Spin lasers in the fast lane: New concept for ultrafast lasers developed

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Electrical engineers in Bochum, Germany, have succeeded in developing a new concept for ultrafast semiconductor lasers. The researchers make clever use of the intrinsic angular momentum of electrons, called spin, to successfully break the previous speed barriers. The new spin lasers have the potential to achieve modulation frequencies of well above 100 GHz in future. This is a decisive step towards high-speed data transmission, e.g. for the Internet of tomorrow. The researchers report on their results in the *Applied Physics Letters*.

Optical data transmission by semiconductor lasers is a basic prerequisite for the globally networked world and today's information society. The ever increasing degree of networking and the desire to exchange larger amounts of data are the driving force behind the development of ever faster optical data transmission systems. The maximum speed of conventional semiconductor lasers has long been a limiting factor - typical modulation frequencies are currently at levels well below 50 GHz.

By using spin lasers, Bochum's researchers were able to overcome the previous limits for the modulation speed. Whereas in conventional lasers, the spin of the electrons injected is entirely arbitrary, in spin lasers, only electrons with a previously determined spin state are used. By injecting these spin-polarised electrons, the laser is forced to work simultaneously on two laser modes with different frequencies.

"This frequency difference can easily be tuned using the so-called

birefringence in the resonator, for example by simply bending the microlaser" said Dr. Nils Gerhardt. By coupling the two laser modes in the microresonator, oscillation with a new frequency occurs, which can theoretically reach well over 100 GHz. The researchers around Dr. Gerhardt obtained their results in the collaborative research centre 491 of the Universities of Bochum and Duisburg-Essen ("Magnetic Heterostructures: Spin Structure and Spin Transport").

More information: N.C. Gerhardt, M.Y. Li, H. Jähme, H. Höpfner, T. Ackemann, and M.R. Hofmann: "Ultrafast spin-induced polarization oscillations with tunable lifetime in vertical-cavity surface-emitting lasers", Appl. Phys. Lett. 99, 151107 (2011), DOI: 10.1063/1.3651339

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