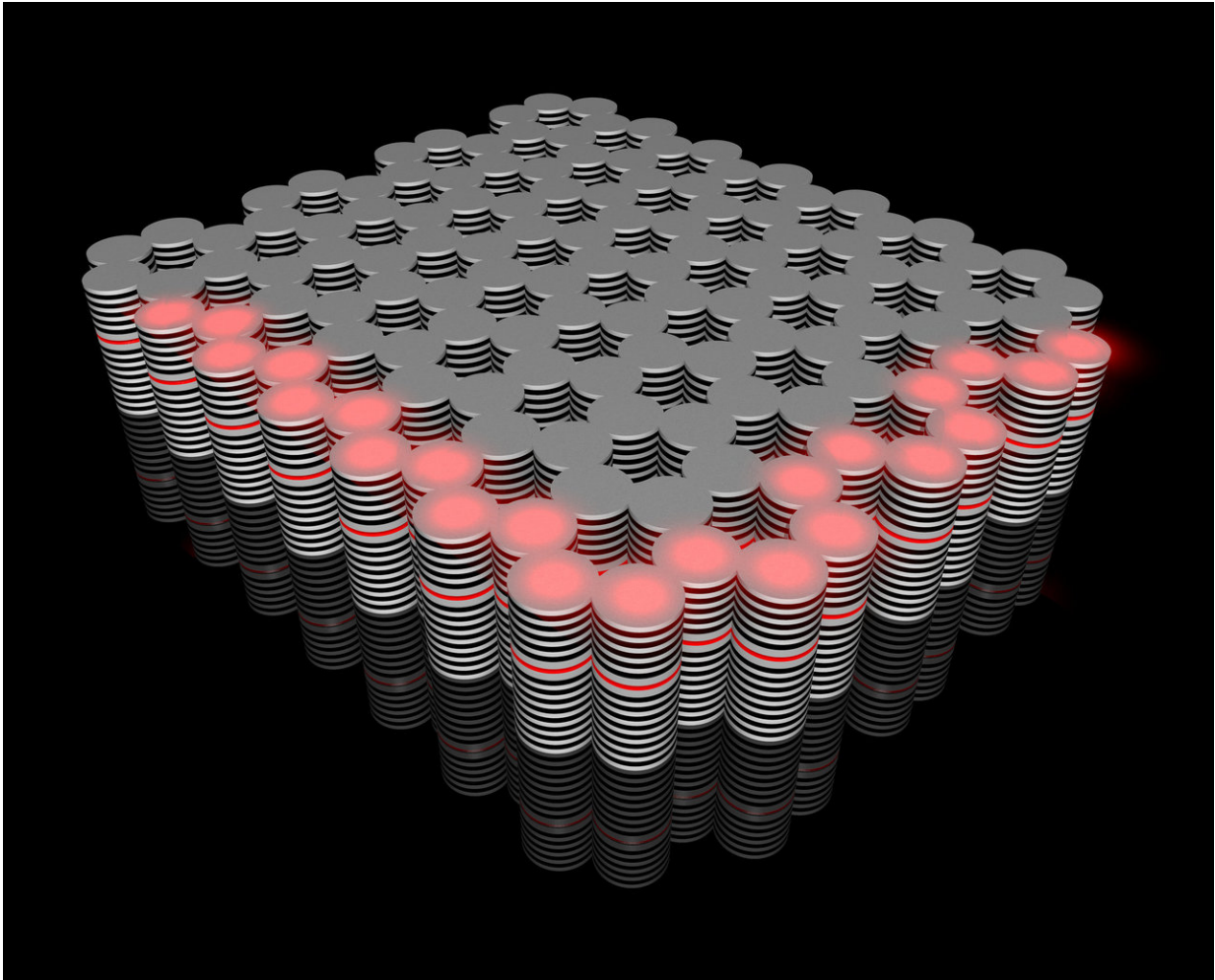


A novel topological insulator

October 12 2018



The novel topological insulator built in the Würzburg Institute of Physics: a controllable flow of hybrid optoelectronic particles (red) travels along its edges.
Credit: Karol Winkler

For the first time, physicists have built a unique topological insulator in which optical and electronic excitations hybridize and flow together. They report their discovery in *Nature*.

Topological insulators are materials with very special properties. They conduct electricity or light [particles](#) only on their surface or edges, not the interior. This unusual characteristic could provide technical innovations, and topological insulators have been the subject of intense global research for several years.

Physicists of Julius-Maximilians-Universität Würzburg (JMU) in Bavaria, Germany, with colleagues from the Technion in Haifa, Israel, and Nanyang Technological University in Singapore have reported their discovery in the journal *Nature*. The team has built the first "exciton-polariton topological insulator," a topological insulator operating with both light and [electronic excitations](#) simultaneously.

Professor Sven Höfling, who heads the JMU Chair for Applied Physics, says such topological insulators have a dual benefit: "They could be used for both switched electronic systems and laser applications." The [topological insulators](#) developed previously are based on either electrons or photons alone.

Dr. Sebastian Klemmt, group leader at Höfling's chair, played a lead role in the project. He gives more details: "The novel topological insulator was built on a microchip and basically consists of the gallium arsenide semiconductor compound. It has a honeycomb structure and is made up of many small pillars, each two micrometres (two millionths of a metre) in diameter."

Propagation direction can be controlled

When exciting this microstructure with laser light, light-matter particles

form inside it, exclusively at the edges. The particles then travel along the edges and around the corners with relatively low loss. "A magnetic field enables us to control and reverse the propagation direction of the particles," Klemmt says.

It is a sophisticated system that works in application-oriented dimensions on a microchip and in which light can be controlled. Usually, this is difficult to accomplish: Pure [light particles](#) have no electric charge and therefore cannot be readily controlled with electric or magnetic fields. The new topological [insulator](#) is capable of doing this by "sending [light](#) around the corner," in a manner of speaking.

More information: S. Klemmt et al, Exciton-polariton topological insulator, *Nature* (2018). [DOI: 10.1038/s41586-018-0601-5](https://doi.org/10.1038/s41586-018-0601-5)

Provided by University of Würzburg

Citation: A novel topological insulator (2018, October 12) retrieved 18 April 2024 from <https://phys.org/news/2018-10-topological-insulator.html>

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