Researchers produce ultra-short light pulses using on-chip microresonator

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(PhysOrg.com) -- Researchers from the NIST Center for Nanoscale Science and Technology and Purdue University have designed and fabricated an on-chip microresonator that converts continuous laser light into ultra-short pulses consisting of a mix of well-defined frequencies, a technology with applications in advanced sensors, communications systems, and metrology.

In the new approach, infrared light from a continuous laser enters a chip through a single optical fiber and is directed into an 80 μm-diameter silicon nitride ring. The microscale ring acts as a nonlinear optical resonator with a defined set of resonances that reemit the light in a set of evenly spaced frequencies. These are called “comb lines” because they resemble teeth on a comb when represented on a frequency graph. The light is then collected through another optical fiber and sent to a pulse shaper to control the phase of each individual frequency line.

The research team demonstrated that an optical frequency comb generated on-chip in this way can be highly coherent, meaning that individual comb lines remain synchronized with each other for long periods of time. Moreover, the phases of the comb lines can be adjusted to compress the light into a train of ultra-short pulses. The high repetition rate of the pulses produced by the on-chip microresonators may enable their use for improving the performance of high speed electron microscopes.

In addition, they may be competitive with mode-locked lasers for some

laboratory measurement applications; such lasers also produce a train of short pulses with well-defined frequencies, but are typically much larger than the chip-based devices and are limited by longer time delays between pulses.

More information: Spectral line-by-line pulse shaping of on-chip microresonator frequency combs, F. Ferdous, H. Miao, D. E. Leaird, K. Srinivasan, J. Wang, L. Chen, L. T. Varghese, and A. M. Weiner, *Nature Photonics* 5, 770-776 (2011). dx.doi.org/10.1038/nphoton.2011.255

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