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Optomechanical crystals

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In the last several years, rapid advances have been made in the field of cavity optomechanics, in which the usually feeble radiation pressure force of light is used to manipulate, and precisely monitor, mechanical motion. Amongst the many new geometries studied, coupled phononic and photonic crystal structures (dubbed optomechanical crystals) provide a means for creating integrated, chip-scale, optomechanical systems. Applications of these new nano-opto-mechanical systems include all-optically tunable photonics, optically powered RF and microwave oscillators, and precision force/acceleration and mass sensing. Additionally there is the potential for these systems to be used in hybrid quantum networks, enabling storage or transfer of quantum information between disparate quantum systems. A prerequisite for such quantum applications is the removal of thermal excitations from the low-frequency mechanical oscillator. In this talk I will describe our recent efforts to optically cool and measure the quantum mechanical ground-state of a GHz oscillator (see figure below), and to demonstrate efficient translation between light and sound quanta.