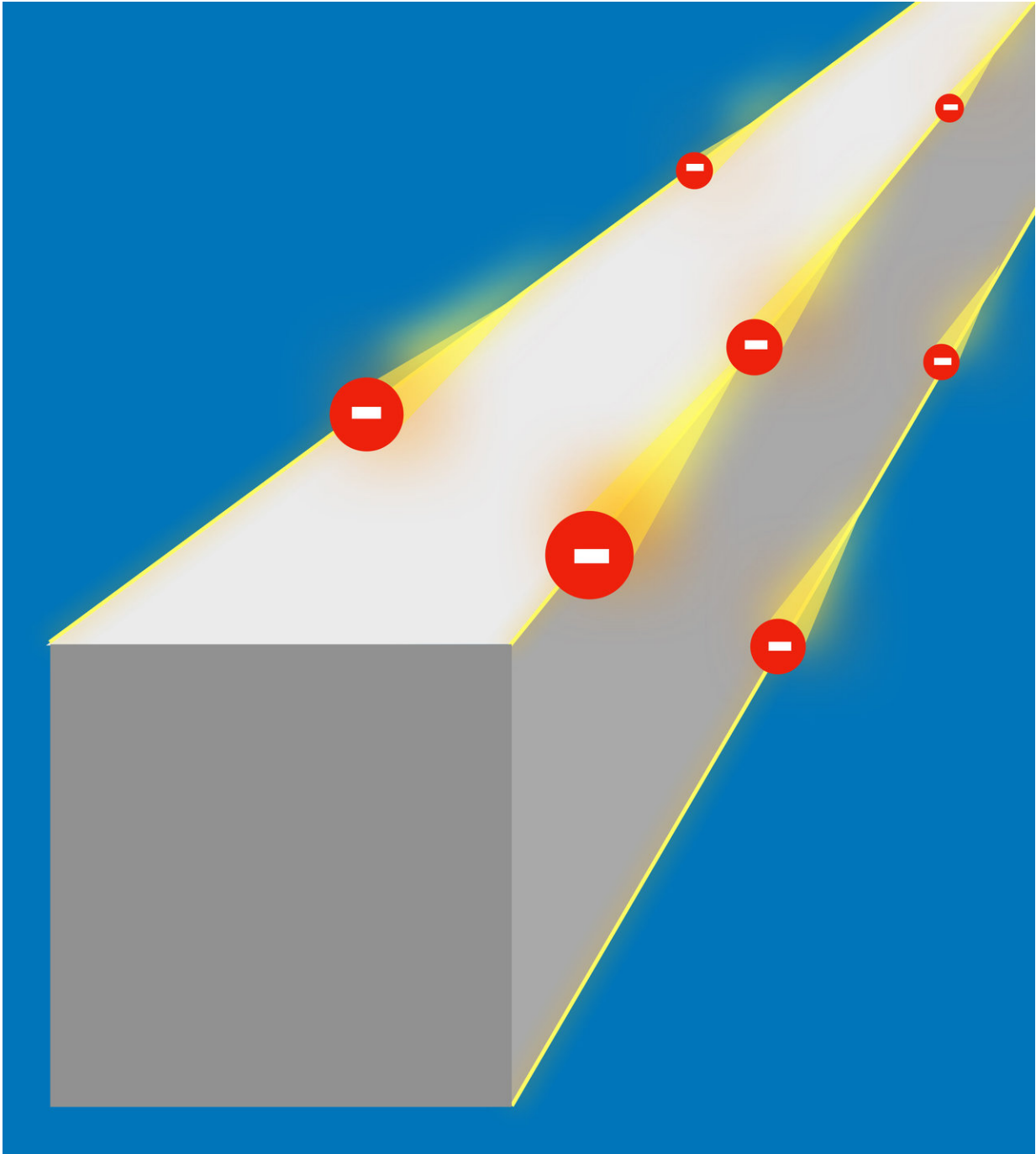


Novel insulators with conducting edges

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Schematic of a higher-order topological insulator in the shape of a nanowire, with conducting channels on its edges. Credit: UZH

Physicists at the University of Zurich are researching a new class of materials: Higher-order topological insulators. The edges of these crystalline solids conduct electric current without dissipation, while the rest of the crystal remains insulating. This could be useful for applications in semiconductor technology and for building quantum computers.

Topology examines the properties of objects and solids that are protected against perturbations and deformations. Materials known so far include topological insulators, which are crystals that insulate on the inside but conduct electrical current on their surface. The conducting surfaces are topologically protected, which means that they cannot easily be brought into an insulating state.

Theoretical physicists at the University of Zurich have now predicted a new class of topological insulators with conducting properties on the edges of crystals rather than on the surface. The research team, made up of scientists from UZH, Princeton University, the Donostia International Physics Center and the Max Planck Institute of Microstructure Physics in Halle, dubbed the new material class "higher-order topological insulators." The extraordinary robustness of the conducting edges makes them particularly interesting: The current of topological electrons cannot be stopped by disorder or impurities. If an imperfection gets in the way of the current, it simply flows around the impurity.

In addition, the crystal edges do not have to be specially prepared to

conduct electrical current. If the crystal breaks, the new edges automatically also conduct current. "The most exciting aspect is that electricity can at least in theory be conducted without any dissipation," says Titus Neupert, professor at the Department of Physics at UZH. "You could think of the crystal edges as a kind of highway for electrons. They can't simply make a U-turn." This property of dissipationless conductance, otherwise known from superconductors at low temperatures, is not shared with the previously known topological insulator crystals that have conducting surfaces, but is specific to the higher-order topological crystals.

The physicists' study still mostly relies on theoretical aspects. They have proposed tin telluride as the first compound to show these novel properties. "More material candidates have to be identified and probed in experiments," says Neupert. The researchers hope that in the future nanowires made of higher-order topological insulators may be used as conducting paths in electric circuits. They could be combined with magnetic and superconducting materials and used for building quantum computers.

More information: Frank Schindler, Ashley M. Cook, Maia G. Vergniory, Zhijun Wang, Stuart S. P. Parkin, B. Andrei Bernevig, Titus Neupert. Higher-order topological insulators. *Science Advances*, June 1st, 2018. , [DOI: 10.1126/sciadv.aat0346](https://doi.org/10.1126/sciadv.aat0346)

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