NEWSLETTER 12th edition | February 2015

IST AUSTRIA
Institute of Science and Technology

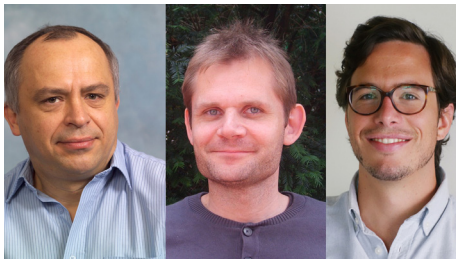
Foreword

2014 was a successful year for IST Austria: six new professors, chosen from about 1000 applicants, signed a contract. Three of them started to work on campus, bringing the total number of research groups to 31. 25 new doctoral students, chosen from about 1500 applicants from almost 100 countries, were admitted to the graduate school, raising the current number of students to more than 100.

Ten students left IST Austria with a PhD degree, most of them pursuing postdoc positions in Europe and North America. Several of our former postdocs were hired as professors in the Czech Republic, France, Germany, and the United States. Krishnendu Chatterjee and Vladimir Kolmogorov were promoted to professor after undergoing extensive tenure reviews. Chris Wojtan received an ERC Starting Grant, resulting in a current total of 15 ERC grantees at IST Austria.

The main challenges remain unchanged for 2015: attracting excellent scientists on all levels while developing the institute and the campus step by step. With the continued help and firm commitment by our supporters, partners, advisers, and friends, our board and committee members, the federal and provincial governments, and all our employees, I am confident that IST Austria will become the desired beacon of scientific excellence.

Thomas A. Henzinger | President, IST Austria



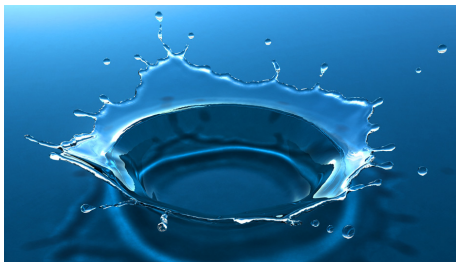
Three new professor presented

President Thomas A. Henzinger announced the names of three new professors: the solid-state physicists Johannes Fink and Georgios Katsaros, and the structural biologist Leonid Sazanov bring the number of the IST Austria faculty to 37.

Sazanov explores the structure and function of membrane proteins and focuses on the determination of the structure of the very large protein assembly respiratory complex I. He will start at IST Austria as Professor in April 2015.

Katsaros works on self-assembled semiconductor nanostructures and their electronic transport properties at low temperatures. He will move to IST Austria as Assistant Professor in early 2016.

Fink studies the interaction of matter and light using superconducting circuit quantum electrodynamics and integrated opto- and electro-mechanical devices. He will set up his lab at IST Austria as Assistant Professor in early 2016.



Chris Wojtan receives ERC Grant

The computer scientist Chris Wojtan has been awarded with an ERC Starting Grant for his project "Big Splash: Efficient Simulation of Natural Phenomena at Extremely Large Scales". He intends to drastically speed up computation with novel dimension reduction and data compression approaches, thus minimizing unnecessary computation by re-using existing simulation data.

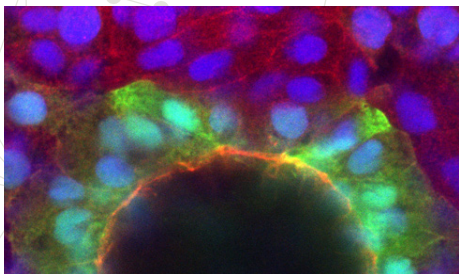
President Thomas A. Henzinger: "The ERC grant for Chris illustrates the continuing attraction of IST Austria for extraordinarily talented scientists in general and the strength of the computer scientists in particular. Now, all six computer scientists at IST Austria have been awarded with this prestigious grant."

Wojtan joined IST Austria in February 2011. Scheduled to start in 2015, his ERC Grant is funded with € 1,5 mio for five years, resulting in a total number of 15 ERC grantees at IST Austria, out of 31 professors currently on campus.

Rapid change of growth

The prominent and evolutionarily ancient role of the plant hormone auxin is the regulation of cell expansion. This expansion requires ordered arrangement of the cytoskeleton. But the molecular mechanisms underlying its regulation by signaling molecules including auxin are unknown. In a Nature paper Jiři Friml and Eva Benková together with their collaborators offer an explanation for the interaction between auxin and the rapid re-orientation of microtubules.

Using the model plant Arabidopsis thaliana the researchers show that exogenous application of auxin or redistribution of endogenous auxin induces very rapid microtubule re-orientation from transverse to longitudinal within minutes. This fast auxin effect requires a specific auxin receptor and involves a contribution of downstream signaling components. These components are required for the rapid re-orientation of microtubules to regulate cell elongation in roots and dark-grown hypocotyls as well as asymmetric growth during gravitropic responses.



Breaking the rules of symmetry

In a Developmental Cell paper the Heisenberg group provides insight into the mechanisms that lead to the left-right asymmetry. In many vertebrates, this left-right asymmetry depends on an organ specialized for symmetry breaking. In zebrafish this organ is called Kupffer's vesicle, a fluid-filled cavity lined by cells. Their cilia beat to make the fluid in the cavity flow towards the left side. This leftward flow is essential for left-right patterning in the zebrafish. For Kupffer's vesicle to achieve an efficient flow, the cilia in the anterior-dorsal region have to be denser than in other regions. As each cell carries only one cilium, the cells in this region have to be clustered together more densely than cells in the other regions. Heisenberg and his group therefore investigated the mechanisms involved in setting up this more densely packed region.

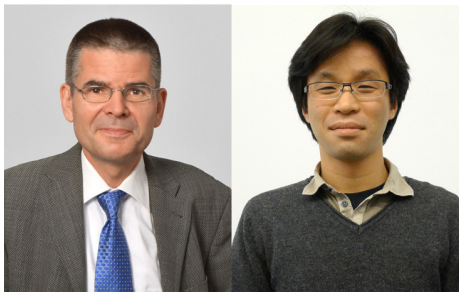
The researchers first made cell density more similar across Kupffer's vesicle using drugs. This led to disruptions in the left-right patterning, confirming that differences in cell density are essential for left-right asymmetry. They then analyzed the morphology of Kupffer's vesicle and its surroundings, to see if there are any structures that could provide Kupffer's vesicle with patterning signals. The most densely packed cells are found adjacent to the notochord. When the researchers induce ectopic Kupffer's vesicles, they see no region of densely packed cells in Kupffer's vesicle. This suggests that the notochord induces the changes in the cell shape that allow cells to pack closely together in the anterior-dorsal region.

The authors finally showed that components of the extra-cellular matrix accumulate on the notochord, close to the densely packed cells of Kupffer's vesicle. When they remove some of these components, the cells are less densely packed. And when they create an artificial gradient of extra-cellular matrix components, the cells are packed more densely on the side with more extra-cellular matrix components.

Hedgehog-ants protected against pathogen

In the Proceedings of the Royal Society B Sylvia Cremer and her team describe the immunoprotective effect of an association of ants with an ectosymbiotic fungus, that gives the ants a "hedgehog-like" appearance. In their work the scientists studied the novel association between the invasive garden ant and the fungal ectosymbiont Laboulbenia, which have both been recently introduced to Europe. The invasive garden ant quickly spreads throughout Europe and several of its populations now carry the Laboulbenia fungus. Ants with higher levels of the fungal ectosymbiont suffer higher mortality under food restriction, but on the upside are more resistant against infection by a common and deadly insect disease, the green muscardine. This protective effect is likely caused by a stimulation of both the ants' hygiene behavior and their immune system. A lower susceptibility to this common and deadly disease may add to the success of the invasive garden ants.

In a review article, Cremer and her postdoc Leila Masri gave an overview of the recent findings on protective immunization of insects. They review recent evidence for and insights into the mechanisms underlying immunization in insects, which can be triggered either by a previous pathogen exposure of the same individual, or by an exposed nest mate. The researchers disentangle general immunoprotective effects from specific immune memory and examine immunization both within the lifetime of an individual or a colony and across generations to the benefit of the offspring. They conclude that recurrent parasitic threats have shaped the evolution of both the individual immune systems and colony-level social immunity in insects..



Solving a paradox

The transmission of information from one nerve cell to the next has long been known to have a puzzling property: the amount of neurotransmitter is highly dependent on the amount of Calcium in the synapse. However, the length of time during which neurotransmitter is released, the so-called time course of release, is independent of Calcium concentrations. This property was originally uncovered in the synapse between nerves and muscle cells. In their eLife paper Peter Jonas and his postdoc Itaru Arai show that also a synapse in the brain shows this paradoxical phenomenon. They suggest that this is probably due to Calcium channels and sensors for transmitter release being located closely together in the nerve terminals. eLife is a new open access journal that reports findings of general significance in life sciences.

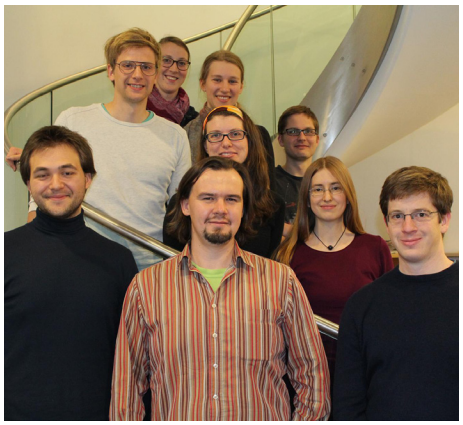
The authors show that at the synapse between basket cells and Purkinje cells in the cerebellum, the time course of neurotransmitter release is largely independent of Calcium concentrations in the synapse, while the amount of neurotransmitter released is highly dependent on Calcium concentrations. They explore the mechanism underlying this paradox using a realistic model of transmitter release, showing that a very short distance between Calcium channels and release sensors, called tight coupling, may play a key role in the time course of transmitter release. Using Calcium chelators, which bind Calcium, the researchers tested whether Calcium channels and release sensors are located closely together in the studied synapse. While the fast-acting Calcium chelator BAPTA can very effectively suppress transmitter release, the slow-acting chelator EGTA works too slowly to suppress release. This finding suggests that tight coupling is at work at the synapse between basket cells and Purkinje cells.

"workandfamily" certificate awarded

The balance between work and family life is nowadays one of the most significant challenges for both employees and employers. Since its beginning, IST Austria has tried to support its employees in bridging the gap. "In the light of the international mobility of our scientists, measures that support the compatibility of work and family life are a matter of course for IST Austria," says Managing Director Georg Schneider.

In order to improve the situation of employees with family obligations, IST Austria decided to participate in the "workandfamily" audit, a sustainable results-oriented quality management instrument under the supervision of the Austrian Federal Ministry of Families and Youth.

The audit's project team started its work in spring 2014 and developed a set of family-friendly measures. For its efforts so far, IST Austria received the audit's "basic certificate". Once all new measures are implemented, the institute will be awarded the "full certificate" in fall 2017.



Young Scientist Symposium 2015 on "Self-Organization"

The postdocs and students of IST Austria cordially invite you to the 4th IST Austria Young Scientist Symposium. The one-day multi-disciplinary event entitled "Self-Organization" will take place on May 8, 2015, and feature six talks by world-known scientific group leaders working on various topics of self-organization in different disciplines.

Self-organization terms the emergence of globally structured behavior from simple local interactions. Self-organizatory phenomena occur throughout a broad range of systems, ranging from superconductivity, fluid dynamics, or molecular self-assembly in the microscopic world, to macroscopic phenomena such as bird flocking, internet communication, behavioral finance, and galaxy formation.

Further information will soon be available on the conference website.

COLLOQUIUM SPEAKERS

PAST SPEAKERS (November - February): Ralf Schneggenburger, EPFL Lausanne (Nov 3) | Anne-Claude Gavin, EMBL Heidleberg (Nov 10) | Pascale Ehrenfreund, Austrian Science Fund (Nov 17) | Matthieu Piel, Institut Curie Paris (Nov 24) | Nathan Linial, The Hebrew University of Jerusalem (Dec 1) | Chris De Zeeuw, Netherlands Institute of Neuroscience (Jan 19) | Felix Randow, University of Cambridge (Jan 26) | Martin Schwab, University of Zurich and ETH Zurich (Feb 2)

FUTURE SPEAKERS (March - May): Ming C. Lin, The University of North Carolina (March 2) | Aurélien Roux, University of Geneva (March 9) | Bill Freema, Massachusetts Institute of Technology (March 16) | Mark Krasnow, Stanford University (April 20) | Jan Born, University of Tübingen (April 27) | Felix Randow, University of Cambridge (Jan 26) | Fred Hamprecht, Fred Hamprecht, University of Heidelberg (May 4) | Rebeca Rosengaus, Northeastern University (May 11) | Pierre Hohenberg, New York University (May 18)

SELECTED RECENT PUBLICATIONS

Gao, Peng, Postiglione, Maria Pia, Krieger, Teresa G, Hernandez, Luisirene, Wang, Chao, Han, Zhi, Streicher, Carmen, Papusheva, Ekaterina, Insolera, Ryan, Chugh, Kritika, Kodish, Oren, Huang, Kun, Simons, Benjamin D, Luo, Liqun, Hippenmeyer, Simon, Shi, Song-Hai: Deterministic progenitor behavior and unitary production of neurons in the neocortex. In: Cell. Elsevier, 4, 2014, 775-788.

Lovrics, Anna, Gao, Yu, Juhász, Bianka, Bock, István, Byrne, Helen M, Dinnyés, András, Kovács, Krisztián: Boolean modelling reveals new regulatory connections between transcription factors orchestrating the development of the ventral spinal cord. In: PLoS One. Public Library of Science, 2014, e-only.

Mitosch, Karin, Bollenbach, Tobias: Bacterial responses to antibiotics and their combinations. In: Environmental Microbiology Reports. Wiley-Blackwell, 6, 2014,545-557.

Hühner, Jens, Ingles Prieto, Álvaro, Neusüss, Christian, Lämmerhofer, Michael, Janovjak, Harald: Quantification of riboflavin, flavin mononucleotide and flavin adenine dinucleotide in mammalian model cells by CE with LED-induced fluorescence detection. In: Electrophoresis. Wiley-Blackwell, 2014,1-6.

Ganguly, Arnab, Petrov, Tatjana, Koeppl, Heinz: Markov chain aggregation and its applications to combinatorial reaction networks. In: Journal of Mathematical Biology. Springer, 3, 2014,767-797.

Novak, Sebastian: Habitat heterogeneities versus spatial type frequency variances as driving forces of dispersal evolution. In: Ecology and Evolution. Wiley-Blackwell, 2014, Epub ahead of print.

Erdős, László, Schröder, Dominik: Phase transition in the density of states of quantum spin glasses. In: Mathematical Physics Analysis and Geometry. Springer, 2014, Epub ahead of print.

Cibulka, Josef, Gao, Pu, Krčál, Marek, Valla, Tomáš, Valtr, Pavel: On the geometric ramsey number of outerplanar graphs. In: Discrete and Computational Geometry. Springer, 2014, Epub ahead of print.

A full list of publications from IST Austria can be found at publist.ist.ac.at.

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