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Electromagnetically induced transparency and slow light with optomechanics

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Resumo

Controlling the interaction between localized optical and mechanical excitations is now possible following advances in micro- and nano-fabrication techniques. To date, most experimental studies of optomechanics have focused on measurement and control of the mechanical subsystem through its interaction with optics, and have led to the experimental demonstration of dynamical back-action cooling and optical rigidity of the mechanical system. However, the optical response of these systems is also modified in the presence of mechanical interactions, leading to effects such as Electromagnetically Induced Transparency (EIT) and parametric normal-mode splitting, and thus a platform for strongly nonlinear optics. In this talk we propose and demonstrate the use of the optomechanical nonlinearity as a new way of controlling the velocity of light via engineered photon-phonon interactions. Our results demonstrate EIT and tunable optical delays on a nanoscale optomechanical crystal device, fabricated by simply etching holes into a thin film of Silicon. At low temperature (8.7 K), we show an optically-tunable delay of 50 ns with near-unity optical transparency, and superluminal light with a 1.4 μs signal advance. These results, while indicating significant progress towards an integrated quantum optomechanical memory, are also relevant to classical signal processing applications.