penetration is crucial for immunity and metastasis, ÖAW DOC, €116’000, 8/17-7/20
- *Drosophila* TNFa´s Funktion in Immunzellen, FWF Stand-alone, €346’000, 11/16-10/19

Sixt group
- Decoding GPCR signaling to understand chemotaxis, FWF Firnberg, €239’000, 9/19-8/22
- Nano-analytics of cellular systems, FWF DK, €197’000, 3/18-2/22
- Spatiotemporal regulation of chemokine-induced signaling in leukocyte chemotaxis, Finnish Found PD Pool postdoctoral fellowship, €102’000, 7/17-7/19
- Quantitative understanding of a cellautonomous component in chemotaxis, EMBO LTF, €76’000, 7/17-6/19
- Cellular navigation along spatial gradients, H2020 ERC CoG, €1’985’000, 4/17-3/22
- Mechanical adaptation of lamellipodial actin, FWF Stand-alone, €387’000, 3/17-2/20
- Mechanical adaptation of lamellipodial actin networks in migrating cells, H2020 MSCA IF, €178’000, 3/17-2/19

Tkačik group
- Can evolution minimize spurious signaling crosstalk to reach optimal performance?, HFSP Program grant, €269’000, 12/18-11/21

Vicoso group
- Sex determination in termites, FWF Meitner, €156’000, 5/18-3/21
- Prevalence and influence of sexual antagonism on genome evolution, H2020 ERC StG, €1’444’000, 3/17-2/22

Wagner group
- Algorithms for embeddings and homotopy theory, FWF Stand-alone, €396’000, 5/18-4/22
- Eliminating intersections in drawings of graphs, FWF Meitner, €162’000, 7/17-6/19

Waitukaitis group
- The active dynamics of the elastic Leidenfrost effect, NWO Veni, €24’000, 8/19-3/20

Wojtan group
- Efficient simulation of natural phenomena at extremely large scales, H2020 ERC StG, €1’500’000, 3/15-2/20

Abbreviations

BIF … Boehringer Ingelheim Fonds
DFG ... Deutsche Forschungsgemeinschaft / German Research Foundation
SPP ... Schwerpunktprogramm / Priority Program
EMBO … European Molecular Biology Organization
LTF … Long-Term Fellowship
EPSRC … Engineering and Physical Sciences Research Council, UK
FFG … Österreichische Forschungsförderungsgesellschaft / Austrian Research Promotion Agency
FP7 … Seventh Framework Programme for Research and Technological Development 2007-2013, European Union
FWF … Fonds zur Förderung der wissenschaftlichen Forschung / Austrian Science Fund
DK … Doktoratskolleg / Doctoral Programme
NFN … Nationales Forschungsnetzwerk / National Research Network
SFB … Spezialforschungsbereiche / Special Research Programmes
H2020 … Horizon 2020, European Union*
FET … Future and Emerging Technologies
ERC … European Research Council, European Union
AdG … Advanced Grant
CoG … Consolidator Grant
PoC … Proof of Concept
StG … Starting Grant
ICT … Information and Communication Technologies
MSCA IF … Marie Sklodowska-Curie Individual Fellowship
HFSP … Human Frontier Science Program
LTF … Long-Term Fellowship
MPS … Mathematical and Physical Sciences
NFB … NÖ Forschung & Bildung / Lower Austrian Research and Education, Austria
NIH … National Institutes of Health, USA
NÖEF … Niederösterreich Fonds
NWO … Nederlandse Organisatie voor Wetenschappelijk Onderzoek / Dutch Research Council
OeAD … Österreichischer Austauschdienst / Austrian Agency for International Cooperation in Education and Research
WTZ … Wissenschaftlich-Technische Zusammenarbeit / Scientific & Technological Cooperation
ÖAW … Österreichische Akademie der Wissenschaften/Austrian Academy of Sciences
ONR … Office of Naval Research, USA
PG … postgraduate
SNF … Swiss National Science Foundation
WWTF … Wiener Wissenschafts-, Forschungs- und Technologiefonds / Vienna Science and Technology Fund, Austria

* Horizon 2020 equals FP8, the eighth Framework Programme for Research and Technological Development 2014-2020, European Union

Publications 2019

(joint publications involving several groups are listed multiple times)

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Events 2019

Scientific conferences, workshops and symposia (selection)

Date	Event name	Description
March 19-22	IUSSI 2019	Conference and workshop, organized by Professor Sylvia Cremer, bringing together researchers interested in the ecology and evolution of social insects
April 24-26	TopApp Workshop 2019	Student workshop in Computational Topology, organized by PhD student Sebastiano de Cultrera di Montesano
May 17	YSS 19 – Motion in Nature and Technology	Young Scientist Symposium, organized by IST Austria students and postdocs, covering different research fields
August 21	Library Services for Open Science (IFLA Satellite Meeting)	Conference with a focus on library services that exceed the classical fields of Open Access and Research Data to support Open Science
October 18	Cryo-EM Inauguration Symposium	Inauguration of Austria's largest cryo-electron microscopy facility recently established at IST Austria, organized by Professors Carrie Bernecky, Leonid Sazanov and Florian Schur

Outreach and science education events (selection)

Date	Event name	Description
January 22-23	"Mein blinder Roboter"	Introduction to programming for children in primary school
March 15-17	ÖMO Training	Mathematics training camp for the Austrian national Olympiad team
June 23-26	CPSA Match	Mathematics training camps for the international Olympiad teams from Czech Republic, Poland, Slovakia, and Austria
July 12	Kinderuni Wien	One exclusive day at IST Austria for about 300 Kinderuni participants around the topic "The coolest animals of science"
August 19-23	Sommercampus	One-week summer camp for 6-12-year old schoolchildren
August 26-30	Talentesommer	One-week summer camp for teenagers
September 27	European Researchers' Night	Yearly research event taking place simultaneously in many cities across Europe; IST Austria participated in the Vienna edition with a hands-on neuroscience booth
September 27	Forschungsfest Niederösterreich	Lower Austria's research festival featuring IST Austria research on fruit flies and zebrafish

TWIST talks (Technology Transfer)

Date	Speaker and affiliation	Talk title
April 4	**Roland Kalb** proionic GmbH	"A startup journey from a Greek beach towards world leadership in manufacture of ionic liquids"
June 12	**Ulrich Mühlner** docdok.health	"The future of healthcare"
October 23	**Nikolaus Krall** Allcyte GmbH	"Taking the plunge: How I quit academia and started my first start-up"

Public lectures

Date	Speaker and affiliation	Talk series and title
March 6	**Helga Nowotny** Vienna Science and Technology Fund	IST Science and Society Lecture: "A humble view from inside evolution: imagining our digital future"
April 24	**Gunnar Carlsson** Stanford University	IST Lecture: "Topological methods for artificial intelligence"
June 5	**Paul Nurse** The Francis Crick Institute	IST Science and Society Lecture: "Science as revolution"
June 6	**Bernhard Schölkopf** Max Planck Institute for Intelligent Systems	ÖAW-IST Lecture: "Can Europe catch up in artificial intelligence?"
November 27	**Philipp Ther** University of Vienna	Commemoration Lecture: "The other ends of history: from Neoliberalism to Illiberalism"
December 11	**Steven Simon** University of Oxford	IST Lecture: "Topologically ordered matter and why you should be interested"

Institute Colloquia

Date	Speaker and affiliation	Talk title
March 11	**Charles Nunn** Duke University	"Shining evolutionary light on sleep and health"
March 18	**Paul Steinhardt** Princeton University	"The second kind of impossible"
March 25	**Silke Bühler-Paschen** Technical University Vienna	"Quantum phases and fluctuations driven by strong correlations"
April 8	**Andrew Mackenzie** Max Planck Institute for Chemical Physics of Solids	"Electrical transport and spectroscopy studies of the delafossite layered metals"
April 29	**Roger Heath-Brown** Oxford University	"All about prime numbers"
May 20	**Magdalena Götz** Max Planck Institute of Biochemistry	"Novel mechanisms of neurogenesis and neural repair"
May 27	**Josh Sanes** Harvard University	"Cell types as building blocks of neural circuits"
June 24	**Gordon Wetzstein** Stanford University	"Computational single-photon imaging"
September 9	**Richard Murray** CalTech	"Synthetic biology: Building molecular scale machines"
September 16	**Eve Marder** Brandeis University	"Differential resilience to perturbation of circuits with similar performance"
September 23	**Zeev Rudnick** Tel Aviv University	"Quantum chaos, eigenvalue statistics and the Fibonacci sequence"
October 7	**Taekjip Ha** Johns Hopkins University	"Revisiting and repurposing the double helix"
October 21	**Jay T. Groves** UC Berkeley	"Phase transitions and molecular timing in T cell signaling"
November 4	**Ed Boyden** MIT	"Tools for analyzing and controlling complex biological systems"
November 11	**Adrian Bird** University of Edinburgh	"Reading DNA methylation in the brain"
November 25	**Nir Shavit** MIT	"Tissue vs silicon: How neurobiology can save machine learning hardware"
November 29	**Subash Khot** New York University	"Hardness of approximation: From the PCP theorem to the 2-to-2 games theorem"
December 16	**Alex Badyaev** University of Arizona	"Control theory in evolution"

IST Austria scientific awards and distinctions 2019
(selection)

Academy Award for Technical Achievement ("Technical Oscar")
Bernd Bickel

AMS Fellowship, American Mathematical Society
Robert Seiringer

Carus Medal, German National Academy of Sciences Leopoldina
Carl-Philipp Heisenberg

EATCS Award, European Association for Theoretical Computer Science
Thomas Henzinger

EMBO Membership, European Molecular Biology Organization
Peter Jonas

EMBO Young Investigators
Edouard Hannezo, Martin Loose

ERC Consolidator Grant, European Research Council
Krishnendu Chattterjee

ERC Starting Grant, European Research Council
Edouard Hannezo, Maksym Serbyn

Fellow of the Royal Society
Leonid Sazanov

Highly Cited Researcher, Clarivate Analytics
Jiří Friml

Ignaz L. Lieben Award, Austrian Academy of Sciences (ÖAW)
Gašper Tkačik

Lopez-Loreta Prize, Jean-Jacques and Felicia Lopez-Loreta Foundation
Marco Mondelli

Ludwig Boltzmann Award, Austrian Physical Society
Maksym Serbyn

Member of the Academia Europaea
Jozsef Csicsvari

Neuron Award, Neuron Foundation, Czech Republic
Jiří Friml

IST Austria internal awards 2019

Outstanding PhD Thesis
Claudia Espinoza Martínez, Jonas group

Outstanding Scientific Achievement
Alfredo Rueda, Fink group

Outstanding Scientific Support
Maria Del Mar Lopez Pelegrin, Loose group

Outstanding Administrative Support
Verena Seiboth, Academic Affairs

Golden Chalk Award for Excellence in Teaching
Robert Seiringer, Seiringer group

Golden Sponge Award for Excellent Teaching Assistance
Julia Raices, Vicoso group

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Boards and leadership of IST Austria

Board of Trustees

The Board of Trustees consists of 16 members. Nine of them are internationally successful scientists, four are appointed by the Federal Government, and three are appointed by the Government of Lower Austria.

Chair: **Claus J. Raidl**, former President, Oesterreichische Nationalbank, Vienna, Austria
Vice-Chair: **Olaf Kübler**, former President, ETH Zurich, Switzerland
Catherine Cesarsky, Chief Scientific Advisor, former High Commissioner for Atomic Energy, CEA-Saclay, Gif-sur-Yvette, France
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Peter Fratzl, Director, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany
Susan Gasser, Director emeritus, Friedrich Miescher Institute (FMI), Basel, Switzerland (since 2020)
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Iain Mattaj, Director, Human Technopole, Milano, Italy
Pietro Perona, Allen E. Puckett Professor of Electrical Engineering and Computation and Neural Systems, California Institute of Technology, Pasadena, USA
Wolfgang Ruttenstorfer, Member of the Supervisory Board, RHI Magnesita, Vienna Airport
Elisabeth Stadler, CEO, Vienna Insurance Group, Vienna, Austria
Stefan Szyszkowitz, Spokesman of the Executive Board, EVN, Maria Enzersdorf, Austria

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.

Leadership

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

Executive Committee of the Board of Trustees

Chair: **Haim Harari**
Vice-Chair: **Reinhard Jahn**
Elisabeth Engelbrechtsmüller-Strauß
Iain Mattaj
Claus J. Raidl
Wolfgang Ruttenstorfer

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, and
- hold preliminary discussions on matters to be brought for approval to the Board of Trustees, such as the annual budget.

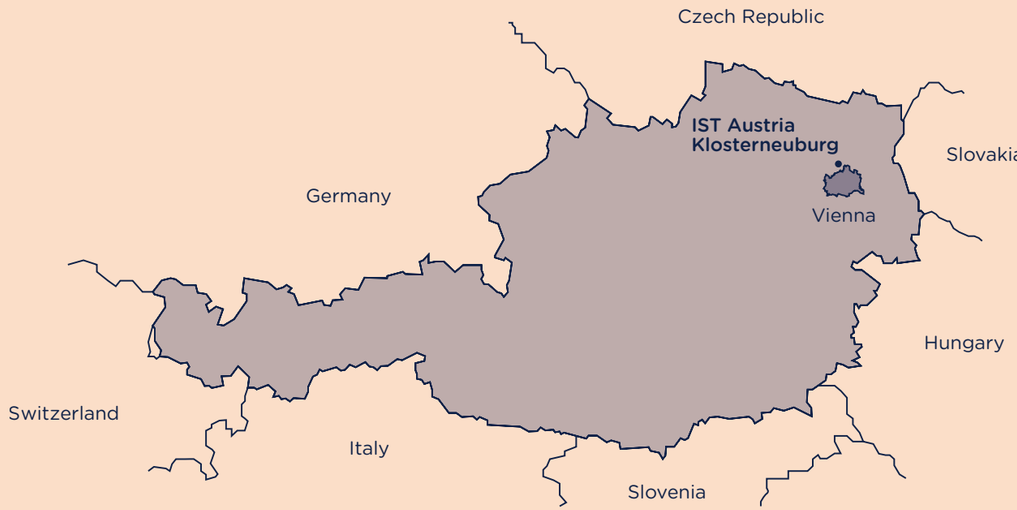
Scientific Board

Chair: **Peter Fratzl**, Director, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany
Vice-Chair: **Maria J. Esteban**, Professor, Centre de Recherche en Mathématiques de la Décision, University of Paris-Dauphine, France
Angelika Amon, Professor, Department of Biology, Massachusetts Institute of Technology (MIT), Cambridge, USA
Ben Feringa, Professor, Stratingh Institute for Chemistry, University of Groningen, The Netherlands
Tony F. Heinz, Professor, Department of Applied Physics, Stanford University, Palo Alto, USA
Hannah Monyer, Professor, Department of Clinical Neurobiology, University of Heidelberg, Germany
Andrew Murray, Professor, Department of Molecular and Cell Biology, Harvard University, Cambridge, USA (since 2020)
Gene Myers, Director, Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany
Bradley Nelson, Professor, Institute of Robotics and Intelligent Systems, ETH Zurich, Switzerland (since 2020)
Martin Nowak, Professor, Program for Evolutionary Dynamics, Harvard University, Cambridge, USA (until 2019)
Petra Schwille, Director, Max Planck Institute for Biochemistry, Martinsried, Germany (until 2019)
Non-voting Member: **Claus J. Raidl**, former President, Oesterreichische Nationalbank, 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, 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.

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
Guesthouse, Info
02 Raiffeisen Lecture Hall
03 voestalpine Building
04 Bertalanffy Foundation Building
05 Preclinical Facility
06 Lab Building East
07 Administration Building
Info
08 Visitor center (planned)
09 Memorial
11 Facility Management
12 Heating plant
13 Miba Machine Shop/
Central storage
16 Power control
21 Lab and Office Building West
22 Cafeteria
23 Chemistry Lab Building
& Graduate School
(under construction)
24 Lab Building North (planned)
27 Kindergarten
CO3 Multipurpose Research Facility
31–35 Apartments
37–45 Apartments
60 Tennis courts
61 Soccer field

The team of the Nanofabrication Facility,
one of IST Austria's eight Scientific Service Units (SSUs).

Imprint
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Over the past ten years, IST Austria has constantly changed and gradually evolved into an international model of success. To be successful, research needs a solid framework as well as loyal friends and supporters in politics and beyond. In the years to come, the Federal Ministry is eager to further strengthen competitive and promising basic research in general and—in close cooperation with the Government of Lower Austria—IST Austria as a place of outstanding scientific excellence in particular.

Heinz Fassmann
Federal Minister of Education, Science and Research

IST Austria is, without a doubt, one of the most important institutes for fundamental research and an example of international scientific excellence. Lower Austria has made great efforts to support scientific advancement in the past years, as science and research serve as a necessary base for a positive economic and societal development. I am very proud of how the Institute has contributed to filling the region with life. Everyone involved has done a great job—congratulations! We are on the right path and I am looking forward to accompanying IST Austria's prosperous future in research and development.

Johanna Mikl-Leitner
Governor of Lower Austria