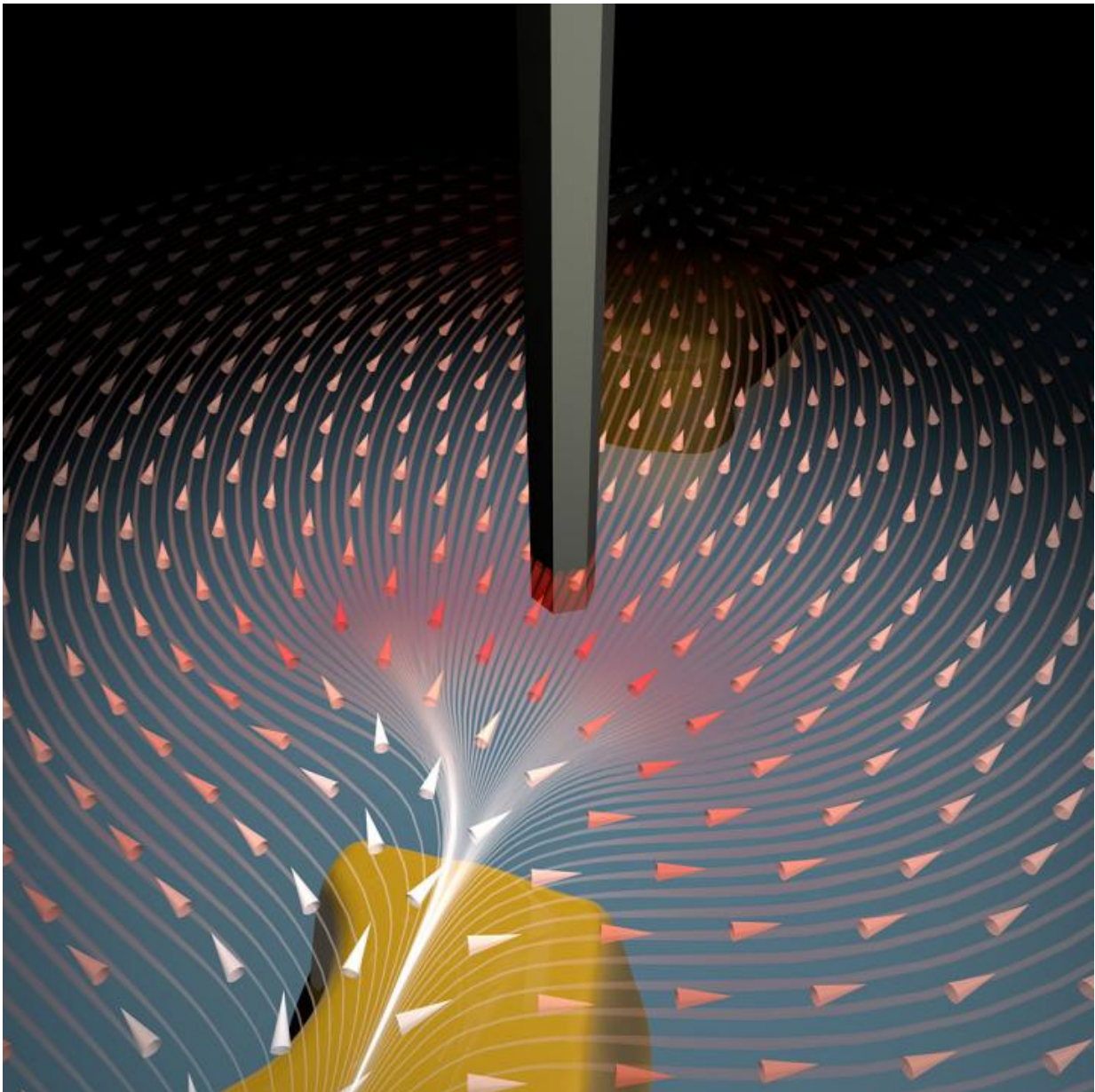


Nanowires as sensors in new type of atomic force microscope

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A nanowire sensor measures size and direction of forces. Credit: University of Basel, Department of Physics

A new type of atomic force microscope (AFM) uses nanowires as tiny sensors. Unlike standard AFM, the device with a nanowire sensor enables measurements of both the size and direction of forces. Physicists at the University of Basel and at the EPF Lausanne have described these results in the recent issue of *Nature Nanotechnology*.

Nanowires are extremely tiny filamentary crystals which are built-up molecule by molecule from various materials and which are now being very actively studied by scientists all around the world because of their exceptional properties.

The wires normally have a diameter of 100 nanometers and therefore possess only about one thousandth of a hair thickness. Because of this tiny dimension, they have a very large surface in comparison to their volume. This fact, their small mass and flawless crystal lattice make them very attractive in a variety of nanometer-scale sensing applications, including as sensors of biological and chemical samples, and as pressure or charge sensors.

Measurement of direction and size

The team of Argovia Professor Martino Poggio from the Swiss Nanoscience Institute (SNI) and the Department of Physics at the University of Basel has now demonstrated that [nanowires](#) can also be used as force sensors in atomic force microscopes. Based on their special mechanical properties, nanowires vibrate along two perpendicular axes at nearly the same frequency. When they are integrated into an AFM, the researchers can measure changes in the perpendicular vibrations caused

by different forces. Essentially, they use the nanowires like tiny mechanical compasses that point out both the direction and size of the surrounding forces.

Image of the two-dimensional force field

The scientists from Basel describe how they imaged a patterned sample surface using a nanowire sensor. Together with colleagues from the EPF Lausanne, who grew the nanowires, they mapped the two-dimensional force field above the sample surface using their nanowire "compass". As a proof-of-principle, they also mapped out test force fields produced by tiny electrodes.

The most challenging technical aspect of the experiments was the realization of an apparatus that could simultaneously scan a nanowire above a surface and monitor its vibration along two perpendicular directions. With their study, the scientists have demonstrated a new type of AFM that could extend the technique's numerous applications even further.

AFM - today widely used

The development of AFM 30 years ago was honored with the conferment of the Kavli-Prize beginning of September this year. Professor Christoph Gerber of the SNI and Department of Physics at the University of Basel is one of the awardees, who has substantially contributed to the wide use of AFM in different fields, including solid-state physics, materials science, biology, and medicine.

The various different types of AFM are most often carried out using cantilevers made from crystalline Si as the mechanical sensor. "Moving to much smaller nanowire sensors may now allow for even further

improvements on an already amazingly successful technique", Martino Poggio comments his approach.

More information: Nicola Rossi et al, Vectorial scanning force microscopy using a nanowire sensor, *Nature Nanotechnology* (2016).
[DOI: 10.1038/nnano.2016.189](https://doi.org/10.1038/nnano.2016.189)

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