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Optomechanical Coupling Between Membrane Modes ALEXEY B. SHKARIN, NATHAN E. FLOWERS-JACOBS, SCOTT W. HOCH, Dept of Physics, Yale University, CHRISTIAN DEUTSCH, JAKOB REICHEL, Laboratoire Kastler Brossel, ENS/UPMC, JACK G.E. HARRIS, Dept of Physics and Dept of Applied Physics, Yale University — In an optomechanical device, radiation pressure couples optical power to mechanical motion. While typical experiments couple a single optical cavity to a single mechanical resonance, there has been increasing theoretical and experimental interest in multi-mode systems where there is coupling between multiple mechanical resonances and/or multiple optical cavity modes. We report on a device consisting of a dielectric SiN membrane located inside a high finesse fiber-cavity, where two nearly-degenerate mechanical modes couple to a single cavity mode. We observe that the original mechanical modes can experience a large coupling that is mediated by intracavity field. This causes the mechanical eigenmodes of the system to depend strongly on the radiation pressure and change from the original mechanical modes to a symmetric and antisymmetric combination of the original modes. The symmetric/antisymmetric modes are also known as "dark" and "bright" modes, as they have very different coupling to the cavity. In the quantum regime, this effective interaction between mechanical modes would open up the possibility of state transfer between multiple mechanical modes.

Alexey Shkarin
Dept of Physics, Yale University

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