



Cover Image: Analysing the waveforms of beating cilia with high speed video microscopy. Primary Cilia Diskinesia (PCD) caused by mutations in DNAH11 and HYDIN genes alter the ciliary dynamics. [M. Chioccioli, *et al.* **American Journal of Respiratory and Critical Care Medicine** 199, 1436-1438 (2019)]

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Items for the newsletter should be  
e-mailed to  
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## Editorial

*In the March 2020 edition,*  
  
*Professor Michelle Peckham*  
*Newsletter Editor*

## *The Committee*

### Chair

Pietro Cicuta

### Honorary Secretary

Mark Leake (new!)

### Honorary Treasurer

Tom Waigh

### Members

Mark Wallace (*cross representative with BBS*)

Chiu Fan Lee (*responsible for website*)

Ewa Paluch

Michelle Peckham (*responsible for newsletter*)

Peter Petrov

Achillefs Kapanidis

Bartek Waclaw

Andela Saric

### *New Members*

[Margarita Staykova](#)

[Marco Mazza](#)

Many thanks to our retiring members: Susan Cox (our honorary secretary), Marisa Martin-Fernandez and Rosalind Allen for all their hard work on the committee.



Marco Mazza: - an introduction to one of our new members:

In my research group, we think that nonequilibrium physics is among the most exciting frontiers of science. We are interested in the transitions, self-organization, and collective states of inert and living matter. We use theory and computer simulations to investigate soft matter systems such as active swimmers, liquid crystals, granular matter. From bacteria to biofilms, from simple molecules to large-scale patterns, our main goal is to identify the driving mechanisms of complex matter organization. On the small scale, molecules with anisotropic interactions exhibit a profusion of interesting states of organization. We aim at investigating their structural and dynamical properties, useful in self-assembly or in functional materials, for example in liquid crystals, whose behaviour is dictated by interactions and topology. Once geometrical confinement or hydrodynamic flow are present, soft matter systems offer opportunities for smart, tunable materials. At larger scales, hydrodynamics open countless nonequilibrium phenomena, from clustering of granular gases to microfluidic manipulation. At the even larger scale of microorganisms, our goal is to understand the complexity in motile phytoplankton and biofilms. Finally, we aim at uncovering basic physical principles in the organization of collections of cognitive agents, the most sophisticated nonequilibrium system.

**The Chair's commentary**

Dear Group,

Welcome to the first newsletter of 2020. The year starts with some positive vibes, such as the announcement of PolNet3 (see piece by Mark Leake in the newsletter) as an important umbrella at national level to coordinate and stimulate activity in biological physics. There are also plenty of thriving local activities, I have recently helped to launch a much needed initiative to better connect the community across physical/life sciences in Cambridge (@camphysbiol). A more murky feeling emerges concerning our eligibility to take part in the next phase of EU funding, Horizon Europe. Those of us working on the more applied end of Biological Physics, with questions close to healthcare or technology, are likely to have access to several funding opportunities within the UK, but for projects aiming at more fundamental questions it is difficult to imagine what could replace EU funding to individual PI (ERC) or collaborative programmes such as ITN. Beyond funding, and possibly of even greater worry, is our ability to remain as an attractive place globally to do science as we have been in the last 20 years. At least locally in our groups, teams and departments, I think these times call us to an increased responsibility to uphold behaviours and values compatible with the scientific endeavour.

As you know, one of the main activities of the IOP group is to organise and support meetings. PolNet3 and other groups and networks (UK Biochemistry society, Microscopy Society, RS, and others) also work in that direction. In the newsletter you will see reports from our recent meetings and the list of events for 2020. Whilst our recent events have been successful, there is a widespread sense that too many meetings can fragment the community, and that no meeting in the UK has achieved a "must-go" status, nor a truly question-driven uber-discipline ethos. One possibility which is being discussed at our group committee and elsewhere is to merge some of our meetings together, each to become a session within a much larger biological physics meeting, with the ambition of increasing critical mass and attracting truly across disciplines. This might be a one-off in 2022 or 2023, or the start of something new, depending on the outcome! Of course we are also all aware that small short focused meetings often deliver the highest "density" of science. Our sense is perhaps that in the presence of an (annual?) larger conference that brings together biologists with physicists, chemists and all others working in this space, an ecosystem of short meetings would continue in order to explore new areas, which could then be brought into later editions of the larger meeting. Such a larger event would need an unprecedented level of coordination, beyond just our physics colleagues. Anyway - for the moment, thoughts in favour or against this vision should be communicated to either PolNet3 or IOP Biological Physics group committees, as well as suggestions of meetings that could potentially be folded into a larger event.

A reminder of our "short video" competition, which we hope will create a nice collection to represent activity in biological physics in the UK – details so far:

- Max 3 minutes
- **Deadline 27<sup>th</sup> March**
- Must be self-produced by early career (PhDs, postdocs, Fellows)
- Permission of PI must be obtained
- Competition is open to members of the Biological Physics group
- Video should be pitched to level of a physics undergraduate
- Prizes (TBC)

best wishes,

Pietro Cicuta (Chair)

**PoLNet3: help to shape your own Physics of Life community in the UK**

Mark C. Leake, University of York

The UK's **Physics of Life Network, PoLNet**, formed in 2012 as an EPSRC/BBSRC funded Grand Challenge "Network Plus" to help nurture, synergise and stimulate the growing community of researchers operating and interface between the physical and life sciences in the UK. The initial formation of POLNet were arguably lit from the still glowing embers of the **Life Sciences Interface (LSI) programme** that ran from 1999 for several years serving to fund a handful of interdisciplinary research programmes pinned to doctoral training centres across the UK. Valuable as this initial stimulus was for focused research groupings nationally there remained core issues of a poverty of wide scale and sustainable funding programmes across the extent of the UK for what was clearly a growing and emergent interdisciplinary science community. This was the *casus belli* of the Physics of Life Network, and since its inception the Network has grown from strength to strength, propagating through an initial phase in PoLNet1 (2013-2016) of building the community through a series of targeted workshops and symposia across the country themed in key focus areas of existing Physics of Life research activity. These Networking events were enormously popular, successfully collocating researchers from across the physical life science divide and giving them the opportunity to establish invaluable dialogues, and served not only to build new collaborations but also to distil discussion across the community as to ways to move forward, culminating in a report for the "**Roadmap of Biological Physics**". The activities of POLNet1 were so successful that EPSRC exceptionally invited the steering team to bid for its continuation – this application was well received culminating in the second PoLNet2 phase (2017-2020) in which Networking activities were steered towards not only continuing to develop new collaborations across the Physics of Life landscape but importantly to building towards establishing competitive research teams in key areas of Physics of Life Research. The culmination of the Network's activities was in the successful lobbying, after several years' of effort, to establish a dedicated RCUK strategic priorities fund of £30M in "**Building Collaboration at the Physics of Life Interface**" to enable substantive research consortia to be funded, whose remit was in no small part steered by the Network itself. The first £15M tranche of research funds was released in 2019 following an enormously popular competition of ca. 130 expressions of interest distilled down to 7 funded research programmes, with an expectation to run a second competition for the remaining £15M of funds in 2021. This enormous and clear demand for funding Physics of Life reflects the absolute need for building even greater resources and synergising the community further. As a result, following an exceptional further invitation to apply for further Networking, the third phase of the Network will commence from April 2020. PoLNet3 is now scheduled to run for three more years, to with a remit to help the community of Physics of Life researchers move towards a position of genuine sustainability. This, third phase of the Network has been stimulated by four evidenced opportunities:

- (1) The hugely over-subscribed and high-quality response to the first call for major PoL grant
- (2) The continuous demand for workshops on life-science/physical science topics, and from people newly-engaged in the Network.
- (3) The increased opportunity and interest in biomedical/physics collaborations, including the participation of MRC in the UKRI SRF, the expression of interest by the Rosetrees Foundation in co-supporting PoLNet, and the relevance of a number of pressing biomedical challenges.
- (4) The growth in demand from the UK ECR community for places on the PoLNet summer schools.
- (5) The new 'Technology Touching Life' (TTL) cross-council initiative.

PoLNet3 will respond to these challenges by:

- \_Supporting the existing and future cluster of PoL UKRI projects by Networking and pump-priming research, and working to mainstream UK national PoL funding.

- \_Stimulating a regular series of agenda-setting and community-creating workshops
- \_Expanding engagement with PoLNet to a wider medical science community, with the support of relevant funders (MRC, Rosetrees, CRUK, Wellcome) and the TTL Networks.
- \_Continuing to provide graduate interdisciplinary PoL education through summer schools and other activities, including the development of an ECR community management role.
- \_Working to engage a wider mathematical and computational community of researchers.
- \_Developing stronger international links to other such Networks worldwide

The *sine qua non* of PoLNet3 is the membership... this determines the core drive, the exciting concepts, the hard efforts of actual implementation... in essence, *the everything*. But the fantastic fact is that it is, absolutely, entirely *your* Network. It is there to serve you, and to be served by you. Join it, be a part of it, help shape it, help make a real difference, help sustain the community of fantastic, exceptional, awe-inspiring Physics of Life research. Let it grow, and grow, and grow!

### Meeting Reports:

#### Quantitative Methods in Gene Regulation V

I had the pleasure of organising the 5th edition of this biennial meeting. Marco Cosentino Lagomarsino co-organised all events so far, and we were joined by Alison Smith and Martin Howard to put together a programme that looked at ecologies and communities, as well as our more traditional topics of mechanisms in development, single cell and molecular scales <http://gene2019.iopconfs.org/speakers>. Multi species and multiple cell type systems (i.e., communities) are, I think, one of the areas to which biological physicists will increasingly gravitate, as single cell methods become more robust, and imaging or organ on chip systems becomes more standard. Lab-scale ecological studies are key to understand some of the most important biological questions in our planet and in human health. The meeting was held in the (highly recommended) new venue of the IOP HQ near Kings Cross. We had about 60 participants. Speakers were excellent and there was a very active engagement by everyone over both days. We did think that although this conference has a solid track record, and fits a unique niche in meeting-space, it has remained (aside from invited speakers) quite dominated by physicists, and it would be an interesting experiment to have this meeting as part of a larger biological physics event in the future.

*Pietro Cicuta*

#### Physics Meets Biology

The sixth of our (nearly) biennial flagship meetings, Physics Meets Biology, was held in Oxford in September with an organising committee comprising Achilles Kapanidis, Michelle Peckham, Andrew Turberfield, Bartek Waclaw and Tom Waigh. Our aims were to engage the whole of the UK Biological Physics community, reinforce our links to biology, and encourage strong international participation. As usual, we came close enough to this ideal to create a fascinating, interdisciplinary and scientifically excellent programme that ranged from time-resolved protein crystallography to the electrical ecology of foraging bumblebees. In its scientific scope and ambition, Physics Meets Biology is already close to the new annual meeting that Pietro suggests elsewhere in this bulletin – perhaps this new ‘larger’ meeting could be developed from PMB as a nucleus. We are already planning the next in the series – provisionally in Oxford on 13-15 September 2021.

*Andrew Turberfield*

#### Coiled coils, myosin, titin and striated muscle: A reflection on the contributions of John Trinick and Gerald Offer

This was a one day meeting held at the University of Leeds on the 10<sup>th</sup> January 2020. The development of research ideas and understanding into specific muscle proteins: titin, myosin and myosin-binding protein C (C-protein) were discussed in recognition of the contributions of John Trinick and Gerald Offer to this field of research. John (a trained physicist) was a world leading expert in titin, and Gerald discovered C-protein. Each of the speakers gave a brief overview of their interactions with either John, Gerald or both researchers, and how they worked alongside them, and how this developed into their current research. Exciting new research was presented on the role of

C-protein in regulating myosin activity, particularly in cardiac muscle (from Howard White and Charlie Scarff), and Dek Woolfson presented his exciting new work on the development of novel synthetic coiled coils based on a meticulous understanding and ability to model these structures, work that was started alongside Gerald Offer. He introduced new software, originally based on modelling coiled coils with the Crick equations, which he started with Gerald Offer: CCBUILDER 2.0. Mathias Gautel reflected back on the first attempts to sequence titin, how titin was now acknowledged as a key disease gene in many cardiac and skeletal muscle diseases, and his new work in this area. The key takeaway from the meeting is that new developments and approaches are providing us with new insight into how these proteins function, building on years of work that began with key research from John and Gerald.

*Michelle Peckham*

## Upcoming Meetings

### Fundamentals of active growing matter

14-15 May 2020

Higgs Centre for Theoretical Physics  
Edinburgh

A wide variety of physical properties of living systems arise from interplay between activity and growth. These include pattern formation in bacterial colonies, ordering in actin networks and the emergence of resistance in tumours.

The workshop's main goal is to gather together researchers working on different systems and using different techniques (theory, simulations, and experiments). We hope that the meeting will help to identify universal characteristics of growing active matter and reveal unifying general principles (if they exist).

**Confirmed speakers:** Dirk Drasdo, Jens Elgeti, Luca Giomi, Rhoda Hawkins, Silke Henkes and Julia Yeomans

There will be a few short contributed talks, and a poster session.

#### Deadlines:

- registration: 14 April 2020

- abstract submission: 31 March 2020.

#### Organising committee:

Richard Blythe

Martin Evans

Chiu Fan Lee

Davide Marenduzzo

Bartek Waclaw

<https://higgs.ph.ed.ac.uk/workshops/fundamentals-of-growing-active-matter/>

### Advanced photonics techniques

1st, 2<sup>nd</sup> September

University of Manchester

This two day meeting will consider advanced photonics techniques in biology. Emphasis will be given to cutting edge techniques (e.g. optical NMR, polarisation sensitive OCT, super-resolution fluorescence microscopy, non-linear Raman etc.), open source projects and artificial intelligence for data analysis.

Organisers: Thomas Waigh, Susan Cox, Michelle Peckham, Pietro Cicuta

### 87<sup>th</sup> Harden Conference: Single-molecule bacteriology II

Sept 21-24.

Milton House, Oxfordshire

Single-molecule imaging has revolutionized our ability to study molecular processes underlying bacterial function. New fluorescent proteins and dyes, ultrasensitive microscopy, and image-analysis

software have helped visualize reactions, interactions and motions inside single bacteria. In a sense, we are “re-discovering” bacteria with a new set of eyes.

The agenda of this interdisciplinary meeting will showcase exciting developments in this young field. This will include structural/mechanistic studies using super-resolution imaging and single-molecule microscopy, new quantitative in vivo techniques applicable to bacteria, complementary theoretical modelling approaches, and studies of clinical/commercial significance.

This topic is the theme of the 87th Harden Conference, an event series unique to the Biochemical Society, providing residential research conferences covering a specialist topic. These events are widely recognised for their emphasis on free and open discussion to encourage the exchange of the latest data and a critical discussion of the technical challenges that these developments face.

<https://biochemistry.org/events/87th-harden-conference-single-molecule-bacteriology-ii/>

Retirement event for Dame Athene Donald

<https://events.iop.org/polymer-physics-meeting-retirement-conference-dame-athene-donald>

21-22 September, Churchill College, University of Cambridge.

[26<sup>th</sup> International Conference on DNA Computing and Molecular Programming.](#)

13-18 September 2020

University of Oxford

The 26th International Conference on DNA Computing and Molecular Programming (DNA26, <http://dna26.iopconfs.org>), sponsored by the Biological Physics Group, will take place in Oxford on 13th – 18th September 2020. Research in DNA computing and molecular programming draws together mathematics, computer science, physics, chemistry, biology, and nanotechnology to address the analysis, design, and synthesis of information-based molecular systems. DNA26 will focus on the most important recent experimental and theoretical results. Papers and presentations are sought in all areas that relate to biomolecular computing, including, but not restricted to: algorithms and models for computation on biomolecular systems; computational processes in vitro and in vivo; molecular switches, gates, devices, and circuits; molecular folding and self-assembly of nanostructures; analysis and theoretical models of laboratory techniques; molecular motors and molecular robotics; information storage; studies of fault-tolerance and error correction; software tools for analysis, simulation, and design; synthetic biology and in vitro evolution; applications in engineering, physics, chemistry, biology, and medicine.