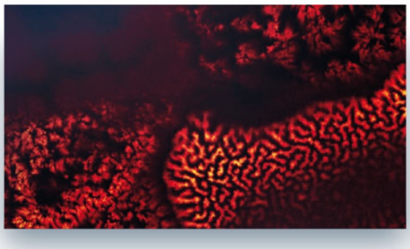


Actin in microvilli of Caco2 cells. Prof. Dorothee Günzel & Roman Mannweiler

Science beyond barriers

abberior Instruments GmbH
Hans-Adolf-Krebs-Weg 1
37077 Göttingen
+49 551 9995 4010

www.abberior.rocks
Media inquiries: m.reuss@abberior.rocks

FOR IMMEDIATE RELEASE March 10, 2023

Microscope observes motor proteins stepping along in living cells

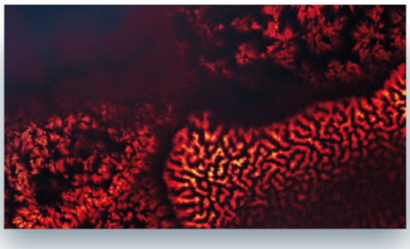
For the first time, the precise motion of the motor protein kinesin-1 as it walks on microtubules in living cells was measured by researchers from *abberior*, the European Molecular Biology Laboratory (EMBL), and Utrecht University.

Kinesin belongs to a class of motor proteins that transport large cargo to their required destinations in the cell. It can be pictured as a small molecule with two legs, which it uses to literally walk along microtubule-tracks inside the cell. Motor proteins are essential for many processes required for life, and consequently there is a huge interest in understanding their exact function and dynamics.

In the past however, the dynamics of kinesin on microtubules could not be studied under physiological conditions inside living cells. First, its individual steps are only a few nanometers long – far less than what conventional light microscopes can resolve. Second, they move so fast that no tracking technique could follow. The single molecule fluorescence tags used to label the motor proteins were simply too dim to provide reliable information on the spatial and temporal scales required here.

In a study now published in *Science*, Deguchi at al. used a superresolution microscopy technology called MINFLUX to investigate kinesin under physiological conditions. MINFLUX (MINimal photon FLUXes) was first published in 2017 by Nobel Laureate Stefan W. Hell and colleagues. It uses the limited photon budget of single fluorescent molecules much more efficiently than conventional techniques. In short, MINFLUX finds the exact position of a fluorescent molecule by actively aligning the central intensity null of a donut-shaped excitation beam onto it, until fluorescence emission is down to zero. In this case, every further photon that is *not* emitted is very useful, because it increases the confidence that the molecule is indeed located exactly at the position of zero intensity. The idea that photons that have never been emitted can carry positional information is the breakthrough concept behind MINFLUX. Once you wrap your head around it, it allows to localize and track single fluorescent molecules attached to e.g. kinesin, with unprecedented nanometer spatial precision and submillisecond temporal precision.

Using a commercial MINFLUX system provided by *abberior*, Deguchi at al. visualized the dynamics of a motor protein for the first time in living cells with a sufficiently small, non-disturbing label, yet a label that could be accurately tracked, thanks to MINFLUX.



Actin in microvilli of Caco2 cells. Prof. Dorothee Günzel & Roman Manweiler

This allowed them to study motor proteins in near physiological conditions, i.e., in an environment that is much closer than before to what happens in living organisms. In the next stage, this paves the way for investigating how stepping behavior is altered by changes of kinesin's natural environment, e.g. by the presence or absence of cargo or various microtubule-associated proteins, or under certain medical conditions.

Paul Selvin from the University of Illinois Urbana-Champaign, who published the first groundbreaking work on how kinesin walks on microtubules almost 20 years ago, says "This is a fantastic paper with beautiful data." Christian Wurm, Head of Application at *abberior* adds: "The publication by Deguchi and colleagues is a prime example, where the unprecedented speed and accuracy of MINFLUX enabled researchers to make breakthrough discoveries. We expect this to be only one of many studies of this type."

A similar study was concurrently published by Wolff et al., also in *Science.* Here, an optimized MINFLUX-setup with even higher precision was used. This enabled Wolff and colleagues, including personnel now at *abberior*, to observe smaller sub-steps and rotational movement of kinesin in vitro under physiological buffer conditions.

Ultimately, these findings are not limited to kinesin or motor proteins. MINFLUX opens the possibility to quantitatively record the precise structure and dynamics of molecular machinery in living cells, in general. This will provide significant insight into many processes that are essential to living systems, with the potential to better understand defects and diseases.

Selected references:

- T. Deguchi et al., *Science* 379, 1010 (2023)
- J. O. Wolff et al., *Science* 379, 1004 (2023)
- F. Balzarotti et al., Science 355, 606 (2017)
- R. Schmidt et al., *Nat. Commun.* 12, 1478 (2021)

About *abberior*

abberior Instruments GmbH was founded as a spin-off of Nobel laureate Prof. Stefan W. Hell's research group at the Max Planck Institute in Göttingen, Germany. Besides Stefan Hell, all founding members and decision makers are senior scientists and have shaped the field of optical super resolution over decades. *abberior* is a leading innovator, developer and manufacturer of modern superresolution STED and proprietary MINFLUX microscopes, which allow unique applications in cell and molecular biology. Numerous awards, including the TOP100 Innovation Award 2021, the Innovation Award of German Science and the Focus Growth Champion 2019, underline the success.