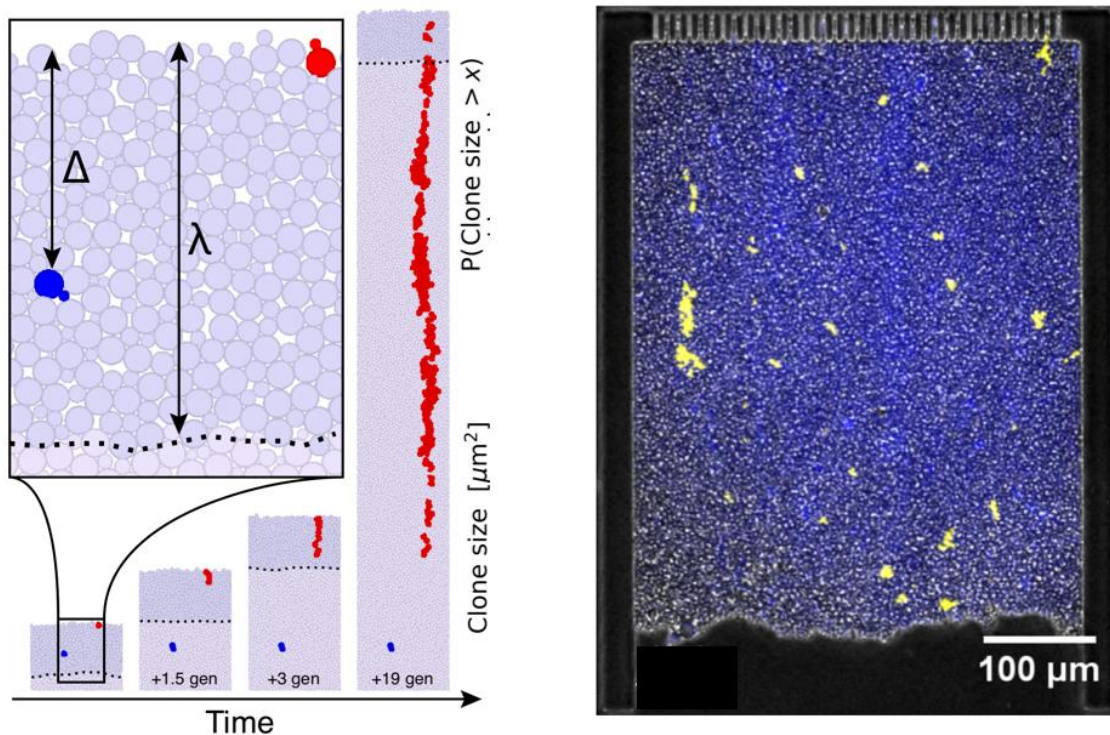


IOP | Institute of Physics
Biological Physics Group

NEWSLETTER

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**Cover Image**

Emergence and fate of neutral mutations occurring at the front of a microbial colony in agent-based mechanical simulations (left) and in microfluidic devices (right).

More details available at <https://www.pnas.org/doi/10.1073/pnas.2208361120>

Image credit: Carl Schreck, Diana Fusco and Yuya Karita

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Items for the newsletter should be e-mailed to Diana Fusco (df390@cam.ac.uk)

Websites

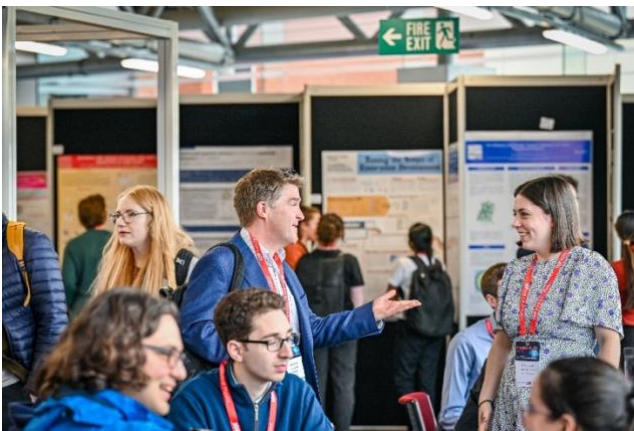
www.iop.org/physics-community/special-interest-groups/biological-physics-group#ref
sites.google.com/view/biologicalphysicsgroupuk/home

The Chair's commentary

Dear Biological Physics Group,

After such intensive and heroic organization efforts over several months it was fantastic to finally start what would turn out to be a hugely successful inaugural conference of the Physics of Life. The strategy in organizing this meeting was to bring together four of the key stakeholders in UK Physics of Life/biophysics/biological physics research. Organized jointly by the Physics of Life network (PoLNET), the Physics of Living Matter consortium, the British Biophysical Society (BBS), and the BPG, the meeting reached out to all researchers in the UK working at the interface between the physical and life sciences. The meeting attracted ~500 participants from across the UK and beyond with multiple parallel themes and plenary sessions over three days spanning broad scales from single molecules, cells, tissues and organs and all the way through to complex systems involving populations of organisms involving in ecology, epidemiology and climate. This was an enormous diverse meeting, with an explicit strategy to encourage a breadth of gender and career level diversity in the invited speakers. There was also a valuable discussion panel themed around the future roadmap to the Physics of Life encompassing wide representation from the major funders as well as both senior and early career researchers, with open engagement with the participants focused around hot topics of future funding sustainability of the physics of life community, career progression, workplace challenges, mechanisms to erode the activation barriers between interdisciplinary research and the future scientific direction of physics of life in the UK. I also had a personal opportunity to pay tribute to my friend and physics of life colleague Tom McLeish, who sadly passed away earlier this year. Tom was an enormous advocate of interdisciplinarity and was instrumental in building up the physics of life research and teaching community in the UK and left such a wonderful legacy in a truly vibrant and forward-looking community. The meeting was a resounding success, rolling in BPG's previous flagship biennial meeting of Physics meet Biology, and it is clear that there was huge enthusiasm to hold a Physics of Life 2025, which is now planned once more to be hosted in Harrogate.

Mark Leake, University of York, Chair of the Biological Physics Committee



The current committee



Professor Mark Leake (Chair)
University of York
Develops new biophysical instrumentation to apply to open biological questions



Dr Margarita Staykova,
University of Durham
Interested in understanding the functional principles of biological membranes and capture them in artificially designed smart interfaces



Professor Mark Wallace
(Treasurer)
KCL
Mark's group builds artificial mimics of cell membranes



Dr Bartlomiej Waclaw,
(Website Editor)
University of Edinburgh,
Interested in applications of statistical and soft matter physics to biological evolution



Professor Michelle Peckham
(Secretary)
University of Leeds.
Interested in the cytoskeleton, molecular motors, super-resolution imaging.



Dr Nirvana Caballero,
University of Geneva,
Theoretical Physicists, specialises in statistical and computational physics



Dr Marco Mazza
University of Loughborough
Uses theory and computer simulations across scales to identify the driving mechanisms of complex matter organization



Dr Timothy Saunders,
University of Warwick,
Quantitative Developmental Biologist



Dr Chiu Fan Lee (Website).
Imperial College London:
Works on universal behaviour in biology, protein amyloid self-assembly and pathogenesis, phase separation in the cell cytoplasm, and active matter



Dr Peter Adams,
University of Leeds,
Nanoscale Physics



Dr Diana Fusco (Newsletter Editor)
University of Cambridge
Physics of microbial ecology and evolution



Dr Massimo Vassali,
University of Glasgow,
Mechanobiology

Meeting reports

Super-resolution light microscopy workshop, December 2022, Sheffield

Organizers: Ashley Cadby (Sheffield), Michelle Peckham (Leeds), Mark Leake (York).

The BPG supported this popular annual 1 day meeting which was hosted by Prof Ashley Cadby in the Mappin Building of the University of Sheffield. The in-person meeting had around 50 participants involving a broad cross-section of researchers from all career stages as well as industrial sponsors, focused on end users of commercial super-resolution optical microscopy instrumentation, builders of home-grown super-resolution microscopes, and developers of new software for analyzing super-resolution imaging data. The application of biological physics to these technology building and software design challenges was very apparent, as was aspects of modeling work concerning the multitude of cross scale biological processes investigated using super-resolution light microscopy. This meeting attracted several participants from the "White Rose Consortium" universities of York, Sheffield, Leeds as well as a healthy number of participants further afield, and is clearly emerging as an important focal point for dissemination and discussion of super-resolution optical microscopy research in the north of England. It was agreed that the meeting was a resounding success and would likely return in December 2023 hosted by York.

Mark Leake

Physics of antibodies, December 2022, Manchester

Organizers: Jian Lu (Manchester), Tom Waigh (Manchester), Fernando Bresme (Imperial), John Seddon (Imperial)

The need for rapid manufacture of protein-based biopharmaceuticals has increased the importance of the development of tools for measuring, understanding and predicting the behaviour of therapeutic proteins, particularly monoclonal antibodies (mAbs). Driven by clinical pressures during the COVID-19 pandemic, many companies accelerated the development of therapeutic antibodies for clinical evaluation and manufacture to a very few months. Many research groups are working on different aspects of structural stability (and, hence functionality) of mAbs. Adsorption and desorption of mAbs are critical indicators of mAb instability/stability and of their potential to form aggregated particles. The capacity to predict the stability of protein biopharmaceuticals will be accelerated by establishment of a specific forum for academic and industrial research communities to exchange knowledge about technical assessment of adsorption and desorption and understand how stability underpins molecular design. Through BBSRC support, an expert workshop disseminated academia-led tool development and shared advances in understanding the stability of therapeutic proteins. We will aim to establish this workshop as a biannual event to develop a multi-disciplinary community of researchers, building from the expertise at the University of Manchester (<https://sites.manchester.ac.uk/coebp/>) and supported by complementarity with BioProNet2, a bioprocessing industry-academic networking club sponsored by industry (<http://biopronetuk.org/>).

Speakers attended from Astra Zeneca (Gaithersburg, USA), Goettingen Max Planck (Germany), University of Oxford, Kings College, ISIS Neutron and Muon Facility, University of Manchester, Imperial College, Fujifilm, University College London, University of Newcastle, Kansas University (USA) and University of Delaware (USA). Crucial new insights in the physics of monoclonal antibodies are becoming available e.g. the viscoelasticity of high concentration formulations, molecular dynamic simulations of adsorption and techniques to measure phase stability and adsorption.

Tom Waigh

Motility in microbes, molecules and matter, February 2023, Edinburgh

Organizers: Marco Mazza (Loughborough), Tyler Shendruk (Edinburgh)

The response to last year's "Motility in Microbes, Molecules, and Matter" workshop was overwhelmingly positive, and we were thrilled to see the level of interest from both biologists and physicists, as well as experimentalists and mathematical modelers. As a result, Tyler Shendruk (University of Edinburgh) and I co-organized "Motility in Microbes, Molecules and Matter 2," which took place on February 27th, 2023 at The Higgs Centre for Theoretical Physics in Edinburgh. While the first edition filled the need to go back to in-person meetings after the lockdown, we experimented with the format to allow for more in-depth discussions of specific problems. We did this by implementing focused round-table dialogues, which enabled participants to delve deeper into the two main systems we addressed. These systems were: Morphogenetic fields and cell motility: This system encompasses the complex feedback loop between motility, adhesion, mechanobiological sensing, and chemical signaling in the life cycle cells in tissues. Structural rearrangements within biofilm communities: To survive and thrive, biofilms must

rapidly respond to environmental conditions, including antagonistic innate immune responses. We examined whether aspects of collective response could be understood from the perspectives of dynamic instabilities or structural transitions. Following a series of insightful invited talks, we moved to the round-table discussions, which sparked lively debates and raised some thought-provoking questions. For example, participants asked, "What do you wish that a theoretician could provide you with to help your experiments?" The workshop drew in around 30 in-person participants, ranging from PIs to PhD students. The latter had the opportunity to present their work in a poster session, providing a platform for early-career researchers to showcase their contributions to the field. Overall, the event proved to be a valuable forum for cross-disciplinary collaboration and knowledge sharing.

Marco Mazza

Physics of Emergent Behaviours IV: Phase Transitions in Biology, March 2023, Harrogate

Organizers: Timothy Saunders (Warwick), Chiu Fan Lee (Imperial), Margarita Staykova (Durham), Peter Adams (Leeds)

The fourth edition of the Physics of Emergent Behaviour conference series was held in Harrogate, UK, on 30-31 March, 2023. This year's theme focuses on the diverse types of phase transitions found in biology, and the sessions were broadly partitioned into four categories based on where these transitions occur: i) tissues, ii) membranes, and iii) cytoplasm and nucleoplasm. Each session was followed by a stimulating panel discussion, with many interactions between the speakers and audience.

"It was a thought-provoking event that provided a great opportunity to discuss the current challenges in phase separated bio-condensates. We heard about both experimental work, simulations and theory, which provided a nice snapshot of different approaches. We heard from researchers with a focus on biological systems and also from those focussed on model systems. It was clear that this is grappling with the very definition of a biological condensate as compared to non-biological de-mixed systems. When looking back on my notes on this event, several questions spring to mind: What level of biological relevance does a phase-separated structure need to be considered a biological condensate? When does a small cluster of protein complexes become an aggregate and when does a large aggregate truly start acting as a different phase of material, as a physicist might define it? What can synthetic or theoretical models of this system teach us about naturally-occurring condensates? It was clear to me that many important advances have been made but that there is much more yet to know. I look forward to another conference with this community soon!"

Peter Adams

"I think the meeting provided a rare opportunity where researchers working on phase transition-related phenomena in distinct biological systems come together. These include scientists working on membranes, tissues, biomolecular condensates. The relaxed schedule and long breaks facilitated extensive discussions. Personally, I find the interactive panel discussions particularly interesting as they provided important insights into how leaders in their respective fields see what the promising research directions are."

Chiu Fan Lee

"I particularly enjoyed the discussion sections of the symposium. Having the opportunity to go through a topic in detail – e.g., phase transitions in tissue morphogenesis with Xavier Trepant and Buzz Baum – with lots of audience participation was really exciting. The talks were also very well presented and the ECRs seemed to benefit from the relaxed environment, with many questions asked. Overall, such a small, focused meeting has clear advantages over larger meetings (e.g., more open discussion and more relaxed environment to encourage ECR participation), and I hope such satellite meetings continue at other major physics of life conferences."

Timothy Saunders

Early career event, March 2023, Harrogate

Organizers: Peter Adams (Leeds)

This event preceded the main Physics of Life meeting and was an opportunity for postdocs and postgraduate researchers to get involved. Over 100 attendees assembled into the main conference auditorium in the Harrogate Convention Centre and a total of 14 talks were delivered on a diverse range of topics across bio/physics (included

8 flash presentations). We heard about a full range of biological macromolecules: proteins, DNA, RNA, lipids, peptidoglycan and condensates. Newly-developed tools were presented, such as DNA PAINT, new phenotyping methods and picolitre-spectroscopy. Research was presented across the length scales from whole organisms (ciliates, virions, bacteria) to the level of single proteins and single nucleotides and finally the level of single hydrogen bonds. The techniques presented ranged from mathematical modelling and simulations to microscopy, spectroscopy and diffraction. A snapshot of other topics included: lipid membrane curvature, pore-forming toxins, the circadian clock and plant roots. Overall, this was an excellent morning of research talks that set a high standard for the rest of the week! Finally, I note that the social event on the previous evening at Cold Bath Brewing Co was a pleasant occasion to relax and network with some like-minded scientists. I look forward to seeing the great work of these ECRs over the next few years.

Peter Adams

Organoids and lab-on-chip, April 2023, IoP London

Organizers: Bartek Waclaw (Edinburgh), Pietro Cicuta (Cambridge), Sally Peyman (Leeds), Diana Fusco (Cambridge)

On April 21st, researchers across different fields, from engineering and physics to biology and medicine, came together to share their latest work and innovations on organoids and lab-on-chip devices. Three invited speakers, Virginia Pensabene from the University of Leeds, Jennifer Rohn from UCL and Shery Huang from the University of Cambridge, presented the state-of-the-art in technologies to improve IVF success, to study antimicrobial resistance in UTIs and to achieve “Green” tissue engineering, respectively. The speakers were joined by 12 flash talks from multiple attendees, which gave everyone the opportunity to share their research interests, exciting results and current challenges in device fabrication and applications. The broad spectrum of topics covered, from microbial physiology, viral infections, brain electrophysiology to cancer treatment and neural implants, highlights the impressive flexibility and range of applications of microfluidic devices across multiple fields. Active and fruitful discussions spontaneously emerged during the break-out sessions and at the end of the meeting and there was strong support from the attendees to organize a follow-up workshop in 2024.

Diana Fusco

Mechanics in Biology: from molecules to cells and tissues, June 2023, Glasgow

Organizers: Massimo Valssali (Glasgow)

From the 4th to the 9th of June, 24 students and 16 speakers from all over the world convened in Scotland, to attend the FEBS practical course “Mechanics in Biology: from molecules to cells and tissues” organised by the University of Glasgow in collaboration with the University of Sydney. This course was funded by the Federation of the European Biochemical Societies (FEBS) and the International Union of Biochemistry and Molecular Biology (IUBMB). After an opening session held within the Advanced Research Centre of the University of Glasgow, the students and speakers moved to the picturesque ecology station of the University of Glasgow, the SCENE, over the shores of Loch Lomond, where they had the opportunity to closely interact for the entire week. The speakers presented the theoretical basis of how to measure forces and mechanics in biology, spanning from traction force microscopy to single molecule stretching, accompanying their introduction with some interesting scientific results. From the second day, an advanced microscopy and spectroscopy lab was set up thanks to the contribution of 5 industrial sponsors, and the students were involved in hands-on activities on their cutting edge technology (we thank HORIBA, Lumicks, ICAPPIC, Nanosurf and Zeiss for this installation). The students brought a poster describing their research and were challenged in small groups by our lecturers, to first introduce it in 3 minutes, to catch the attention of the audience and further present it in full. The 3 best posters were awarded a prize specifically offered by the Biological Physics special interest group of the IoP. After dinner (and a nice barbecue on the Tuesday), round table discussions covered “A Journey into Industrial R&D” and “Women in Science”.

Massimo Vassalli

Upcoming meetings

Physics of Living Matter: 28-29 September 2023, Cambridge

Early registration deadline, 1 August 2023

<http://www.plm-symposium.org/>

Innovations in EM and their relevance to biological physics: 11 December 2023, IoP London

Innovations in biomedical detector/clinical diagnosis technologies: 12-15 December 2023, IoP London

IoP – Biological Physics Prizes

Several prizes, including for ECRs, best PhD thesis, communication and outreach, will be announced in the upcoming months and awarded in 2024. More information and details on how to apply will be coming soon.

Election of Biological Physics Group Committee Members

Elections for two ordinary members of the Biological Physics Group committee have opened on 5th of July and will close on 19th of July. All members have received a personalized email inviting them to vote (check your spam folder!). Don't miss the opportunity to cast your vote!

Major contributions of physics to biology

What can physics contribute to biology and what has it already contributed? The BP committee has compiled a list of what we consider to be some of the major contributions of physics to biology in the last 70 years. Check out the list on our website:

<https://sites.google.com/view/biologicalphysicsgroupuk/major-achievements?authuser=0>