Constructing and powering nanoscale DNA origami motors

Fact Sheet

Project Information

DNA ORIGAMI MOTORS

Grant agreement ID: 724261

Project website

DOI
10.3030/724261

Project closed

EC signature date
4 April 2017

Start date
1 May 2017

End date
30 April 2022

Funded under
EXCELLENT SCIENCE - European Research Council (ERC)

Total cost
€ 2 000 000,00

EU contribution
€ 2 000 000,00

Coordinated by
TECHNISCHE UNIVERSITAET MUENCHEN
Germany

Objective

Our goal is to advance the field of DNA nanotechnology by achieving directed transport on the nanoscale using robustly functioning synthetic motor units. To do so, we propose to construct spatially periodic, diffusive mechanisms that have broken inversion symmetry and to subject these mechanisms to conditions away from thermal equilibrium. We will build on recent progress in creating complex DNA-based structures and construct various nanoscale rotary and translational Brownian ratchet mechanisms that have well- defined degrees of freedom for motion within periodic and asymmetric energy landscapes. The mechanisms will be self-assembled from DNA origami components. We will use cryo-Transmission Electron Microscopy

(TEM) to evaluate and iteratively refine our structures. Conventional video-rate fluorescence microscopy, in addition to super-resolution microscopy, will be employed to study in solution and in real time the diffusive motion of the mechanisms on the single particle level. We will introduce various deterministic or stochastic thermal, mechanical, or chemical perturbations to drive the systems away from thermal equilibrium. We will use laser heating and cooling to experimentally test thermal and flashing ratcheting mechanisms; we will employ dissipative asymmetric fluxes arising in active matter as realized in high-density ATP-hydrolysing motility assays; and we will couple out-of-equilibrium chemical reactions to the motion of our mechanisms. The ultimate goal of our work is to take insights from these experiments and create robustly functioning nanoscale motor units that can drive directed motion against external load and perform at levels comparable to those of natural macromolecular motor proteins. Achieving this goal will create unprecedented technological opportunities, for example, to drive chemical synthesis, actively propel nanoscale drug- delivery vehicles, pump and separate molecules across barriers or package molecules into cargo components.

Fields of science (EuroSciVoc)

natural sciences > biological sciences > genetics > **DNA**

natural sciences > physical sciences > optics > microscopy > **super resolution microscopy**

natural sciences > physical sciences > optics > microscopy > **electron microscopy**

natural sciences > **chemical sciences**

natural sciences > physical sciences > optics > **laser physics**

Programme(s)

H2020-EU.1.1. - EXCELLENT SCIENCE - European Research Council (ERC) MAIN PROGRAMME

Topic(s)

ERC-2016-COG - ERC Consolidator Grant

Call for proposal

ERC-2016-COG

See other projects for this call

Funding Scheme

ERC-COG - Consolidator Grant

Host institution

TECHNISCHE UNIVERSITAET MUENCHEN

Net EU contribution

€ 2 000 000,00

Total cost

€ 2 000 000,00

Address

Arcisstrasse 21
80333 Muenchen
Germany

Region

Bayern > Oberbayern > München, Kreisfreie Stadt

Activity type

Higher or Secondary Education Establishments

Links

Contact the organisation Website
Participation in EU R&I programmes
HORIZON collaboration network

Beneficiaries (1)

TECHNISCHE UNIVERSITAET MUENCHEN

Germany

Net EU contribution

€ 2 000 000,00

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Last update: 10 March 2023

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