

PRESS RELEASE

Ultrafast computers controlled by light: a new frontier opened by Politecnico di Milano and CNR

A study published in the prestigious journal *Nature Photonics* describes how laser sequences can be used not only to transmit information, but also to process it

Milan, 10 March 2026 – The future for our computers will literally be at the speed of light. **Extremely short light pulses can perform ultrafast logical operations: these are the findings of a study recently published in the prestigious journal *Nature Photonics*.** The study was carried out by a group of researchers from the **Department of Physics at the Politecnico di Milano**, in collaboration with the **Istituto di Fotonica e Nanotecnologie (IFN) - Institute for Photonics and Nanotechnologies of the Consiglio Nazionale delle Ricerche (CNR) - National Research Council**, and with international research centres. The project coordinator was **Giulio Cerullo**, Professor of Physics at the Politecnico di Milano. He headed a team from the Department consisting of professors **Stefano Dal Conte** and **Margherita Maiuri**, and researchers **Francesco Gucci** (lead author of the article) and **Mattia Russo**. Researcher **Franco Camargo** also took part in the study on behalf of the IFN-CNR.

The study represents an important step towards developing a new generation of information processing technologies, potentially hundreds of times faster than what we have at present. Today's computers rely on the movement of electrical charges inside transistors; however, these can only achieve a maximum frequency whose physical limits are hard to overcome. **Unlike traditional electronics**, based on the movement of electric charges, **this innovative approach manipulates the state of electrons in matter by the use of oscillating light**. As **Giulio Cerullo** of the Politecnico di Milano explained: "We have shown that light can be used not only to transmit information, but also to process it. **With the use of ultra-short laser pulses, we can control the quantum states of matter** on time scales of a few millionths of a billionth of a second: i.e. at the same frequencies as light oscillations, speeds previously unknown in electronics". These operations are performed **at rates above 10 terahertz**, over a hundred times faster than the best modern electronic devices.

To achieve this aim, the researchers used the physical properties of a new two-dimensional semiconductor, **tungsten disulfide (WS₂)**, which is only three atomic layers thick. Because of the quantum phenomena associated with this nanometric film, electrons can occupy two distinct quantum states within it, known as "valleys". These valleys can be used as a new unit of information, similar to zero and one for traditional computers, but much quicker to control.

Using a precise sequence of laser pulses only a few femtoseconds (millionths of a billionth of a second) long, the researchers were able to **selectively turn on, turn off and expand the information**, so performing proper logical operations just like those in electronic circuits, but at

immensely higher speeds. All this was done at room temperature, and using pulses of light already routinely available in laboratories. The study also makes it possible to measure how long such quantum information remains stable in the material, a critical aspect for future technological applications.

As **Franco Camargo** (IFN-CNR) pointed out: "Looking to the future, this proof of principle indicates a number of new scientific and technological challenges we need to overcome in order to produce competitive devices based on this principle: from creating ever more complex sequences of pulses to the possibility of increasing the number of bits in feasible devices." Overcoming these barriers will pave the way for a new class of ultra-fast logic devices, transforming this proof of principle into real technology for the computers of the future.

[LINK TO THE FULL PUBLICATION](#)

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FOR MORE INFORMATION:

POLITECNICO DI MILANO - Media Relations Office

Raffaella Turati | +39 3402652568 | relazionimedia@polimi.it

CNR Press Office

Francesca Gorini | +39 3293178725 | francesca.gorini@cnr.it