OCT. 2021

ArtMoMa
Artificial Molecular Machines

DETAILED PROGRAMME

BIONANOTECHNOLOGY & BIOMOLECULAR MACHINES WORKSHOP

2 & 3 NOVEMBER 2021

B CUBE, UNIVERSITY OF DRESDEN - GERMANY
AND ONLINE

artmoma.sciencesconf.org

2021

NOV. 2 - 3

Dresden & online

BIONANOTECHNOLOGY & BIOMOLECULAR MACHINES WORKSHOP

▶▶▶ Public Workshop

PRESENTATION

ArtMoMa, an Innovative European Training Network focusing on the emerging field of artificial molecular machines, is happy to invite you to its 1st public workshop on **Bionanotechnology & Biomolecular Machines**. Invited talks will include newest results on Microrobotics and Motility, Dynamic DNA Nanotechnology and Synthetic Protein Systems. ArtMoMa is designed to push the current scientific boundaries and to explore entirely new directions of fundamental research towards technologically relevant implementations: this meeting will provoke exciting discussions on novel applications of well-controlled molecular movements and their orchestration in large systems."

Prof. Stefan Diez - University of Dresden & Prof. A. J. Turberfield - University of Oxford, co-organisers of the 1st ArtMoMa public workshop.

LOCATION

The workshop will take place as a **hybrid event** offering the possibility for participants to attend either on site - at the University of Dresden / B CUBE building (How to get there?) or online (link upon registration).

B CUBE
Center for Molecular Bioengineering TU Dresden

B CUBE - Center for Molecular Bioengineering
University of Dresden
Tatzberg 41, 01307 Dresden - Germany

REGISTRATION

For non-members of the ArtMoMa network, the following fees apply:

- On-site: 100€ incl. lunches and social event (dinner on Nov. 2)
- On-line: 50€

Register on https://artmoma.sciencesconf.org by Oct. 22nd.

HEALTH & SAFETY

An health and safety protocols will be put in place:

- Each participants will have to provide evidence of 3G (vaccinated, recovered or tested)
- It is compulsory to wear a mouth and nose cover in closed rooms and whenever a distance of 1.50 meters cannot be maintained

Further measures might apply based on the situation at the time of the workshop.

Tuesday

NOV. 2

Dresden & online

MICROROBOTICS AND MOTILITY, DYNAMIC DNA STRUCTURES, VISIT OF B CUBE

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▶▶▶ Programme

08:30 - 08:55	Registration
08:55 - 09:00	Opening
	Session 1: Microrobotics and Motility
09:00 - 10:00	Biohybrid microrobots: how we put cells to work Dr. Veronika Magdanz (IBEC - Spain)
10:00 - 11:00	Chemically driven synthetic active systems Dr. Juliane Simmchen (University of Dresden - Germany)
11:00 - 11:30	Coffee break
	Session 2: Dynamic DNA Structures
11:30 - 12:30	Synthetic cells: De novo assembly with DNA nanotechnology Dr. Kerstin Göpfrich (Max Planck Institute for Medical Research- Germany)
12:30 - 14:00	Lunch break
14:00 - 15:00	Dynamic DNA Networks and Machines and Their Applications Prof. Itamar Willner (Hebrew University of Jerusalem - Israel)
15:00 - 16:00	On-site visit of B CUBE - Center for Molecular Bioengineering/ Campus Tour
16:00 - 16:30	Coffee break
16:30 - 17:30	Virus traps and other molecular machines of the future Prof. Hendrik Dietz (University of München - Germany)
Evening	Social event: Dinner in the historical centre of Dresden

Wednesday
NOV. 3
Dresden & online

PROTEIN ACTUATORS, MODERN PUBLISHING, DISCUSSION

▶▶▶ Programme

08:45 - 09:00	Registration
	Session 3: Protein Actuators
09:00 - 10:00	Engineering motor proteins to recognize DNA codes for programmable transport on DNA nanotubes - Ken'ya Furuta (Japanese Institute of Information & Communications Technology)
10:00 - 11:00	Towards autonomous, artificial protein motors Prof. Heiner Linke (Lund University - Sweden)
11:00 - 11:30	Coffee break
11:30 - 12:30	Synthetic genetics and evolutionary engineering Phil Holliger, MRC Laboratory of Molecular Biology, Cambridge - UK
12:30 - 14:00	Lunch break
14:00 - 15:00	Rational and computational de novo design of dynamic peptide and protein assemblies Dek Woolfson (University of Bristol - UK)
	Session 4: Modern publishing
15:00 - 16:00	Current trends and future perspectives on publishing scientific results Dr. Neville Compton (Wiley-VCH - Germany)
16:00 - 16:30	Coffee break
	Session 3 bis: Protein Actuators
16:30 - 17:30	Engineering cytoskeletal motors Zev Bryant (Stanford University - USA)
	Session 5: Discussion & wrap-up
17:30 - 18:15	Podium discussion

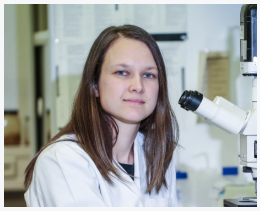
NOV. 2, 2021- DETAILED PROGRAMME -

08:30 - 08:55	**REGISTRATION**
08:55 - 09:00	**OPENING**

Microrobotics and Motility

09:00 - 10:00 **Biohybrid microrobots: how we put cells to work**

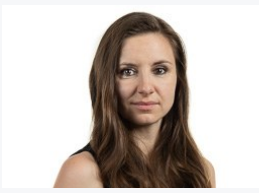
The integration of cells and cellular components with synthetic nanomaterials for the creation of nano-and microrobotic devices is an innovative and rapidly growing field. This lecture will give an overview of the latest developments in nano-and microrobotics, specifically biohybrid robots, and their potential impact in revolutionizing medical interventions



Dr. Veronika Magdanz
IBEC, Institute for Bioengineering of Catalonia – Spain

10:00 - 11:00 **Chemically driven synthetic active systems**

The talk will present a systematic overview on different synthetic systems and principles, that are are used as model systems for active matter. The inspiration in synthetic systems generally comes from nature, but scientists have been creative to design a variety of different driving mechanisms: While the vast majority of examples took benefit of catalytic reactions, there is a number of important approaches, relying on different reaction types, each with specific advantages and disadvantages and distinct consequences for the observed motility.



Dr. Juliane Simmchen
Physical Chemistry, Technische Universität Dresden - Germany

11:00 - 11:30	**COFFEE BREAK**

Dynamic DNA Structures

11:30 - 12:30 **Synthetic cells: De novo assembly with DNA nanotechnology**

The future of manufacturing may entail the construction of biological systems and synthetic cells from the bottom up. Instead of relying exclusively on biological building blocks, the integration of functional DNA-based parts may be a shortcut towards the assembly of active and eventually fully functional synthetic cells. In particular, we demonstrate DNA-based cytoskeleton mimics inside lipid vesicles, which we divide based on physical principles rather than the biological building blocks of a cell's division machinery. In this way, artificial molecular machines may help accelerate synthetic biology research.

Dr. Kerstin Göpfrich
Max Planck Institute for Medical Research, Heidelberg - Germany

12:30 - 14:00 **LUNCH BREAK**

14:00 - 15:00 **Dynamic DNA Networks and Machines and Their Applications**

The topics that will be addressed in the talk includes:

• Introduction of constitutional dynamic DNA networks and transient, out-of-equilibrium networks and their applications (operation of biocatalytic cascades, dynamic transcription/translation processes).

• Introduction of supramolecular DNA machines (tweezers, walkers, catenanes), reconfigurable origami nanostructures, and reversible unlocking/locking of nanoholes in origami frameworks

• Dynamic intercommunication of nucleic acid-based protocells. Controlling biocatalytic transformations in the protocells, including enzyme cascades, switchable and gated transcription processes.

Prof. Itamar Willner
Institute of Chemistry, Hebrew University of Jerusalem - Israel

15:00 - 16:00 **On-site visit of B CUBE / Campus tour**

16:00 - 16:30 **COFFEE BREAK**

16:30 - 17:30 **Virus traps and other molecular machines of the future**

The talk will cover recent advances with:

- programmable DNA blocks self-assemble into icosahedral shells with specific geometry and apertures that can encapsulate and neutralize viruses.
- controlling the movement of nanoscale assemblies, as illustrated with micrometer long hollow DNA filaments through with DNA pistons move with micrometer-per-second speeds, and with reciprocating rotary mechanism with coordinated mobility control.
- autonomous, power-generating rotary DNA motors.

Prof. Hendrik Dietz
Physics Department, Technische Universität München - Germany

Evening **SOCIAL EVENT - Dinner in the historical centre of Dresden**

NOV. 3, 2021- DETAILED PROGRAMME -

08:45 - 09:00 **REGISTRATION**

Protein Actuators

09:00 - 10:00 **Engineering motor proteins to recognize DNA codes for programmable transport on DNA nanotubes**

Here, we developed protein-based motors that efficiently move on DNA nanotubes by combining a motor protein and DNA-binding proteins. We achieved flexible arrangement of binding sites, local control of directionality, and multiplexed cargo transport by different motors. These technologies were combined to realize a molecular cargo sorter and integrator that automatically transport two different cargos as programmed in DNA sequences on a branched DNA nanotube.

Dr. Ken'ya Furuta
National Institute of Information and Communications Technology - Japan

10:00 - 11:00 **Towards autonomous, artificial protein motors**

Fantastic progress has been made in the field of artificial molecular motors using the tools of supramolecular chemistry and DNA nanotechnology. However, Nature's choice of building material for molecular machines are proteins. I will report on the status of a decade-old effort to create artificial motor proteins, and on our thought son how to reach the aim of an autonomous protein motor built from non-motor parts.

Reference: H. Linke, B. Höcker, K. Furuta, N. Forde and P. Curmi, Biophys Rev. 12 1041 (2020)
https://link.springer.com/article/10.1007/s12551-020-00717-1

Prof. Heiner Linke
Center for Nanoscience, Lund University - Sweden

11:00 - 11:30 **COFFEE BREAK**

11:30 - 12:30 **Synthetic genetics and evolutionary engineering**

Synthetic biology seeks to probe fundamental aspects of biological form and function by construction (i.e. resynthesis) rather than deconstruction (analysis). Synthesis thus complements reductionist and analytic studies of life, and allows novel approaches towards fundamental biological questions.
We have been exploiting the synthesis paradigm to explore the chemical etiology of the genetic apparatus shared by all life on earth. I will present recent progress in the development and application of strategies to enable the replication and evolution of synthetic genetic polymers not found in nature, which we term XNAs. Furthermore, I will present our progress in the engineering and evolution of RNA polymerase ribozymes towards self-replication.

Dr. Philippe Holliger
MRC Laboratory of Molecular Biology, Cambridge - UK

12:30 - 14:00 **LUNCH BREAK**

14:00 - 15:00 **Rational and computational de novo design of dynamic peptide and protein assemblies**

Protein design—i.e., the construction of entirely new protein sequences that fold into prescribed structures—has come of age: it is now possible to generate a wide variety stable protein folds from scratch using rational and/or computational approaches. A new challenge for the field is to move past protein structures offered up by nature and to target the so-called 'dark matter of protein space'; that is, protein structures that should be possible in terms of chemistry and physics, but which biology seems to have overlooked or not used prolifically. This talk will illustrate what is currently possible in this nascent field using de novo a-helical coiled-coil peptides as building blocks.

Prof. Dek Woolfson
University of Bristol – UK

Modern publishing

15:00 - 16:00 **Current trends and future perspectives on publishing scientific results**

The requirements of researchers are not only to do excellent research but to get that work published in top peer-reviewed journals that can best reach the communities of interest to further the field. This talk will discuss the current role of journals and publishers in this regard as well as move towards facilitating more open research and collaborations for the benefit of all.

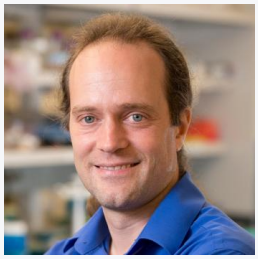
Dr. Neville Compton
Executive Editor, Wiley-VCH - Germany

16:00 - 16:30 **COFFEE BREAK**

Protein Actuators

16:30 - 17:30 **Engineering cytoskeletal motors**

Molecular machines lie at the heart of biological processes ranging from DNA replication to cell migration. We use single-molecule tracking and manipulation to characterize the structural dynamics of these nanoscale assemblies, and further challenge our understanding by designing and testing structural variants with novel properties that expand the functional range of known biomolecular machines. In the process, we are developing an engineering capacity for molecular motors with tunable and dynamically controllable physical properties, providing a toolkit for precise perturbations of mechanical functions. We have recently developed a new generation of light-responsive cytoskeletal motors, enabling precise control of fast and processive molecular transport in vitro and in living cells. I will describe our ongoing efforts to augment and diversify engineered cytoskeletal motors, along with applications in cells and in reconstituted systems.



Prof. Zev Bryant
Bioengineering Department, Stanford University – USA

Discussion

17:30 - 18:15	Podium Discussion
18:15	Conclusion

ArtMoMa

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This workshop takes place in the frame of the first ArtMoMa Autumn School. ArtMoMa is an Innovative Training Network funded by the European Union's Horizon 2020 research and innovation programme - Marie Skłodowska-Curie Actions (grant agreement No 860434).