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(https://thedebrief.org)



Research scientists say they have developed a potentially breakthrough photonic computer chip that uses light waves instead of electricity to perform its calculations.

Specifically designed to help train AI models, the new 'light-speed' chip has the potential to increase processing speed dramatically, is essentially un-hackable, and can also reduce energy consumption in AI computer systems.

# PHOTONIC COMPUTER CHIP REPLACES ELECTRICITY WITH LIGHT WAVES

Since computer chips were first put to use in the 1960s, their fundamental design that uses electricity to perform computations has essentially remained the same. Unfortunately, the faster computer chips become, the closer they get to the processing speed limit imposed by basic physics.

Now, a pair of researchers from the University of Pennsylvania (Penn) have tapped into their combined experience to break through that barrier. The result is a silicone-photonic microchip (SiPh) that uses light waves instead of electricity.

New Photonic Computer Chip Performs Calculations at 'Light Speed' Using Light Waves Instead of Electricity - The Debrief

"We decided to join forces," <u>said</u> Professor Nader Engheta of his partnership with Associate Professor in Electrical and Systems Engintepsing) **Dig co2** Adjatounid Specifically, the pairing brought together Engheta's research into manipulating materials at the nanoscale to perform mathematical computations using light and Adjatouni's team's expertise in nanoscale silicon devices.

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## **BUILDING THE PHOTONIC COMPUTER CHIP**

Working together with researchers from both of their labs, the team's goal was to develop a physical platform for something called vector-matrix multiplication. According to the press release announcing the duo's research, vector-matrix multiplication is "a core mathematical operation in the development and function of neural networks, the computer architecture that powers today's AI tools."

The researchers say that the key to creating their functioning photonic computer chip was the ability to manipulate silicon at the nanoscale. That's mainly because traditional silicon chips are uniform in height, whereas the type of photonic chip they were hoping to create needed to vary in height to work properly.

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"[First] you make the silicon thinner, say 150 nanometers," Engheta explained. However, this disparity in height needs to be placed in exactly the correct places on the chip.

If done correctly, the researchers say that these variations in height "provide a means of controlling the propagation of light through the chip, since the variations in height can be distributed to cause light to scatter in specific patterns." The result is a true photonic chip that is able to "perform mathematical calculations at the speed of light."

## **NEW PLATFORM OFFERS NUMEROUS COMPETITIVE ADVANTAGES**

<u>Published</u> in the journal *Nature Photonics*, the team's newly designed photonic computer chip offers <u>futperofus advantages overactives futperform</u> light-speed calculations at the very limit of physics. Second, the photonic chip design uses 01394-2)

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less energy than conventional chips. The researchers say this is a critical advantage, as power consumption is one of the largest drawbacks to increased processing speed and power.

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The researchers alectnosis thrus is photonic chip can perform numerous calculations simultaneously, which removes the store critical personal information in the computer's working memory. The result, they say, is a computer that is essentially "un-hackable."

"No one can hack into a non-existing memory to access your information," says Aflatouni.

Perhaps even more significant, the team says that due to "constraints" imposed by the manufacturer, their new photonic this is ready to go right now. In fact, they say their chip, which is made out of widely available silicon, could be immediately adapted for use in graphics processing units (GPUs), which are critical in the development of new AI systems.

"They can adopt the Silicon Photonics platform as an add-on," says Aflatouni, "and then you could speed up training and classification."

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