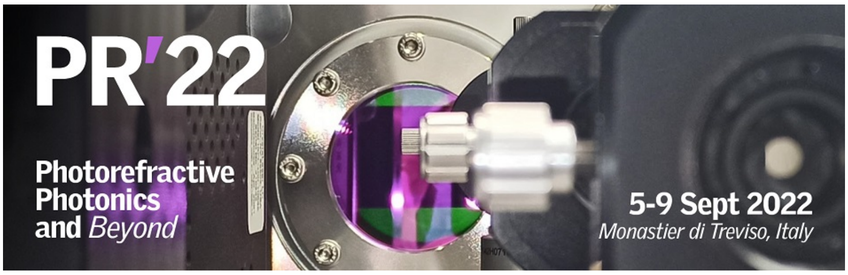

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Photorefractive soliton synapsis for Surface-Plasmon-Polariton circuits

Tuesday, 6 September 2022 12:40 (25 minutes)

The realization of low-loss, high-speed all-optical interconnections is of great interest for possible photonic applications; having plastic interconnections will extend applications to the field of neural networks. To mimic biological neuroplasticity, interconnections should be able to be created, deleted, strengthened, and weakened due to the learning and reasoning purposes of neural networks. Traditional photonics suffers from limited integrability with respect to electronics, due to the difference in the size of the photonic and electronic wavelengths. Recently, a major improvement has been represented by the use of plasmonics, which limits light signals in nanometric dimensions. On the other hand, plasmonics is mainly linear, thus limiting the possibility of processing signals. In this study, the authors developed a novel Plasmonic-Solitonic hybrid photorefractive interconnection, capable of linking two metal circuits carrying Surface-Plasmon-Polariton (SPP) waves. The light transported in the form of SPP can generate a photorefractive soliton channel which in turn is re-coupled to a second nanostrip. Soliton coupling adds plasticity to plasmonic circuits which can now store information and can act as active neuromorphic systems. The photorefractive soliton channel satisfies the conditions of low loss, long-range propagation, and wide transmission band, fundamental characteristics for future applications. Here, the authors study the formation characteristics of the soliton, which can be addressed according to the applied bias field. Consequently, the re-coupling to a second plasmonic nanostrip is not constant but depends on the experimental conditions, perfectly simulating the sigmoid-like activation function as a replication of the action potential of biological neurons within the soma

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