Quantum optical micro-combs

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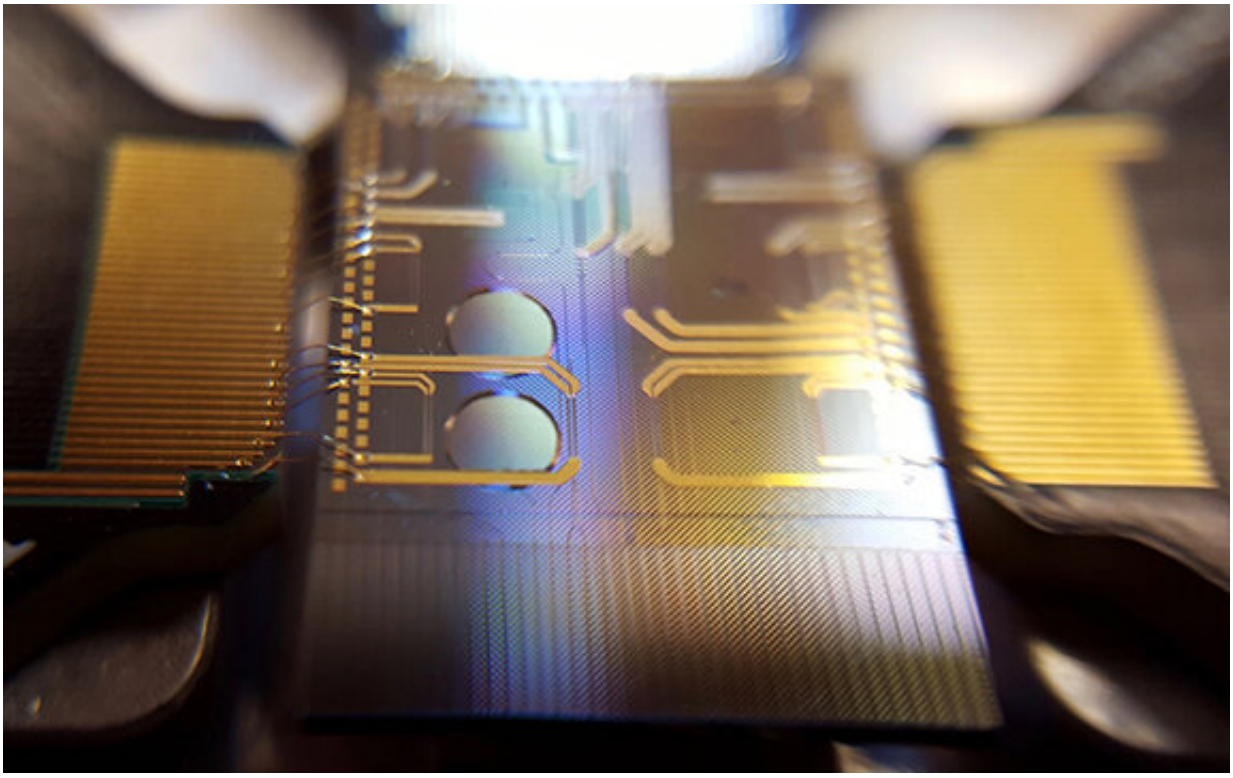

Integrated ring resonator circuitry that is used to generate quantum optical frequency combs. Credit: Swinburne University of Technology

Compact quantum devices could be incorporated into laptops and mobile phones, thanks in part to small devices called quantum optical micro-combs.

Quantum optical micro-combs are devices that generate very sharp

precise frequencies of light an equal distance apart – a bit like the teeth of a comb. They can enable ultrafast processes and could be an important component of quantum computer systems.

In a review paper covering the development of these devices, Professor David Moss, Director of the Centre for Micro-Photonics (CMP) at Swinburne describes the advances that have been made in making these devices smaller and portable enough to be included on a chip.

"These devices will enable an unprecedented level of sophistication in generating entangled photons on a chip – a key breakthrough that, in my opinion, could very well accelerate the quest of achieving so-called 'quantum supremacy' – quantum devices that have the ability to perform functions beyond the capability of conventional electronic computers", says Professor Moss.

A key challenge for quantum science and technology is to develop practical large-scale, systems that can be precisely controlled. Quantum optical micro-combs provide a unique, practical and scalable framework for quantum signal and information processing to help crack the code to ultra-secure telecommunications and greatly advance quantum computing.

Quantum optical micro-combs have achieved record complexity and sophistication in the photon quantum version of a classical computer bit, a QuDit,that can be generated and controlled in the tiny space of a computer chip.

These breakthroughs have shown that compact, highly complex quantum can exist outside of large laboratories, opening the possibility that ultimately- quantum devices could be used in laptops and mobile phones, bringing the vision of powerful optical quantum computers for everyday use closer than ever before.

More information: Michael Kues et al. Quantum optical microcombs, *Nature Photonics* (2019). DOI: 10.1038/s41566-019-0363-0