# University of Pennsylvania engineers develop groundbreaking photonic switch



Researchers at the University of Pennsylvania School of Engineering and Applied Science have developed a groundbreaking photonic switch that addresses the longstanding tradeoff between the size and speed of optical signal routing. The findings, recently published in *Nature Photonics*, signal a major advancement in the domain of data transmission across global networks.

This novel photonic switch, measuring just 85 by 85 micrometers—smaller than a grain of salt—enables rapid manipulation of data travelling through fibre-optic cables. "This has the potential to accelerate everything from streaming movies to training AI," asserts Liang Feng, a Professor in Materials Science and Engineering and Electrical and Systems Engineering, and the senior author of the paper.

Traditionally, larger photonic switches have been able to handle higher speeds and larger volumes of data but came at the cost of greater energy consumption, physical space requirements, and increased expenses. This innovative design leverages non-Hermitian physics, a branch of quantum mechanics that provides enhanced control over the behaviour of light. "We can tune the gain and loss of the material to guide the optical signal towards the right information highway exit," states Xilin Feng, a doctoral student and the study's first author.

The switch utilizes ground-breaking technology to redirect signals in trillionths of a second, operating with minimal power usage. Co-author Shuang Wu highlights the significance of this achievement: "This is about a billion times faster than the blink of an eye,” indicating a paradigm shift from previous switches, which were often constrained to either speed or size.

A notable aspect of this switch is its partial construction from silicon, a material ubiquitous in the tech industry. Wu explains that "non-Hermitian switching has never been demonstrated in a silicon photonics platform before," suggesting that the incorporation of silicon could greatly facilitate the scalability and production of this innovative device, positioning it for wide adoption across the industry. The switch is compatible with existing silicon photonic foundries, integrating seamlessly with technologies used in devices such as graphics processing units.

The new device consists of a silicon base paired with a semiconductor layer made of Indium Gallium Arsenide Phosphide (InGaAsP), specifically effective for manipulating infrared wavelengths of light, the type typically transmitted by undersea optical cables. The challenges involved in aligning these two layers, analogous to the precision required in creating a complex sandwich, are significant—any misalignment, even by a nanometer, could render the device nonfunctional, according to Wu.

The implications of this innovative switch extend beyond academic research. It stands to benefit data centre operators and the billions of consumers that depend on rapid and efficient data transmission. Liang Feng underlines its potential impact: "Data can only go as fast as we can control it," indicating that the groundbreaking system can achieve operational speeds limited only to 100 picoseconds.

The research received support from several institutions, including the Army Research Office and the National Science Foundation, showcasing a collaborative effort to push the boundaries of technology that will influence future trends in AI automation for businesses, among other sectors. Additional contributing authors from Penn Engineering include Tianwei Wu, Zihe Gao, Haoqi Zhao, and Yichi Zhang, as well as Li Ge from the City University of New York.

Source: [Noah Wire Services](https://www.noahwire.com)

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