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Radiation-pressure-induced regenerative mechanical oscillations in optical microcavities HOSSEIN ROKHSARI, MANI HOSSEIN-ZADEH, TOBIAS KIPPENBERG, TAL CARMON, KERRY VAHALA, California Institute of Technology, VAHALA RESEARCH GROUP TEAM — A silica microcavity is shown to allow both circulation of long lived cavity photons as well as mechanical vibrations at characteristic radio frequencies. Radiation pressure or the force due to impact of photons can couple the mechanical modes of an optical cavity structure to its optical modes, leading to regenerative RF mechanical oscillations of the micro structure with only micro-Watts of optical threshold power. Embodied within a microscale, chip-based device, this mechanism can benefit both research into macroscale quantum mechanical phenomena and improve the understanding of the mechanism within the context of Laser interferometer gravitational-wave observatory (LIGO). This novel class of oscillators that acquire gain directly from CW optical fields may also find applications in all-optical photonic systems. Through a detailed study of the short-term stability of these optomechanical oscillators we demonstrate that thermo-mechanical noise also referred to as Brownian noise, is the dominant noise mechanism at room temperatures. Preliminary calculations show that lowering the temperature in a vacuum environment may enable the observation of quantum back action noise in microtoroidal resonators.

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