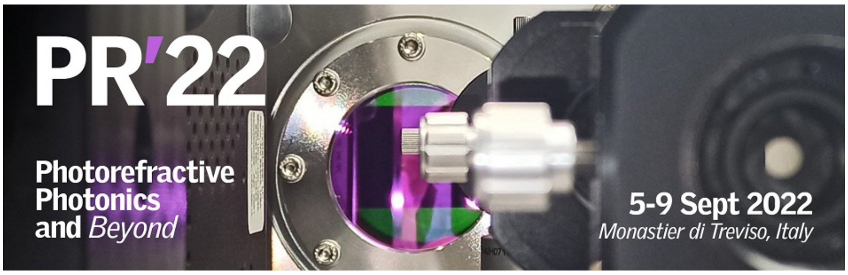

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Addressable and erasable photonic neurons using solitonic X-junctions in lithium niobate films

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We show that undoped $LiNbO_3$ films constitute an attractive photosensitive medium to form reconfigurable optical functions controlled by pyroelectric effect. The present work illustrates this potential through the formation light-induced tunable X-junctions capable of fulfilling the function of optical neurons.
The $LiNbO_3$ films is fabricated from a photonic grade $LiNbO_3$ wafer gold-bonded to a silicon wafer with an intermediate silica buffer layer. After grinding and polishing, it forms an 8μm thick slab $LiNbO_3$ waveguide. This planar configuration is exploited to demonstrate the realization of photoinduced X-junctions generated by self-confined crossing CW beams of μw power. Further to inscription, the memorized structure allows two optical input signals to be mixed and redirected with a chosen ratio to the two outputs. A salient point of the demonstration reveals that this ratio is dictated by the power ratio between the two incoherent writing beams. The planar configuration offers a very good control of the propagating beams and of their coupling along with the possibility of erasing the structure using light. Other advantages of the slab configuration are response time up to two orders of magnitude faster than in $LiNbO_3$ bulk and the compactness of the devices made.
To conclude, our work shows that $LiNbO_3$ films, offering the possibility of inducing reconfigurable optical functions, constitute a valid configuration for the realization of neuromorphic circuits. By analogy to biological neurons, soliton formed x-junction neurons in LiNbO3 films can increase and decrease their synaptic strength depending on the entries similarly to what happens in biological tissue.

Primary authors: BILE, Alessandro (Sapienza); Prof. CHAUVET, Mathieu (Femto-ST); Dr BASSIGNOT, Florent (FEMTO-Engineering); Dr GAUTHIER-MANUEL, Ludovic (FEMTO-ST); Dr TARI, Hamed (Sapienza); Prof. FAZIO, Eugenio (Sapienza)

Presenter: BILE, Alessandro (Sapienza)

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