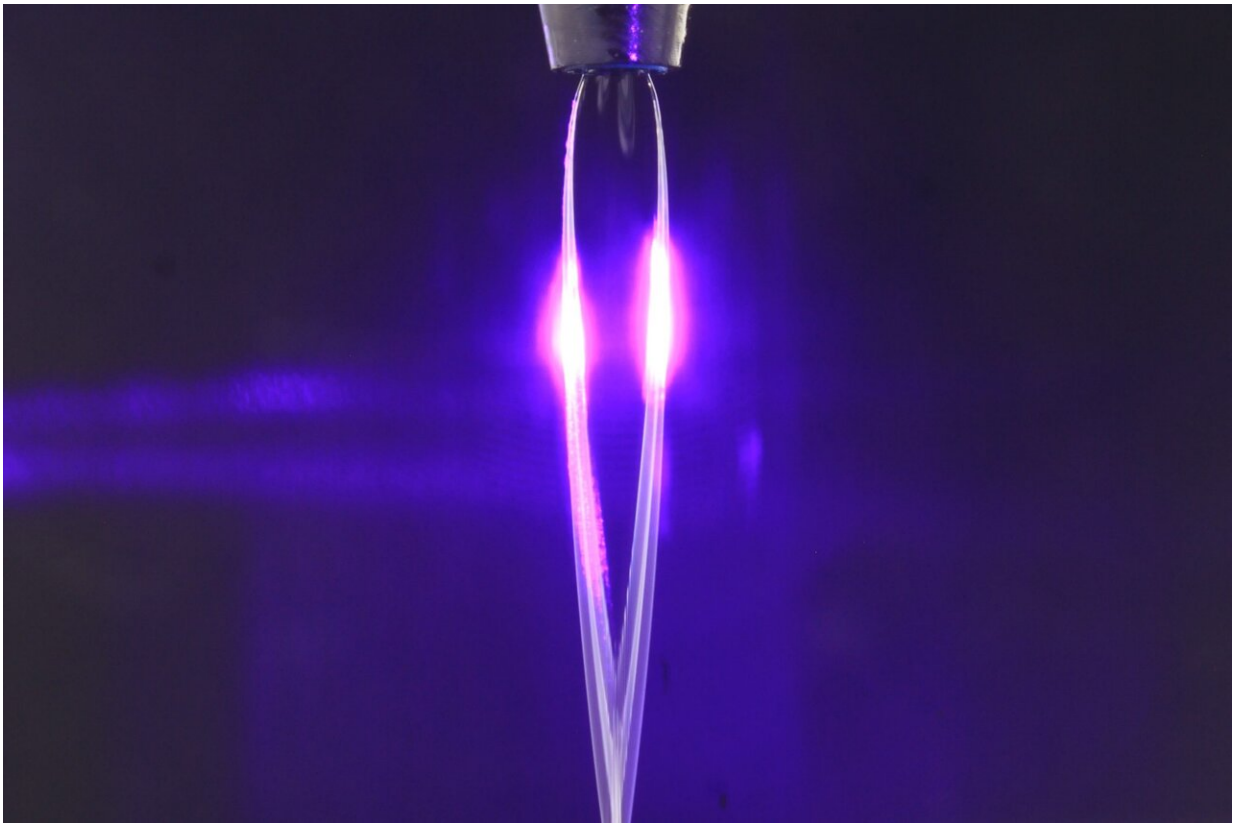


Laser controls ultra-fast liquid switch for terahertz radiation

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The water is fanned out through a specially developed nozzle. Then the laser is passed through it. Credit: RUB

Researchers at Ruhr University Bochum, Germany, have developed an ultra-fast water-based switch. A short but powerful laser pulse converts

the water into a conductive state within less than a trillionth of a second (10^{-12} seconds), during which time it behaves almost like a metal. This makes it faster than the fastest known switching speed of a semiconductor to date.

Adrian Buchmann, Dr. Claudius Hoberg and Dr. Fabio Novelli from the Ruhr Explores Solvation Cluster of Excellence RESOLV published their findings in the journal *APL Photonics* on December 6, 2022.

Laser makes water behave like a high-speed switch

All the operations of computers and smartphones are based on circuits. The speed at which a component can switch between the states zero and one ultimately determines how fast a computer can run. Modern computers use semiconductors that make electrical switching possible. "They are inherently limited in their speed," explains Claudius Hoberg.

Together with his colleagues, he has unveiled a possible novel approach to water-based circuits. The water in which the researchers had dissolved iodide ions—[salt water](#), in other words—is fanned out by a custom-made nozzle so that it streams as a flattened jet with a thickness of only a few micrometers.

"Think of it like squeezing a gardening hose to make the jet of water broad and flat, only on a much smaller scale," explains Hoberg.

A short yet powerful laser pulse is then directed through this water jet. The laser frees [electrons](#) from the salt dissolved in the water so that the water becomes suddenly conductive at terahertz frequencies, exhibiting properties similar to those of a metal. The short duration of the laser pulse of 10^{-14} seconds turns the water into an ultra-fast switch.

"A [speed](#) of 10^{-12} seconds was observed in the terahertz range," says

Claudius Hoberg. A second [laser](#) probes the state of the water.

More information: Adrian Buchmann et al, An ultra-fast liquid switch for terahertz radiation, *APL Photonics* (2022). [DOI: 10.1063/5.0130236](https://doi.org/10.1063/5.0130236)

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