Researchers implement logic gates using two-photon absorption in carrier reservoir semiconductor optical amplifiers

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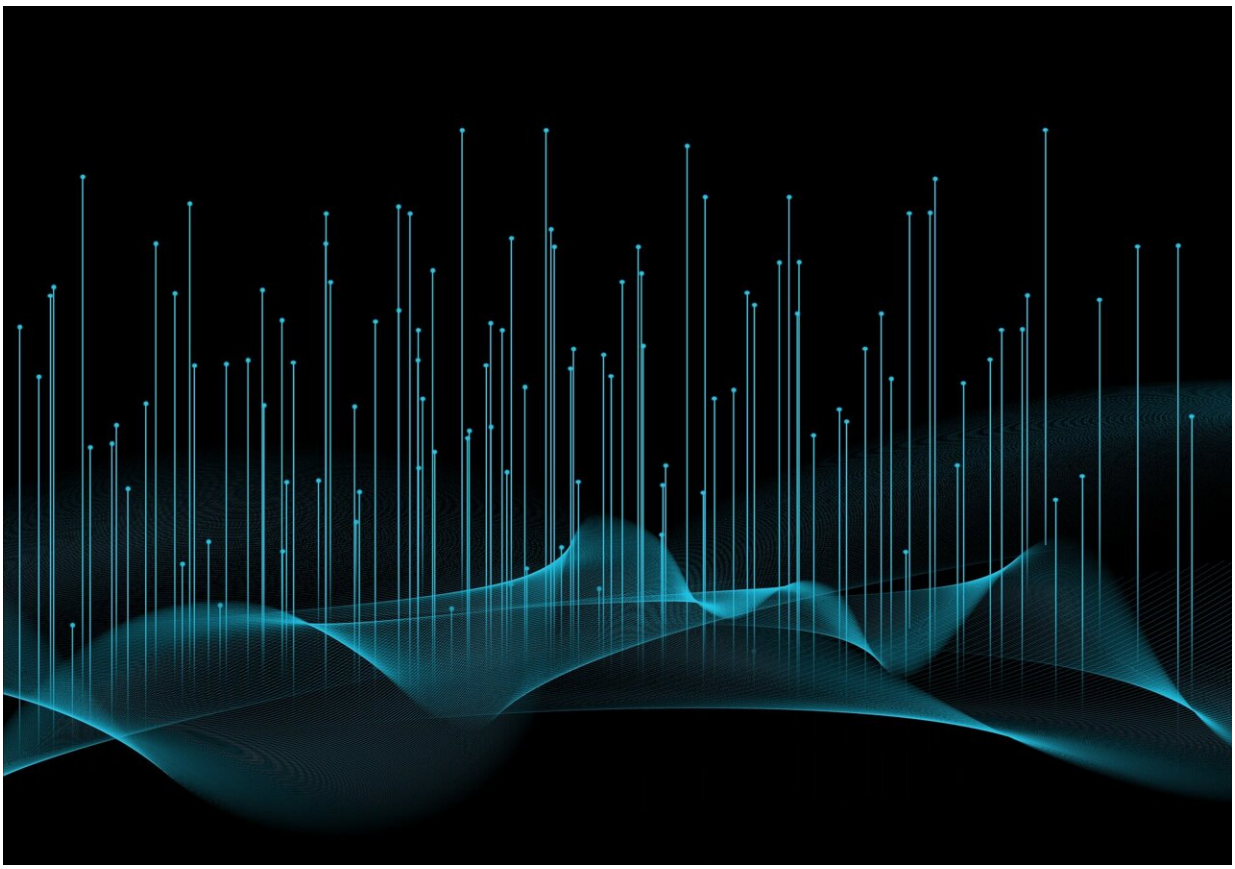

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When an optical pulse train is delivered, two-photon absorption

(TPA)-induced pumping causes considerable and quick gain and phase shifts in the carrier reservoir semiconductor optical amplifier (CR-SOA).

Recently, Amer Kotb and Li Wei from the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) of the Chinese Academy of Sciences and Kyriakos Zoiros from the Democritus University of Thrace in Greece have combined the physical benefits of TPA with those of CR-SOAs to theoretically implement all-optical XOR, AND, NOR, OR, NAND, and XNOR logic gates at a data rate of 320 Gb/s.

This study was published in *Optik*. Until now, the performance of the studied logic gates had never been investigated utilizing CR-SOAs with induced TPA at 320 Gb/s.

The Mach-Zehnder interferometer, which has two symmetrical CR-SOAs arranged in its two arms, is used to implement the XOR, AND, NOR, NAND, and XNOR logic gates, while the OR logic gate is built by combining a CR-SOA with a delayed interferometer. The gates' performance was evaluated using the quality factor (QF) and the accompanying bit error rate (BER).

The researchers also compared their work to the reported schemes for theoretically implementing the considered logic gates employing (CR)-SOAs at different speeds.

The simulation results show that these logic gates can be implemented at 320 Gb/s with far better QF and BER when TPA is considered in CR-SOAs, while without TPA this is not possible since the metrics are seriously degraded.

More information: Amer Kotb et al, 320 Gb/s all-optical logic operations based on two-photon absorption in carrier reservoir

semiconductor optical amplifiers, *Optik* (2022). DOI: 10.1016/j.ijleo.2022.169494