Nanomechanical Systems

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Nanomechanical resonators are freely suspended bridges with nanoscale diameters which can be driven to vibrate under resonant actuation. These nanostructures are receiving an increasing amount of attention both in fundamental experiments and sensing applications for their remarkable mechanical properties. However, the investigation of nanomechanical systems calls for novel transduction mechanisms to actuate and detect their motion, for integrated control and tuning schemes as well as a fundamental understanding of the underlying dissipation mechanisms to enable high mechanical quality factors.

In this presentation, I will show how the above requirements can be met using doubly-clamped pre-stressed silicon nitride string resonators, which are explored as high Q nanomechanical systems (NEMS), in combination with dielectric gradient forces which are employed to transduce and manipulate their motion. In particular, I will demonstrate gradient-field induced strong coupling and coherent control of mechanical resonator modes. Furthermore, coupling to a cavity allows for back-action induced manipulation of the mechanical response, which can give rise to self-oscillation and cooling.