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Abstract for an Invited Paper
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Spinning Photons and Twisting Oscillators[1]

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Optomechanics is the study of the interaction between electromagnetic radiation and mechanical motion. A typical optomechanical system involves an optical resonator coupled to a mechanical degree of freedom. Some of the most striking experimental achievements include preparation of macroscopic mechanical oscillators in their quantum ground states, the detection of optomechanical quantum back-action, and generation of optomechanically induced transparency and slow light. Most optomechanical systems rely on linear coupling between the radiation and the displacement of the mechanical oscillator. I will begin this talk instead by discussing the basic quantum mechanics of a generic quadratically coupled optomechanical system. I will also mention our efforts in extending optomechanics to torsional and rotational systems. Specifically, I will describe our theoretical proposal to couple a windmill-shaped dielectric to cavity Laguerre Gaussian modes. Subsequently, I will suggest a method for coupling LG modes to surface acoustic waves on a cavity mirror as a new platform for storage of photons carrying orbital angular momentum. Finally, I will discuss our most recent study of the prospects of cooling full rotational motion to the quantum regime.

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