

DIOSCURI
CENTRE FOR
SINGLE-MOLECULE OPTICS



Barbora Špačková

Department of Optical and Biophysical Systems
Institute of Physics of the Czech Academy of Sciences



MAX-PLANCK-GESELLSCHAFT



Bundesministerium
für Bildung
und Forschung



MINISTERSTVO ŠKOLSTVÍ
MLÁDEŽE A TĚLOVÝCHOVY



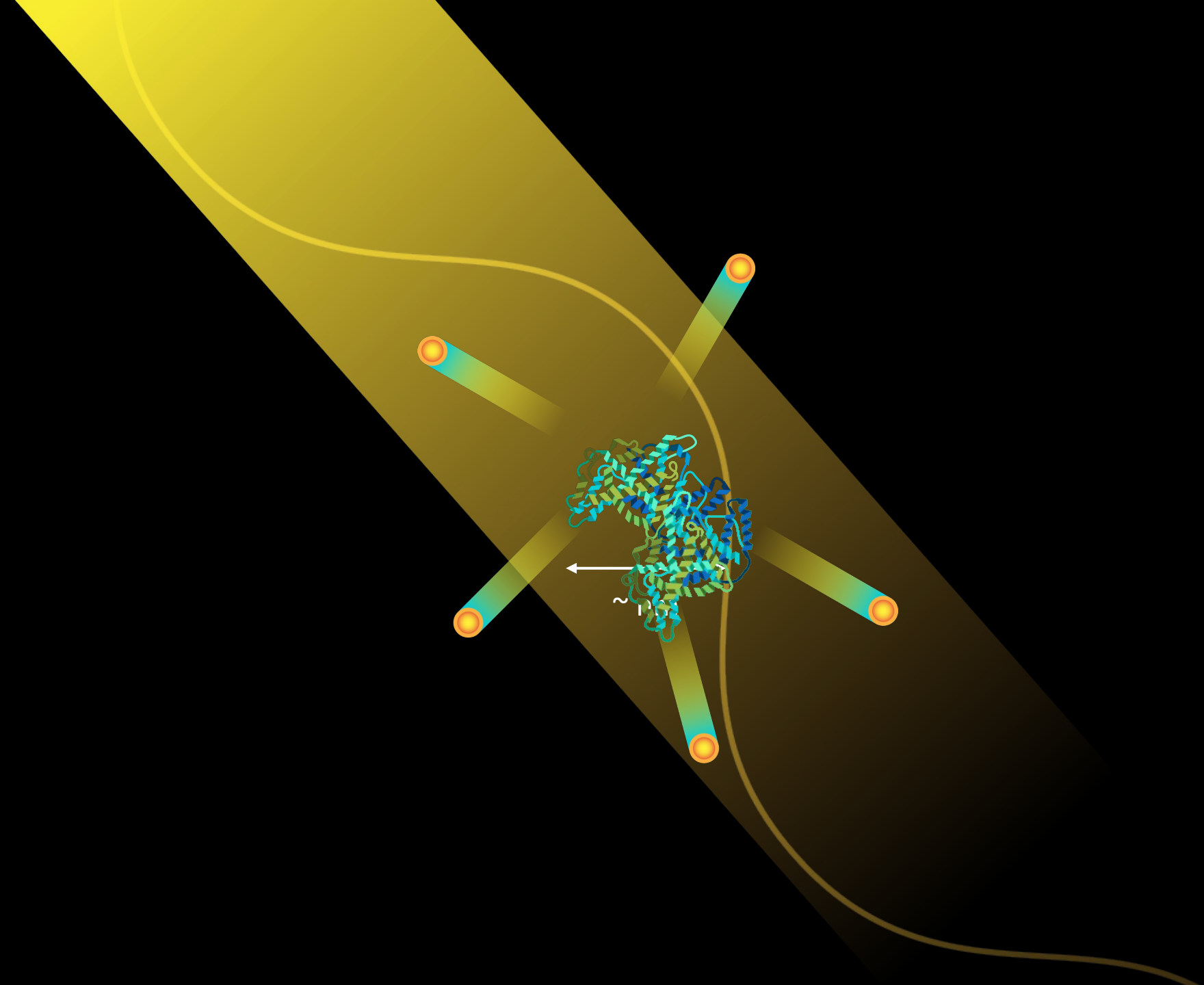
FZU

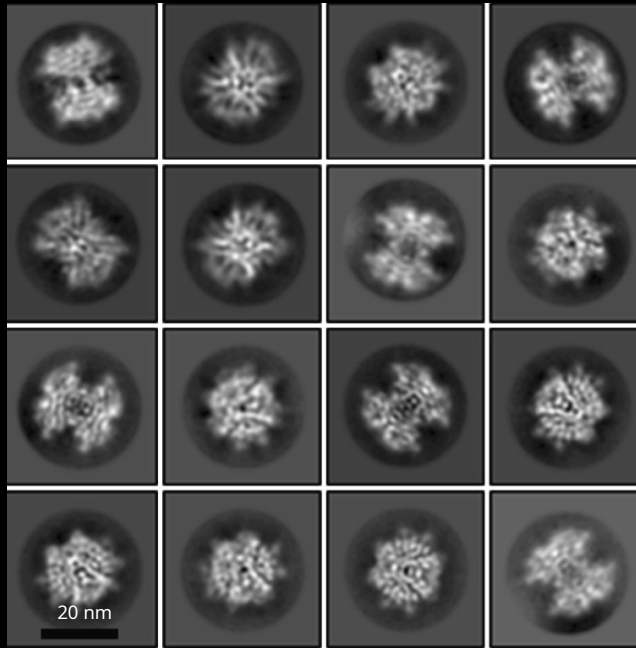
Institute of Physics
of the Czech
Academy of Sciences

It is very easy to answer many of
these fundamental biological
questions;

you just look at the thing!

Richard P. Feynman: *There is Plenty of Room at the Bottom*, 1959

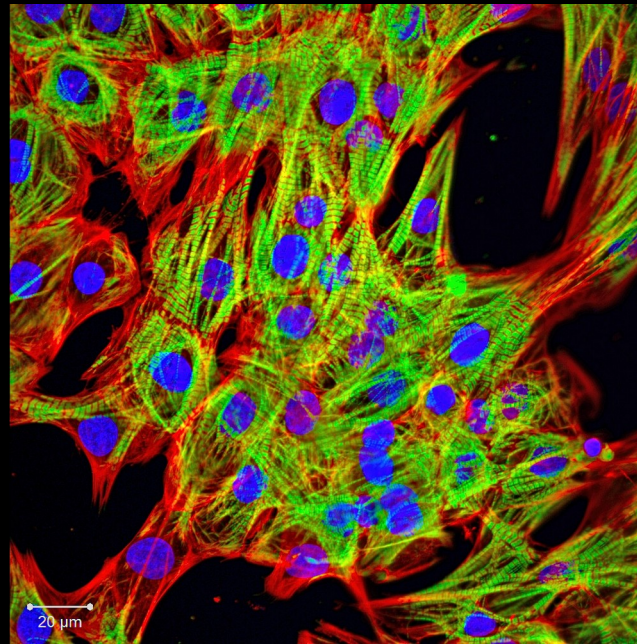




Electron Microscopy



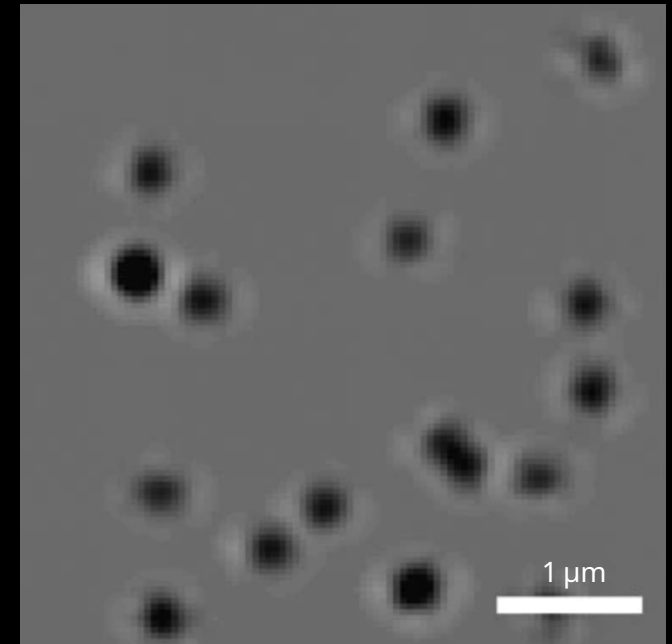
1931



Single-molecule Fluorescence
Microscopy



1985



Interferometric microscopy
(iSCAT)

2014

DIOSCURI
CENTRE FOR
SINGLE-MOLECULE OPTICS



Goals



Develop a unique single-molecule microscopy technique for quantitative studies of molecular properties, interactions, and dynamics under native conditions.



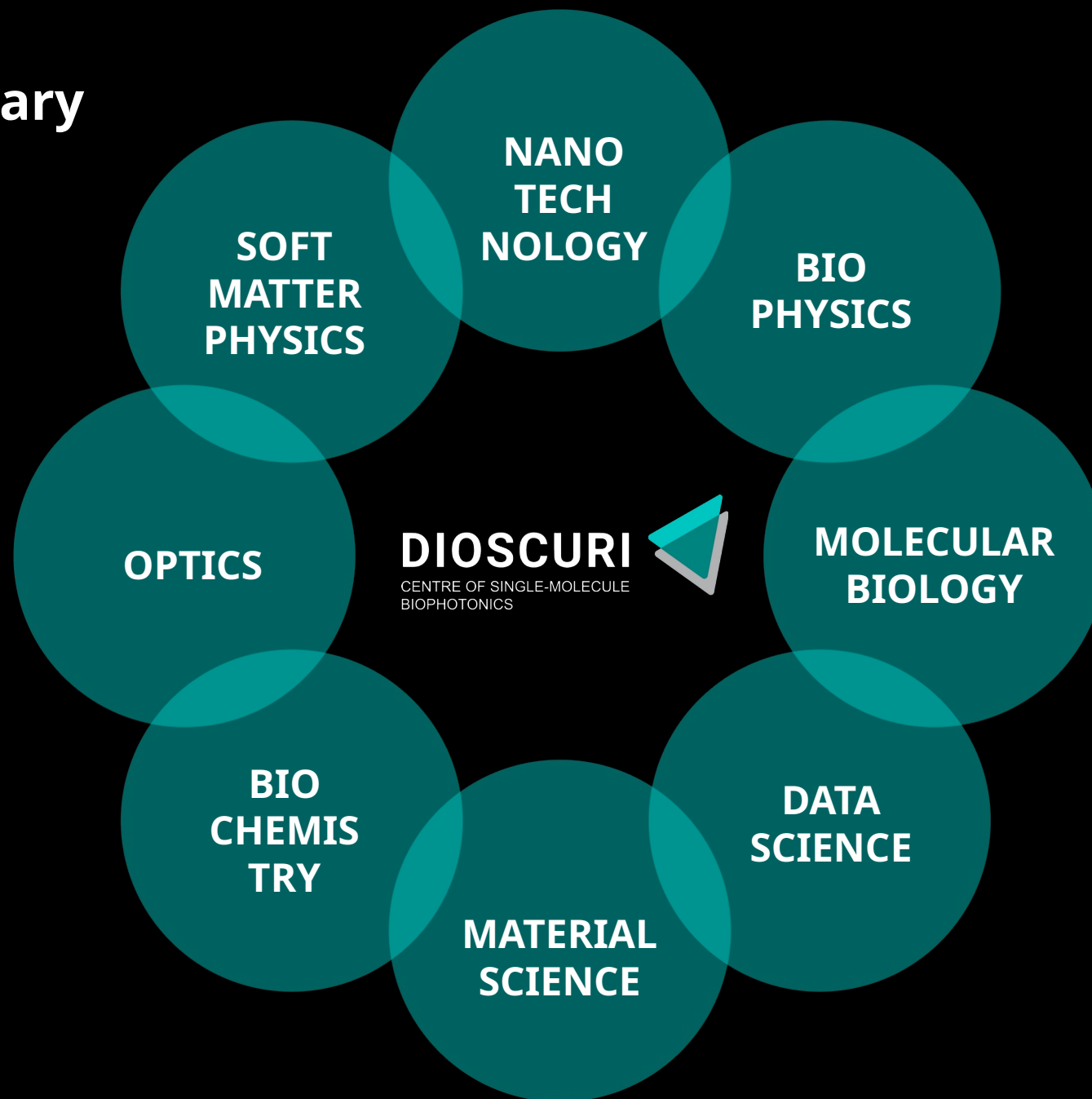
Make key contributions to the fundamental understanding of single-molecule processes.



Inspire novel strategies

- early diagnosis
- therapeutic intervention
- novel biotechnologies mimicking nature

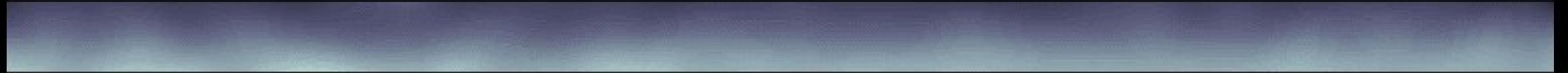
Interdisciplinary research



Nanofluidic Scattering Microscopy

1 μm

Thyroglobulin





FZU

Institute of Physics
of the Czech
Academy of Sciences



Division of
Optics

Division of
Elementary
Particle Physics

Division of
Condensed
Matter Physics

Division of Solid
State Physics

Division of High
Power Systems
HiLase Centre

Optical and Biophysical
Systems

Low-Temperature
Plasma

Analysis of Functional
Materials

Joint Laboratory of
Optics

DIOSCURI
CENTRE FOR
SINGLE-MOLECULE OPTICS





Barbora Špačková
Team leader



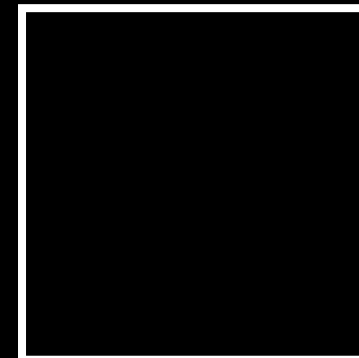
Edita Poláchová
Project coordinator



**Evangelos
Efremidis**
PhD student



Taha Nasir
PhD student



PhD student

**Adéla
Potužníková**
Bc student

Čeněk Potužník
High-school
student



Tereza Roesel
Postdoc
(maternity leave)



**Miroslav
Hekrdla**
Postdoc



**Alberto
Ascencio**
Postdoc



Yulia Yancheva
Postdoc
(starting Feb 2026)



Anastasiia Skvortsova
Postdoc
(starting Oct 2025)

Prof. Stefan Diez

DC partner

- Expertise in optical techniques for investigation molecular transport in cell biology and nanotechnology
- Collaboration in research projects
- Mentoring
- Exchange of PhD students and postdocs
- Organisation of workshops/conferences



Collaborations

FZU

J. Dostálek, Laboratory of Biophotonics

H. Lísalová, Laboratory of Functional Biointerfaces

National

M. Piliarik, Institute of Photonics and Electronics, CAS

M. Hof, J. Heyrovsky Institute of Physical Chemistry, CAS

V. Petráková, J. Heyrovsky Institute of Physical Chemistry, CAS

International

G. Volpe, University of Gotheburg, Sweden

M. Estrader, Universitat de Barcelona, Spain

S. Schrittwieser, AIT, Austria

G. Kaminski Schierle, University of Cambridge, UK

Science popularization

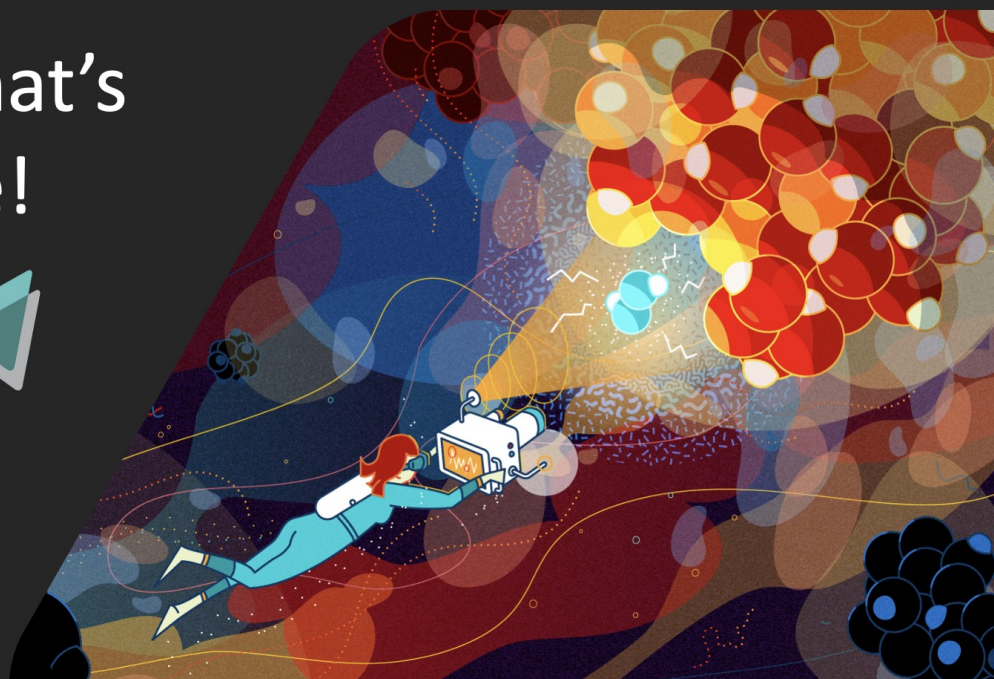
Science fair / Prague / 5. – 7.6.2025

- organised by the Czech Academy of Sciences every year
- largest popular science event in the Czech Republic



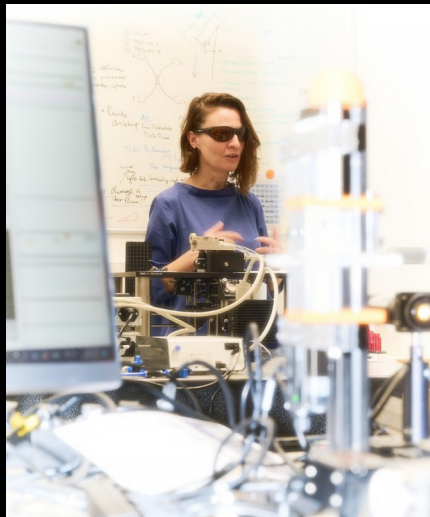
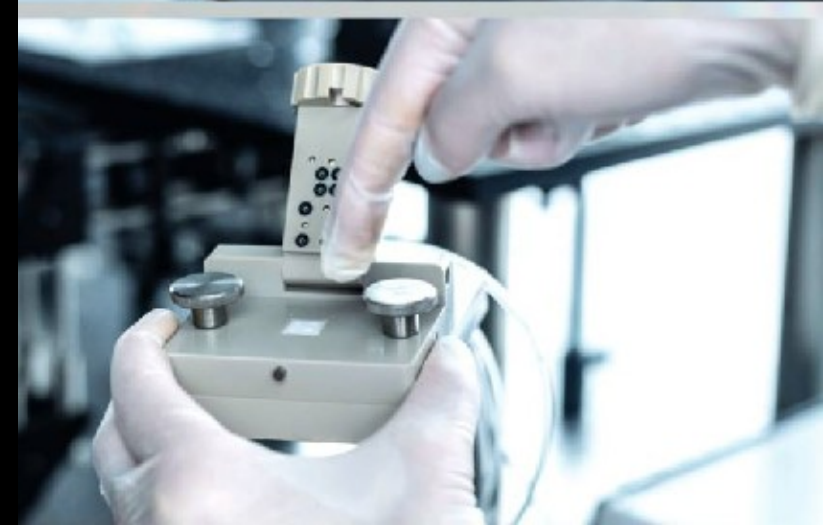
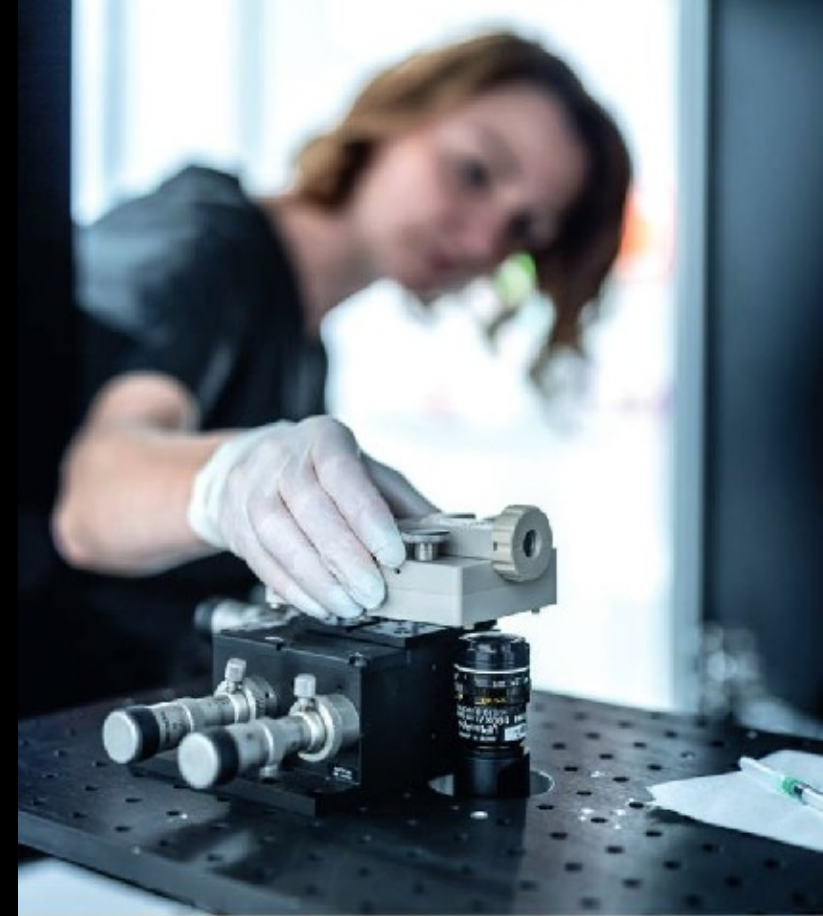
We see what's
invisible!

DIOSCURI
CENTRE FOR
SINGLE-MOLECULE OPTICS



Media attention

- **WIRED:** *In the biological nanoverse*
- **Physics World:** *Peering inside the biological nano-universe*
- **Věda a Výzkum:** *From spin calorimetry to a patent for a microscopic method*
- **A / Magazine:** *Illuminating the invisible*
- **Forbes:** *They didn't believe it would work*
- **TV channel Nova:** *V hlavní roli mozek*
- **Forbes:** *Top 10 female scientists in Czechia for 2024*



Funding

2024 – 2029 **Dioscuri Programme**

BMBF, MEYS

1.625 M€

2024 – 2029 **Johannes Amos Comenius Programme / SENDISO**

The Ministry of Education, Youth and Sports

290 k€

2025 – 2029 **EIC Pathfinder / Watersense**

EU-Horizon Europe

310 k€

2025 – 2026 **M. Skłodowska-Curie Postdoctoral Fellowship (T. Roesel)**

EU-Horizon Europe

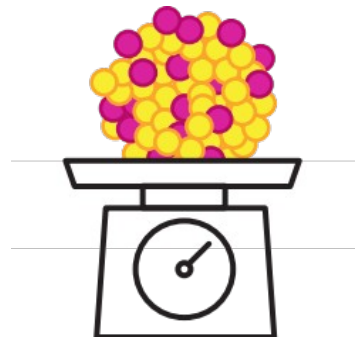
166 k€

Key milestones, July 2024 – August 2025

Lab Infrastructure Established

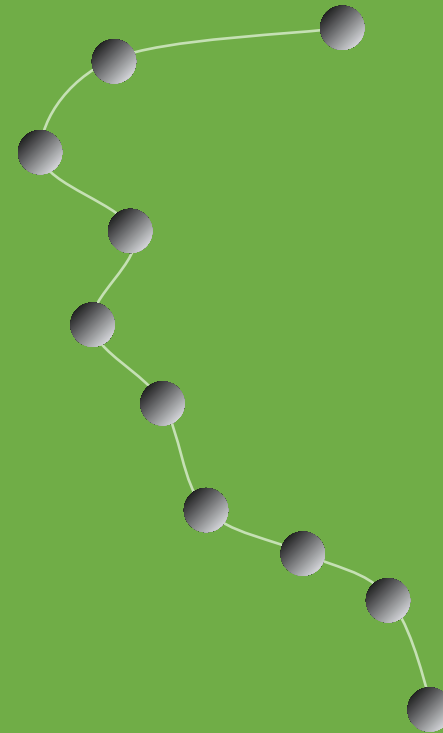


High-Resolution Single-molecule Mass-Spectrometry



T. Roesel, et al.: *From photons to Daltons - a leap in molecular mass precision* (in preparation)

Next-Gen Particle Tracking Algorithm



M. Hekrdla, et al.: *Track-before-detect algorithm for single-molecule sensing* (in preparation)

Single-Molecule Reviews

Volpe G; et al.: *Roadmap for Deep Learning for Microscopy*, JPhys: Photonics (accepted)

T. Roesel, et al.: *Label-free single-molecule optical detection*, npt Biosensing (accepted)

Thank you!



<http://dioscuri-one.com/>