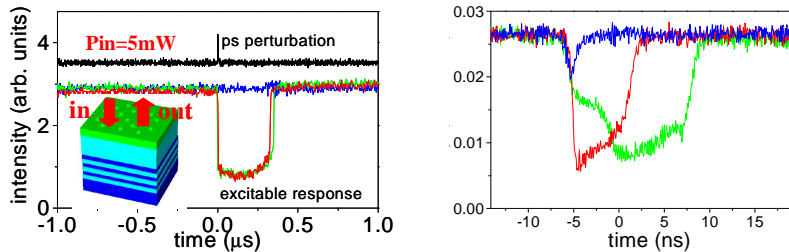


## Excitability in two dimensional photonic crystals: a neuron-like mechanism for optical delay

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Excitability is a non-linear dynamical mechanism underlying all-or-none responses to small perturbations, at the origin of neuronal spiking. We report on the first demonstration of optical excitability in a Bloch mode 2D PhC resonator [1]. The mechanism is based on the fast carrier dynamics [2] coupled to thermal relaxation. Upon CW light injection @1.55  $\mu\text{m}$ , efficient heat diffusion leads to response pulses as short as few ns. A critical slowing down due to on-threshold perturbation leads to an optical delay of the same amount of the pulse duration. This can be used in arrays of integrated photonic excitable microcavities to realize all-optical delay lines.



**Fig. 1.** Excitable responses to 60ps-width-pulse perturbations with 1.6pJ (blue), 1.9pJ (red) and 2.5pJ (green line) energies (U). Inset : PhC InP slab with a graphite lattice of air holes on a SiO<sub>2</sub>/Si-SiO<sub>2</sub> Bragg mirror.

**Fig. 2.** Demonstration of one pulse-duration delay. U=5.5 pJ (blue line, below threshold), U=6.125 pJ (green line, on threshold), and U=9.3 pJ (red line, above threshold).

[1] A. M. Yacomotti *et al.*, *Phys. Rev. Lett.* **97**, 143904 (2006)

[2] A. M. Yacomotti *et al.*, *Phys. Rev. Lett.* **96**, 093901 (2006)