Life Sciences
Newsletter 10
Soft Matters
July 2010

New External Senior Fellow Nir Ohad

In July biologist Nir Ohad (Department of Plant Sciences, Tel-Aviv University) joined LifeNet to work on the molecular and biochemical characterization of *Physcomitrella patens* polycomb mutants.

After his graduation and the completion of his PhD thesis at the Hebrew University of Jerusalem, Nir Ohad joined the laboratory of Professor R. Fischer in UC Berkeley, USA, to work on plant embryogenesis. In 1998 he returned to Israel (Tel-Aviv University) to study the epigenetic regulation of gene expression mediated by polycomb proteins (PcG) which methylate Histone 3 on L27.

Since then Nir Ohad's research has been aimed at understanding the role of PcG in regulating plant development. To this end he uses the model organism *Arabidopsis* as a representative of flowering plants and the moss *Physcomitrella patens*, a representative of early terrestrial plants, both serving to understand how polycomb function has evolved during land plant evolution.

Report on the 6th HS Lecture by Nobel Laureate Aaron Ciechanover

"Hi, I am Aaron." was the greeting of Nobel Laureate Aaron Ciechanover from Haifa, Israel, who visited FRIAS June 22nd for a Staudinger Lecture. He received the Nobel Prize in chemistry in 2004 together with Avram Hershko and Irwin Rose for the discovery of ubiquitin-mediated protein degradation. Before he gave his lecture Aaron spent the afternoon at the ZBSA discussing scientific and political issues with several group leaders. All in all he spent no more than eight hours in Freiburg but left a mark on everyone he met.

Over lunch Aaron and several FRIAS members discussed scientific as well as cultural and social subjects. At this point it was evident how friendly and easy-going Aaron is, "a regular guy" in the most positive sense. Right from the start one could feel his enthusiasm and curiosity about science. He travels a lot but always finds as much time as possible to spend with his students. At the meeting in the ZBSA he was very interested in the working conditions and career opportunities of young group leaders in Germany. A subject which he also picked up during his lecture was the pressure to publish in high ranking journals. The paper which laid the basis for the Noble Prize was published 1978 in Biochemical and Biophysical Research Communications, a journal with an impact factor of about 2.5. During his early career scientists were mostly interested in protein synthesis and only a few groups worldwide were working on protein breakdown making publishing quite difficult. One of his messages was, care about your science and perform your experiments properly regardless if it is in vogue or not. After an instructive and entertaining lecture Aaron Ciechanover left as swiftly as he arrived, leaving many people motivated to continue their scientific work.

Science publication by ISF Jens Timmer

LifeNet co-director Jens Timmer publishes his recent work on how a combination of mathematical modelling and biochemicel analyses can facilitate the investigation of intracellular processes in the renowned journal *Science*.

The hormone erythropoietin (Epo) triggers progenitor cells to become red blood cells. In the case of a demand for large amounts of red blood cells as in the case of a major injury, the amount of Epo can increase by a factor of a

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External Fellow Joseph Klafter publishes his calculations on geometry-controlled kinetics in Nature Chemistry (Vol 2, 472-477; 18th April 2010)

Molecular transport processes can influence the course of a subsequent reaction. Critical importance is attached to the time required by a molecule to travel from its starting point in the cell (S) to its target reactant (T), whereby these points are separated by the distance (r). As the reaction takes place upon the first collision of the diffusing protein with its reactant, this is called the first passage time (FPT).
In order to be able to determine reaction rates, it is necessary to know the probability distribution of this FPT variable as a function of the distance r and the volume (V) in which the reaction takes place. However, to date only the mean of the FPT in such a situation was known.
For the first time, the group led by Professor Klafter was able to analyse the entire probability distribution of the FPT for a finite volume (such as a cell) as a function of r and V. Within this analysis it emerged that two different cases must essentially be differentiated: as the cell plasma is densely filled with many other molecules which act as obstacles, the diffusion of larger proteins is slower (disturbed) than that of smaller proteins. In the quicker (or undisturbed) diffusion of smaller particles, r(t), the distance of the diffusing particle from its starting point S, grows with the square root of t. This is also called non-compact diffusion. In this process, the reaction rate is only dependent on the mean of the FPT.
If, in the case of larger proteins, diffusion is disturbed, r(t) grows more slowly and diffusion is compact. Knowledge of the full FPT probability distribution is necessary here in order to be able to determine the reaction rates. The ability to calculate this probability distribution in compact cases is the central result of the Klafter study. It has shown that the FPT is strongly dependent on the initial distance (r) of the reactants. This implies that the spatial arrangement of the reaction constituents plays a crucial role. Reaction kinetics are therefore determined by geometry, leading to the new concept of "geometry-controlled kinetics".

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Report on the 3rd BFF on "Frontiers in Dynamics - from Random to Quantum Walks", held from June 3 - 5, 2010 in Breisach

Transport is an essential process in many physical, chemical, and biological systems. Random walks have been one of the most successful and powerful tools in describing incoherent dynamic processes in various systems ranging from molecular crystals to biomolecules and even to social sciences. Their coherent counterparts, the quantum walks, are acquiring a similar breadth in applications. The Black Forest Focus on Soft

Matter 3 took place from June 3-5 in Breisach. Organized by the School of Soft Matter Research at FRIAS and the Institute of Physics, this workshop brought together experts from different fields of theoretical and experimental physics in order to discuss various approaches for studying coherent and/or incoherent transport in a large domain of systems. The topics considered ranged on the

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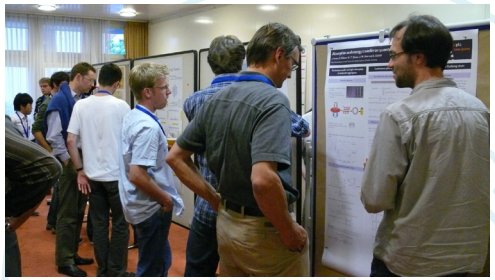
first day from single particle trajectories in DNA to focusing wave packets, on the second day from energy transfer in photosynthesis to quantum walks in photonic lattices, and on the last day from search algorithms in quantum computers to the dynamics of ultracold quantum gases. Excellent presentations as well as lively discussions guaranteed a very successful meeting where researchers from different communities met for the first time.
The breadth of topics was also mirrored in the poster session.



This interdisciplinary approach was very well received by the participants, many of whom left the workshop with new ideas and new prospects for future collaborations.

New Junior Fellow Francesco Rao

In May 2010 physicist Francesco Rao joined the School of Soft Matter Research. His PhD training at the University of Zurich in the Biochemistry department was concluded by a thesis on protein folding and aggregation, introducing the novel technique of complex networks analysis of molecular dynamics (MD) simulations (2002).
He was then awarded a prestigious Italian fellowship from the research center “E. Fermi" located in Rome where he continued to work

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on the theory of complex networks and their application to biomolecular transitions.

In 2007 he moved to the University of Strasbourg /ISIS to the group of Prof. M. Karplus as an EMBO fellow, investigating the role of dynamics in protein allostery and enzyme catalysis.
At FRIAS Francesco Rao will continue to study these dynamics to gain more insight in the mechanisms of protein function.

EXTERNAL SENIOR FELLOW TO COME

Katarina Edwards
Dept. of Physical and Analytical Chemistry
Div. of Physical Chemistry
University of Uppsala, Sweden

Natalie Stingelin
Department of Materials
Imperial College London, England

EVENTS TO COME

July 20-23, 2010
4th Black Forest Focus on Soft Matter "Micro- and Nano Fabrication: From Lithography to Self Assembly", Hotel Saigerhöh, Titisee, Black Forest

October 18-20, 2010
Exploratory Workshop: Nontrivial Quantum Effects in Biomolecular Systems,
Hotel San Michele, Anacapri, Italy

STAUDINGER LECTURE

November 23, 2010 at 16.15 h
Nobel Laureate **Anthony Leggett**,
Physics, University of Illinios at Urbana-Champaign, USA
"Why can't time run backwards?"

thousand compared to its basal level.The question arises how the progenitor cells can process the information of the basal level as well as the increased demand encoded by the increased amount of Epo. In principle four strategies are imaginable. First, there could be a large number of receptors for Epo on the cell surface. Second, receptors could be mobilized from intra-cellular pools triggered by the binding of Epo to the receptors. Third, receptors could be recycled quickly after having bound Epo and transmitted the signal downstream into the cell. Fourth, the receptor could undergo a rapid turn-over independent from Epo-binding.
The first possibility could be ruled out experimentally. The three remaining possibilities represent highly intertwined non-linear dynamical processes that cannot be discriminated by classical biological investigations. In an interdisciplinary cooperation, the Timmer theoretical group together with Dr. Ursula Klingmüller´s experimental group at the German Cancer Research Center, Heidelberg, applied a systems biology approach to resolve the question which of the three remaining possibilities is applied by nature.
Based on experimental data of the dynamic response of the receptor to the Epo stimulus, they built a mathematical model of the information processing of the Epo receptor. By statistically comparing the performance of the three mathematical models for the three competing biological hypotheses, they were able to infer that only the fourth hypothesis can explain the experimentally observed dynamic behavior.

Full article available at: www.frias.uni-freiburg.de/Timmer_Science

Report on the SBMC Conference 2010

From June 3rd to 5th the conference "Systems Biology of Mammalian Cell 2010" organized by Jens Timmer took place in Freiburg´s Concert Hall.
The conference was opened by the Parliamentary State Secretary of the Federal Ministry forEducation and Research (BMBF), Dr. Helge Braun. He emphasized the importance of systems biology for the further development of biology and especially medicine and gave an overview of the various systems biology initiatives supported by the BMBF to a total of 300 Mio €.
The conference was organized in six sessions: New Approaches and Cutting Edge Technologies, Signaling, Metabolism, Biomedicine, Whole Body Models, Industry. They spanned the range from basic research to medical applications of systems biology. In addition to 21 invited speakers there were 13 short talks by Ph.D. students and young PostDocs selected from the submitted poster abstracts.
The conference was attended by 330 participants from around the world. For more information, including live streams of the talks, visit http://www.sbmc2010.de

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EXTERNAL SENIOR FELLOWS TO COME

Jouni Uitto, Jefferson Medical College, Philadelphia, USA

Christopher Mark Overall, University of British Columbia, Canada

Fritz Vollrath, Oxford University, England

JUNIOR FELLOWS TO COME

Tom Michoel, Ghent University, Belgium

EVENTS TO COME

September 3-5, 2010
Plant Systems Biology Workshop

September 13-15, 2010
3rd Physcomitrella Genome Workshop

October 7-8, 2010
Joint Symposium: From Signal to Structure in Embryogenesis and Organogenesis

www.frias.uni-freiburg.de/lifenet-events

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