UNDERSTANDING THE Physics of Life

January 2019 Newsletter

EPSRC Pioneering research and skills

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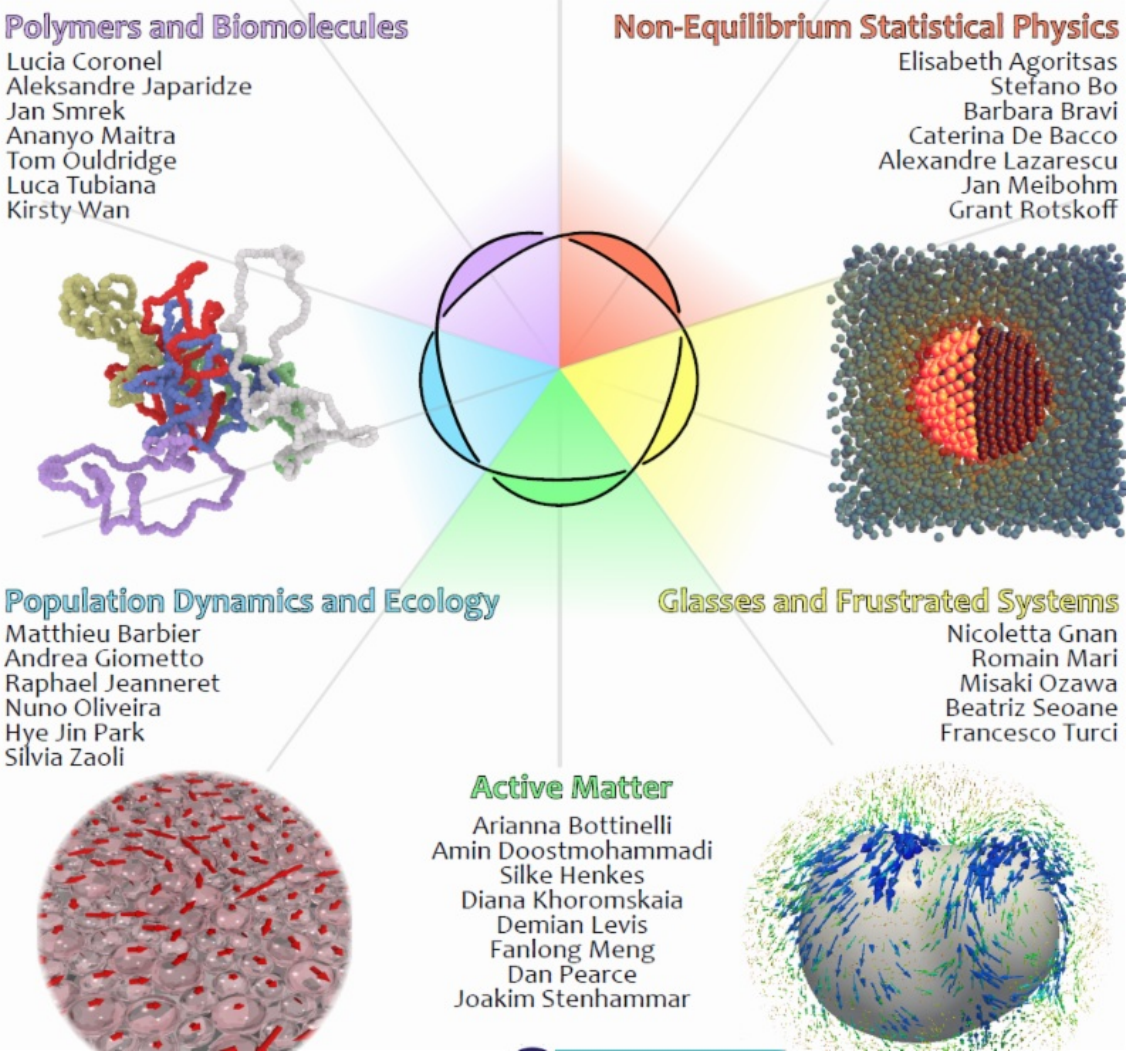
Physics of Life Upcoming Events

Interdisciplinary Challenges for Young Researchers in Non-equilibrium

10-13 April 2019, Higgs Centre for Theoretical Physics, University of Edinburgh
Davide Michieletto, Gianmaria Falasco, George Constable & Elsen Tjhung

Non-equilibrium processes play important roles at many length scales, from controlling chromatin interactions within a cell nucleus to governing the collective dynamics of fish schools. "Interdisciplinary Challenges in Non-Equilibrium Physics" will bring together early career researchers working across these scales. By identifying common theoretical insights, computational approaches and experimental methodologies between disciplines, the meeting aims to promote collaborations and knowledge exchange among early career researchers. The sessions will each focus on one of six inter-related topics: biophysics, polymers, ecology and population dynamics, active matter, non-equilibrium statistical mechanics and glasses and disordered systems.

Registration fee: £10



Register for Interdisciplinary Challenges for Young Researchers in Non-equilibrium

Physics of Evolution

SAVE THE DATE! 8-10 July 2019, Francis Crick Institute

Bhavin Khatri, Tom McLeish and Ard Louis

Physics of Life News: Recent Events

Physics of Biological Oscillators: New Insights into Non-Equilibrium and Non-Autonomous Systems

27-30 November 2018, Chicheley Hall, Buckinghamshire

Report from Peter McClintock and Aneta Stefanovska

Oscillatory processes in biology differ markedly from those analysed over the centuries by physicists and mathematicians in that their amplitudes, frequencies and phases vary in time. The underlying reason is of course that living systems are open, subject to their environments, and having continuing inputs and outputs of matter and energy. In the language of mathematics, they are non-autonomous. Analysing such oscillations is challenging because the traditional approaches (e.g. Fourier based) either fail completely or require particular care in application.

To grapple with this challenge, 56 researchers from 17 countries came together for an intensive 3-day interdisciplinary meeting in Chicheley Hall. They included physicists, mathematicians, engineers, computer scientists, information theorists, biologists, physiologists, and clinicians. Their aim was to share their understanding of biological

oscillators in a diversity of different systems, to pool their experience of the latest methods introduced to analyse the signals that they generate, and to consider applications, especially in medicine.
Contributions encompassed the huge range of frequencies and length scales over which biological oscillations manifest themselves, and considered both the theoretical and experimental aspects of the phenomena. The relevant length scales run from the sub-cellular (e.g. calcium and glycolytic oscillations), through cellular (e.g. endothelial) and organ (e.g. heart and brain) levels up to whole organism and beyond, to populations Frequencies include the range from circadian, through cardiac (1 Hz) up to the fastest EEG frequencies (arguably around 500 Hz). All of these oscillations share features in common, with attendant difficulties in their analysis.

Keynote papers were given by: Alex Webb (Cambridge, UK) on “Dynamic plasticity of circadian oscillators”; Robert MacKay (Warwick, UK) on “Normal hyperbolicity for non-autonomous networks of oscillators”; Peter Kloeden (Tuebingen, Germany) on “Attractors in non-autonomous dynamical systems”; and Constantino Tsallis (Centro Brasileiro de Pesquisas Fisica, Brazil, and Santa Fe Institute, USA) on “Statistical mechanics for far-from-equilibrium systems”.

The conference generated several important questions which were considered (though not always answered) in the wrapping-up session chaired by Aneta Stefanovska and Robert MacKay. These questions have provided grounds for new ideas. A proceedings volume including selected contributions is under currently under consideration.

Nanostructures at Interfaces: Technology and Biophysics

University of Cambridge, 7 December 2018

Report from Lorenzo Di Michele

This one-day workshop took place at the Maxwell Centre, Cavendish Laboratory, and featured invited speakers Dr Valeria Garbin (Chemical Engineering, Imperial College London), Prof. Oscar Ces (Chemistry, Imperial College London) and Prof. Ulrich Keyser (Cavendish Laboratory, University of Cambridge). Additionally, the programme included contributed talks from senior scientists including Prof. Matthew Turner (Physics, Warwick), Dr Martin Buzza (Physics, Hull), Dr Ralf Richter (Leeds), Dr Guido Bolognesi (Loughborough), and 8 short presentations from junior researchers and students. Lorenzo Di Michele also delivered a seminar. The aim of the workshop was to tap into the current activities of the expanding community interested interfacial nanoscience and nanotechnology, including fundamental soft-matter aspects and its applications to the physics of living systems and bottom-up synthetic biology.
The event began with a bottom-up SynBio session opened by Prof. Ces’s seminar on membrane-based artificial cellular systems. The session focusing on interfacial soft matter took place in the late morning and early afternoon, featuring Dr Garbin’s lecture on colloidal self-assembly at mechanically-perturbed interfaces. The last session was dedicated to biological systems and technological applications, closed by Prof. Keyser with his seminar on DNA-based membrane nanopores.

The workshop ultimately highlighted the substantial synergies and overlap between apparently distinct areas of interfacial soft matter and biophysics and soft nanotechnology, demonstrating the scope for larger-scale interdisciplinary initiatives aimed at bringing together this heterogeneous community.

PoLNET2 2018 Symposium: Molecules, Mechanics, Medicine and

More!
University of York, 10 December

This symposium celebrated cutting-edge interdisciplinary science at the interface between the life and physical sciences that has been explored during themed workshops as a result of Physics of Life Network 2 funding. The day was organised in association with **BPSI York** with 80 delegates attending. The symposium facilitated networking and discussion across scientific disciplines, and showcased examples of successful interdisciplinary collaborative projects. Talks covered the Physics of Animal Health (Cyril Rauch, Nottingham), Evolution (Bhavin Khatri, Imperial/Crick) Multi scale Mechanics (Lorna Dougan, Leeds), Bio computation (Sarah Harris, Leeds), Epigenetics (Davide Michieletto, Edinburgh), Cancer (Steve Smye, Leeds) and Anti microbial resistance (Jamie Hobbs, Sheffield). We were also delighted to host a conference call with Kate Bowman and Luke Boldock (EPSRC) to answer our questions related to the major UKRI funding announcement **'Building Collaboration at the Physics of Life Interface'.**



Other activities of interest in 2019

- **IPLS / IHE Workshop: Applying physics and engineering to fight cancer**, January 30, UCL, London.
- **IFF Spring School: Scattering! Soft, Functional and Quantum Materials,** March 11-22, Jülich, Germany.
- **The Physics of Microorganisms II,** April 8, IOP London.
- **Field theories of Active and Driven matter**, 2-3 May, University of Edinburgh
- **International Soft Matter Conference,** June 3-7, Edinburgh.
- **CELLMECH 2019** June 3-6, Milan, Italy.
- **Physics meets Biology,** September 9-11, University of Oxford.
- **Various Upcoming EMBO workshops**

If you would like to advertise an event of interest to Physics of Life members, please email: k.h.baker@dur.ac.uk.

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