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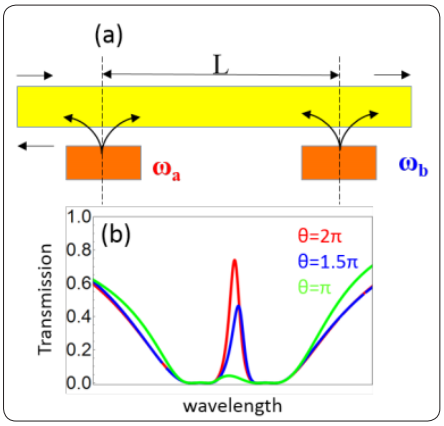
Tunable optical buffer using coupled photonic crystal cavities

Slow light devices are of interest for applications such as optical buffers and delay lines. Integrated optical delay lines are an important component of optical signal processing systems and are required for a range of functionalities, e.g. bit swapping or signal re-timing. Considerable efforts have been devoted to on realizing optical delay lines based on photonic crystal waveguides and coupled cavity structures however significant challenges remain. In particular, it has been realized that current delay lines are generally limited by the propagation loss in the structure, rather than by dispersion. In this work, we present an alternative approach to optical buffers. We combine low loss polymer waveguides with silicon photonic crystal cavities to realise behaviour analogous to electromagnetically induced transparency (EIT), resulting in large, and dynamically controllable optical delay, similar to. In this system, the light spends a significant percentage of the time traveling in the polymer waveguides, which has lower propagation loss relative to silicon nanowires, resulting in record low loss values, approx. 15dB/cm. The use of polymer waveguides also increases the coupling efficiency to optical fibres and the fibre to fibre loss of our system can be less than 3 dB. Tuning is implemented using mico-heaters delay giving a maximum delay approaching 300ps and tuning over 120ps. Thanks to the low footprint silicon PhC cavities the power consumed during operation is low.



Recent Publications

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3. Melloni A et al. (2010) Tunable delay lines in silicon photonics: coupled resonators and photonic crystals, a comparison. IEEE Photonics Journal. 2(2):181-194.
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5. Q Xu et al. (2006) Experimental realization of an on-chip alloptical analogue to electromagnetically induced transparency. Physical Review Letters. 96:123901.

Biography

Liam O'Faolain received his PhD degree from the University of St Andrews in Scotland in 2005. He is the Deputy Director of the Centre for Advanced Photonics and Process Analysis at the Cork Institute of Technology, Ireland. In 2012, he joined the group of Professor David A B Miller at Stanford University as an SU2P Entrepreneurial Fellow before returning to begin an ERC Starting Grant and take up a lecturing position at St Andrews at the start of 2013. In August 2016, he re-located his research group to Cork Institute of Technology. His group's main research goals is the realization of a new family of low power optical interconnects using nanophotonics.

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