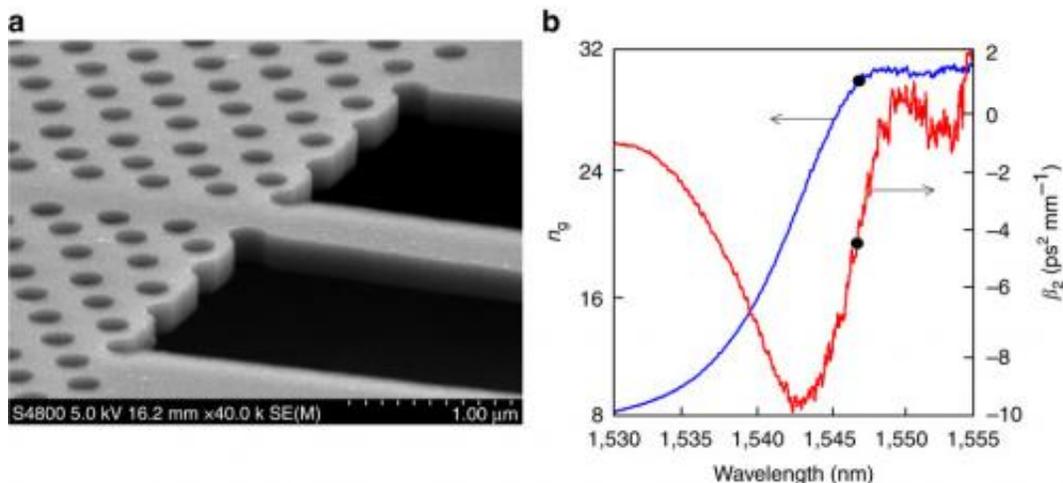


A first in silicon photonics research: On-chip soliton compression observed

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(a) Scanning electron micrograph; (b) group index (blue) and group velocity dispersion parameter (red) measured with an interferometric technique. The dot indicates the operating point of the experiment. Credit: *Nature Communications* 5, Article number: 3160 doi:10.1038/ncomms4160

(Phys.org) —An international research team, led by researchers from the University of Sydney, have observed an on-chip soliton compression in a silicon photonic crystal for the first time.

Andrea Blanco-Redondo and Dr Chad Husko from CUDOS (ARC Centre of Excellence for Ultrahigh bandwidth Devices for Optical Systems) at the University of Sydney's School of Physics led the research, published in *Nature Communications* today.

The study builds on a long-standing collaboration in [silicon](#) photonics between the University of Sydney, the University of St Andrews and the University of York, as well as new partner Sun Yatsen University in Guangzhou, China.

"Optical soliton waves in a silicon [photonic crystal](#) chip the size of a human hair could add key insights to future integrated optical communications systems," said Dr Husko

In their simplest form, solitons are nonlinear waves that propagate through a medium undistorted. One of the most striking natural examples is rogue waves, enormous water waves capable of toppling ocean-going vessels.

"Due to their ubiquitous appearance in diverse physical systems including, plasmas, proteins, magnetism, and optics, solitons are arguably the most fundamental nonlinear wave," said Dr Husko

In the ideal case, the soliton behaviour in silicon would be similar to that in a glass media, such as optical fibres.

Until now, however the composition of the silicon waveguide in practice drastically changed the picture, and hindered the observation in silicon photonic crystals.

The understanding of solitons in [optical fibres](#) played a key role in the development of long-haul optical telecommunications and continues to inform how terabits of data are sent down them.

"I am delighted with this latest breakthrough which is of both fundamental and technological importance and builds on almost 20 years of my own research in optical solitons and photonic crystals," said Professor Eggleton, CUDOS Director and co-author.

"Our experiments will inform the ongoing push to develop optical circuits in CMOS-compatible materials such as silicon for on-chip communication, similar to the community's research in glass fibre in the 1980s," said Dr Husko.

The team is pursuing this avenue of research in line with the mission of CUDOS to develop photonic chips that are 'faster, smaller, greener'.

In contrast to kilometre fibres, the soliton propagation occurs at the micron scale, the size scale of human hair, due to slow-light in the photonic crystal device. These results could allow for the miniaturisation of optical components featuring soliton-based functionality in integrated silicon photonic chips.

"This is just the beginning, from here there are many other fascinating phenomena left to explore from this experiment," said Ms Blanco-Redondo.

More information: "Observation of soliton compression in silicon photonic crystals." A. Blanco-Redondo, C. Husko, D. Eades, Y. Zhang, J. Li, T.F. Krauss & B.J. Eggleton. *Nature Communications* 5, Article number: 3160 [DOI: 10.1038/ncomms4160](https://doi.org/10.1038/ncomms4160) . Received 04 November 2013.

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