



# NEWSLETTER

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Science and industry can benefit from each other, especially if they are in close proximity encouraging the free flow of ideas and people. This exchange will only work if it is voluntary and driven by actual needs and a complementary relationship. This long-term vision of a flourishing basic research organization accompanied by an industrial park including a significant number of small and medium enterprises was laid down by Haim Harari, Olaf Kübler and Hubert Markl in their recommendations for the establishment of IST Austria in 2006.

Building a technology park is certainly a long-term endeavor. To shape its development, the process has to be a conscious one. For this reason, Markus Wanko has joined IST Austria, and is responsible for attracting appropriate companies. Markus Wanko has a strong background in venture capital investment and consulting. Ideally, we foresee a range of small to medium-sized enterprises joining the park, as well as R&D departments of larger companies, which benefit from the proximity to IST Austria's campus, scientists and research facilities.

More generally, Markus Wanko will also help foster awareness for entrepreneurship. IST Austria always recruits scientists for their scientific excellence in performing basic research. For those students and postdocs wishing to pursue an entrepreneurial career after their time at IST Austria, Markus Wanko will be offering his support and experience. We look very much forward to developing this particular aspect of the long-term vision for the institute.

*Georg Schneider, Managing Director*

## AWARDS

**Nick Barton** received the Erwin-Schrödinger-Prize 2013 for his achievements in the field of evolutionary population genetics. With this award, the Austrian Academy of Sciences honors Barton as "worldwide leading scientist in this field". With his research, Nick Barton has significantly contributed to the understanding of how species adapt and split.

**Tom Henzinger** has been named a Fellow of the American Association for the Advancement of Science (AAAS). Election as AAAS Fellow is an honor bestowed upon AAAS members by their peers. Henzinger, who was elected for contributions to formal verification and hybrid systems, is only the seventh Austrian scientist to receive this distinction.

Postdoc **Hildegard Uecker** received the "For Women in Science" 2013 grant, which supports the mathematician's research in Nick Barton's group.

## GRANTS



### ERC Grant for Vladimir Kolmogorov

**Vladimir Kolmogorov** has received an ERC Consolidator Grant. Vladimir Kolmogorov works in the areas of computer vision and combinatorial optimization. In his work, Kolmogorov employs mathematical methods to make computers understand images. Specifically, he focuses on graphical models and their applications to image segmentation, stereo vision and other vision problems. Kolmogorov is also interested in theoretical aspects of discrete optimization.

The ERC Consolidator Grant will enable Kolmogorov to look into details of "Discrete Optimization in Computer Vision". Special dedication will be given to MAP estimation algorithms. These have transformed computer vision in the last dec-

ade and are now routinely used for various applications, and are also utilized in commercial systems. The grant, funded with € 1.6 Mio, supports Kolmogorov research for four years and will start in June 2014. Kolmogorov's ERC grant brings the number of computer scientists at IST Austria who are supported by the European Research Council to five.

Vladimir Kolmogorov received his PhD in Computer Science at Cornell University in 2003. After two years at Microsoft Research Cambridge, he joined University College London as a lecturer in 2005 before moving to IST Austria in 2011. Kolmogorov received the Koenderink Prize at the 2013 European Conference on Computer Vision.

## RESEARCH AT IST AUSTRIA

### Spotlight on Neuroscience

A range of research in neuroscience is carried out at IST Austria, with several publications in the past months giving insights into the mechanisms of brain waves, memory formation and neurodegenerative disease.

In research published in *Neuron*, postdoc **Alejandro Pernía-Andrade** and Professor **Peter Jonas** discovered the synaptic mechanisms underlying theta-gamma oscillations at the dentate gyrus, the main entrance of the hippocampus. Theta-gamma oscillations are „brain waves“, observed in the hippocampus. In rodents, these oscillations are associated with information processing during exploration and spatial navigation. To understand how oscillations are generated, Pernía-Andrade and Jonas looked at synaptic transmission in granule cells in the hippocampus from both the extracellular perspective, measuring oscillations, and the intracellular perspective, measuring synaptic currents and neuronal firing. Then they correlated the two types of oscillation. They discovered that excitatory and inhibitory synaptic signals contributed to different frequencies of oscillations, and together provide the rhythmic signals of oscillations. Pernía-

Andrade and Jonas also show that granule cell neurons send signals only at specific times in the cycle of oscillations, which is necessary if oscillations are to function as reference signals in the temporal coding of information.

In two publications in *PNAS*, **Ryuichi Shigemoto** and his team presented new insights into the subcellular changes underlying memory formation during motor learning. They show that during short-term learning, receptors are removed from synapses – the sites of information transmission, while during long-term learning, this is followed by changes in the number of synapses and their ultra-structure. Different structural changes therefore underlie short- and long-term memory in motor learning. A peculiarity in memory formation, which the authors investigate in their second paper, is that the way in which information is presented also affects if, and how, memories are formed and how long they last. When learning is broken up by rest periods (spaced training), stronger and longer memories are formed than if learning is not broken up (massed training). Shigemoto and his team show that in spaced training, long-term memory builds up more quickly and lasts longer and correspond-

ingly, the synapse structure changes more quickly and the modification lasts longer. In massed training, instant memory is formed quickly but also fades quickly, and long-term memory builds up slowly and lasts shorter. Here, the synapse also changes more slowly and the modifications only last for a shorter time period. The researchers conclude that the regulation of synapse numbers and its kinetics underlies the different memory formation in spaced and massed learning.

**Gaia Novarino**, who joined IST Austria as Assistant Professor at the beginning of 2014, published results from her postdoctoral research at the University of California, San Diego, in *Science*. The team of researchers reported to have doubled the number of known causes for a neurodegenerative disorder known as hereditary spastic paraplegia (HSP), characterized by progressive stiffness and contraction of the lower limbs. This allowed the researchers to point towards key biological pathways underlying the disease, identifying promising targets as a first step towards developing new treatments.

## SYNCHRONIZE!

“Synchronize! Clocks, Rhythms and Communication across the sciences” is the topic of the **Young Scientist Symposium 2014**, taking place at IST Austria on **Friday, May 16**. The one-day multidisciplinary event presents six talks by experts in neuroscience, biology, physics, and computer science, and a panel discussion. Organized entirely by young scientists working at IST Austria, the symposium explores synchronization from different disciplinary angles. The emergence of regular patterns in initially disorganized systems appears all over science. The study of synchronization and its applications has been undertaken in a variety of fields ranging from the neuroscience of brain oscillations or quorum sensing in bacterial populations to the complexity of distributed computing in computer science and the mathematics of coupled oscillators.

## PUBLIC EVENTS

This spring, IST Austria will again open its doors! Neighbors, friends and everyone interested in the research of IST Austria, and the development of the Institute, are invited to the campus on the occasion of the “**Long Night of Research 2014**” and the **Open Campus**.

IST Austria participates in the nationwide Long Night of Research, on April 4 from 4pm to midnight. Visitors interested in IST Austria's research, as well as in other Lower Austrian institutes in-



cluding the Wolf Science Center and the Wasser Cluster Lunz, are invited to the IST Austria campus to join in the biggest Austrian science festival.

On May 25, IST Austria celebrates the campus' 5th birthday at its Open Campus 2014. Opened in 2009 with a festival, this year's Open Campus gives again a chance to visit labs, try out research hands-on, and talk to IST Austria's scientists about their work.



## CELL BIOLOGY

How do cell layers spread to cover and close a wound? A team of researchers, led by **Carl-Philipp Heisenberg** and including first author **Pedro Campinho**, published new insights into epithelial cell layer spreading in *Nature Cell Biology*. To study epithelial cell layer spreading, they used the process of epiboly in zebrafish development, during which a thin epithelial cell layer spreads over the entire spherical embryo within a space of only 6 hours. This fast cell layer spreading comes along with a rapid increase of the epithelium's surface area, and a build-up of tension within the cell layer - similar to a balloon that is inflated rapidly. The researchers found a new mechanism required for releasing the built-up tension, namely orienting the direction in which cells divide through mechanical tension; this ensures tissue integrity.

## CONFERENCES

The **Symposium - Frontiers in Soft Matter Research** on April 28 aims to present an overview on the latest developments in soft matter chemistry and physics, showing where we are today and what might be expected from future research.

The **Stochastic Biology: from Cells to Populations** meeting from May 5 to 7 brings together researchers with diverse backgrounds to help address the most challenging questions arising from stochasticity in biology. This exciting new field strongly relies on interdisciplinary approaches, and so the conference will bring together established as well as early career researchers in the fields of physics, biology, mathematics, and computer science. More information and registration details can be found on the conference website:

[ist.ac.at/stochastic biology](http://ist.ac.at/stochastic%20biology)

## GAME THEORY

The Prisoner's Dilemma is the standard model for studying the evolution of co-operation. In the December edition of *PLoS ONE*, a team of researchers – including **Krishnendu Chatterjee** and PhD student **Johannes Reiter** – examine a scenario in which two players have to alternately decide over numerous moves whether to cooperate with or defect each other. Using a mathematical model and computer simulation the team show that the strategy named “Forgiver” proves to be the most successful. A forger defects once when the opponent has defected but subsequently tries to re-establish cooperation which leads to a long term success in the alternating Prisoner's Dilemma.

## COLLOQUIUM SPEAKERS

PAST SPEAKERS (NOVEMBER - JANUARY): **Spencer Barrett**, University of Toronto (Nov 11) | **Tomas Jungwirth**, Institute of Physics, Academy of Sciences of the Czech Republic (Nov 25) | **Silvia Arber**, University of Basel (Dec 9) | **Emo Welzl**, ETH Zurich (Jan 13) | **Tomas Bohr**, Technical University of Denmark (Jan 20) | **Deborah Gordon**, Stanford University (Jan 27)

FUTURE SPEAKERS (FEBRUARY - MARCH): **Martin Fussenegger**, ETH Zurich (Feb 17) | **Rupak Majumdar**, Max Planck Institute for Software Systems (Feb 24) | **Jan Philip Solovej**, University of Copenhagen (Mar 3) | **Niloy J. Mitra**, Stanford University (Mar 10) |

**Lotte S øgaard-Andersen**, Max Planck Institute for Terrestrial Microbiology (Mar 17) | **Ivan Bjerre Damgård**, Aarhus University (Mar 24) | **Joachim Spatz**, Max Planck Institute for Intelligent Systems (Mar 31)

## SELECTED RECENT PUBLICATIONS

**Theta-gamma-modulated synaptic currents in hippocampal granule cells in vivo define a mechanism for network oscillations** | Pernía-Andrade A & Jonas P, 2013 | *Neuron* 81, 140-152

**Distinct cerebellar engrams in short-term and long-term motor learning** | Wang W, Nakadate K, Masugi-Tokita M, Shutoh F, Aziz W, Tarusawa E, Lorincz A, Molnár E, Kesaf S, Li Y-Q, Fukazawa Y, Nagao S & Shigemoto R, 2013 | *PNAS* doi:10.1073/pnas.1315541111

**Forgiver triumphs in alternating prisoner's dilemma** | Zagorsky BM, Reiter JG, Chatterjee K & Nowak MA, 2013 | *PLoS ONE* 1 doi:10.1371/journal.pone.008081

**Modeling framework for the establishment of the apical-basal embryonic axis in plants** | Wabnick K, Robert HS, Smith RS & Friml J, 2013 | *Current Biology* 23, 2513-2518

**Local auxin sources orient the apical-basal axis in *Arabidopsis* embryos** | Robert HS, Grönes P, Stepanova AN, Robles LM, Lokerse AS, Alonso JM, Weijers D & Friml J, 2013 | *Current Biology* 23, 2506-2512

**Distinct kinetics of synaptic structural plasticity, memory formation, and memory decay in massed and spaced learning** | Aziz W, Wang W, Kesaf S, Mohamed AA, Fukazawa Y & Shigemoto R, 2013 | *PNAS* doi:10.1073/pnas.1303317110

**Tension-oriented cell divisions limit anisotropic tissue tension in epithelial spreading during zebrafish epiboly** | Campinho P, Behrndt M, Ranft J, Risler T, Minc N & Heisenberg CP, 2013 | *Nature Cell Biology* 115, 1405-1414

**Dissection of gene function at clonal level using mosaic analysis with double markers** | Hippenmeyer S, 2013 | *Frontiers in Biology* 8, 557-568

**Sharp wave/ripple network oscillations and learning-associated hippocampal maps** | Csicsvari J & Dupret D, 2013 | *Philos Trans R Soc Lond B Biol Sci* 369, no 1635

**A full list of publications from IST Austria can be found at [publist.ist.ac.at](http://publist.ist.ac.at).**

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