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## Joint Quantum Sciences Seminar

**Wednesday, November 15, 4:00 pm**  
**Jefferson 250**

**Prof. Tongcang Li**  
*Purdue University*

### **“Levitated spin-optomechanics”**

Optomechanical systems, such as the Laser Interferometer Gravitational-Wave Observatory (LIGO) and atomic force microscopes, are very sensitive devices. Among different optomechanical systems, an optically levitated nanoparticle in vacuum can have a particularly high quality factor. In this talk, I will discuss how to couple the mechanical motion of an optically levitated nanoparticle to photon spins, electron spins, and the spin angular momentum of quantum vacuum fluctuations for sensing, quantum information science, and macroscopic quantum mechanics. Recently, we optically levitated a nanodiamond and demonstrated electron spin control of its built-in nitrogen-vacancy (NV) centers in vacuum. We have also driven a nanoparticle to rotate beyond 1GHz with a circularly polarized laser beam, and observed the torsional vibration of a nanoparticle with a linearly polarized laser beam. Based on our experimental results, we propose to achieve strong coupling between an NV electron spin and the torsional vibration of a levitated nanodiamond with a uniform magnetic field. We also propose to use our system to detect the Casimir torque due to angular momentum of quantum vacuum fluctuations, which has not been observed to date. At the end of the talk, I will briefly describe my other works in quantum optics.

Student Presentation will begin at 4:00 PM  
Guest Presentation will begin at 4:30 PM  
Refreshments will be provided