

Annual Report **2011**



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IST AUSTRIA SCIENTISTS (December 31, 2011)

PROFESSORS (by last appointment before IST Austria)

- 1 Nick Barton University of Edinburgh, UK
- 2 Jonathan Bollback University of Edinburgh, UK
- 3 Tobias Bollenbach Harvard Medical School, Boston, USA
- 4 Krishnendu Chatterjee University of California, Santa Cruz, USA
- 5 Sylvia Cremer University of Regensburg, Germany
- 6 Jozsef Csicsvari University of Oxford, UK
- 7 Herbert Edelsbrunner Duke University, Durham, USA
- 8 Călin Guet Harvard University, Cambridge, USA
- 9 Carl-Philipp Heisenberg Max-Planck Institute, Dresden, Germany
- 10 Thomas Henzinger EPFL, Lausanne, Switzerland
- 11 Simon Hippenmeyer Stanford University, Palo Alto, USA
- 12 Harald Janovjak LMU Munich, Germany
- 13 Peter Jonas University of Freiburg, Germany
- 14 Vladimir Kolmogorov University College London, UK
- 15 Christoph Lampert Max-Planck Institute, Tübingen, Germany
- 16 Krzysztof Pietrzak CWI, Amsterdam, Netherlands
- 17 Ryuichi Shigemoto NIPS, Okazaki, Japan
- 18 Daria Siekhaus NYU Medical Center, USA
- 19 Michael Sixt Max-Planck Institute, Martinsried, Germany
- 20 Gašper Tkačik University of Pennsylvania, Philadelphia, USA
- 21 Caroline Uhler University of Minnesota, USA
- 22 Chris Wojtan Georgia Institute of Technology, Atlanta, USA

POSTDOCS (by institution of PhD degree)

- 23 Alice Alvernhe University of Provence, Marseille, France
- 24 Itaru Arai University of Tokyo, Japan
- 25 Tobias Bergmiller ETH Zurich, Switzerland
- 26 Udi Boker Tel-Aviv University, Israel
- 27 Pavol Černý University of Pennsylvania, Philadelphia, USA
- 28 Chao Chen Rensselaer Polytechnic Institute, Troy, USA
- 29 Guillaume Chevereau ENS de Lyon, France
- 30 Julien Compagnon Paris Diderot, France
- 31 Cesara Dragoi Paris Diderot, France
- 32 David Field University of Wollongong, Australia
- 33 Jian Gan University of Glasgow, UK
- 34 Ashutosh Gupta Technical University of Munich, Germany
- 35 Jose Guzman University of Leipzig, Germany
- 36 Hua Hu University of Oslo, Norway
- 37 Adrian Ion Technical University of Vienna, Austria
- 38 Michael Kerber Universität des Saarlandes, Saarbrücken, Germany
- 39 Eva Kiermaier University of Vienna, Austria
- 40 Janina Kowalski Albert-Ludwigs-University Freiburg, Germany
- 41 Gabriel Krens University of Leiden, Netherlands
- 42 Anne Kupczok University of Vienna, Austria
- 43 Maria Mateescu EPFL, Lausanne, Switzerland
- 44 Hitoshi Morita National Institute for Basic Biology, Okazaki, Japan

- 45 Christine Moussion Paul Sabatier University, Toulouse, France
- 46 Joseph O'Neill University of Oxford, UK
- 47 Tiago Paixao Universidade do Porto, Portugal
- 48 Alejandro Pernia Andrade Venezuelan Institute for Scientific Research, Caracas, Venezuela
- 49 Melinda Pickup The Australian National University, Canberra, Australia
- 50 Jitka Polechová University of Prague, Czech Republic
- 51 Rodrigo Fernandes Redondo Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
- 52 Verena Ruprecht Johannes Kepler University Linz, Austria
- 53 Keisuke Sako Osaka University, Japan
- 54 Philipp Schmalhorst Hannover Medical School, Germany
- 55 Philipp Schönenberger Friedrich Miescher Institute, Basel, Switzerland
- 56 Ali Sezgin University of Utah, USA
- 57 Michael Smutny University of Vienna, Austria
- 58 Olga Symonova University of Trento, Italy
- 59 Line Vej Ugelvig University of Copenhagen, Denmark
- 60 Harold Viadar University of Groningen, Netherlands
- 61 Meghan Vyleta Oregon Health and Science University, Portland, USA
- 62 Nicholas P. Vyleta Oregon Health and Science University, Portland, USA
- 63 Michele Weber University College London, UK
- 64 Daniel Benjamin Weissman Stanford University, Palo Alto, USA
- 65 Stefan Wieser Johannes Kepler University Linz, Austria
- 66 Stephanie Zur Nedden University of Warwick, UK

PHD STUDENTS (by nationality)

- 67 Hande Acar Turkey
- 68 Vanessa Barone Italy
- 69 Martin Behrndt Germany
- 70 Morten Bojsen-Hansen Denmark
- 71 Pedro Campinho Portugal
- 72 Barbara Casillas Perez Mexico
- 73 Martin Chmelik Czech Republic
- 74 Marta Dravecka Slovakia
- 75 Jakob Egger Austria
- 76 Alexander Eichner Germany
- 77 Thomas Ellis Great Britain
- 78 Brittany Fasy USA
- 79 Sarit Goswami India
- 80 Fabienne Jesse Netherlands
- 81 Sooyun Kim USA
- 82 Matthias Konrad Germany
- 83 Jean-Léon Maître France
- 84 Catherine McKenzie USA
- 85 Rajiv Mishra India
- 86 Karin Mitosch Germany
- 87 Maurizio Morri Italy
- 88 Sebastian Novak Austria
- 89 Florian Pausinger Austria
- 90 Pavel Payne Czech Republic
- 91 Ekaterina Pukhlyakova Russia
- 92 Arjun Radhakrishna India
- 93 Johannes Reiter Austria
- 94 Georg Rieckh Austria
- 95 Joachim Schipper Netherlands
- 96 Jan Schwarz Germany
- 97 Viktoriia Sharmanska Ukraine
- 98 Magdalena Steinrück Austria
- 99 Miriam Stock Germany
- 100 Anmol Tomar India
- 101 Murat Tugrul Turkey
- 102 Haibing Xu China
- 103 Damien Zufferey Switzerland



**35 NATIONALITIES ARE
REPRESENTED ON CAMPUS.**



Creating impact step by step

Thomas A. Henzinger » President, IST Austria

IST Austria looks back at another year of strong growth. In 2011, about 100 scientists and scientific support staff moved into the Bertalanffy Foundation Building, the first laboratory building on campus, which is dedicated to experimental research in the life sciences. Altogether, the number of IST employees doubled in 2011, from less than 100 to almost 200.

The year 2011 also marked the first fully functional year of the IST Graduate School, which trains doctoral students from around the world to become successful research scientists. Our cross-disciplinary PhD program currently covers biology, neuroscience, computer science, and mathematics. We are well aware of the fact that the reputation of the Institute will depend critically not only on the research feats accomplished on campus, but also on the future success of our graduates in the world.

Six new professors were recruited in 2011, bringing the number of research groups working on campus to 19, with three more professors arriving soon. Our 22 professors come from twelve different countries, and in total, 30 nationalities are now represented among the scientists on the IST campus. They published more than 100 research papers in 2011 and, so far, have been awarded more than 20 million Euro in third-party research funds, of which more than 90 % come from sources outside of Austria.

Out of the 19 professors on campus, eight have won a coveted research grant from the European Research Council (ERC). ERC grants have become a yardstick for measuring research excellence in Europe, being awarded only to the very best scientists as chosen by their peers. Relative to its size, IST Austria is cur-

rently likely the institution in Europe with the highest density of ERC funded researchers.

This independent evaluation of our faculty by the ERC was confirmed by the first comprehensive scientific evaluation of IST Austria, which took place in 2011 and is to be repeated every four years. An evaluation team of six internationally renowned scientists, including two Nobel laureates, visited the Institute for two days before submitting a report to the Federal Ministry of Science and Research and to the Austrian parliament, from which I am proud to quote: “IST managed to attract an amazing group of almost twenty faculty members that would be the pride of any top university in the world.” Recommendations for the future development of IST Austria included a broadening of the research scope towards the physical sciences and a medium-term target of 100 research groups.

When the IST campus opened in June 2009, the Institute was a high-risk, high-reward project. Through the hard work of everyone involved – especially the board members and employees of IST Austria – we have managed to tip the balance decisively from risk towards reward in less than three years. I am immensely grateful to all who have contributed to this achievement and I thank the Federal Minister for Science and Research, Karlheinz Töchterle, and his predecessors, the governor of Lower Austria, Erwin Pröll, and the president of the Federation of Austrian Industry, Veit Sorger, for their strong support. With their continued commitment, this exciting project of building a world-class institution for basic science in Austria will succeed.

Thomas A. Henzinger



A long-term commitment

Haim Harari » Chair, IST Austria Executive Committee

Former President, Weizmann Institute of Science, Rehovot, Israel

Five years ago, the federal Austrian government, the government of Lower Austria and their respective parliaments took the bold decision to create a major new Institute of basic scientific research in Klosterneuburg, near Vienna. Funding was guaranteed for ten years of operations and the construction of the first buildings has been financed. Four years ago, the campus of the new Institute still housed an old functioning hospital. Two and a half years ago, the first buildings and facilities of the Institute were inaugurated and the first president, Professor Tom Henzinger, took office. One year ago the first laboratory building was opened. In 2011, scientists at the Institute performed the first experimental research in the new campus, the Institute had its first international evaluation and the founding Board of Trustees completed its five-year term, as prescribed by law. Twenty-two outstanding professors joined the Institute, each leading his or her own research team. Of these, eight researchers have already been awarded European Research Council Grants ("senior" or "junior"), a high mark of distinction, offered by the EU to its most outstanding scientists on the basis of their personal performance record.

We look back at the first five years with pride and satisfaction. We must look forward towards the coming years with hope, ambition and far-reaching goals. The Institute must continue to grow fast, without the slightest compromise on quality and excellence. A proper balance among the various scientific disciplines, emphasizing interdisciplinary areas of research, necessitates a certain minimal size. A successful basic research program must cover segments of each of the broad areas of mathematics, computer science, physics, chemistry and numerous different fields of the life sciences, with possible occa-

sional minor excursions into bordering areas like environmental science, technology and engineering, agriculture and medicine. This can only happen if, as planned, the Institute doubles its size by its tenth birthday and, even more importantly, doubles again within the following decade. An overall panorama of 80 to 100 research groups is internationally considered as an appropriate critical size for an outstanding Institute, covering selected fields from all the broad areas of the natural sciences. The distinguished international committee, which evaluated IST Austria in January 2011, made clear recommendations in this direction and we, at the Board of Trustees, concur and endorse this goal.

The double task of fast growth and outstanding standards of excellence is an ambitious enterprise. So far, IST Austria has received very high marks for its way of coping with this challenge. The Austrian authorities have earned the admiration of many in the scientific world for taking the courageous step of establishing a new first-class European center of research and PhD studies. But science never happens in short bursts, and excellence is only gained by a long-term continued commitment. The Institute stands on several legs, and if one of them falters it might be damaged severely. It is crucial that the federal Austrian government, the province of Lower Austria, the Board of Trustees of the Institute, the management led by President Henzinger and, above all, the scientists and their teams jointly continue to develop the Institute, with the same formula of determination, energy, generous resources and quality. Only this will allow IST Austria to become a recognized beacon of excellence to European science.

Haim Harari

The **HIGH NUMBER OF ERC GRANTS** awarded to IST Austria this year shows in short what the evaluation in 2011 has demonstrated in detail: the past four years of **HARD WORK** have led to an environment of **HIGHEST INTERNATIONAL STANDARDS** for curiosity-driven research that stimulates the Austrian research landscape as a whole.



Prof. Karlheinz Töchterle » Federal Minister for Science and Research

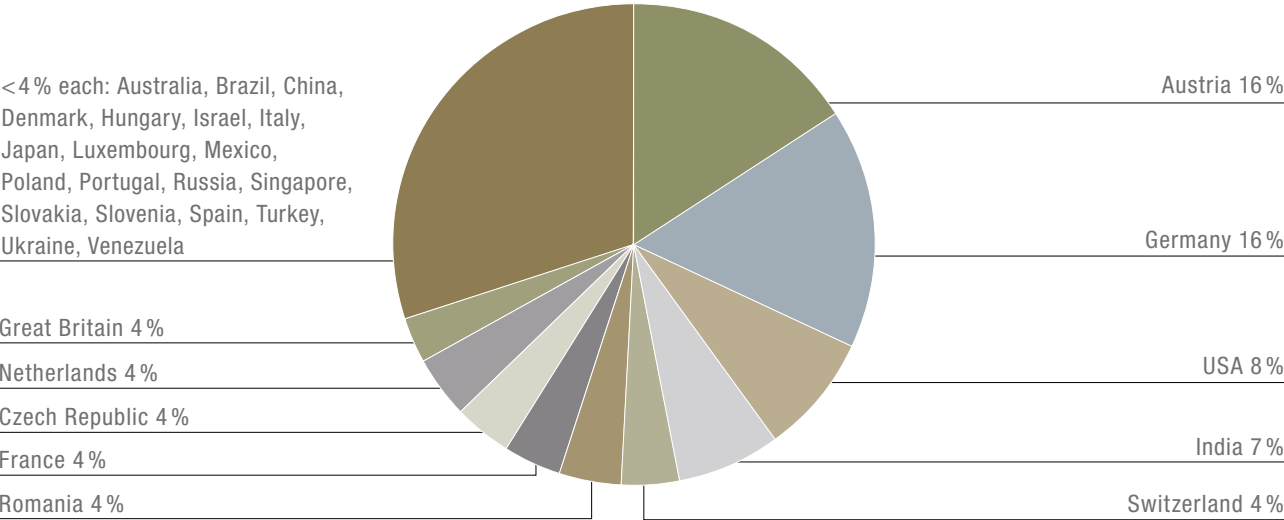


Only two years after the official opening of the IST campus, IST Austria **RECEIVED AN EXCELLENT GRADE** from a high-ranking international **EVALUATION COMMITTEE**. The report shows that Klosterneuburg – and Lower Austria – is well on the way to becoming a **WORLD-RENOWNED LOCATION FOR BASIC SCIENCE**.

Dr. Erwin Pröll » Governor of Lower Austria

IST AUSTRIA at a Glance

Nationalities of Scientists at IST Austria



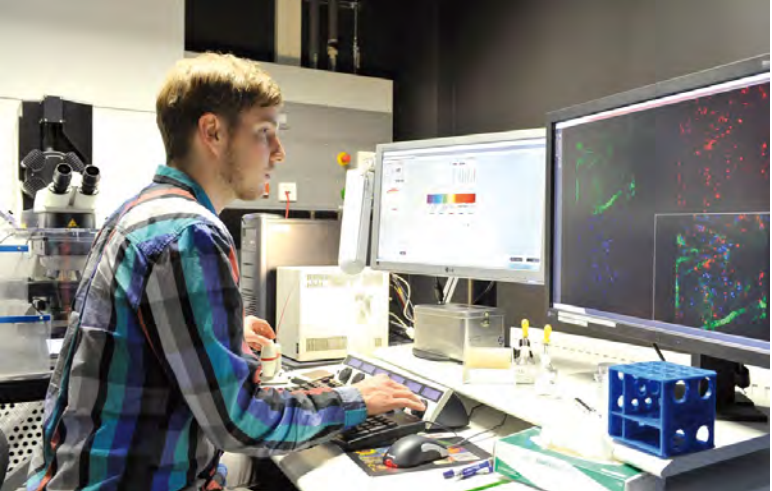
The Institute of Science and Technology Austria (IST Austria) is a multidisciplinary research institution dedicated to basic research in the natural, computer and mathematical sciences. The Institute is located in the city of Klosterneuburg, 18 km from the center of Vienna. As a PhD granting institution, the graduate school at IST Austria educates doctoral students from around the world to become research scientists. IST Austria was established jointly by the federal government of Austria and the provincial government of Lower Austria and inaugurated in 2009. In the fall of 2010, the Bertalanffy Foundation Building, the first laboratory building on the IST campus, was opened and the first experimental research groups started their work at the Institute. By the end of 2011, 19 professors and a total of 196 employees from 35 different countries worked at IST Austria. A second laboratory building is under construction and will be completed by the end of 2012, leading to a further expansion of the research activities. The development plans of the campus allow a growth to 40–45 professors and 500–600 employees by 2016.

To foster a creative and interdisciplinary scientific atmosphere, all hierarchical and separating organizational structures, such as departments, are avoided at IST Austria. The scientists are

organized into independent research groups, each headed by a Professor or a tenure-track Assistant Professor. The decision to promote an Assistant Professor to Professor with a permanent contract is based entirely on an evaluation of the scientific achievements of the Assistant Professor by international experts. Research excellence and promise are the exclusive hiring criteria for all scientists at IST Austria – from doctoral students to professors. The Institute chooses which fields of science to enter based solely on the availability of outstanding individuals. It will pursue a direction of research only if it can compete with the best in the world.

Diverse Funding Sources

IST Austria is dedicated to the principle of basic research, driven only by the curiosity of its scientists. Nevertheless, the Institute owns the rights to all resulting scientific discoveries and is committed to promote their use. The long-term financial health of IST Austria will rely on four different sources of funding: public funding, national and international research grants, technology licensing, and donations. For the period until 2016, the federal government of Austria will provide up to 290 million Euro in operational funds. Of these, 195 million Euro are guaranteed, while the payment of



the remaining 95 million Euro is conditional on the Institute raising an equal amount of third-party funds. By the end of 2011, IST Austria has received more than 17 million Euro in donations and more than 20 million Euro in research grants, bringing the current third-party total to more than 37 million Euro. The province of Lower Austria contributes the budget for construction and campus maintenance – so far approximately 140 million Euro.

Independent Leadership

The governance and management structures of IST Austria guarantee the Institute's freedom from political and commercial influences. IST Austria is headed by the President, who is appointed by the Board of Trustees and advised by the Scientific Board. The first President of the Institute is Thomas A. Henzinger, a computer scientist and former professor of the University of California at Berkeley and the EPFL in Lausanne, Switzerland. The administration of IST Austria is led by the Managing Director, Gerald Muraier. The Institute is evaluated regularly by leading international scientists and science administrators. The first such evaluation took place in 2011 and attested to IST Austria being “a start-up institution on a track to excellence” (see page 10 for more details on the evaluation).



IST EMPLOYEES 2011

	HEAD COUNT
Scientists	103
▪ Professors	19
▪ Postdocs	44
▪ PhD students	37
▪ Student interns	2
▪ Staff scientists	1
Scientific support	40
Administration	53
TOTAL	196

FACULTY RECRUITMENT

	2011	total since 2007
Applications and nominations	720	3006
Evaluated by international experts	95	399
Invited to campus	59	176
Offers made	8	36
Offers accepted	6	22

RESEARCH GRANTS

ERC European Research Council	13'150'000 €
EC Framework Program 7	4'165'000 €
FWF Austrian Science Fund	1'766'000 €
DFG Deutsche Forschungsgemeinschaft	885'000 €
HFSP Human Frontier Science Program	550'000 €
ÖAW Österreichische Akademie der Wissenschaften	220'000 €
NSF National Science Foundation	114'000 €
Others	150'000 €
TOTAL	21'000'000 €

ERC GRANTS

The Champions League of European Science



At the end of 2011, eight of the 19 professors on campus at IST Austria are supported by prestigious grants of the European Research Council (ERC). The ERC was established in 2007 as a European initiative to promote curiosity-driven “frontier research” in Europe by providing generous, unbureaucratic funding to the few very best, most creative researchers in Europe. The ERC recognizes that in many areas of science, the most significant breakthroughs can be traced to individuals with visionary ideas who also have the technical skills to execute these ideas. The ERC therefore rewards individual scientific excellence and encourages risk taking by its researchers.

ERC grants have been awarded annually since 2009 in two categories. ERC Starting Independent Researcher Grants aim to support young scientists who show exceptional promise and have the proven potential of becoming future leaders in their field. These grants provide each recipient with an average budget of 1.5 million Euro over five years, which is intended to let the young scientist build and lead an independent research team. The second category of ERC grants, the ERC Advanced Investigator Grants, supports the research of highly accomplished scientists with an average budget of 2 million Euro over five years in order to permit them to pursue ambitious projects and address challenging problems.

Scientists apply for ERC grants in a Europe-wide competition and the winners are chosen by panels of leading scientists from each field. The choice is based purely on the scientific merits of the candidate and his/her research proposal, without quotas for nationalities or strategic topics. To aid the choice, each proposal is graded for scientific quality, originality, and potential for ground-breaking results by 5 to 6 expert reviewers. The selection process is highly competitive; for example, in 2011 a total of 480 starting grants were chosen from 4080 proposals.



As a result, ERC grants are considered awards that provide an unbiased mark of extraordinary excellence to the recipient and, thus, a measure of scientific prowess for the home institution of the researcher. Indeed, the list of ERC awardees reads like a “Who’s Who of European Science” and their institutions form the Champions League of scientific research in Europe. The most successful universities are the Universities of Cambridge and Oxford in the UK, and the EPFL in Lausanne (based on the first six ERC calls). On a per-capita basis, the most successful countries in this league are Switzerland and Israel, while Austria ranks in seventh place (source: Austrian Research & Technology Report 2011).

With eight out of 19 professors funded by the ERC, IST Austria is currently, at the end of 2011, the most successful institution in Europe of a comparable or larger size in terms of ERC grants per faculty member. The IST professors awarded ERC Starting Grants in 2011 are the computer scientist **Krishnendu Chatterjee (1)**, the neuroscientist **Jozsef Csicsvari (2)**, and the cell biologist **Michael Sixt (3)**. Together with the transfer of the ERC Starting Grant held by computer scientist **Krzysztof Pietrzak (4)** to his new position at IST Austria in 2011, and the transfer of the ERC Starting Grant of evolutionary biologist **Sylvia Cremer (5)** to IST in 2010, the current number of ERC Starting Grants held by professors at IST is five. In addition, three IST professors hold coveted ERC Advanced Grants: computer scientist and IST president **Thomas A. Henzinger (6)** as well as neuroscientist **Peter Jonas (7)** received ERC Advanced Grants in 2010; evolutionary biologist **Nick Barton (8)** in 2009.

“WE TRUST THE SCIENTISTS”

Prof. Helga Nowotny » President of the European Research Council (ERC)



On the ERC

“The ERC was set up at the beginning of the current framework program in 2007. What is special about the ERC are the following principles. It is strictly bottom-up, so we have no thematic priorities whatsoever. Secondly, it targets the individual researcher, as we trust scientists to know best where the frontier of knowledge lies. The most important principle, of course, is that the criterion for evaluation is excellence only. There is no question of geographic distribution or of just retour, so we do not look at whom we are funding except for their scientific quality.”

On the impact of the ERC

“We have an enormous credibility and response in the scientific community. Wherever I go, people tell me this is the best thing in research funding that has happened to European research. For the starting grantees, an ERC grant naturally helps them in their scientific standing and their career. It is an enormous boost for them, but of course we do nothing more. We trust that it is the scientific quality that will carry them further. If they are as good as we believe they are they will make their way.”

On European science

“When I speak about European science, I think that Europe has to overcome the thinking and the career

structures that are still embedded in national structures – this is the biggest challenge for European science. Success in ERC grant applications shows that internationalization pays, it is the only strategy to follow if you want to be at the very top.”

On ERC grant applications from Austria

“My impression is that the most successful institutions in Austria are those that are internationally open, that is very obvious. Then you have two distinctive clusters of excellence – a physics cluster in Innsbruck, which is very visible, and a life science cluster in and around Vienna.”

On IST Austria

“I think it is a wonderful success story, a model institution of its own kind. IST Austria has taken a very good institution as model namely the Weizmann Institute of Science. But very often, taking a model from elsewhere is difficult because the context is never the same. I think IST Austria has been able to influence the context into which this model has been brought, which is a major achievement. Secondly, IST Austria is obviously following an internationalization strategy in its fullest sense, and has an excellent selection process – find the best, fund the best, this is the way to go.”

THE EVALUATION:

An Excellent Grade for IST Austria

In summary, over a period of about two years, IST managed to identify and attract an **AMAZING GROUP** of almost twenty faculty members that would be the **PRIDE OF ANY TOP UNIVERSITY** in the world.

David Baltimore » Chair of the Evaluation committee



An important milestone in the short history of IST Austria was the Institute's first scientific evaluation. On January 24 and 25, 2011, a high-ranking, independent group of six international scientists and science administrators visited the campus of IST Austria to evaluate the progress the Institute has made since its founding. The federal law that established IST Austria mandates an external scientific evaluation of the performance of the Institute every four years. The procedures used for this regular evaluation of IST Austria are modeled after the quality control mechanisms that are in place at internationally leading research institutions, such as the Max-Planck Society in Germany.

The 2011 evaluation panel of IST Austria was chaired by David Baltimore, a Nobel Laureate and former president of the Rockefeller University in New York and the California Institute of Technology, two of the most successful research institutions in the world. The other members of the panel were Jonathan Dorfan, former director of the Stanford Linear Accelerator Center and president of the Okinawa Institute of Science and Technology; Manfred Morari, professor at ETH Zurich; Erwin Neher, Nobel Laureate and Max-Planck Director; Linda Partridge, professor at University College London and Max-Planck Director; and Moshe Vardi, professor at Rice University in Houston. The panel represented science and technology broadly, beyond the specific research fields that are currently present at IST Austria.

The evaluation panel looked carefully at the principles of scientific organization on which IST Austria is based, the implementation of these principles, and the faculty that has been recruited. The report of the Baltimore committee, which was received in March 2011, describes the establishment of IST Austria as a bold and visionary step by the Austrian government. The Institute was attested a rapid and successful launch and lauded for its ability to compete with the most prestigious institutions in the world for the very best scientists. The evaluation panel identified the tenure-track career model, the interdisciplinary focus of the Institute, and the excellent research conditions as main strengths. A further strong point of IST Austria is the international graduate school, which has already attracted a highly international student body of outstanding quality and adds an important component to higher education in Austria. In the eyes of the evaluation panel, IST Austria is well-positioned on its way to becoming a leading research institution that will be recognized throughout the world.

The report of the Baltimore committee was presented at IST Austria on May 25 by Claus J. Raidl, Chair of the Board of Trustees, together with the Federal Minister for Science and Research, Karlheinz Töchterle, and the Governor of Lower Austria, Erwin Pröll, who pledged their continued support of the Institute. The report was presented by Minister Töchterle to the federal government on June 15 and then went to the federal parliament, where it was unanimously approved by the subcommittee on science on October 13.



President of IST, Thomas A. Henzinger, Governor of Lower Austria, Dr. Erwin Pröll, Federal Minister for Science and Research, Prof. Karlheinz Töchterle, and Chair of the Board of Trustees, Dr. Claus J. Raidl, on May 25, the day of the presentation of the evaluation report.

SCHEDULE OF THE VISIT OF THE EVALUATION COMMITTEE

DAY 1

Morning:
9:00 am
11:00 am

BUILDING A NEW INSTITUTE

Presentations: The development of IST Austria (C. Raidl, H. Harari, T. Henzinger)
Campus Tour

Afternoon:
1:00 pm

THE SCIENCE AT IST AUSTRIA

Presentations: Faculty recruiting at IST (T. Henzinger, O. Kübler, Chair of the Professorial Committee of IST Austria)
2:00 pm Presentations: Research at IST (N. Barton, H. Edelsbrunner, CP Heisenberg, P. Jonas)
4:00 pm Round-table discussion with the professors
5:00 pm Panel members meet professors individually

DAY 2

Morning:
9:00 am
10:00 am
10:30 am
11:00 am
11:30 am

THE ORGANIZATION OF IST AUSTRIA

Presentations: Organizational structures, budget, and administration (T. Henzinger, G. Muraueur)
Round-table discussion with the heads of the administrative divisions and scientific service units
Round-table discussion with the postdocs
Round-table discussion with the PhD students
Private meeting and Q&A with the president

Afternoon:
1:30 pm
3:00 pm
4:00 pm

REPORT PREPARATION AND FEEDBACK

Private meeting of the evaluation panel
Panel reports to C. Raidl, H. Harari, K. Mehlhorn, and T. Henzinger
Panel reports to the Federal Ministry of Science and Research

THE IST GRADUATE SCHOOL

Educating Future Scientists

The international IST Graduate School offers its PhD students a first step into a scientific career in biology, neuroscience, computer science, mathematics, as well as interdisciplinary areas. Entry to the Graduate School is open to applicants from all over the world, and prospective PhD students are selected in an annual, institute-wide admissions procedure. Highly qualified students who are committed to pursue a scientific career in a truly multidisciplinary, international research environment are encouraged to apply to the IST Graduate School.

A multidisciplinary PhD program

Owing to the interdisciplinary spirit of IST Austria, a single, joint graduate program is offered for all students who are interested in the different research fields present at IST. We train a new generation of researchers who are able to approach scientific questions from different angles and are fluent in the languages of both the life sciences and analytical sciences. Admission to the IST Graduate School is open to prospective students holding either a BS or an MS degree. The length of the PhD program varies depending on previous degrees and individual progress, but is anticipated to be four to five years.

The doctoral program is divided into two phases, one before and one after the qualifying exam. During the first phase of the program, which lasts from one to two years, students take advanced courses in all scientific fields represented at IST Austria and carry out projects with three different research groups. This phase offers the student an opportunity to work closely with several professors before identifying a thesis supervisor and dissertation topic. The interdisciplinary curriculum gives

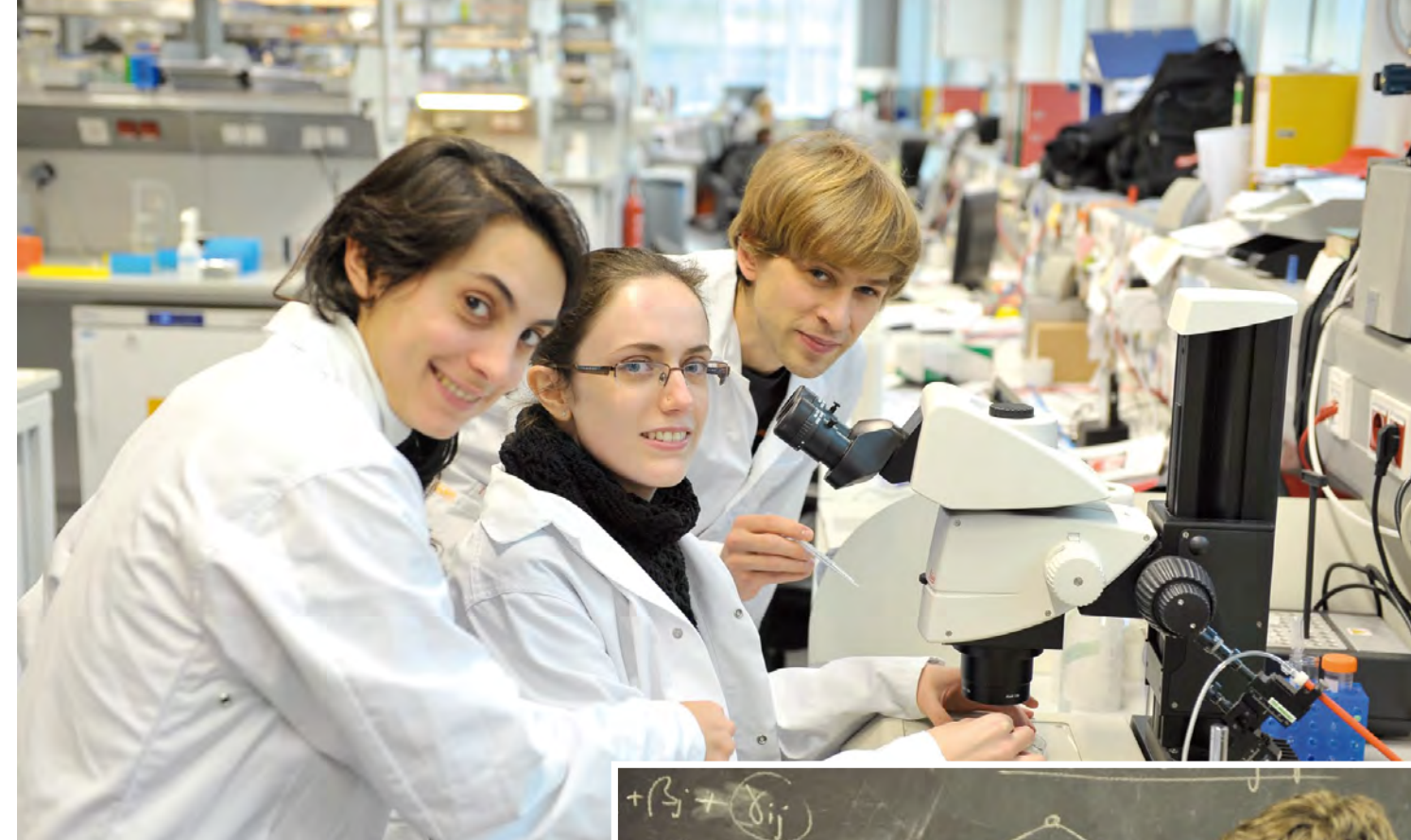
students both breadth and depth in their scientific background. At the end of the first phase, the student prepares a thesis proposal and takes a qualifying exam. Upon successfully passing the exam, students enter the second phase of the doctoral program, during which they focus on research towards a doctoral thesis. Progress is monitored through regular reviews by the entire faculty. After a successful thesis defense, the student receives the PhD degree from IST Austria.

Annual call for PhD students

All students interested in joining the PhD program at IST Austria in September must apply by January 15. The entire IST faculty evaluates the applicants, as prospective students need not identify a potential supervisor when applying. All admitted PhD students are offered employment contracts with an internationally competitive salary and full Austrian social-security coverage. To ease the transition for international students, accommodation on campus may be rented for a period of up to one year after arrival at IST.

Current PhD students at IST Austria

In September 2011, the second intake of graduate students joined IST Austria. Of 638 students from 80 different countries who applied for admission, 56 were invited to campus for interviews. The Graduate School made offers to 28 applicants, of which 16 were accepted. The newest class of PhD students at IST comes from 11 different nations including China, the US, and Mexico; four Austrians are also among the doctoral students who started at IST Austria in 2011. In total, 37 PhD students are currently working at IST Austria.



Admission to the IST Graduate School

- › Online application opens November 15 (www.ist.ac.at)
- › Open day for prospective applicants in November
- › Application deadline January 15
- › Visit day for shortlisted candidates in March
- › Deadline for accepting an offer April 15
- › PhD Program starts September 15



Application

- › MS or BS or equivalent degree required
- › Academic CV and Statement of Purpose
- › Official university transcripts
- › Contact addresses for three reference letters
- › GRE and TOEFL scores optional



CURRENT RESEARCH

at IST Austria



Currently, research at IST Austria focuses on four areas: cell biology and biophysics, evolutionary and mathematical biology, neuroscience, as well as computer science. There are strong synergies between these fields, and to foster an interdisciplinary spirit, the Institute is not organized into departments. The Central Building, in which theoretical research groups are located, is linked by a bridge with the Bertalanffy Foundation Building, which houses experimental research groups. The bridge contains communal areas, encouraging interaction.



NICK BARTON
MATHEMATICAL MODELS OF EVOLUTION

How do new species emerge from a single population? Why do so many organisms reproduce sexually? How quickly can species adapt to changes in conditions? The Barton group develops mathematical models to probe essential issues of evolution.



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

Nick Barton and his group study diverse topics in evolutionary genetics. The main focus of their work is the evolution of populations that are distributed through space and that experience natural selection on many genes. Understanding how species adapt to their environment, and how they split into new species, requires understanding the effects caused by the subdivision of the space that a population inhabits. The distribution of genes through space can, in turn, tell us about the strengths of evolutionary processes that are hard to measure directly. The interaction between large numbers of genes is important in the formation of new species as well as in their response

to natural and artificial selection. The recent flood of genomic data makes analysis of the interactions amongst large numbers of genes essential, and the Barton group uses mathematical models to make sense of this mass of data and to find answers to fundamental questions of evolution.

Current Projects

- › Evolution of Sex and Recombination
- › Evolutionary Computation
- › Statistical Mechanics and the Evolution of Quantitative Traits
- › Limits to Selection
- › Limits to a Species Range
- › Speciation & Hybridization in *Antirrhinum*

CV

CAREER

- 2008 Professor, IST Austria
- 1990– Reader/Professor, University of Edinburgh, UK
- 1982–1990 Lecturer/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
- 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
- 1995 Fellow, Royal Society of Edinburgh
- 1994 Fellow, Royal Society of London
- 1994 David Starr Jordan Prize

P

SELECTED PUBLICATIONS

1. Barton NH, Turelli M. 2011. Spatial waves of advance with bistable dynamics: cytoplasmic and genetic analogs of the Allee effect. *American Naturalist* 178: E48–75.
2. Barton NH. 2009. Why sex and recombination? *Cold Spring Harbor Symposia Quant. Biol.* 74.
3. Barton NH, Briggs DEG, Eisen JA, Goldstein DB, Patel NH. 2007. *Evolution*. Cold Spring Harbor Laboratory Press.

T

TEAM

- Tom Ellis (PhD student), David Field (Postdoc), Tiago Paixao (Postdoc), Melinda Pickup (Postdoc), Jitka Polechová (Postdoc), Murat Tugrul (PhD student), Harold P. de Vladar (Postdoc), Daniel Weissman (Postdoc)

JONATHAN P. BOLLBACK
MICROBIAL EXPERIMENTAL EVOLUTION AND
STATISTICAL GENOMICS



Microbes can be found everywhere – in the soil, air, water, our food, and even inside us. The Bollback group uses these ubiquitous organisms to study the process of evolution and to better understand which evolutionary forces have shaped the microbes themselves.

Microbes – viruses, bacteria, Archaea, and protists – account for half of the world’s biomass, the majority of the biological diversity on Earth, and are the culprits of many human diseases. Microbes are also an extraordinarily powerful model system for understanding how evolution works. By studying microbes, the Bollback group addresses a variety of fundamental evolutionary questions. Firstly, how does adaptation differ between sexual and asexual populations? Microbes are mostly asexual and asexuality slows down the rate of adaptation. Secondly, how do microbes defend themselves against parasites? Microbes, like other organisms, have their own parasites, and are thus a good model system for understanding the evolutionary dynamics of host-parasite interactions. Lastly, microbes can readily donate and receive genes, via a process called horizontal gene transfer, from other individuals and species. Yet it is unclear which evolutionary forces are acting to promote and restrict this process.

Current Projects

- › Microbial Population Genetics
- › Evolutionary Host-Parasite Interactions
- › Evolution of Microbial Immune Systems
- › Experimental Evolution

CV

CAREER

- 2010 Assistant Professor, IST Austria
- 2008–2010 Postdoc, Interdisciplinary Centre for Human and Avian Influenza Research, University of Edinburgh, UK
- 2004–2008 Postdoc, University of Copenhagen, Denmark
- 2004 PhD, University of Rochester, USA

SELECTED DISTINCTIONS

- 2007–2009 Forskningsrådet for Natur og Univers, FNU Grant
- 2007 Featured in *Aktuel Naturvidenskab* nr 3 (Current Science)
- 2006 Forskningsrådet for Sundhed og Sygdom, FSS Grant
- 1995–1998 Predoctoral Fellow, Smithsonian Institution, USA

P

SELECTED PUBLICATIONS

1. Bollback JP, Huelsenbeck JP. 2009. Parallel genetic evolution within and among bacteriophage species of varying degrees of divergence. *Genetics* 181: 225–234.
2. Bollback JP, Huelsenbeck JP. 2007. Clonal interference is alleviated by high mutation rates in large populations. *Molecular Biology and Evolution* 24(6): 1397–1406.
3. Bollback JP. 2002. Bayesian model adequacy and choice in phylogenetics. *Molecular Biology and Evolution* 19(7): 1171–1180.

T

TEAM

- Hande Acar (PhD student), Anne Kupczok (Postdoc), Rodrigo A. F. Redondo (Postdoc)



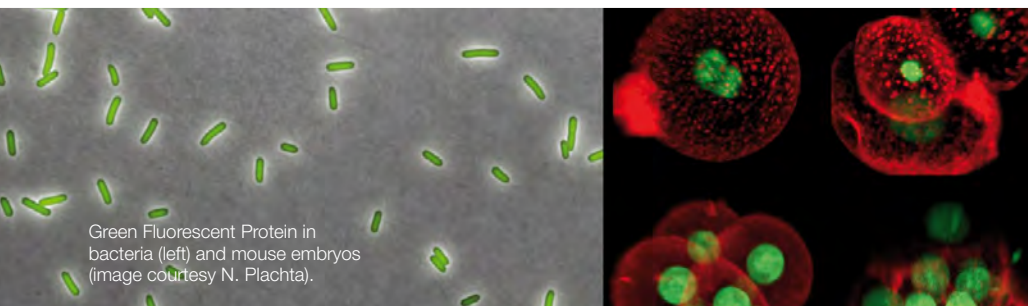
A cluster of *Escherichia coli*



TOBIAS BOLLENBACH

BIOPHYSICS AND SYSTEMS BIOLOGY

Cells perceive a broad spectrum of signals. But how are these signals processed in the cell? And how are conflicts between different signals resolved? The Bollenbach group uses a quantitative approach to understand cellular information processing.



Green Fluorescent Protein in bacteria (left) and mouse embryos (image courtesy N. Plachta).

CV

CAREER

- 2010** Assistant Professor, IST Austria
- 2006–2010** Postdoc, Department of Systems Biology, Harvard Medical School, Boston, USA
- 2005–2006** Postdoc, Max-Planck Institute, Dresden, Germany
- 2005** Guest Scientist, University of Tokyo, Japan
- 2005** PhD, Max-Planck Institute, Dresden, Germany

SELECTED DISTINCTIONS

- 2011–** Member of the Young Academy ("Junge Akademie") at the German National Academy of Sciences Leopoldina and the Berlin-Brandenburg Academy of Sciences and Humanities
- 2007–2009** Feodor Lynen Fellowship, Alexander von Humboldt Foundation
- 2005** REES Fellowship, Japan International Science & Technology Exchange Center
- 2000–2005** Student and PhD Fellowships, German National Scholarship Foundation

P

SELECTED PUBLICATIONS

1. Bollenbach T, Kishony R. 2011. Resolution of gene regulatory conflicts caused by combinations of antibiotics. *Molecular Cell* 42: 413–25.
2. Bollenbach T, Quan S, Chait R, Kishony R. 2009. Nonoptimal microbial response to antibiotics underlies suppressive drug interactions. *Cell* 139: 707–718.
3. Kicheva A*, Pantazis P*, Bollenbach T*, Kalaidzidis Y, Bittig T, Jülicher F, González-Gaitán M. 2007. Kinetics of morphogen gradient formation. *Science* 315: 521–525.

*equal contribution

T

TEAM

Guillaume Chevereau (Postdoc), Alexander Kitzmann (Technical assistant), Karin Mitosch (PhD student)

Cells need to respond to a variety of signals in their environment, such as nutrients, drugs and signaling molecules. The Bollenbach group studies how cellular responses are computed and integrated, particularly in environments that contain multiple, potentially conflicting, signals. The experimental system the group currently focuses on is the bacterial response to combinations of antibiotics. While such drug combinations are crucially important for the treatment of infections, bacteria are getting more and more resistant to all available antibiotics. To use available antibiotics more efficiently, and identify any so far unexploited weaknesses, bacterial responses to different drugs and their combinations need to be understood in detail. The Bollenbach group combines quantitative experiments with statistical data analysis and theoretical modeling approaches to identify general design principles of cellular gene regulation responses. Using these quantitative approaches, the group aims to find new strategies of combining the currently available drugs in ways that maximize their efficiency while minimizing the evolution of drug resistance.

Current Projects

- Cellular responses to conflicting signals
- Mechanisms of drug interactions
- Physical descriptions of animal development

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, the study of interactive decision problems, can be used to study problems in logic and set theory, economics, cell, population and evolutionary biology, and the design of the internet. The Chatterjee group is interested in the theoretical foundations of game theory and formal verification. Game theory in the formal verification of software involves the algorithmic analysis of various forms of games played on graphs. This broad framework allows effective analysis of many important questions of computer science and helps in the development of software systems. The Chatterjee group works on theoretical aspects for the better understanding of games and develops new algorithms,

presenting the theoretical foundations for the formal verification of systems.

Current Projects

- Quantitative Verification
- Stochastic Game Theory
- Modern graph algorithms for verification problems
- Evolutionary Game Theory



CV

CAREER

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

SELECTED DISTINCTIONS

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

P

SELECTED PUBLICATIONS

1. Chatterjee K., Henzinger M. 2011. Faster and dynamic algorithms for maximal end component decomposition and related graph problems in probabilistic verification. In: SODA: Symposium on Discrete Algorithm. ACM, 1318–1336.
2. Chatterjee K. 2007. Concurrent games with tail objectives. *Theoretical Computer Science* 388: 181–198.
3. Chatterjee K. 2005. Two-player non-zero sum omega-regular games. *Concurrency Theory Lecture Notes in Computer Science* 3653. Springer, 413–427.

T

TEAM

Martin Chmelik (PhD student), Johannes Reiter (PhD student)



SYLVIA CREMER

COOPERATIVE DISEASE DEFENSE IN INSECT SOCIETIES

Ants live together in tightly cramped colonies. Even if this lifestyle should favor disease spread, ants rarely fall ill. When one ant contracts an infection, the colony's disease defenses prevent an outbreak of the infection. The Cremer group investigates social immunity in ants and its impact on disease management in societies.

Social insect colonies are sometimes described as “superorganisms”, as – like cells or organs in a multicellular body – individual members take over specific roles and only the colony as a whole, not its individual members, can produce offspring. Like in any organism, an immune system protects the insect society from infections. This immune system is composed of two parts – the individual immune response of each colony member, and the collective disease defense or “social immunity” of the entire colony. Social immunity, the focus of research in the Cremer group, results from the cooperation of colony members for the benefit of the entire colony, and is especially important in social insect societies due to the close contact between individuals. Different types of behavior make up social immunity, such as hygiene behaviors like mutual allogrooming; joint physiological defenses, including the application of

antimicrobial substances; and “social vaccination”, in which the social contact with an infected individual promotes the immunity of naïve colony members. The Cremer group studies all aspects of social immune defense in ants to learn more about the

management of disease in societies.

Current Projects

- › Understanding Social Vaccination
- › Pathogen Detection Abilities in Ants
- › Host-Parasite Coevolution

CV

CAREER

- 2010** Assistant Professor, IST Austria
- 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

- 2011** Member of “Junge Kurie” of the ÖAW (Austrian Academy of Sciences)
- 2009** ERC Starting Grant
- 2008** Member, German Young Academy of Sciences Leopoldina and Berlin Brandenburg
- 2004–2006** Marie Curie Intra-European Fellowship & Reintegration Grant
- 2003–2004** Feodor Lynen Fellowship, Alexander von Humboldt Foundation
- 2000** Diploma thesis award, German Life Sciences Association

P

SELECTED PUBLICATIONS

1. Ugelvig LV, Kronauer DJC, Schrepf A, Heinze J, Cremer S. 2010. Rapid anti-pathogen response in ant societies relies on high genetic diversity. *Proceedings of the Royal Society B: Biological Sciences*, 277: 2821–2828.
2. Ugelvig LV, Cremer S. 2007. Social prophylaxis: group interaction promotes collective immunity in ant colonies. *Current Biology* 17: 1967–1971.
3. Cremer S, Armitage SAO, Schmid-Hempel P. 2007. Social Immunity. *Current Biology* 17: R693–R702.

T

TEAM

Anna Grasse (Technical assistant), Matthias Konrad (PhD student), Barbara Mitteregger (Technical assistant), Miriam Stock (PhD student), Line Vej Ugelvig (Postdoc), Meghan Vyleta (Postdoc)



Raster electron microscopy image of healthy (above) and fungus-infected (below) ants



JOZSEF CSICSVARI

SYSTEMS NEUROSCIENCE

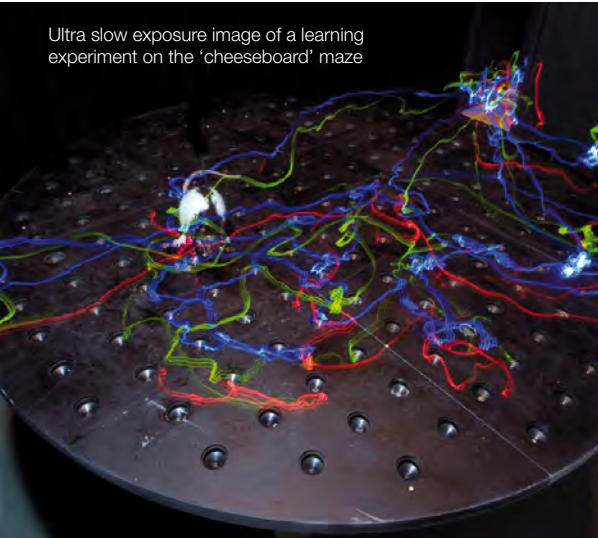
Transforming novel information to memory is essential if we want to remember it again later. Memory formation is therefore crucial for learning new facts or skills. The Csicsvari group studies how learning is implemented in the brain.

During learning, memory traces are processed and encoded in neuronal circuits and consolidated for later recall. The Csicsvari group focuses on the hippocampus, a brain area known to be important for spatial memory formation, and aims to understand how learning leads to memory formation. The group seeks to understand how neuronal circuits process information and form spatial memory by recording the activity of many neurons in different brain circuits during learning tasks and sleep. In addition, optogenetic methods are used to selectively manipulate neuronal activity in the hippocampus. Different place learning tasks allow the researchers to investigate the role

of oscillatory activity during encoding, consolidation and recall of spatial information. To store spatial memory, the hippocampus interacts with other cortical regions, and the Csicsvari group investigates whether and how synchronous oscillations between the hippocampus and the entorhinal cortex are required for storing spatial information.

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



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

CV

CAREER

- 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, USA
- 1999–2001** Postdoctoral Fellow, Center for Behavioral and Molecular Neuroscience, Rutgers University, USA
- 1993–1999** Graduate Assistant, Center for Behavioral and Molecular Neuroscience, Rutgers University, USA
- 1999** PhD, Rutgers University, USA

SELECTED DISTINCTIONS

- 2011** ERC Starting Grant (consolidator)
- 2010** Title of Ad Hominem Professor in Neuroscience at the University of Oxford

P

SELECTED PUBLICATIONS

1. Dupret D, O'Neill J, Pleydell-Bouverie B, Csicsvari J. 2010. The reorganization and reactivation of hippocampal maps predict spatial memory performance. *Nature Neuroscience* 13: 995–1002.
2. Huxter JR, Senior TJ, Allen K, Csicsvari J. 2008. Theta phase-specific codes for two-dimensional position, trajectory and heading in the hippocampus. *Nature Neuroscience* 11: 587–594.
3. O'Neill J, Senior TJ, Allen K, Huxter JR, Csicsvari. 2008. Reactivation of experience-dependent cell assembly patterns in the hippocampus. *Nature Neuroscience* 11: 209–215.

T

TEAM

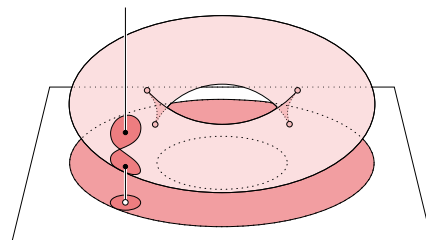
Alice Alvernhe (Postdoc), Michael Lobianco (Technical assistant), Joseph O'Neill (Postdoc), Philipp Schönenberger (Postdoc), Haibing Xu (PhD student)



HERBERT EDELSBRUNNER

ALGORITHMS, COMPUTATIONAL GEOMETRY & TOPOLOGY

Uncovering fundamental shapes in a sea of occurrences is a central task in Computational Geometry and Topology. The Edelsbrunner group drives the frontiers in this constantly reshaping field of science.



The projection of the torus to the plane. The distance function defined by the marked value in the plane is illustrated by showing one of its sublevel sets.

Current Projects

- › Discrete and Computational Geometry
- › Applied Computational Algebraic Topology
- › Reconstruction and Description of Root Traits

Topology, the study of shapes and how they are connected, can be used to address a number of questions in applications as diverse as scientific visualization, structural molecular biology, systems biology, geometry processing, medical imaging and orthodontics. The common theme in these applications is the importance of the recognition, matching, and classification of shapes. The Edelsbrunner group studies the two related subjects of topology and geome-

try from a computational point of view, in order to make mathematical insights useful in applications that are workable for non-specialists. The group believes in a broad approach to problems, including the development of new mathematics, the translation into new computational methods, and the application to frontiers of science. Some candidate areas for fruitful collaborations are cell biology, neuroscience, medical imaging and material science.

CV

CAREER

- 2009** Professor, IST Austria
- 2004–** Professor for Mathematics, Duke University, Durham, USA
- 1999–** Professor for Computer Science, Duke University, Durham, USA
- 1996–** 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
- 2009** Member, Academia Europaea
- 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

P

SELECTED PUBLICATIONS

- Edelsbrunner H, Harer JL. 2010. Computational Topology. An Introduction. American Mathematical Society, Providence, Rhode Island.
- Edelsbrunner H. 2001. Geometry and topology for mesh generation. Cambridge University Press, Cambridge, England.
- Edelsbrunner H. 1987. Algorithms in combinatorial geometry. Springer-Verlag, Heidelberg, Germany.

T

TEAM

Chao Chen (Postdoc), Brittany Fasy (PhD student), Adrian Ion (Postdoc), Michael Kerber (Postdoc), Salman Parsa (PhD student), Florian Pausinger (PhD student), Olga Symonova (Postdoc)

CĂLIN GUET

SYSTEMS AND SYNTHETIC BIOLOGY OF GENETIC NETWORKS

Networking is important on any level and in any environment – even in bacteria, genes and proteins are networking. But which rules, if any, do these networks follow? Using systems and synthetic biology, the Guet group explores questions of networking by analyzing both natural and synthetic networks.



Genes and proteins constitute themselves into bio-molecular networks in cells. These genetic networks are engaged in a constant process of decision-making and computation over time scales that span from seconds to the time it takes the organism to replicate, and even beyond. By studying existing networks and constructing synthetic networks in living cells, the Guet group aims to uncover universal rules that govern bio-molecular networks. The group uses the bacterium *Escherichia coli* as their model system because of its relative simplicity and the powerful experimental genetic tools available. One aspect of the Guet group's work covers information processing at complex bacterial promoters, which integrate signals and regulate the expression of genes accordingly. The group studies how promoters are shaped by evolution and what constraints are imposed by the molecular hardware on information processing, by subjecting promoters to artificial selection and building synthetic promoters.

Current Projects

- › Information processing at complex promoters
- › Systems biology of the *mar* regulon

CV

CAREER

- 2011** Assistant Professor, IST Austria
- 2009** Postdoc, Harvard University, Cambridge, USA
- 2005** Postdoc, The University of Chicago, USA
- 2004** PhD, Princeton University, USA

SELECTED DISTINCTIONS

- 2011** HFSP Research Grant
- 2005** Yen Fellow, The University of Chicago, USA
- 1997** Sigma XI Membership

P

SELECTED PUBLICATIONS

- Park H, Pontius W, Guet CC, Marko JF, Emonet T, Cluzel P. 2010. Interdependence of behavioural variability and response to small stimuli in bacteria. *Nature* 468: 819–823.
- Kinkhabwala A, Guet CC. 2008. Uncovering cis regulatory codes using synthetic promoter shuffling. *PLoS One* 3: e2030.
- Guet CC, Elowitz MB, Hsing WH, Leibler S. 2002. Combinatorial synthesis of genetic networks. *Science* 296: 1466–1470.

T

TEAM

Tobias Bergmiller (Postdoc), Maria Mateescu (Postdoc), Magdalena Steinrück (PhD student)

Colonies of *Escherichia coli* performing Boolean logic computations with two chemical inputs and green fluorescent protein (GFP) as the output state





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.

The Heisenberg group studies the molecular and cellular mechanisms by which vertebrate embryos take shape. To gain insights into critical processes in morphogenesis, the group focuses on gastrulation movements in zebrafish. Gastrulation is a highly conserved process in which a seemingly unstructured blastula is transformed into a highly organized embryo. The group has chosen a multi-disciplinary approach to analyzing gastrulation, employing a combination of genetic, cell biological, biochemical and biophysical techniques. Using these tools, the group is deciphering key effector mechanisms involved in giving vertebrate embryos shape, such as cell adhesion and aggregation, cell polarization and cell migration. One central question they address is how adhesion between cells influences the specification and sorting of different populations of cells, which ultimately develop into

different tissues and organs. 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 Contractility and Morphogenesis
 - › Cell Polarization and Migration

CV

CAREER

- 2010** Professor, IST Austria
2001–2010 Group Leader, Max-Planck Institute, Dresden, Germany
1997–2000 Postdoc, University College London, UK
1993–1996 PhD, Max-Planck Institute, Tübingen, Germany

SELECTED DISTINCTIONS

- 2000** Emmy Noether Junior Professorship
1998 Marie Curie Postdoctoral Fellowship
1997 EMBO Postdoctoral Fellowship

P

SELECTED PUBLICATIONS

1. Diz-Muñoz A, Krieg M, Bergert M, Ibarlucea-Benitez I, Muller D, Paluch E, Heisenberg CP. 2010. Control of directed cell migration in vivo by membrane-to-cortex attachment. PLoS Biology 8: e1000544.
2. Krieg M, Arboleda-Estudillo Y, Puech PH, Käfer J, Graner F, Müller DJ, Heisenberg CP. 2008. Tensile forces govern germ-layer organization in zebrafish. Nature Cell Biology 10: 429–436.
3. Heisenberg CP, Tada M, Rauch GJ, Saúde L, Concha ML, Geisler R, Stemple DL, Smith JC, Wilson SW. 2000. Silberblick/Wnt11 mediates convergent extension movements during zebrafish gastrulation. Nature 405: 76–81.

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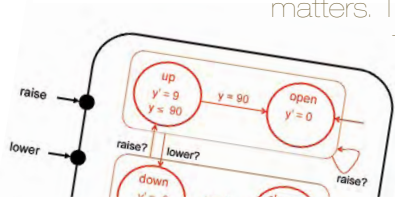
TEAM

Zsuzsa Akos (Student intern), Vanessa Barone (PhD student), Martin Behrndt (PhD student), Pedro Campinho (PhD student), Julien Compagnon (Postdoc), Gabby Krens (Postdoc), Jean-Leon Maitre (PhD student), Hitoshi Morita (Postdoc), Julia Rönsch (Technician), Verena Ruprecht (joint Postdoc with Sixt group), Keisuke Sako (Postdoc), Philipp Schmalhorst (Postdoc), Michael Smutny (Postdoc), Stefan Wiesner (joint Postdoc with Sixt group)

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 developing complex hardware and software systems.



CV

CAREER

- 2009** Professor, IST Austria
2004–2009 Professor, EPFL, Lausanne, Switzerland
1999–2000 Director, Max-Planck Institute, Saarbrücken, Germany
1998–2005 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 of Grenoble, France
1991 PhD, Stanford University, Palo Alto, USA

SELECTED DISTINCTIONS

- 2011** Member, Austrian Academy of Sciences
2011 ACM SIGSOFT Impact Paper Award
2010 ERC Advanced Grant
2006 ISI Highly Cited Researcher
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

P

SELECTED PUBLICATIONS

1. Chatterjee K, de Alfaro L, Henzinger TA. 2011. Qualitative concurrent parity games. ACM Transactions on Computational Logic 12: 1–51.
2. Henzinger TA, Singh V, Wies T, Zufferey D. 2011. Scheduling large jobs by abstraction refinement. Proceedings of EuroSys, ACM Press 329–342.
3. Fisher J, Harel D, Henzinger TA. 2011. Biology as reactivity. Communications of the ACM 54: 72–82.

T

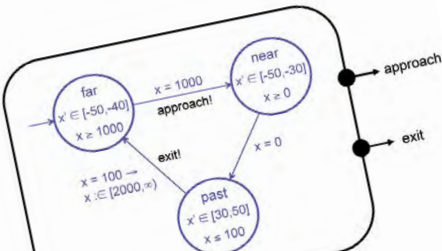
TEAM

Pavol Černý (Postdoc), Cezara Dragoi (Postdoc), Ashutosh Gupta (Postdoc), Dejan Nickovic (Postdoc), Arjun Radhakrishna (PhD student), Ali Sezgin (Postdoc), Vasu Singh (Postdoc), Anmol Tomar (PhD student), Thomas Wies (Postdoc), Damien Zufferey (PhD student)

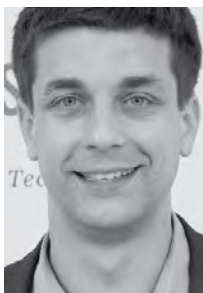
Over 90 % of today's worldwide computing power is found in unexpected places like cell phones, kitchen appliances, and pace-makers. Software has become one of the most complicated artifacts produced by man, making software bugs unavoidable. The Henzinger group addresses the challenge of reducing software bugs in concurrent and embedded systems. Concurrent systems 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 only 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 fast. The Henzinger group invents mathematical methods and develops computational tools for improving the reliability of software in concurrent and embedded systems.

Current Projects

- › Quantitative modeling and analysis of reactive systems
- › Interfaces and contracts for component-based hardware and software design
- › Predictability and robustness for real-time and embedded systems
- › Modern concurrency paradigms such as software transactional memory and cloud computing
- › Model checking biochemical reaction networks



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



HARALD JANOVJAK

OPTICAL CONTROL OF CELLULAR SIGNALING

When first faced with a new machine, an engineer's instinct is to disassemble it to understand its inner workings. The Janovjak group uses optogenetics to take apart the cell's signaling machinery and gain a better insight into how it orchestrates virtually all cellular functions.

CV

CAREER

- 2011 Assistant Professor, IST Austria
- 2010–2011 Research Associate, University of Munich, Germany
- 2006–2010 Postdoc, University of California, Berkeley, USA
- 2005 PhD, University of Technology, Dresden, Germany

SELECTED DISTINCTIONS

- 2007–2009 Long-term fellow of the European Molecular Biology Organization
- 2005 PhD with highest honors (summa cum laude)

P

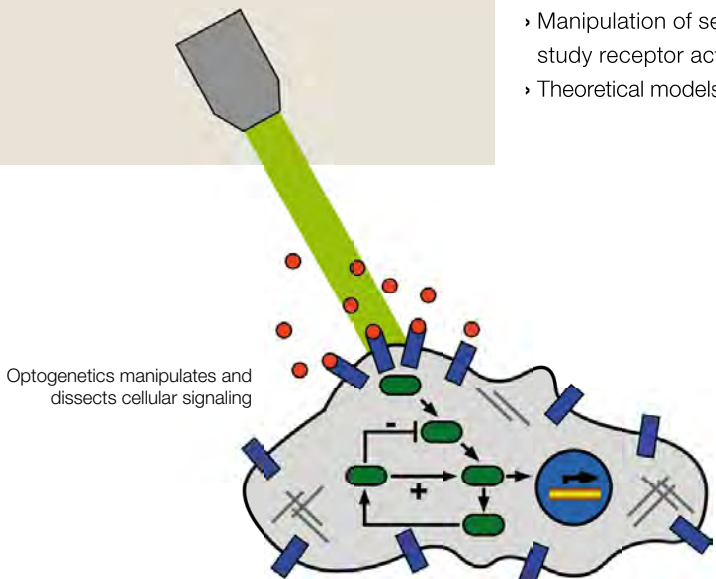
SELECTED PUBLICATIONS

1. Janovjak H, Sandoz G, Isacoff EY. 2011. A modern ionotropic glutamate receptor with a potassium-selectivity signature sequence. *Nature Communications* 2 (232): 1–6.
2. Janovjak H, Szobota S, Wyart C, Trauner D, Isacoff EY. 2010. A light-gated, potassium-selective glutamate receptor for the optical inhibition of neuronal firing. *Nature Neuroscience* 18: 1027–1032.
3. Syzmcyak P, Janovjak H. 2009. Periodic forces trigger a complex mechanical response in ubiquitin. *Journal of Molecular Biology* 390: 443–456.

T

TEAM

Alexander Kitzmann (Technician),
Maurizio Morri (PhD student),
Stephanie zur Nedden (Postdoc),
Robert Riedler (Student intern)



Cell surface receptors are the antennas that receive signals and pass them on to the inside of the cell, causing specific and tightly controlled responses. The Janovjak group seeks to understand this process and takes a unique biophysical approach to actively manipulate signaling pathways. In multiple experimental systems, receptors are engineered to respond to a light stimulus rather than to the native signal. Light is then used as a “remote control” that allows researchers to switch receptors “on” and “off”. This optogenetic approach is used to study cellular circuits and networks by activating or inactivating them at any given position and with unprecedented time resolution, with the goal to understand information processing in the nervous system and in signaling processes in general.

Current Projects

- › Optogenetic identification of active signaling pathways
- › Manipulation of sensory domains to study receptor activation
- › Theoretical models of receptor activation



PETER JONAS

SYNAPTIC COMMUNICATION IN HIPPOCAMPAL MICROCIRCUITS

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

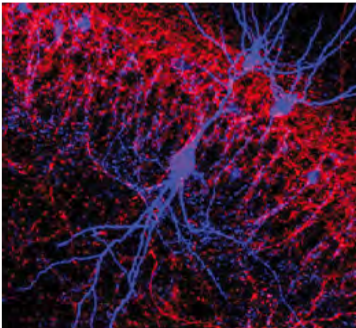
Understanding the function of neuronal microcircuits is one of the major challenges of life science in the 21st century. The human brain is comprised of approximately 10 billion neurons, which communicate with each other at a huge number of synapses, specialized sites of contact between neurons. Broadly, synapses in the brain fall into two categories: excitatory synapses releasing the transmitter glutamate and inhibitory synapses releasing Gamma-Aminobutyric acid (GABA). The Jonas group seeks to quantitatively address the mechanisms of synaptic signaling, using multiple-cell recording, subcellular patch-clamp techniques, Ca²⁺ imaging,

and modeling. Amongst other projects, the group examines subcellular elements of the fast-spiking, parvalbumin-expressing GABAergic interneurons in the hippocampus, which is thought to contribute to storage and retrieval of memories. These interneurons play a key role in cortical neuronal networks, and the Jonas group aims to obtain a quantitative nanophysiological picture of signaling in this type of interneuron. This research has far-reaching implications for understanding the contribution of GABAergic interneurons to neuronal coding and brain energetics, and may lay the basis for the development of new therapeutic strategies against diseases of the nervous system.

Current Projects

- › Nanophysiology of fast-spiking, parvalbumin expressing GABAergic interneurons
- › Analysis of synaptic mechanisms of information storage
- › Analysis of hippocampal synaptic transmission in vivo

Presynaptic hippocampal basket cell (lower left) and postsynaptic granule neurons (upper right)



CV

CAREER

- 2010 Professor, IST Austria
- 1995–2010 Professor & Department Head, University of Freiburg, Germany
- 1994–1995 Associate Professor, Technical University of Munich, Germany
- 1990–1994 Research Assistant, Max-Planck Institute, Heidelberg, Germany
- 1988–1989 Postdoc, University of Giessen, Germany
- 1987 PhD, University of Giessen, Germany

SELECTED DISTINCTIONS

- 2011 ERC Advanced Grant
- 2009 Adolf-Fick-Award, Physicomedical Society, Würzburg, Germany
- 2008 Member, Academy of Sciences, Heidelberg, Germany
- 2007 Tsungming Tu Award, National Science Council Taiwan
- 2006 Szentagothai memorial lecture, University of California, Irvine, USA
- 2006 Gottfried Wilhelm Leibniz Award, German Research Foundation
- 2002 Member, German Academy of Sciences Leopoldina
- 1998–2001 Human Frontiers Science Program Organization Grant
- 1998 Max-Planck Research Award
- 1997 Medinfar European Prize in Physiology, Portugal
- 1994 Heinz Maier Leibniz Award, German Ministry for Education and Science
- 1992 Heisenberg Fellowship, German Research Foundation

P

SELECTED PUBLICATIONS

1. Eggermann E, Jonas P. 2012. How the ‘slow’ Ca²⁺ buffer parvalbumin affects transmitter release in nanodomain-coupling regimes. *Nature Neuroscience* 15: 20–22.
2. Eggermann E, Bucurenciu I, Goswami SP, Jonas P. 2012. Nanodomain coupling between Ca²⁺ channels and sensors of exocytosis at fast mammalian synapses. *Nature Reviews Neuroscience* 13: 7–21.
3. Hu H, Martina M, Jonas P. 2010. Dendritic mechanisms underlying rapid synaptic activation of fast-spiking hippocampal interneurons. *Science* 327: 52–58.

T

TEAM

Jian Gan (Postdoc), Sarit Goswami (PhD student), Jose Guzman (Postdoc), Hua Hu (Postdoc), Sooyun Kim (PhD student), Janina Kowalski (Postdoc), Eva Kramberger (Administrative assistant), Florian Marr (Technical assistant), Rajiv Mishra (PhD student), Alejandro Pernia-Andrade (Postdoc), Alois Schlögl (Software engineer), Nicholas Vyleta (Postdoc)



VLADIMIR KOLMOGOROV
COMPUTER VISION AND DISCRETE OPTIMIZATION ALGORITHMS

Stepping out on the street, we automatically judge the distance and speed of cars. For computers, estimating the depth of objects in an image requires complex computation. The Kolmogorov group's work on algorithms gives computers "stereo vision".



Stereo vision is one of the possible applications of Kolmogorov's research.

The Kolmogorov group's research focuses on the development of efficient algorithms for inference in graphical models, which have applications in many different fields such as computer vision, computer graphics, data mining, machine learning and bioinformatics. Using inference algorithms for Markov Random Fields, the Kolmogorov group addresses two important issues in computer vision and graphics – binary image segmentation and stereo vision. Binary image segmentation gives automatic systems the ability to divide an image

into foreground and background, while stereo vision allows them to infer the depth of objects, an essential skill for the navigation of autonomous vehicles. Kolmogorov has developed algorithms widely used in computer vision, such as a maximum flow algorithm and the sequential tree-reweighted message passing algorithm (TRW-S).

Current Projects

- › Inference in Graphical Models
- › Combinatorial Optimization Problems
- › Theory of Discrete Optimization

CV

CAREER

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

SELECTED DISTINCTIONS

- 2007** Honorable mention, outstanding student paper award (to M. Pawan Kumar) at Neural Information Processing Systems Conference
- 2006–2011** The Royal Academy of Engineering/EPSRC Research Fellowship
- 2005** Best paper honorable mention award at IEEE Conference on Computer Vision and Pattern Recognition
- 2002** Best paper award at the European Conference on Computer Vision

P

SELECTED PUBLICATIONS

1. Kolmogorov V, Blossom V. 2009. A new implementation of a minimum cost perfect matching algorithm. Mathematical Programming Computation 1: 43–67.
2. Kolmogorov V. 2006. Convergent tree-reweighted message passing for energy minimization. IEEE Transactions on Pattern Analysis and Machine Intelligence 28: 1568–1583.
3. Boykov Y, Kolmogorov V. 2004. An experimental comparison of min-cut/max-flow algorithms for energy minimization in vision. IEEE Transactions on Pattern Analysis and Machine Intelligence 26: 1124–1137.

CHRISTOPH LAMPERT
COMPUTER VISION AND MACHINE LEARNING

Every kid knows how to play "I spy with my little eye", but to a computer the task of analyzing images and recognizing objects in them is tremendously difficult. The Lampert group helps computers "see" with the tools of Computer Vision and Machine Learning.



Recognizing objects in an image is child's play to humans, but presents an exceedingly difficult challenge to computers. The Lampert group develops algorithms and methods that allow computers to analyze high-dimensional data and make decisions based on it. In machine learning, computers arrive at knowing general rules by making abstractions based on examples provided. Object recognition is one aspect of machine learning essential for applications requiring computer vision. In their research, the Lampert group members develop algorithms that enable automatic image understanding systems to analyze digital images regarding their contents. In the long run, the Lampert group is interested in building automatic systems that understand images on the same semantic level as humans do, enabling them to answer questions like: What objects are visible in an image? Where are they located? How do they interact?

Current Projects

- › Learning Methods for Computer Vision
- › Object Recognition and Localization
- › Structured Prediction and Learning
- › Attribute-Enabled Representations

CV

CAREER

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

SELECTED DISTINCTIONS

- 2008** Main Price, German Society for Pattern Recognition (DAGM)
- 2008** Best Paper Award, IEEE Conference for Computer Vision and Pattern Recognition (CVPR)
- 2008** Best Student Paper Award, European Conference for Computer Vision (ECCV)

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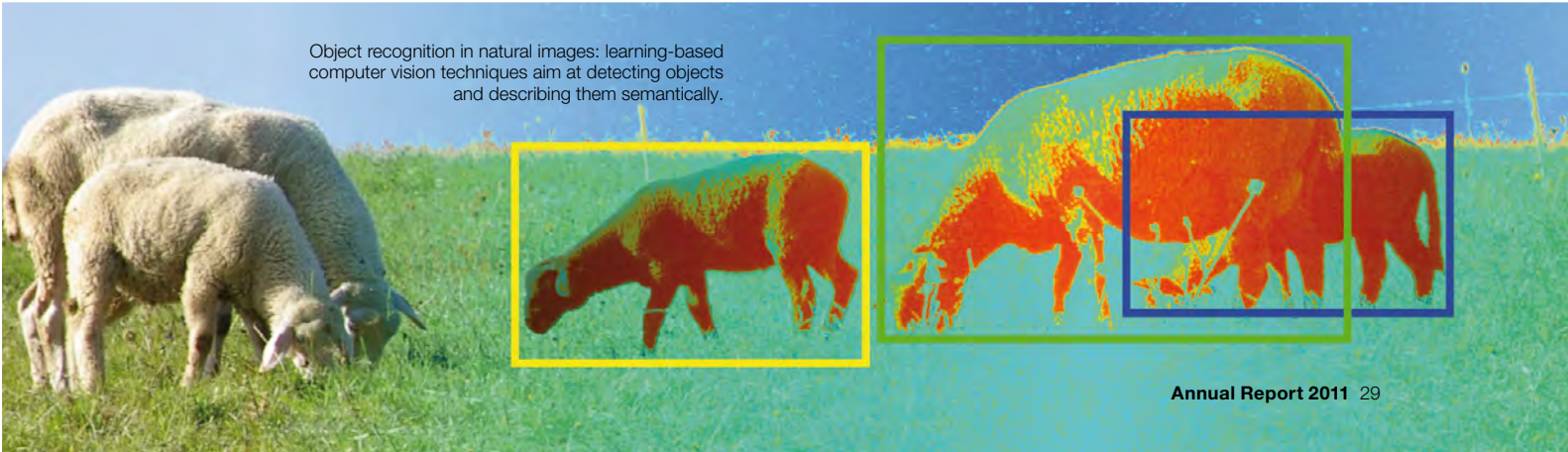
SELECTED PUBLICATIONS

1. Lampert CH, Nickisch H, Harmeling S. 2009. Learning to detect unseen object classes by between-class attribute transfer. IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 951–958.
2. Lampert CH, Blaschko MB, Hofmann T. 2008. Beyond sliding windows: Object localization by efficient subwindow search. IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 1–8.
3. Blaschko MB, Lampert CH. 2008. Learning to localize objects with structured output regression. European Conference on Computer Vision (ECCV), 2–15.

T

TEAM

Filip Korč (Postdoc), Viktoriia Sharmanska (PhD student), Novi Quadrianto (Student intern)



Object recognition in natural images: learning-based computer vision techniques aim at detecting objects and describing them semantically.



KRZYSZTOF PIETRZAK

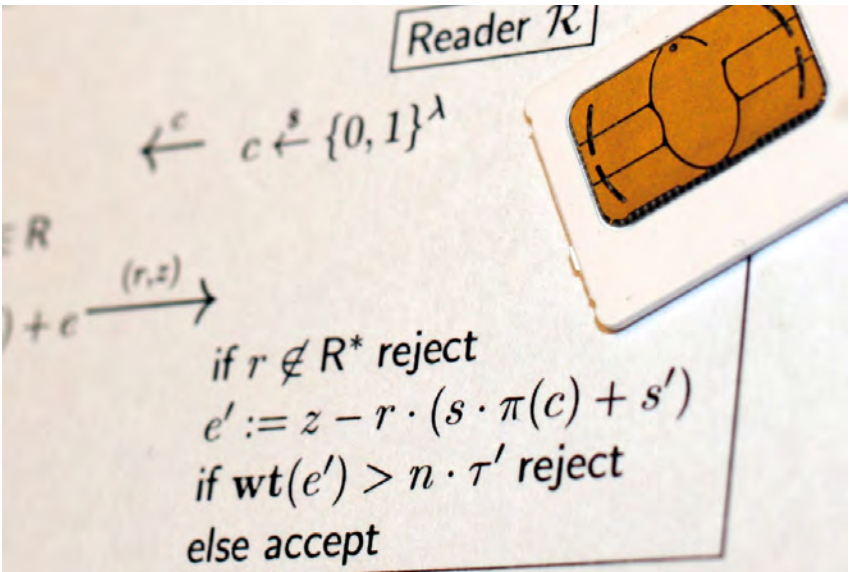
CRYPTOGRAPHY

Cryptography is often relegated to the realm of spies and agents. However, we all rely on cryptography every time we withdraw money from an ATM. The Pietrzak group works on cryptographic theory and practice to improve the security of light-weight devices.

The Pietrzak group is interested in the theoretical and practical aspects of cryptography, the science of information security. Their work focuses on constructing secure cryptographic schemes for light-weight devices such as smart-cards and RFID tags which are used, for example, in security-relevant applications like electronic passports, wireless car keys, or bankcards. These frequently used devices are susceptible to side-channel attacks, in which information automatically leaked from the device, such as power consumption or radiation, is measured and used to break security completely. Pietrzak's group works on developing cryptosystems for light-weight devices that are provably secure against all side-channel attack. Smart-cards and RFID tags are also often computationally highly restricted, and the group is establishing simple cryptographic schemes that are provably secure, but at the same time simple and efficient enough so that they can be implemented on such devices.

Current Projects

- › Leakage-Resilient Cryptosystems
- › Cryptosystems for Computationally Restricted Devices



Light-weight devices require simple and efficient cryptographic schemes.

CV

CAREER

- 2011** Assistant Professor, IST Austria
- 2005–2011** Scientific staff member, Centrum Wiskunde & Informatica, Amsterdam, Netherlands
- 2006** Postdoc, École Normale Supérieure, Paris, France
- 2005** PhD, ETH Zurich, Switzerland

SELECTED DISTINCTIONS

- 2010** ERC Starting Grant

P

SELECTED PUBLICATIONS

1. Kiltz E, Pietrzak K, Cash D, Jain A, Venturi D. 2011. Efficient authentication from hard learning problems. EUROCRYPT, 7–26.
2. Dziembowski S, Pietrzak K, Wichs D. 2010. Non-malleable codes. International Conference on Supercomputing, 434–452.
3. Dziembowski S, Pietrzak K. 2008. Leakage-resilient cryptography. IEEE Symposium on Foundations of Computer Science, 293–302.

T

TEAM

Stephan Krenn (Postdoc),
Joachim Schipper (PhD student)



MICHAEL SIXT

MORPHODYNAMICS OF IMMUNE CELLS

Immune cells zip through our body at high speed 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 body are stationary, forming solid tissues and encapsulated organs. One exception are leukocytes, immune cells essential for both the innate and adaptive immune response 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 mechanistic principles that then might be generalized to other migrating cells, such as metastasizing cancer cells or migratory cells during development or regeneration. A current focus of research is how the cell's internal skeleton, the actin cytoskeleton, generates the force to deform the cell body and how this force is transduced to the surrounding tissue in order to move the cell forward. The group also investigates other, closely related aspects, such as cell polarization and guidance within tissues. To challenge their findings in the context of living tissues, the Sixt group has developed tissue explants and whole-animal imaging techniques that complement studies in reductionist in vitro systems.

Current Projects

- › Environmental Control of Leukocyte Migration
- › Cellular Force Generation & Transduction
- › Invasion of Tissue Barriers

CV

CAREER

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

SELECTED DISTINCTIONS

- 2011** ERC Starting Grant
- 2011** FWF START Award
- 2008** Endowed Professor of the Peter Hans Hofschneider Foundation
- 2003** Novartis research price for the best medical dissertation at the University of Erlangen

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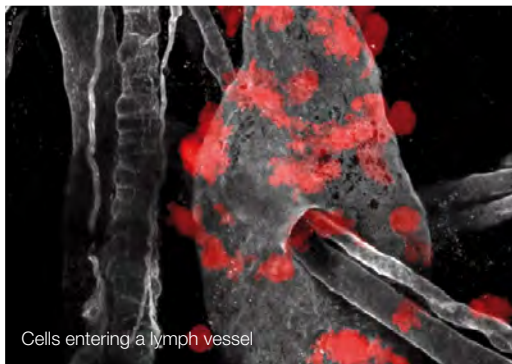
SELECTED PUBLICATIONS

1. Schumann K, Lämmermann T, Bruckner M, Legler DF, Polleux J, Spatz JP, Schuler G, Förster R, Lutz MB, Sorokin L, Sixt M. 2010. Immobilized chemokine fields and soluble chemokine gradients shape migration patterns of dendritic cells. Immunity 32: 703–713.
2. Renkawitz J, Schumann K, Weber M, Lämmermann T, Pflücke H, Polleux J, Spatz JP, Sixt M. 2009. Adaptive force transmission in amoeboid cell migration. Nature Cell Biology 11: 1438–1443.
3. Lämmermann T, Bader BL, Monkley SJ, Worbs T, Wedlich-Söldner R, Hirsch K, Keller M, Förster R, Critchley DR, Fässler R, Sixt M. 2008. Rapid leukocyte migration by integrin-independent flowing and squeezing. Nature 453: 51–55.

T

TEAM

Alexander Eichner (PhD student),
Maria Frank (Technician), Eva Kiermaier (Postdoc), Christine Moussion (Postdoc), Verena Ruprecht (joint Postdoc with Heisenberg lab), Jan Schwarz (PhD student), Ingrid de Vries (Technician), Michele Weber (Postdoc), Stefan Wieser (joint Postdoc with Heisenberg lab)



Cells entering a lymph vessel



GAŠPER TKAČIK

THEORETICAL BIOPHYSICS AND NEUROSCIENCE

Networks that process and transmit information are everywhere in biology. Neurons, signaling molecules, genes, and organisms are part of extensive networks that have evolved to detect, represent, and compute responses to changes in the environment or the organism's internal state. The Tkačik group uses theoretical biophysics to study information processing in such biological networks.

The Tkačik group focuses on information flow in biological networks, using tools from statistical physics of disordered systems and information theory to analyze, compare and model examples of biological computation. This biological computation takes place across a large range of time scales and is implemented using very different substrates, for instance electrical signals, transcription factor concentrations, covalent modification states of signaling molecules, or visual and auditory signals. The group looks for design principles that would predict how biological networks are wired to perform their functions well under biophysical noise and resource constraints. Their work spans the range from biophysics, signal transduction and genetic regulation over computational neuroscience and neural coding to the collective motion of groups of organisms. For example, the Tkačik group studies how the visual systems of various organisms have adapted to their environments to efficiently extract information from natural stimuli and send it to the central nervous system.

Current Projects

- › Visual encoding in the retina
- › Genetic regulation during early embryogenesis
- › Collective dynamics in groups of organisms

CV

CAREER

- 2011** Assistant Professor, IST Austria
- 2008–2010** Postdoc, University of Pennsylvania
- 2007** Postdoc, Princeton University
- 2007** PhD, Princeton University

SELECTED DISTINCTIONS

- 2006** Charlotte E Procter Honorific Fellowship, Princeton University
- 2003** Burroughs-Wellcome Fellowship, Princeton University
- 2002** Golden sign of the University of Ljubljana

P

SELECTED PUBLICATIONS

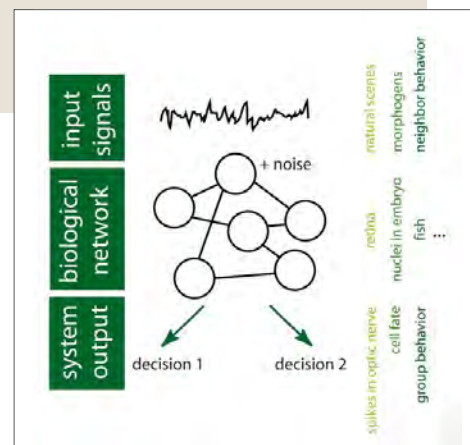
1. Tkačik G, Prentice JS, Victor JD, Balasubramanian V. 2010. Local statistics in natural scenes predict the saliency of synthetic textures. *Proceedings of the National Academy of Sciences USA* 107: 18149–18154
2. Tkačik G, Prentice JS, Balasubramanian V, Schneidman E. 2010. Optimal population coding by noisy spiking neurons. *Proceedings of the National Academy of Sciences USA* 107: 14419–14424.
3. Tkačik G, Callan CG, Bialek W. 2008. Information flow and optimization in transcriptional regulation. *Proceedings of the National Academy of Sciences USA* 105: 12265–12270.

T

TEAM

Georg Rieckh (PhD student)

Processing of information input by biological networks



CAROLINE UHLER

ALGEBRAIC STATISTICS AND COMPUTATIONAL BIOLOGY



How are chromosomes packed into the cell's nucleus? How many observations are minimally needed for estimating interactions between genes? How can privacy be ensured when releasing genomic data? The Uhler group works on algebraic statistics and addresses questions in computational biology.

Algebraic statistics exploits the use of algebraic techniques to study statistical problems, and to develop new paradigms and algorithms for data analysis and statistical inference. Algebraic methods have proven to be useful for statistical theory and applications alike. As such, the work of the Uhler group is at the interface of mathematical modeling, statistics and computational biology. On the theoretical side, the Uhler group works on gaining a better understanding of the mathematics and geometry of graphical models with hidden variables, particularly for causal models.

Another research direction consists of developing methods for model selection in random graph models. Projects motivated by biological problems include the understanding of the spatial organization of chromosomes inside the cell's nucleus. Gene expression is, amongst others, dependent on the proximity of different chromosomes and chromosomal regions. The Uhler group studies the organization of the mammalian genome under a probabilistic model, a fascinating problem at the interface of computational biology, statistics, optimization and computational geo-

metry. Other questions addressed include the development of methods to release data from genome-wide association studies without compromising an individual's privacy.

Current Projects

- › Graphical models with hidden variables
- › Parameter identifiability in graphical models
- › Model selection in random graph models
- › Chromosome packing in cell nuclei
- › Privacy preserving data sharing for genomic data

CV

CAREER

- 2011** Assistant Professor, IST Austria
- 2011** Postdoc, Institute of Mathematics and its Applications, University of Minnesota
- 2011** PhD, University of California, Berkeley

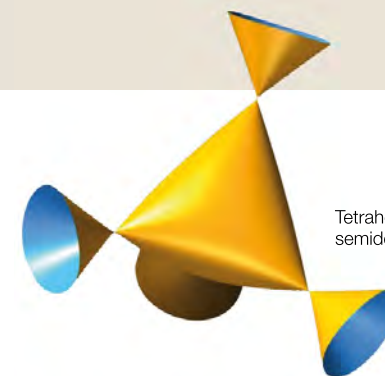
SELECTED DISTINCTIONS

- 2010–2011** Janggen-Poehn Fellowship
- 2007–2010** International Fulbright Science and Technology Award
- 2006** Best Student Award of the University of Zurich

P

SELECTED PUBLICATIONS

1. Uhler C. 2012. Geometry of maximum likelihood estimation in Gaussian graphical models. To appear in: *Annals of Statistics*.
2. Sturmfels B, Uhler C. 2010. Multivariate Gaussians, semidefinite matrix completion and convex algebraic geometry. *Annals of the Institute of Statistical Mathematics* 62: 603–638.
3. Evans SN, Sturmfels B, Uhler C. 2010. Commuting birth-and-death processes. *Annals of Applied Probability* 20: 238–266.



Tetrahedron-shaped pillow consisting of all positive semidefinite 3x3 matrices with ones on the diagonal



CHRIS WOJTAN COMPUTER GRAPHICS

Deceptively realistic virtual worlds, animated movies and computer games are highly popular. Complex calculations and models operate in the background to achieve these accurate simulations. The Wojtan group uses numerical techniques to provide the basis for complex animations and graphics.

The realistic simulation of complex processes in the physical world is the focus of research in the Wojtan group. Using numerical techniques, they create computer simulations of physical phenomena such as fluids, deformable bodies or cloth. Such accurate representations are required not only for computer animation, but also for medical simulations, computational physics and digital modeling. In their work, the Wojtan group combines mathematical methods from computati-

onal physics with geometric techniques from computer graphics. A key contribution of the Wojtan group is the efficient treatment of topological changes with deforming meshes that split and merge, in order to simulate highly detailed surface tension phenomena, such as the formation of water droplets and splashes. This method is used for the realistic animation of flowing and splashing water. Latest research of the group couples high-resolution embedded surface

geometry to low-resolution simulations, to simulate detailed animations of elastic, plastic, and fluid phenomena.

Current Projects

- › Simulating fractured materials to create highly detailed mesh surfaces
- › Defining and computing topology changes for non-manifold surface meshes
- › Generating temporally coherent deforming surfaces with changing topology from arbitrary space-time data

CV

CAREER

- 2011** Assistant Professor, IST Austria
- 2010** PhD, Georgia Institute of Technology, USA

SELECTED DISTINCTIONS

- 2011** Georgia Institute of Technology Sigma Chi Best PhD Thesis Award
- 2010** Outstanding Graduate Research Assistant Award (Georgia Institute of Technology)
- 2005** National Science Foundation Graduate Research Fellowship
- 2004** Presidential Fellowship
- 2003** James Scholarship

P

SELECTED PUBLICATIONS

1. Wojtan C, Thuerey N, Gross M, Turk G. 2010. Physics-inspired topology changes for thin fluid features. *ACM Transactions on Graphics* 29, 4 (Proceedings of SIGGRAPH 2010), Article 50.
2. Wojtan C, Thuerey N, Gross M, Turk G. 2009. Deforming meshes that split and merge. *ACM Transactions on Graphics*. 28, 3 (Proceedings of SIGGRAPH 2009), Article 76.
3. Wojtan C, Turk G. 2008. Fast viscoelastic behavior with thin features. *ACM Transactions on Graphics* 27, 3 (Proceedings of SIGGRAPH 2008), Article 47.



Simulation of highly detailed surface tension phenomena such as the formation of water droplets using mesh-based surface tracking

IST AUSTRIA PROFESSORS

Starting in 2012 and 2013



Daria Siekhaus

Daria Siekhaus is a cell biologist investigating the principles of cell migration. After studying biology at Harvard and Radcliffe Colleges, Siekhaus moved to Stanford University, where she earned her PhD in 1998 for studies on propheromone processing enzymes in *Drosophila*. Siekhaus then worked as Postdoc in the group of David Drubin at the University of California in Berkeley. Since 2003, Siekhaus has worked as a research scientist in Ruth Lehmann's group at the Skirball Institute, NYU Medical Center. Her research focuses on the study of hemocyte migration and barrier penetration in *Drosophila*. She has identified an important regulator of transepithelial migration of blood cells. Siekhaus' study of *Drosophila* migration has opened up a new area of hemocyte research, showing clear parallels with migration in the mammalian immune system and during cancer cell invasion. Siekhaus will join IST Austria as Assistant Professor in January 2012.



Simon Hippenmeyer

Simon Hippenmeyer studied molecular biology at the University of Basel and received his PhD in 2004 after performing his predoctoral studies in the group of Sylvia Arber at the Friedrich Miescher Institute in Basel. Having spent two years as a postdoc in Sylvia Arber's lab, Hippenmeyer moved to Stanford University in 2006, where he worked as a Postdoc and Research Associate in the group of Liqun Luo. Hippenmeyer

has used and advanced the newly developed MADM technique to dissect the molecular and cellular mechanisms responsible for neuronal circuit assembly in the mouse brain. Using this cutting-edge method, Hippenmeyer is able to analyze the development of the mouse cortex at break-through single-cell resolution, visualizing individual neurons. His work pushes the boundaries of our understanding of essential processes in brain development. Hippenmeyer will join IST Austria as Assistant Professor in July 2012.



Ryuichi Shigemoto

Ryuichi Shigemoto works on the mechanisms of signaling and plasticity in the brain. He received his MD from the University of Kyoto in 1985 and his PhD in 1994, having performed research in the groups of Noboru Mizuno and Shigetada Nakanishi. Shigemoto was appointed Assistant Professor at the Kyoto University Faculty of Medicine Department of Anatomy in 1989 and at the Department of Morphological Brain Science in 1990. Since 1998, Ryuichi Shigemoto has been a Professor at the National Institute for Physiological Sciences in Okazaki. Shigemoto is interested primarily in the subcellular localization of neurotransmitter receptors and voltage-gated Calcium channels, as well as in the mechanisms of long-term stabilization of memory in the mouse. He has pioneered the cutting-edge SDS-FRL method for detecting single membrane proteins at unprecedented sensitivity and received an ISI Citation Laureate Award in 2000. Shigemoto will join IST Austria as Professor in 2013.

PUBLICATIONS 2011

Publications by IST members published or accepted in 2011 (joint publications involving several groups are listed multiple times)

BARTON GROUP

• Abbot, P., Abe, J., [...] Barton, N.H., et al., 2011. Inclusive fitness theory and eusociality. *Nature*, 471(7339), E1–E4.

• Barton, N.H., 2011. Estimating linkage disequilibria. *Heredity*, 106(2), 205–206.

• Barton, N.H. & Etheridge, A.M., 2011. The relation between reproductive value and genetic contribution. *Genetics*, 188(4), 953–973.

• Barton, N.H. & Turelli, M., 2011. Spatial waves of advance with bistable dynamics: Cytoplasmic and genetic analogues of Allee effects. *American Naturalist*, 178(3), E48–E75.

• Logeswaran, S. & Barton, N.H., 2011. Mapping Mendelian traits in asexual progeny using changes in marker allele frequency. *Genetics Research*, 93(3), 221–232.

• Lohse, K., Harrison, R.J. & Barton, N.H., 2011. A general method for calculating likelihoods under the coalescent process. *Genetics*, 189(3), 977–987.

• Palero, F., Abello, P., Macpherson, E., Beaumont, M. & Pascual, M., 2011. Effect of oceanographic barriers and overfishing on the population genetic structure of the European spiny lobster *Palinurus elephas*. *Biological Journal of the Linnean Society*, 104(2), 407–418.

• Palero, F., Guerao, G., Clark, P.F. & Abello, P., 2011. *Scyllarus arctus* (Crustacea: Decapoda: Scyllaridae) final stage phyllosoma identified by DNA analysis with morphological description. *Journal of the Marine Biological Association of the United Kingdom*, 91(2), 485–492.

• Polechova, J. & Barton, N.H., 2011. Genetic drift widens the expected cline but narrows the expected cline width. *Genetics*, 189(1), 227–235.

• Polechova, J., Barton, N.H. & Marion, G., 2011. Species range adaptation in space and time vol 174 pg E186 2009. *American Naturalist*, 177(4), 546–547.

• de Vladar, H.P. & Barton, N.H., 2011. The statistical mechanics of a polygenic character under stabilizing selection mutation and drift. *Journal of the Royal Society Interface*, 8(58), 720–739.

• de Vladar, H.P. & Barton, N.H., 2011. The contribution of statistical physics to evolutionary biology. *Trends in Ecology and Evolution*, 26(8), 424–432.

• de Vladar, H.P. & Chela-Flores, J., 2012. Can the evolution of multicellularity be anticipated in the exploration of the solar system? Cellular Origin, Life in Extreme Habitats and Astrobiology. *Genesis: Origin of Life on Earth and Planets*, in press.

BOLLBACK GROUP

• Kupczok, A., 2011. Consequences of different null models on the tree shape bias of supertree methods. *Systematic Biology*, 60(2), 218–225.

• Kupczok, A., 2011. Split based computation of majority rule supertrees. *BMC Evolutionary Biology*, 11(205), 1–13.

• Pavan, A.C., Martins, F., Santos, F.R., Ditchfield, A.D. & Redondo, R.A.F., 2011. Patterns of diversification in two species of short-tailed bats (Carollia Gray, 1838): the effects of historical fragmentation of Brazilian rainforests. *Biological Journal of the Linnean Society*, 102, 527–539.

BOLLENBACH GROUP

• Bollenbach, T. & Kishony, R., 2011. Resolution of gene regulatory conflicts caused by combinations of antibiotics. *Molecular Cell*, 42(4), 413–425.

• Plachta, N., Bollenbach, T., Pease, S., Fraser, S.E. & Pantazis, P., 2011. Oct4 kinetics predict cell lineage patterning in the early mammalian embryo. *Nature Cell Biology*, 13(2), 117–123.

CHATTERJEE GROUP

• Bloem, R., Chatterjee, K., Greimel, K., Henzinger, T.A. & Jobstmann, B., 2011. Specification-centered robustness. In: *SIES: International Symposium on Industrial Embedded Systems*. IEEE, 176–185.

• Boker, U., Chatterjee, K., Henzinger, T.A. & Kupferman, O., 2011. Temporal specifications with accumulative values. In: *LICS: Logics in Computer Science*. IEEE, 43–52.

• Brazdil, T., Brozek, V., Chatterjee, K., Forejt, V. & Kucera, A., 2011. Two views on multiple mean payoff objectives in Markov Decision Processes. In: *LICS: Logics in Computer Science*. IEEE, 33–42.

• Černý, P., Chatterjee, K. & Henzinger, T.A., 2011. The complexity of quantitative information flow problems. In: *CSF: Computer Security Foundations*. IEEE, 205–217.

• Černý, P., Chatterjee, K., Henzinger, T.A., Radhakrishna, A. & Singh, R., 2011. Quantitative synthesis for concurrent programs. In: *LNCS. CAV: Computer Aided Verification*, 6806. Springer, 243–259.

• Chatterjee, K., 2011. Bounded rationality in concurrent parity games. In: *CoRR: Computing Research Repository*, abs/1107.2146, 1–51.

• Chatterjee, K., 2011. Graph games with reachability objectives. In: *LNCS. RP: Reachability Problems*, 6945. Springer, 1–1.

• Chatterjee, K., 2011. Robustness of structurally equivalent concurrent parity games. In: *CoRR: Computing Research Repository*, abs/1107.2009.

• Chatterjee, K. & Doyen, L., 2011. Energy and mean-payoff parity Markov Decision Processes. In: *LNCS. MFCS: Mathematical Foundations of Computer Science*, 6907. Springer, 206–218.

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DISSERTATIONS

› Jean-Leon Maitre, Mechanics of Adhesion and De-Adhesion in Zebrafish Germ Layer Progenitors. (Heisenberg group)

› Kathrin Schumann, The Role of Chemotactic Gradients in Dendritic Cell Migration. (Sixt group)

RESEARCH GRANTS 2011

Peer-reviewed research grants acquired or active in 2011

BARTON GROUP

› Limits to selection in biology and in evolutionary computation, ERC, € 1'975'000, 7/2010–6/2015.

BOLLENBACH GROUP

› MC-CIG Career Integration Grant, € 100'000, 6/2012–5/2016

› APART, OeAW, € 220'000, 5/2012–4/2015

CHATTERJEE GROUP

› RiSE – Rigorous Systems Engineering, FWF, € 464'000, 3/2011–2/2015.

› Modern Graph Algorithmic Techniques in Formal Verification, FWF, € 350'000, 9/2011–9/2014.

› Quantitative Graph Games: Theory and Applications, ERC, € 1'164'000, 12/2011–11/2016.

› Microsoft Research Faculty Fellowship, Microsoft Research, \$200'000, 7/2011–12/2013.

CSICSVARI GROUP

› Related Information Processing in Neuronal Circuits of the Hippocampus and Entorhinal Cortex, ERC, € 1'440'000, 12/2011–11/2016.

CREMER GROUP

› Social Vaccines – Social Vaccination in Ant Colonies: from individual mechanisms to society effects, ERC, € 1'280'000, 11/2010–3/2015.

› Host-Parasite Coevolution, DFG, € 95'000, 11/2010–12/2011.

› Studentische Hilfskraft Junge Akademie Leopoldina, JA, 11/2010

EDELSBRUNNER GROUP

› Genome-wide Analysis of Root Traits, NSF, \$ 160'100, 9/2010–8/2012.

GUET GROUP

› Multi-Level Conflicts in Evolutionary Dynamics of Restriction-Modification System, HFSP, € 250'000, 11/2011–10/2014.

HEISENBERG GROUP

› SPP, DFG, € 51'000, 11/2010–3/2012.

› ZF Cancer, EC-FP7, € 138'000, 4/2008–3/2011.

› Cell cortex and germ layer formation in zebrafish gastrulation. DFG/FWF, € 281'000, 11/2011–10/2014.

HENZINGER GROUP

› Combest, FP7, € 106'000, 1/2008–3/2011.

› Artist Design, FP7, € 62'500, 1/2007–12/2011.

› Quantitative Reactive Modeling (QUAREM), ERC, € 2'326'000, 5/2011–4/2016.

› RiSE – Rigorous Systems Engineering, FWF, € 464'000, 3/2011–2/2015.

› Microsoft MSR Education Studio Award, Microsoft Research, € 7'250, 2/2011–12/2011.

JANOWIAK GROUP

› MC-CIG Career Integration Grant, € 100'000, 3/2012–2/2016

JONAS GROUP

› Synaptic Mechanisms of Neuronal Network Function, DFG/FWF, € 220'000, 10/2010–12/2011.

› Glutamaterge synaptische Übertragung und Plastizität in hippocampalen Mikroschaltkreisen, DFG/FWF, € 74'300, 10/2010–12/2011.

› Nanophysiology of fast-spiking, parvalbumin-expressing GABAergic interneurons, ERC, € 2'500'000, 6/2011–5/2016.

PIETRZAK GROUP

› Provable Security for Physical Cryptography, ERC, € 1'004'000, 9/2011–10/2015.

SIXT GROUP

› Cell migration in complex environments: from in vivo experiments to theoretical models, HFSP, € 300'000, 11/2011–10/2014.

› Cytoskeletal force generation and force transduction of migrating leukocytes, FWF START, € 200'000, 8/2011–9/2017.

› Leukocyte Forces: Cytoskeletal force generation and force transduction of migrating leukocytes, ERC, € 1'460'000, 2/2012–3/2017.

› Zytoskelettdynamik und Kraftgenerierung wandernder Leukozyten, DFG, € 101'000, 11/2010–4/2012.

› Einfluss der Chemokinpräsentation auf das Reaktionsmuster von Leukzyten, DFG, € 180'000, 1/2011–12/2012.

› Role of the WAVE-complex in the haematopoietic system, DFG, €170'000, 11/2010–12/2011.

› Marie Curie ITN, FP7, € 240'000, 2012–2016



MODERN SCIENCE

means Networking

Sharing and exchanging insights and ideas among scientists is integral in scientific progress and discovery. As such, research at IST Austria is embedded within a vibrant network of cooperations with other research institutions and groups, both on the international and national level. As of December 2011, scientists at IST collaborate actively with more than 50 research groups at Austrian universities, and with many more international groups.

One example is the RiSE (Rigorous System Engineering) national research network, a research cooperation of Austrian computer scientists funded by the Austrian science fund, FWF. In addition to Krishnendu Chatterjee and Thomas A. Henzinger at IST Austria, the RiSE network includes researchers working at TU Vienna, TU Graz, the University of Linz, and the University of Salzburg. The kick-off meeting of the RiSE network was held at IST Austria on March 14 and 15, 2011 and a weekly RiSE lecture series alternates between IST Austria and the TU Vienna. The aim of this research network is to develop new methods for software design that prevent programming mistakes from being

made. The collaboration of computer scientists from IST and Austrian universities has put Austria firmly on the international map in this important research area.

With the arrival of the evolutionary biologists Nick Barton, Jon Bollback, and Sylvia Cremer at IST Austria, and the recruitment of evolution researchers at other institutions in and around Vienna, the Austrian capital has become a hotspot in evolutionary research in Europe. The more than 50 evolutionary biology groups in the Vienna area have organized themselves in the evolVienna platform. The autumn symposium of evolVienna took place at IST Austria on November 15, 2011. A graduate workshop on evolutionary genetics, a joint initiative with the Vienna Graduate School in Population Genetics, was also held at IST Austria in September 2011.

Lively exchanges exist also between the cell biologists and the neuroscientists at the Medical University of Vienna, the Vienna Biocenter, and IST Austria, with joint projects and shared supervision of students.



SPEAKERS AT IST AUSTRIA IN 2011 Abouheif, Ehab (Montreal, Canada) | Ackermann, Martin (Zurich, Switzerland) | Albéri, Lavina (Fribourg, Switzerland) | Amon, Angelika (Cambridge, USA) | Andrei, Eva Y. (Piscataway/New Jersey, USA) | Andres, Björn (Heidelberg, Germany) | Averof, Michalis (Heraklion, Greece) | Bachtrog, Doris (Berkeley, USA) | Balandin, Alexander A. (Riverside, USA) | Baudrimont, Antoine (Vienna, Austria) | Beck, Heinz (Bonn, Germany) | Bednarek, Ewa (Basel, Switzerland) | Benkova, Eva (Ghent, Belgium) | Bergmiller, Tobias (Zurich, Switzerland) | Bischof, Horst (Graz, Austria) | Blahna, Karel (Prague, Czech Republic) | Boccara, Charlotte (Trondheim, Norway) | Boots, Mike (Sheffield, UK) | Borgwardt, Karsten (Tübingen, Germany) | Bos, Herbert (Amsterdam, Netherlands) | Bosmans, Frank (Bethesda, USA) | Brose, Nils (Göttingen, Germany) | Brown, Mark (London, UK) | Broy, Manfred (Munich, Germany) | Bühler, Oliver (New York, USA) | Callahan, Ben (Stanford, USA) | Chevereau, Guillaume (Lyon, France) | Contreras, Diego (Philadelphia, USA) | Crane, Keenan (Pasadena, USA) | Davidson, Lance (Pittsburgh, USA) | Dierkes, Kai (Dresden, Germany) | Dobbelaere, Jeroen (Vienna, Austria) | Dorken, Gary (Edinburgh, UK) | Doyen, Laurent (Cachan, France) | Dragosits, Martin (Davis, USA) | Drndic, Marija (Philadelphia, USA) | Duke, Tom (London, UK) | Dye, Natalie (Stanford, USA) | Ebert, Dieter (Basel, Switzerland) | El Masri, Leila (Tübingen, Germany) | Erdős, László (Munich, Germany) | Faas, Guido (Los Angeles, USA) | Farber, Michael (Durham, UK) | Federica Tavano (Trieste, Italy) | Field, David (Toronto, Canada) | Fletcher, Daniel A. (Berkeley, USA) | Forejt, Vojtech (Oxford, UK) | Fries, Pascal (Frankfurt, Germany) | Friml, Jiri (Ghent, Belgium) | Gerland, Ulrich (Munich, Germany) | Goldstein, Ray (Cambridge, UK) | Goswami, Prashant (Zurich, Switzerland) | Graham, Gerard (Glasgow, UK) | Gross, Markus (Zurich, Switzerland) | Grosu, Radu (New York, USA) | Gutnick, Michael J. (Jerusalem, Israel) | Hahn, Jooyoung (Graz, Austria) | Hampölz, Bernhard (Marseille, France) | Hegemann, Peter (Berlin, Germany) | Heiser, Gernot (Kensington, Australia) | Henneberger, Christian (London, UK) | Herlihy, Maurice (Providence, USA) | Hill, Sean (Stockholm, Sweden) | Hippenmeyer, Simon (Palo Alto, USA) | Iwasa, Yoh (Fukuoka, Japan) | Jancsary, Jeremy (Vienna, Austria) | Jinek, Martin (Berkeley, USA) | Jun, Suckjoon (Cambridge, USA) | Kaltenpoth, Martin (Jena, Germany) | Karayannis, Theofanis (New York, USA) | Kaschube, Matthias (Princeton, USA) | Kauppi, Liisa (New York, USA) | Keil, Wolfgang (Göttingen, Germany) | Kermany, Amir R. (Montreal, Canada) | Kerr, Jason (Göttingen, Germany) | Kiermaier, Eva (Barcelona, Spain) | Kim, Yuseob (Phoenix, USA) | Kinder, Johannes (Lausanne, Switzerland) | Klein, Ludger (Munich, Germany) | Kolmogorov, Vladimir (London, UK) | Kopp, Artyom (Davis, USA) | Korc, Filip (Bonn, Germany) | Koskinen, Eric (Cambridge, UK) | Kovalenko, Maksym V. (Zurich, Switzerland) | Lampert, Kathrin P. (Bochum, Germany) | Larkum, Matthew (Bern, Switzerland) | Lässig, Michael (Cologne, Germany) | Laurens, Jean (St. Louis, USA) | Lenzen, Christoph (Zurich, Switzerland) | Leonhardt, Ulf (St. Andrews, UK) | Lisman, John (Waltham, USA) | Luria, Victor (New York, USA) | Luther, Sanjiv (Lausanne, Switzerland) | Madry, Aleksander (Cambridge, USA) | Malaspinas, Anna-Sapfo (Berkeley, USA) | Marko, John (Evanston, USA) | Markram, Henry (Lausanne, Switzerland) | Martina, Marco (Chicago, USA) | Memoli, Facundo (Palo Alto, USA) | Mills, Rob M. (Southampton, UK) | Mogilner, Alex (Davis, USA) | Nedelec, François (Heidelberg, Germany) | Novotny, Lukas (Rochester, USA) | Nuzhdin, Sergey (Los Angeles, USA) | Oates, Andrew C. (Dresden, Germany) | Ott, Patrick (Leeds, UK) | Paixao, Tiago (Houston, USA) | Paluch, Ewa (Dresden, Germany) | Pantazis, Periklis (Zurich, Switzerland) | Pascucci, Valerio (Salt Lake City, USA) | Pietrzak, Krzysztof (Amsterdam, Netherlands) | Pikhurko, Oleg (Pittsburgh, USA) | Pohl, Christian (New York, USA) | Pottmann, Helmut (Thuwal, Saudi Arabia) | Preibisch, Stephan (Dresden, Germany) | Przeworski, Molly (Chicago, USA) | Raskin, Jean-François (Brussels, Belgium) | Ratheesh, Aparna (Brisbane, Australia) | Rättsch, Gunnar (Tübingen, Germany) | Raveendran, Karthik (Atlanta, USA) | Raynaud, Franck (Paris, France) | Raz, Erez (Münster, Germany) | Reizis, Boris (New York, USA) | Reversat, Anne (Paris, France) | Reyes, Nicolas (New York, USA) | Rodrigues, Rodrigo (Saarbrücken, Germany) | Rogers, Tamara (Tucson, USA) | Roostalu, Urmis (Heidelberg & Karlsruhe, Germany) | Roska, Botond (Basel, Switzerland) | Rouhani, Shahin (Tehran, Iran) | Rzyhyk, Leonid (Kensington, Australia) | Sadd, Ben M. (Zurich, Switzerland) | Salbreux, Guillaume (Dresden, Germany) | Sangiovanni-Vincentelli, Alberto (Berkeley, USA) | Saykally, Richard J. (Berkeley, USA) | Schiele, Bernt (Saarbrücken, Germany) | Schiffels, Stephan (Cologne, Germany) | Schlager, Benjamin (San Francisco, USA) | Schmid-Hempel, Paul (Zurich, Switzerland) | Schnorrer, Frank (Munich, Germany) | Seiringer, Robert (Montreal, Canada) | Sella, Guy (Jerusalem, Israel) | Shigemoto, Ryuichi (Hayama, Japan) | Siekhaus, Daria (New York, USA) | Sikora, Mateusz (Warsaw, Poland) | Solomon, Justin (Palo Alto, USA) | Sourjik, Victor (Heidelberg, Germany) | Stan, Cladiu A. (Cambridge, USA) | Stenese, Michelle (Dundee, UK) | Svartal, Hannes (Vienna, Austria) | Swart, Ingmar (Regensburg, Germany) | Székely, Tamás (Bath, UK) | Tarnita, Corina (Cambridge, USA) | Tazzyman, Samuel J. (London, UK) | Teis, David (Innsbruck, Austria) | Tomancak, Pavel (Dresden, Germany) | Trauner, Dirk (Munich, Germany) | Turelli, Michael (Davis, USA) | Uhler, Caroline (Berkeley, USA) | Vahtomeri, Kari (Helsinki, Finland) | Vilar, José M. G. (Bilbao, Spain) | Viljakainen, Lumi (Oulu, Finland) | Wattenhofer, Roger (Zurich, Switzerland) | Weissman, Michael (Urbana-Champaign, USA) | Werner, Philipp (Zurich, Switzerland) | Widmann, Thomas (Dresden, Germany) | Wolf, Fred (Göttingen, Germany) | Wrachtrup, Jörg (Stuttgart, Germany) | Wonka, Peter (Thuwal, Saudi Arabia) | Zaccane, Alessio (Cambridge, USA) | Zellinger, Anton (Vienna, Austria) | Zuleger, Florian (Vienna, Austria)



The RiSE members' meeting at IST Austria on March 14/15, 2011.

COMMUNICATING SCIENCE

Open to the Public



Communicating the research performed at IST Austria – both to other scientists, and to the wider public interested in science – is a central objective of the Institute. IST Austria has developed a range of different formats to communicate the activities of the Institute to distinct target groups, be they fellow researchers to exchange opinions and share new knowledge within the privacy of a seminar room, or children and their parents at the Open Campus Day on the lawn next to the pond.

Open Campus Day and School Competition

The Open Campus Day is the biggest event each year at IST Austria and has become an annual tradition starting with the official campus opening in June 2009. The anniversary of the Institute's inauguration is celebrated on a weekend in early June with a big open day for the friends and neighbors of IST Austria. On June 19, 2011, 1'200 visitors came to spend a day on the IST campus. They enjoyed a family lecture by IST professor Michael Sixt, tours of the Bertalanffy Foundation Building, hands-on science stations such as an ant farm and a computer animation workshop, and an outdoors BBQ.

A central activity of each Open Campus Day is the award ceremony for the annual School Science Competition run by IST Austria, aimed at 6 to 19 year-old students from the

Klosterneuburg region. In 2011, the topic was “Biology – Learning from Nature”. Elementary school students were asked for creative contributions on the subject of nature as guiding principle for human innovation; 10- to 14-year old students demonstrated their knowledge in a science competition; and 14- to 19-year old students submitted editorial reports. With these competitions, IST Austria seeks to instill and deepen an enthusiasm for science in children and youths.

IST Lectures

In the IST Lecture series, distinguished scientists are invited to present their work to the general public. IST Lectures are targeted at a general audience interested in current developments in science and the impact of basic science. The talks are followed by Q&A sessions and a social get-together, offering the possibility for conversations with the speaker.

In 2011, three eminent scientists gave public lectures at IST Austria. The first IST Lecture of 2011, on March 20, was given by molecular biologist and MIT professor Angelika Amon, who is also a member of the IST Scientific Board. Her talk introduced the audience to the “Consequences of Aneuploidy” – an abnormal number of chromosomes, which may have significant ramifications for the development, prevention, and treatment of different types of cancer. The second IST Lecture, on May 18,

- 1 Angelika Amon presents her research on chromosomal aneuploidy.
- 2 IST Austria President Thomas A. Henzinger and Dr. Michael Häupl, the Mayor of Vienna.
- 3 Friends and neighbors of IST Austria at the annual Open Campus Day.
- 4 Exploring the science at IST Austria through hands-on research islands.
- 5 Campus tours give an insight into IST Austria.
- 6 Exciting science for all ages.



was given by Henry Markram, a neuroscientist from EPFL. Throughout his career, Markram has focused on understanding the neuronal circuits that make up the architecture of the brain. His “Blue Brain Project” and its follow-up – the “Human Brain Project” – are attempts to simulate these circuits in true biological detail using massive computers. Finally, Alberto Sangiovanni-Vincentelli, an engineering professor from the University of California in Berkeley, visited IST Austria on November 24 to speak about the design of complex systems. His lecture – called “Taming Dr. Frankenstein” – presented a future with interconnected products made of electronic, mechanical, and biological components. The IST Lecture series will continue in 2012, again offering a distinguished line-up of speakers.

Scientific Symposia, Workshops, and Seminar Talks

Modern science lives from the interaction between scientists. With its guesthouse, lecture hall, and seminar center, IST

SCIENTIFIC EVENTS

- | | |
|------------------------|---|
| January 12–15, 2011: | Coalescence in Structured Populations Workshop |
| March 14–15, 2011: | Alpine Verification Meeting 2011 and RiSE Kick-off Meeting |
| August 4–5, 2011: | Spatial Models in Population Genetics Workshop |
| September 20–23, 2011: | Evolutionary Genetics Workshop 2011 |
| September 30, 2011: | The Many Interfaces of Physics Symposium |
| October 7, 2011: | Second IST Workshop on Computer Vision and Machine Learning |
| November 15, 2011: | EvoVienna Autumn Symposium |

PUBLIC EVENTS

- | | |
|--------------------|---|
| March 20, 2011: | IST Lecture Angelika Amon |
| May 18, 2011: | IST Lecture Henry Markram |
| June 19, 2011: | Open Campus Day |
| November 24, 2011: | IST Lecture Alberto Sangiovanni-Vincentelli |

Austria has attractive facilities to host scientific symposia, workshops, and visitors. The symposia and workshops held at IST in 2011 are listed above. Every Monday, a leading researcher from Austria or abroad is invited to give a colloquium lecture of general scientific interest to IST scientists from all fields. In addition to these weekly IST Colloquia, in a typical week there are several seminar talks by visiting scientists which are targeted towards more specialized audiences. For forthcoming events, please visit our website: www.ist.ac.at

DONATIONS

Building for the Future

If someone decides to make a **CONSIDERABLE DONATION** to us, I see this primarily as proof that we are on the **RIGHT TRACK** concerning the development and the basic principles of IST Austria.

Thomas A. Henzinger » President, IST Austria

Since its founding in 2007, such a confirmation of the progress at IST Austria has now come from several donors that have made significant contributions to the Institute. The extraordinary donation of 10 million Euro by the Invicta Foundation, established by the Austrian entrepreneur Peter Bertalanffy, was the largest single gift to a scientific institution in Austria in the last 100 years. The list of benefactors that have made considerable donations to IST Austria, totaling more than 17 million Euro, includes major Austrian businesses such as voestalpine AG, Raiffeisen, OMV AG, and Mondi AG. To acknowledge these special gifts, the Institute inaugurated the IST Donor Club, with Platinum membership for donations of 10 million Euro or more, Gold membership for donations of 1 million Euro or more, and

DONORS	
Platinum Club	
Invicta Foundation	10'000'000 €
Gold Club	
Raiffeisen Group	2'000'000 €
voestalpine AG	1'900'000 €
Mondi AG	1'000'000 €
OMV AG	1'000'000 €
Silver Club	
Oberbank AG	400'000 €
Miba AG	350'000 €
Berndorf AG	150'000 €
Prinzhorn Holding GmbH	100'000 €
Schoeller Bleckmann AG	100'000 €
W. Hamburger GmbH	100'000 €
Donor Club	
Kapsch AG	50'000 €
Gebrüder Weiss GmbH	30'000 €
Alcatel-Lucent Austria AG	15'000 €
TOTAL	17'195'000 €

Silver membership for donations of 100'000 Euro and above. IST Austria expresses its deep gratitude to all donors for their support and looks forward to gaining new members for the IST Donor Club, who wish to invest in the future through scientific research.

While philanthropy is one of the prime sources of funding for universities and research institutions elsewhere, private support of basic science does not have a strong tradition in Austria. IST Austria follows international role models when raising private donations. Adhering to the Institute's founding principle of letting its scientists pursue their own research directions, donors cannot influence the research projects nor the recruitment of scientists at IST Austria. Neither can they profit from the scientific results. Instead, a donor's contribution to the Institute is honored by naming a building or part of a building, a professorial chair, or a doctoral or postdoctoral fellowship after the donor. In recognition of the generous gift by the Invicta Foundation, the first laboratory building of IST Austria was named "Bertalanffy Foundation Building". Also the names of the Raiffeisen Lecture Hall, the voestalpine Administration Building, and the Mondi Seminar Center provide expressions of gratitude. Both the second laboratory building, which is under construction and will be open for science by the end of 2012, and the Central Building, where theoretical researchers perform their work, remain as yet unnamed ...

The remarkable success in raising donations has been achieved to a large degree because of the help of many patrons that support the Institute selflessly, with Veit Sorger – the president of the Federation of Austrian Industry – leading the way. Several members of the IST Board of Trustees, including Claus Raidl and Wolfgang Ruttenstorfer, have also been involved energetically. Particularly important for the success of IST Austria has been Haim Harari who, in addition to helping in so many other essential ways, has contributed his unique experience in raising private donations.

OPPORTUNITIES FOR NEW DONORS

Buildings to be named



CENTRAL BUILDING

The Central Building is one of the period buildings on campus; it was carefully renovated and adapted to the needs of a modern research institute. With 8'500 m² floor space, the Central Building provides offices for theoretical scientists, a seminar center where advanced courses are taught, a guesthouse for visiting scientists, and the campus restaurant.



SECOND LABORATORY BUILDING

The roof-topping ceremony for the second laboratory building on the IST campus took place on November 17, 2011, just over a year after the groundbreaking ceremony. The building is due to open to experimental scientists by the end of 2012 and will, on 7'000 m² floor space, house 10 new research groups with up to 120 scientists.

GUESTHOUSE AND APARTMENTS

Newly arrived and visiting scientists can find on-campus accommodation in the guesthouse and in five small apartment buildings. The guesthouse offers 38 hotel-like rooms for short-term stays and the apartment buildings offer 31 one- and two-room apartments for students and postdocs.



FACILITY MANAGEMENT BUILDING

Construction and facility management are located in a renovated period building on the far side of the campus access road.



RESTAURANT AND CAFE

The campus restaurant, which includes an outdoor dining area and a terrace overlooking the pond, caters to more than 100 people. It is not just a place for lunch, but also a meeting point for discussions and scientific exchange. The cafe is open in the evenings and provides a relaxed atmosphere for meeting and socializing with colleagues.



BOARDS of IST Austria



BOARD OF TRUSTEES (as of December 31, 2011)

Claus J. Raidl, Chair; President Oesterreichische Nationalbank, Vienna; Member, Executive Committee (1)

Anton Zeilinger, Vice-chair; Professor, University of Vienna and IQOQI, Austrian Academy of Sciences; Member, Executive Committee (2)

Catherine Cesarsky, High Commissioner for Atomic Energy, CEA Saclay, Gif-sur-Yvette, France (3)

Alice Dautry, President, Institut Pasteur, Paris, France (4)

Haim Harari, Former President, Weizmann Institute of Science, Rehovot, Israel; Chair, Executive Committee (5)

Alexander Hartig, Member of the Management Board, Industrieliegenschaftsverwaltungs AG, Vienna (6)

Gisela Hopfmüller-Hlavac, Freelance journalist, Vienna; Member, Executive Committee (7)

Eric Kandel, Professor, Columbia University, New York, USA (8)

Olaf Kübler, Former President, ETH Zurich, Switzerland; Vice-chair, Executive Committee (9)

Peter Layr, Member of the Executive Board EVN, Maria Enzersdorf (10)

Kurt Mehlhorn, Director, Max-Planck Institute for Informatics, Saarbrücken, Germany (11)

Wolfgang Ruttenstorfer, Chairman of the Supervisory Board, Vienna Insurance Group, Vienna; Member, Executive Committee (12)

Wolfgang Schürer, Chairman of the Foundation Lindau Nobel Laureates Meetings and Vice-President of the Council for Lindau Nobel Laureates Meetings, Lindau, Germany (13)

Elisabeth Stadler, Chairwoman of the Board of Management, ERGO Austria International AG, Vienna (14)

Ernst-Ludwig Winnacker, Secretary General, Human Frontier Science Program, Strasbourg, France (15)

SCIENTIFIC BOARD

(as of December 31, 2011)

Kurt Mehlhorn, Chair; Director, Max-Planck Institute for Informatics, Saarbrücken, Germany (11)

Arnold Schmidt, Vice-chair; Former President of the Austrian Science Fund (FWF) (16)

Frank Allgöwer, Professor, University of Stuttgart, Germany (17)

Angelika Amon, Professor, MIT, Cambridge, USA (18)

Peter Fratzl, Max-Planck Institute for Colloids and Interfaces, Potsdam, Germany (19)

Tony Heinz, Professor, Columbia University, New York, USA (20)

Hannah Monyer, Professor, University of Heidelberg, Germany (21)

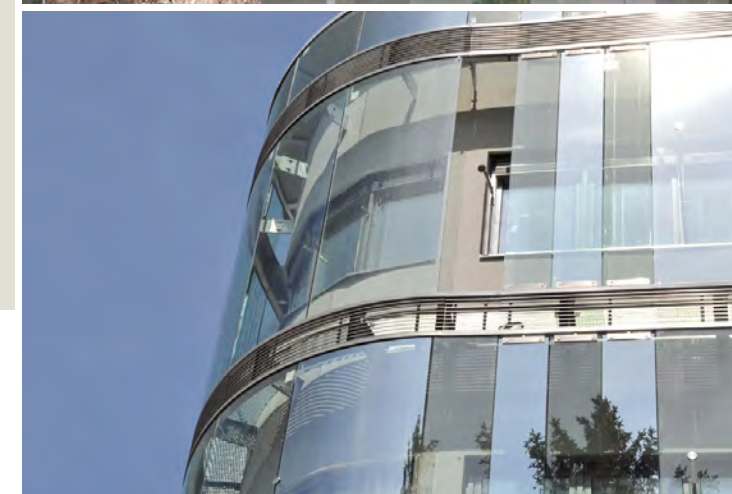
Martin Nowak, Professor, Harvard University, Cambridge, USA (22)

Ernst-Ludwig Winnacker, Secretary General, Human Frontier Science Program, Strasbourg, France (15)

Anton Zeilinger, Professor, University of Vienna and IQOQI, Austrian Academy of Sciences (2)

Non-voting Member:

Claus J. Raidl, President Oesterreichische Nationalbank, Vienna (1)





1



ADMINISTRATION

IST Austria continued to grow strongly in 2011. The experimental research groups moved into the Bertalanffy Foundation Building and took up their work during the course of the year. The construction of the second laboratory building is well under way. The Scientific Service Units (SSUs) were set up and have grown in accordance with the research activities, requiring an ample amount of support from the administration. As the Institute continues to grow, the administrative personnel will moderately grow in parallel to maintain the high level of quality in supporting the scientists.

2011 was also the year of the first evaluation of IST Austria and, like the Institute as a whole, the administration received excellent grades from the evaluation committee. I would like to cite one sentence from the report of the evaluation panel, which illustrates the high appreciation of the work done by the administrative personnel: "A well-structured and service-minded administrative staff has been appointed, with strong support for the quality of their work voiced at all levels among the scientific staff."

I would like to thank all administrative employees for their excellent work in 2011.

Gerald Murauer, Managing Director

ADMINISTRATION

Managing Director: Gerald Murauer (1)

Academic Affairs: Laurenz Niel (Head; 2), Arinya Eller, Barbara Kunes, Helga Materna, Ulrike Seiss (Graduate School; 3), Marie Trappl, Katya Tugendsam

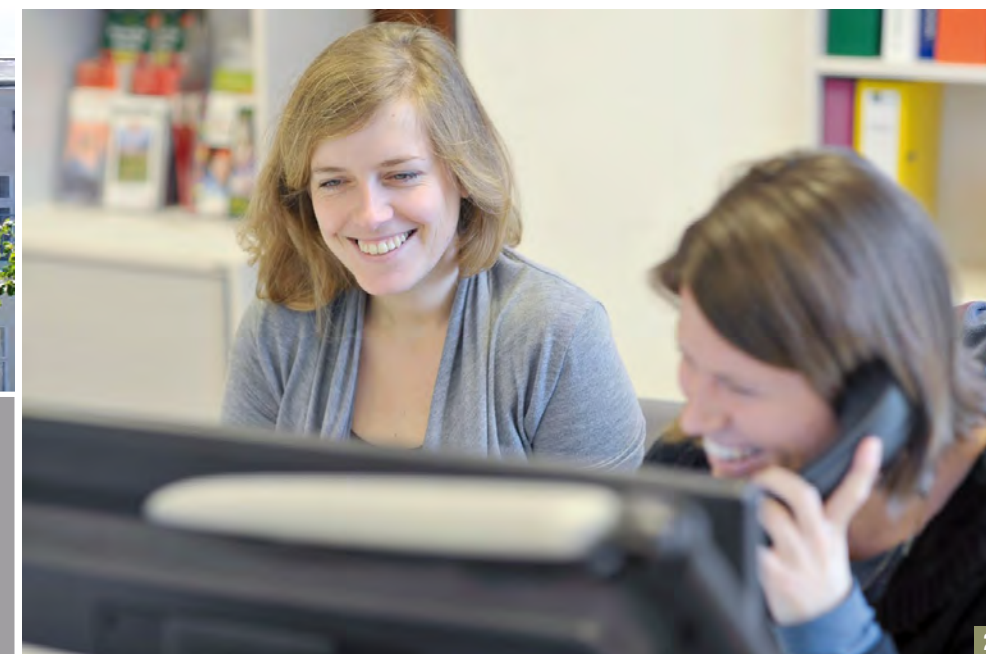
Executive Office: Gerald Murauer (Head), Sophie Cate, Lisa Cichocki, Martina Doppler, Ursula Gerber (4), Irene Hetzenauer (5), Oliver Lehmann (Media Relations; 6), Bernhard Wenzl

Human Resources: Claudia Kernstock (Head; 7), Julia Asimakis (Gender & Diversity; 8), Andrea Mühlberger, Michaela Stöckel

Construction and Maintenance: Stefan Hipfinger (Head; 9), Robert Hojski (Deputy Head; 10), Christian Chaloupka, Daniel Grössmann, Daniel Jaudl, Nadja Kronmüller, Jetlir Memeti, Catalin Mitru, Michael Pletzer, Gertrude Resch, Michael Rockenschaub, Manuel Rojdl, Martin Träxler

Finance and Operations: Leopold Kronlachner (Head; 11), Peter Jakubitz (Procurement, Deputy Head; 12), Barbara Abraham (Grant Office; 13), Denise Albrecht, Willetta Barnhill, Janja Bilic, Ursula Prandstätter, Eva-Maria Riedler, Eva Strieck

Campus Services and Hospitality: Wolfgang Erdhart (Head; 14), Leopold Bernhard, Benny Fasasi, Carina Grössl, Elisabeth Oelschlägel, Martin Rinder, Petra Sonleitner



2



3



4



5

1 The voestalpine Administration Building.

2 The administration provides the support for creating a prospering scientific environment.

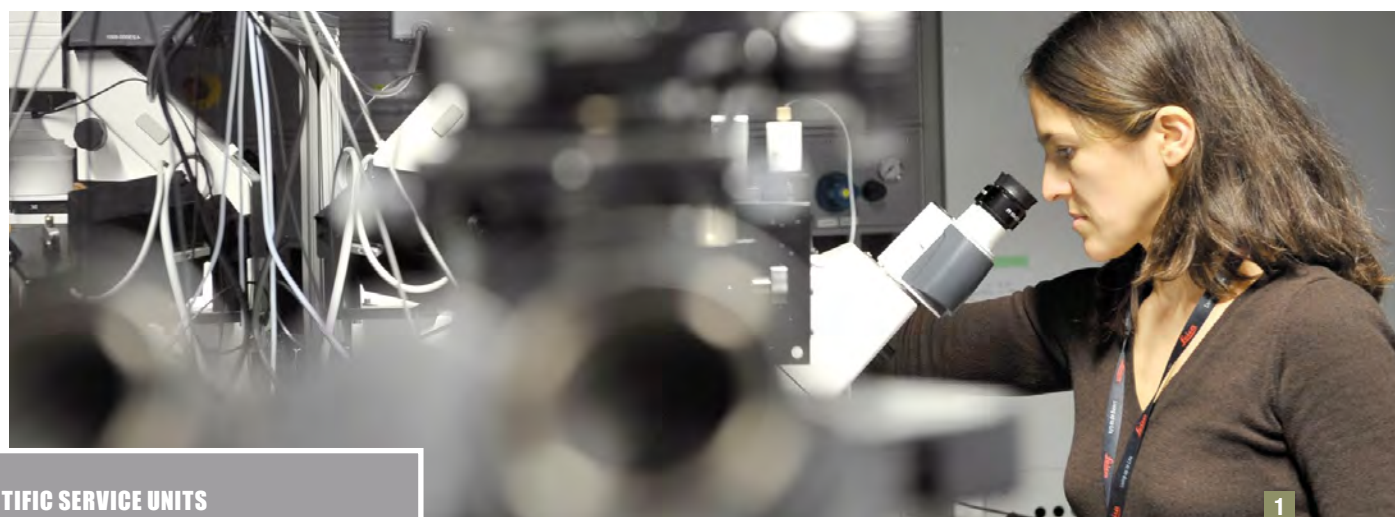
3 Grant applications are supported by a dedicated Grant Office team.

4 The future development of the campus is overseen by the Construction team.

5 The IT team takes care of the general and scientific computing needs of the Institute.

SCIENTIFIC SERVICE UNITS

Supporting the Scientists



SCIENTIFIC SERVICE UNITS

Laco Kacani (Head of Division; 1)

Life Science Facilities: Matthias Nowak (Facility Manager; 2), Michael Schunn (Facility Manager; 3), Sabina Deixler, Cornelia Kohl, Günther Reiterer, Eva Schlegl, Melanie Sedlacek, Mersija Smailagic, Renate Srsek, Gertraud Stift

Machine Shops: Todor Asenov (Facility Manager; 4), Thomas Adletzberger, Philipp Maier, Mathias Wascher, Astrit Arslani

Bioimaging: Ekaterina Papusheva (Facility Manager; 5), Robert Hauschild, Ludek Lovicar, Doreen Milius

IT: Franz Schäfer (Facility Manager; 6), Michael Adletzberger, Michael Brandstätter, Christoph Leitl, Nina Pollak, Moritz Schepp, Alois Schlögl, Florian Schmied

Library: Patrick Danowski (7)

Assistants to Professors: Elisabeth Hacker, Nicole Hotzy, Eva Kramberger, Christine Krebs

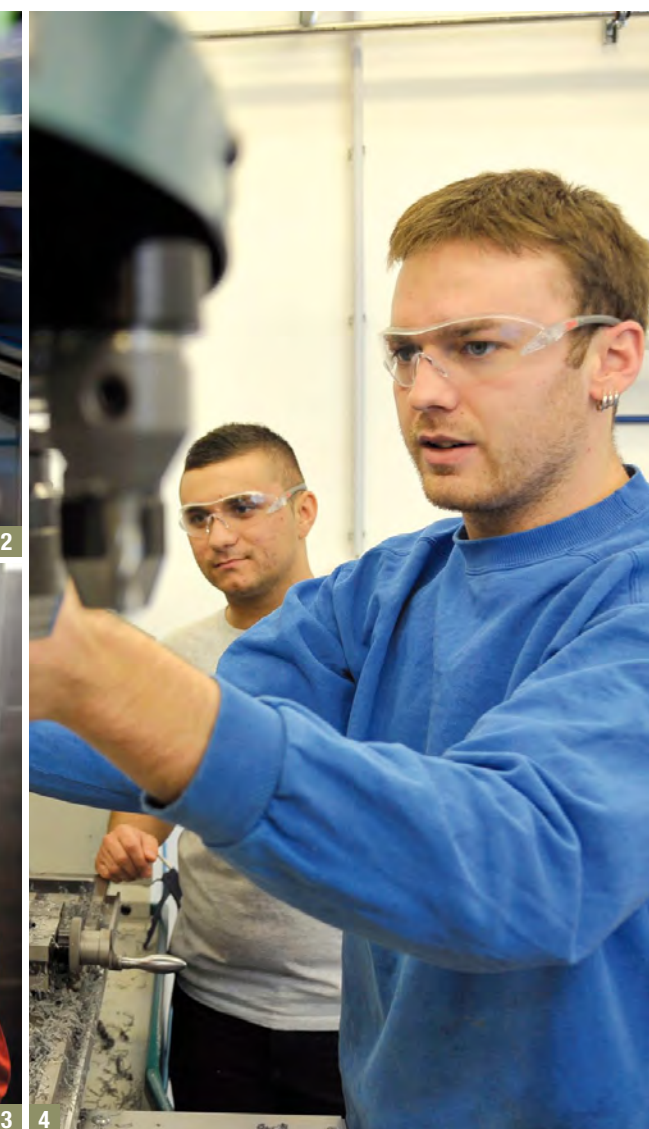


An essential part of the philosophy at IST Austria is to maximize the sharing of space, equipment, and services among research groups, in order to avoid duplicating both efforts and expenses. Accordingly, IST Austria established shared facilities that provide the scientists with the cutting-edge equipment and professional services that allow them to perform research at an internationally competitive level. All valuable resources are pooled in so-called Scientific Service Units whose equipment and services can be used by all research groups on campus.

The following Scientific Service Units have been set up at IST Austria:

› **Bioimaging facility (1):** State-of-the-art microscopes support the work of biologists at IST. Currently, the facility includes two confocal microscopes, an atomic-force microscope, a multi-photon microscope, an inverted microscope, a fluorescent stereo microscope, and a spinning disc laser cutter. A cell sorter and a flow cytometer complete the equipment of the bioimaging facility.

› **Life sciences facilities (2, 3):** Extensive infrastructure has been built for the life



sciences at IST Austria, covering not only the standard research infrastructure for experimental biologists, but also a media kitchen, DNA and protein analysis, tissue culture and chromatography equipment. In addition, zebra fish and rodent facilities support the work of developmental biologists and neuroscientists.

› **IT and scientific computing:** In addition to standard IT services, the scientific computing facility offers storage and maintenance of research data, a computer cluster, as well as software developers

who support the researchers with regard to their software needs.

› **Library:** The library of IST Austria has been designed as a predominantly electronic library, providing electronic access to scientific journals, conference proceedings, and books for scientists of all disciplines.

› **Machine shops (4):** The mechanical and electronic machine shops of IST Austria support the experimental scientists through fabricating custom-ordered mechanical

and electronic devices for their research. A milling machine, a turning machine, a grinding and buffing machine, a 3D printer, and several smaller pieces of equipment allow the manufacturing of customized laboratory set-ups.

The use of scientific services is internally charged to the research groups in order to achieve an appropriate load for the facilities and an effective allocation of the Institute's resources, as well as to enable a partial reimbursement of the costs for services from external grants.

THE MEMORIAL

Remembering the Past



The memorial is located centrally, close to the pond.



The IST Austria campus is situated on the site of a former hospital for neurology and psychiatry, which operated here for about 120 years. Between 1939 and 1945, the hospital was the site of unforgivable medical crimes committed by Nazi doctors. Commemorating the victims is an important concern of IST Austria. In the fall of 2007, the Executive Committee of IST Austria commissioned the Viennese historian Herwig Czech to undertake a detailed study of the Nazi medical crimes in the psychiatric hospital. This study was used by the artists who participated in a competition to design a memorial. The work of the German artist Dorothee Golz was chosen and unveiled on the IST campus in 2010. The design by Dorothee Golz was described as a “poetic sign of transience” by Edelbert Köb, chairman of the competition

jury, then director of the Vienna Museum of Modern Art (MUMOK). The central element of the memorial is an old freight container, tilted at a 45-degree angle. Looking up through the container, a sketch of a table and a chair can be seen, as well as a broken line of spheres, symbolizing life that suddenly and unexpectedly ended. The word “Leben”, German for life, can still be read, although the spheres are dispersed on the floor. At the upper end of the container, a door opens to the sky, a new future and new hope.

The memorial on the grounds of IST Austria is open to the public at all times. More information about the memorial, as well as the study on medical crimes committed at the hospital, can be found at www.memorialgugging.at.



LOCATION and Directions

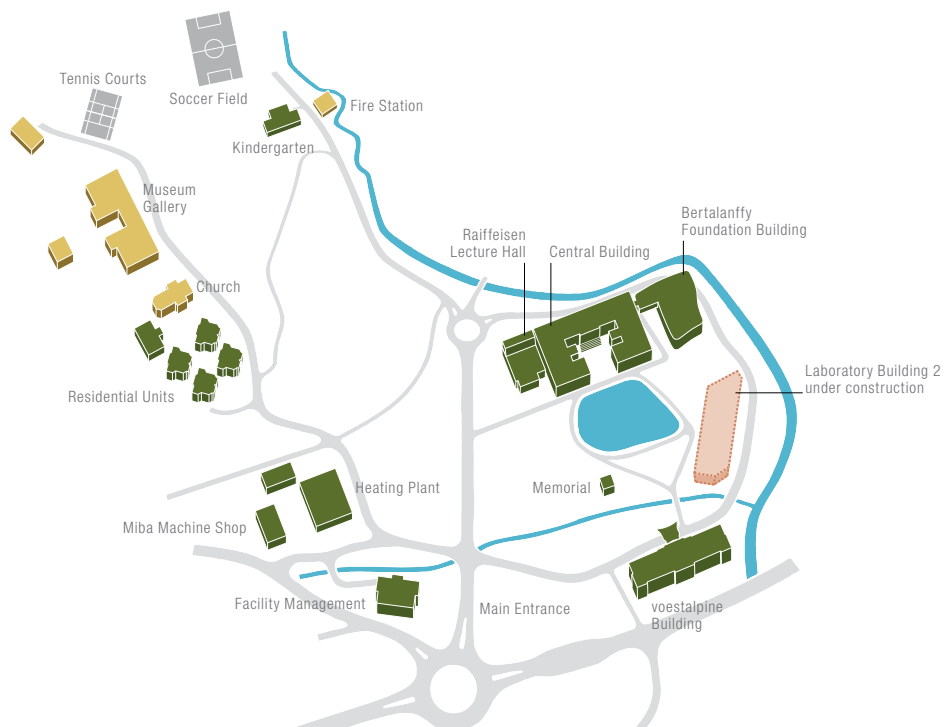


IST Austria is located in Klosterneuburg, a town known for its high standard of living. The location of the campus—close to the river Danube and amid the hills of the Vienna Woods, with its vineyards, pastures, and forests—provides an environment which is both tranquil and stimulating for studying and recreation. The city of Klosterneuburg offers educational, medical, social, and cultural facilities of the highest standard.

The historical center of Klosterneuburg is dominated by its medieval monastery, which was redesigned in the Baroque style as residence for the Austrian emperor in the early 18th century. Close to the monastery, the Essl Museum is world-famous for its collection of contemporary art. Our immediate neighbor on campus is the internationally renowned Art Brut Center Gugging.

IST Austria can be easily reached by public transportation. The bus lines 239 and 242 (IST Shuttle) leave from the U4 station Heiligenstadt in Vienna and stop at the campus entrance. Interchange between the buses and the S40 train is possible at the station Klosterneuburg-Kierling.





IMPRINT

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