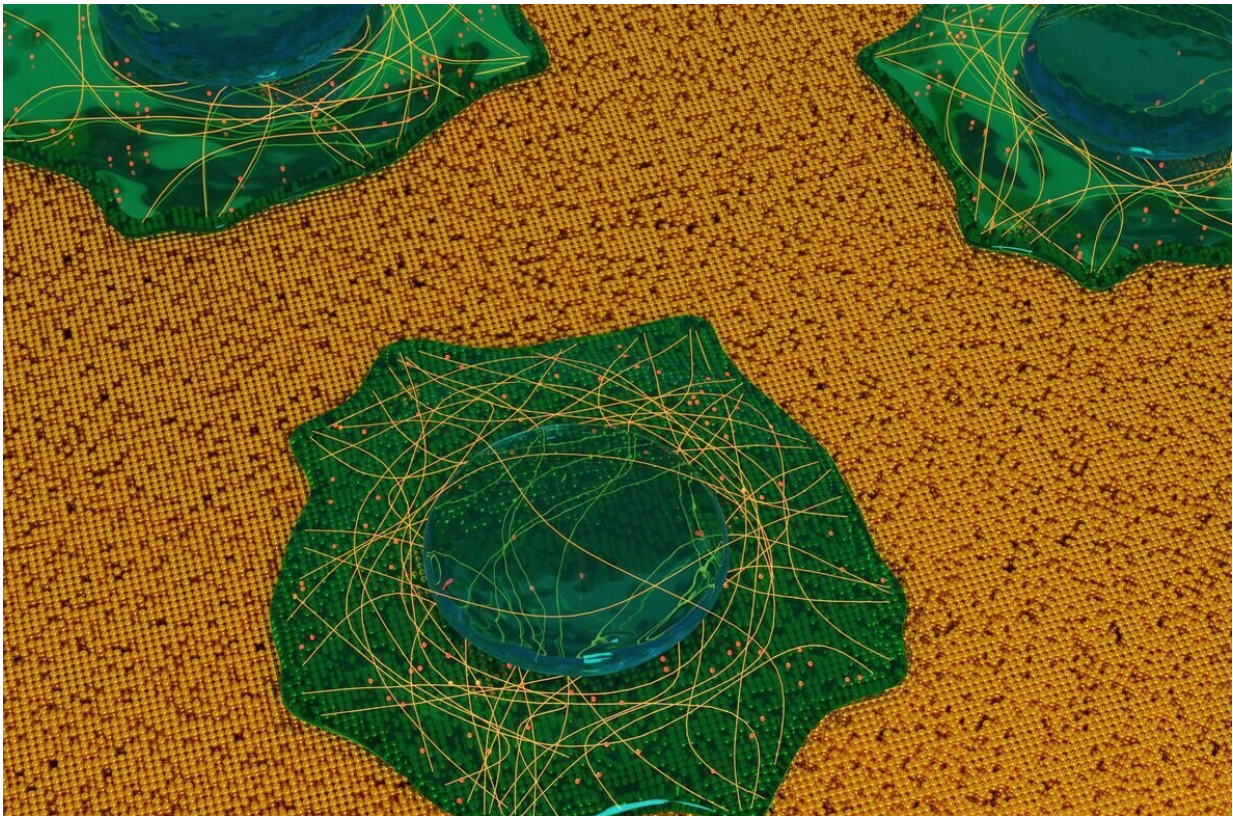


Microscopy technique enables 3D super-resolution nanometer-scale imaging

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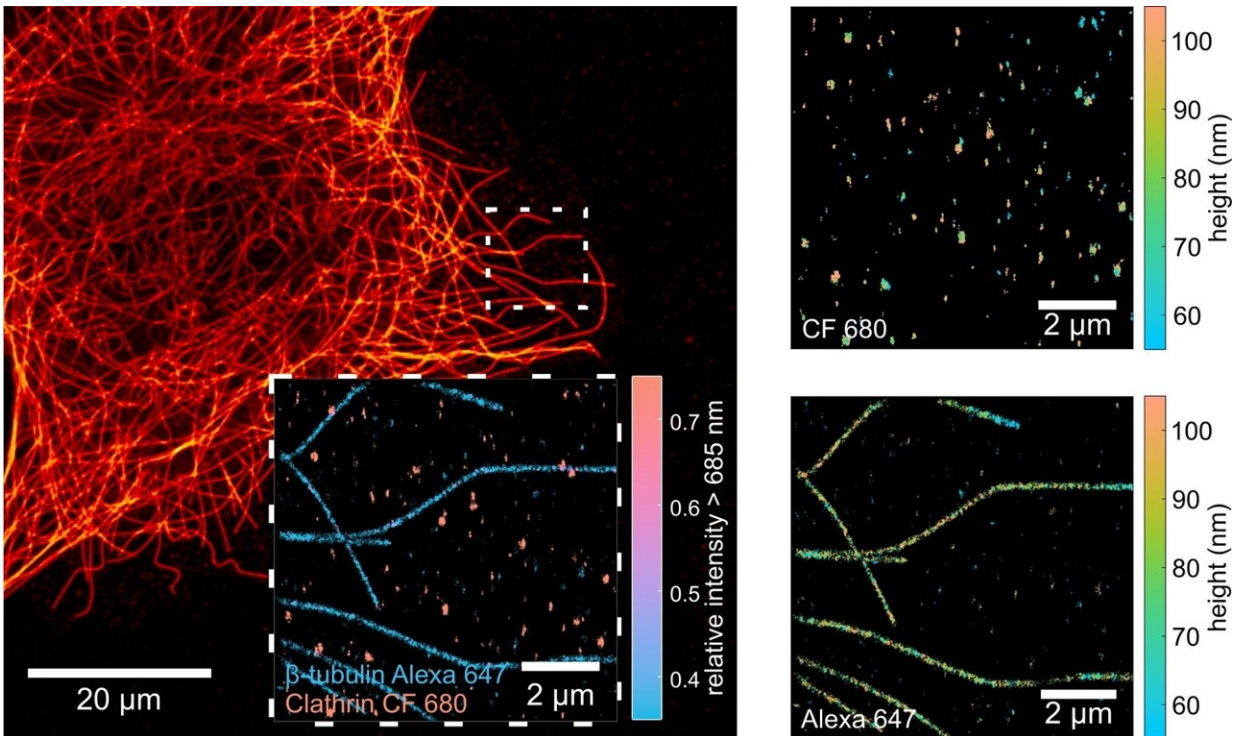
To show that 3D imaging with MIET-SMLM is compatible with biological samples, cells were seeded on a cover glass coated with 10 nm of gold and 5 nm of SiO₂ using standard immunofluorescence sample preparation procedure. The artistic rendering illustrates cells imaging on a gold surface resolving microtubules network and clathrin coated pits. Credit: Alexey Chizhik

Over the last two decades, microscopy has seen unprecedented advances in speed and resolution. However, cellular structures are essentially three-dimensional, and conventional super-resolution techniques often lack the necessary resolution in all three directions to capture details at a nanometer scale. A research team led by Göttingen University, including the University of Würzburg and the Center for Cancer Research in the U.S., investigated a super-resolution imaging technique that involves combining the advantages of two different methods to achieve the same resolution in all three dimensions; this is isotropic resolution. The results were published in *Science Advances*.

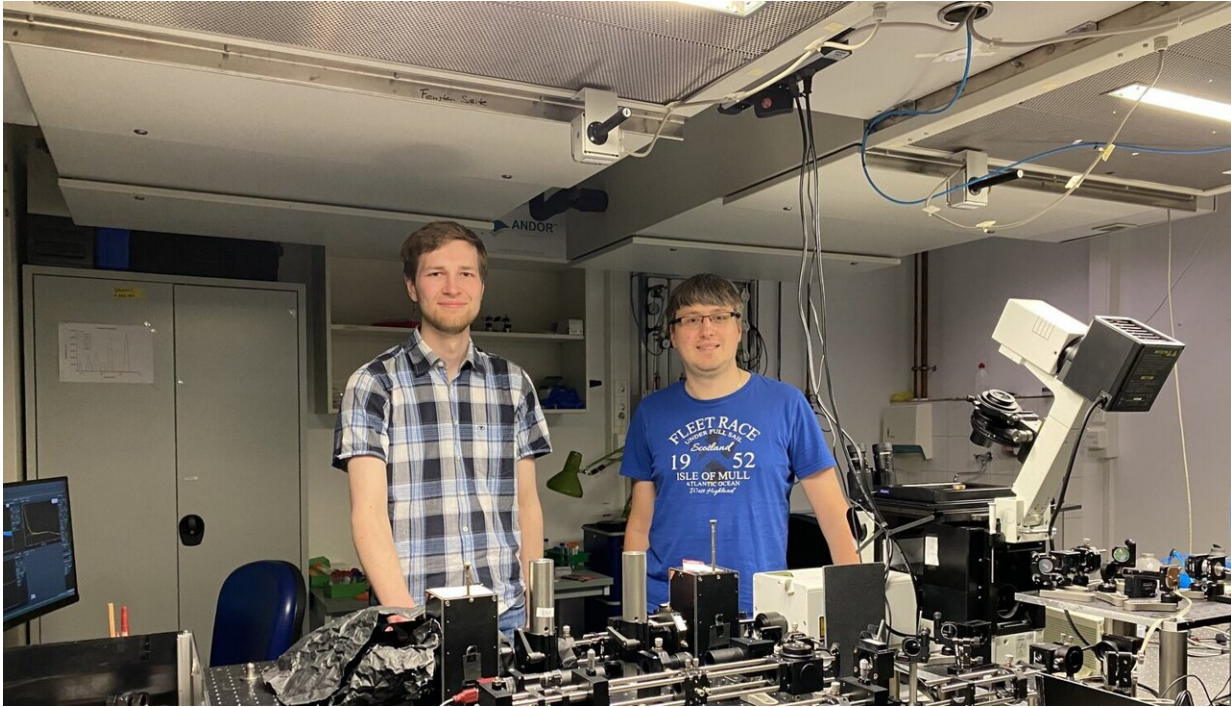
Despite tremendous improvements in microscopy, there still exists a remarkable gap between [resolution](#) in all three dimensions. One of the methods that can close this gap and achieves a resolution in the nanometer range is metal-induced [energy transfer](#) (MIET) imaging. The exceptional depth resolution of MIET imaging was combined with the extraordinary lateral resolution of single-molecule localization microscopy, in particular with a method called direct stochastic optical reconstruction microscopy (dSTORM). The [novel technique](#) based on this combination allows researchers to achieve isotropic three-dimensional super-resolution imaging of sub-[cellular structures](#). In addition, the researchers implement dual-color MIET-dSTORM enabling them to image two different cellular structures in three dimensions, for example microtubules and clathrin coated pits—tiny structures within cells—that exist together in the same area.

"By combining the established concepts, we developed a new technique for super-resolution microscopy. Its main advantage is it enables extremely high resolution in three dimensions, despite using a relatively simple setup," says Dr. Jan Christoph Thiele, first author of the publication, Göttingen University. "This will be a powerful tool with numerous applications to resolve protein complexes and small organelles with sub-nanometer accuracy. Everyone who has access to confocal

microscope technology with a fast laser scanner and fluorescence lifetime measurements capabilities should try this technique," says Dr. Oleksii Nevskyi, one of the corresponding authors.



MIET-SMLM imaging of microtubules and clathrin pits in COS7 cells. Spectral splitting (inset) allows to efficiently distinguish between two different targets and MIET imaging (right panel) gives height profiles with exceptionally high resolution. Credit: University of Göttingen



Two of the researchers involved in this paper: Dr Christoph Thiele and Dr Oleksii Nevskiy. Credit: Oleksii Nevskiy

"The beauty of the technique is its simplicity. This means that researchers around the world will be able to implement the technology into their microscopes quickly," adds Professor Jörg Enderlein who led the research team at the Biophysics Institute, Göttingen University. This method shows promise to become a powerful tool for multiplexed 3D super-resolution [microscopy](#) with extraordinary high resolution and a variety of applications in structural biology.

More information: Jan Christoph Thiele et al, Isotropic three-dimensional dual-color super-resolution microscopy with metal-induced energy transfer, *Science Advances* (2022). [DOI: 10.1126/sciadv.abo2506](https://doi.org/10.1126/sciadv.abo2506)

Provided by University of Göttingen

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