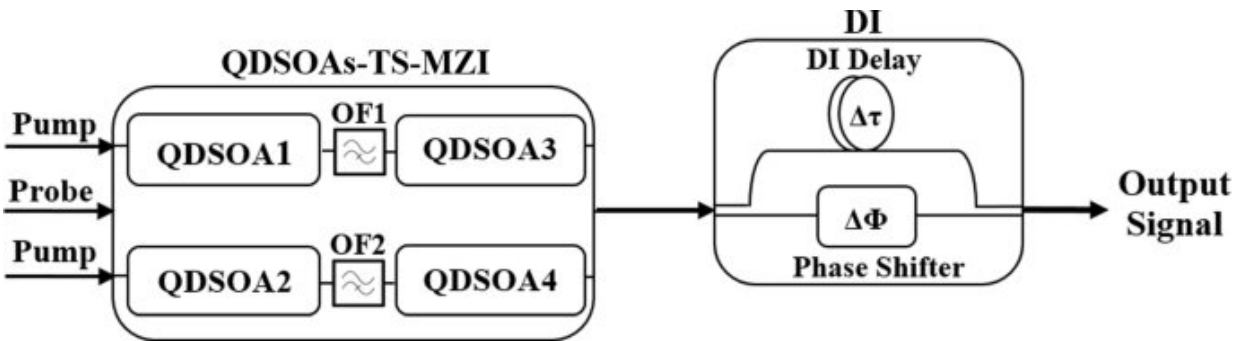


Novel scheme for logic operations running at 1 Tb/s

May 27 2022, by Li Yuan



Credit: *Pramana* (2022). DOI: 10.1007/s12043-022-02329-8

Due to their unique capabilities for implementing all-optical logic gates, quantum-dot semiconductor optical amplifiers (QD-SOAs) can help to cope with the vast information capacity in modern telecommunication networks.

Recently, Prof. Li Wei and Associate Professor Amer Kotb from the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) of the Chinese Academy of Sciences and Prof. Kyriakos Zoiros from Democritus University of Thrace in Greece used the turbo-switched Mach-Zehnder interferometers (TS-MZIs) [architecture](#) to realize all-optical NOT-AND (NAND) and exclusive-NOR (XNOR) [logic](#) operations that run at 1 Tb/s.

The TS-MZIs architecture incorporates QD-SOAs and is followed by a serially connected delayed interferometer (DI) in a combined scheme (QDSOAs-TS-MZIs-DI).

In the QDSOAs-TS-MZI architecture, a pair of identical QD-SOAs are cascaded and separated by optical bandpass filters in each interferometric branch. The serially inserted DI, on the other hand, adds a phase difference to the direct and delayed copies of the incoming switched signal. This in turn further enhances the switching performance and speed of the formed logic gates.

The researchers calculated and compared the quality factor (Q-factor) and cross-correlation coefficient (XC) of QDSOAs-TS-MZIs-DI and the conventional MZIs with QDSOAs (QDSOAs-MZIs) to evaluate the performance of the two considered logic gates at 1 Tb/s.

The comparison reveals that the QDSOAs-TS-MZIs-DI outperforms the other two alternatives (QDSOAs-TS-MZIs and QDSOAs-MZIs), implying that it should be used as a switching module for ultrahigh-speed Boolean logic functions.

The study was published in *Pramana*. It is expected to shed light on the design of future integrated logic circuits at high speeds and with better performance.

More information: AMER KOTB et al, Numerical demonstration of NAND and XNOR Boolean functions using quantum-dot semiconductor optical amplifiers-based turbo-switched Mach–Zehnder interferometers and delayed interferometer at 1 Tb/s, *Pramana* (2022). [DOI: 10.1007/s12043-022-02329-8](https://doi.org/10.1007/s12043-022-02329-8)

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