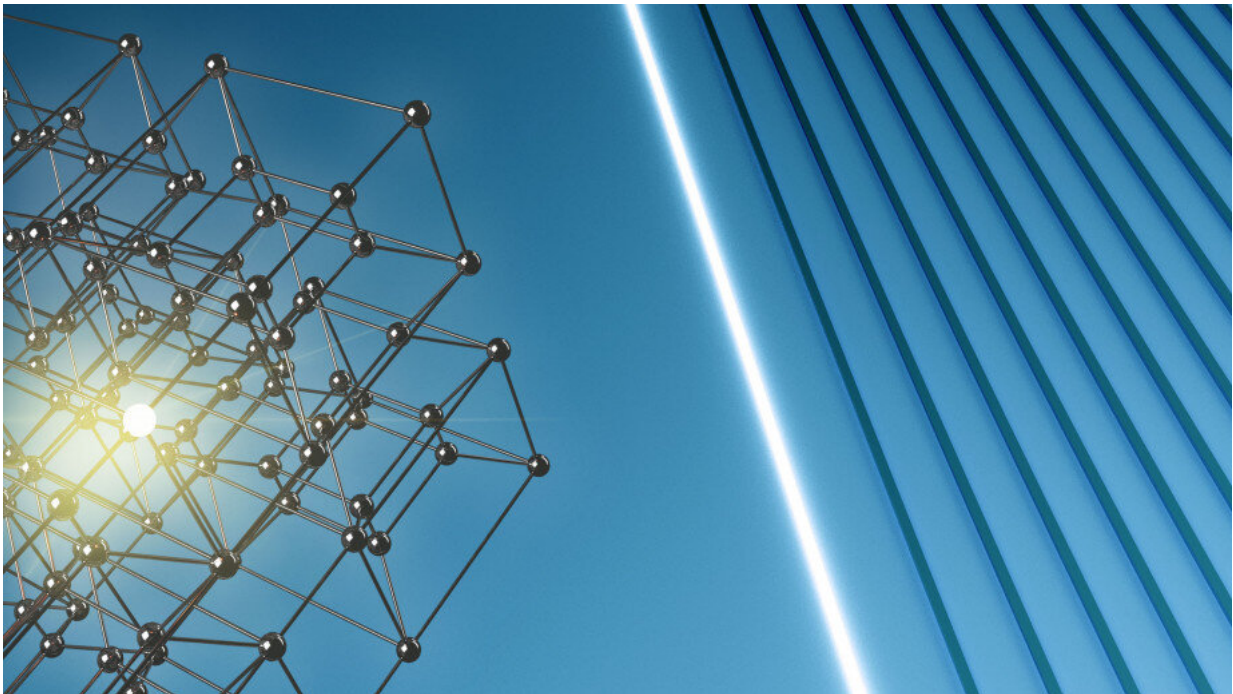


Multidimensional study offers new vision for optical tech

December 17 2019



An artist's impression of light in higher-dimensional networks realised on a two-dimensional optical circuit. Credit: Kai Wang (ANU) and Lukas Maczewsky/University of Rostock

A new design of optical chips enables light to experience multiple dimensions, which could underpin versatile platforms for advanced communications and ultra-fast artificial intelligence technologies.

This scientific breakthrough was led jointly by The Australian National University (ANU) and the University of Rostock in Germany, with other collaborators in Germany, the University of Central Florida in the US and UNSW Canberra.

"Light can evolve in up to seven dimensions on our specially designed [circuits](#), which is mind boggling when you realize that the space around us is three-dimensional," said Professor Andrey Sukhorukov, who led the development of new theoretical concepts with a team of scientists at the Nonlinear Physics Centre of the ANU Research School of Physics.

Professor Alexander Szameit from the University of Rostock led the [experimental work](#), including the cutting-edge fabrication of optical circuits.

"Making use of higher dimensions on optical chips could support a variety of future technologies that involve [machine learning](#) and performing [complex tasks](#) autonomously," Professor Szameit said.

Dr. Kai Wang, who worked on the key aspects of the project at ANU, said enabling [light](#) to travel beyond our three-dimensional space is a major breakthrough, and would drastically enhance the capability of today's optical chips.

"High-dimensional network structures can be found in [human brains](#)—if optical circuits can emulate this, their computation capability will also be boosted dramatically," Dr. Wang said.

"This takes us into the realm of science fiction, which I think is really exciting. The sky is the limit in terms of potential future applications that could build on our discovery."

Lukas Maczewsky, a Ph.D. scholar who performed the experiments at

University of Rostock, said the team's innovation can be used to develop optical switches and sensors that can respond very sharply to transmit or block light.

"Our work is an important step towards creating an ultra-compact and energy-efficient platform for optical networks," Mr Maczewsky said.

"Light can travel inside the circuits on an optical [chip](#) but, on a mass-scale, circuits are most efficiently made within one plane—just like roads without overpasses. Without the need to build overpasses on planar circuits, we make better use of the cross-talks of light between neighboring pathways to engineer the behavior of light."

More information: Lukas J. Maczewsky et al. Synthesizing multi-dimensional excitation dynamics and localization transition in one-dimensional lattices, *Nature Photonics* (2019). [DOI: 10.1038/s41566-019-0562-8](#)

Provided by Australian National University

Citation: Multidimensional study offers new vision for optical tech (2019, December 17) retrieved 25 April 2024 from <https://phys.org/news/2019-12-multidimensional-vision-optical-tech.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.