

Coffee with Anupam Sengupta – Interfacing Engineering, Physics and Biology!

Could you tell us a bit about yourself?

I am originally from the City of Joy, Kolkata, in India. As an undergrad, I studied Mechanical Engineering at I.I.T Bombay in Mumbai, and for the first time arrived in Europe with a job in a German firm. However, within a year, I started missing the challenges and excitement that come with academia. This is when I started my Ph.D. in Physics at the Max Planck Institute for Dynamics and Self-Organization in Göttingen.

While writing my doctoral thesis, I realised that principles of Physics – especially, Soft Matter Physics – could be applied to understand biological systems. I wanted to develop these ideas, so I applied for an independent fellowship from the [Human Frontier Science Program](#) (HFSP), which, among others, supports researchers to transition from non-life-sciences (say, physics, engineering or mathematics) to biological sciences. As an HFSP Cross-disciplinary Fellow, I moved to MIT to work in marine microbial ecology, kick starting my first real encounter with biology. My HFSP stints at MIT, and thereafter at ETH Zurich trained me in biological tools and techniques, and incubate ideas for the next career step.

How did you join the University of Luxembourg?

To be candid, I came to know of the University only in my final year of HFSP Fellowship, when I was approached by the PhyMS-RU¹. I was informed about the opportunities in Luxembourg, and suggested that I apply for the FNR ATTRACT Grant. Before reaching a decision, I came for a visit, and returned to Zurich with a positive impression – of the University and the vision of the RU in regards to biophysics and biomaterials. Incidentally, I had a chance to also meet Rudi, and on later occasions, Alex (Skupin) and Paul (Wilmes), during which we had exciting discussions on tangible synergies between physics and biology. The vision of our RU, the encouraging feedback from LCSB, and FNR's strategic focus on cross-disciplinarity, brilliantly coincided with my own plans. It was almost serendipitous!

I received the [FNR ATTRACT Grant](#) in summer 2017 for the project MBACE (Microbial Biophysics of Rapid Adaptation in Changing Environments) and joined the University in May 2018 as an Assistant Professor in the PhyMS-RU.

What is your research group working on?

Our lab, [Physics of Living Matter](#), is embedded within the PhyMS-RU¹, and is located at the Campus Limpertsberg. We are a growing team of cross-disciplinary scientists, with a current strength of 4 post-docs, 2 PhD students and an administrative assistant. We interface automation, physics, microbial ecology and genetic engineering to uncover *LIFE*, or as we call it “Living In Fluctuating Environments”. The overarching goal is to understand microbial response changes in their environment over different time scales. It can be response of algae to turbulence in oceans (short time scales), or their adaptation to anthropogenic stressors (over longer times). We work in precise and controlled micro-environments using

¹ Physics and Materials Science Research Unit

micro- and milli- fluidics, and capture the dynamics using high resolution imaging. You could call it microbial biophysics of adaptation.

In addition, we work on the microbial organisation in gut-like environments, where the goal is to develop biophysical frameworks to explain structure-function relations, specifically, to fluctuations in the gut environment. We are one of the first groups worldwide to pursue a quantitative image-based approach to uncover the community structures of microbial consortia and the effect of physical forces such consortia. Then, we also do fundamental research on the dynamics of biological fluids. We want to understand the behaviour of complex biological fluids, for instance, the mucus lining the wall of the gut.



What is the format of the collaboration with the LCSB?

My team has been allocated lab and office spaces in BT1. One of my post-docs, will be based entirely here, where he will set up experiments to study the interactions between microbes and micro-plastics. Two PhD students will also conduct part of their research in BT1, where

they will perform omics analysis complementing, biophysics experiments. I will have a desk in the same office, and will split my time between the Limpertsbeg and Belval campuses.

As my group is part of the PhyMS-RU, it makes sense to settle in Limpertsberg, but we wanted to have a foot in Belval to build bridges with biology. Some facilities, such as the omics and sequencing platforms, are vital to establish links between our physical approach and relevance for biological systems. High-resolution imaging and soft lithography are also technologies that are crucial for our work. All of these have been developed by the LCSB and, by being in Belval, we will be able to capitalise on the existing equipment and skills.

Why is this partnership with the LCSB relevant?

Since joining the UL, I have had discussions with Prof. Wirtz (RU Head), and colleagues including Prof. Lagerwall and Prof. Esposito, about synergies that could emerge across the two campuses through active research collaborations. This was strongly reciprocated by Rudi, and thereafter, also by the PIs at LCSB. The most obvious connection is probably with the Eco-Systems Biology group. I am co-PI in the MICROH DTU and part of our collaboration is already outlined there. We have also recently started working on the gut-brain axis, specifically on the role of the *curli* protein. Alongside, there are emerging plans to draft a joint proposal with the Integrative Cell Signalling group on the physics of complex systems. Overall, we believe it is a win-win scenario: our team will benefit from the expertise and facilities of the LCSB, and, in return, we will bring a novel “material” perspective on microbial biophysics and share our expertise in trait-based modelling of complex systems.

The social aspect is also important for our PhD students and post-docs. By having access to the two sites, my team will get opportunities to interact and discover a bigger research ecosystem. Plus, some of them have a background in biology – they are eager to meet their peers in life sciences, starting with the team meetings and TGIFs!

A last word to conclude maybe?

First, I want to thank Rudi, Paul and Alex for their generous support toward the current and emerging collaboration opportunities. I greatly appreciate the overall excitement of the other PIs at the LCSB as well – eager to learn more about you and your exciting science! And a BIG thanks to Nicolas, Monika and Nathalie, who while still being at LCSB, played a critical role in getting a few things moving in Campus Limpertsberg during the early days. And now, they are helping us set-up our BT-1 lab, and have made us feel at home already.

Finally, as (bio)physicists, we may approach topics from a different perspective but we share the same passion for science, so please don't hesitate to reach out. We are hungry for stimulating interactions! I will be at the LCSB with my group on September 26 for a presentation during the team meeting. We are looking forward to meeting the LCSB members in the flesh!