Special Joint Quantum Information Science Seminar

Thursday, January 24, 2019
PHYS 242 at 11:00 am

(Refreshments served at 10:30 am)

Dr. Yuan Zhang

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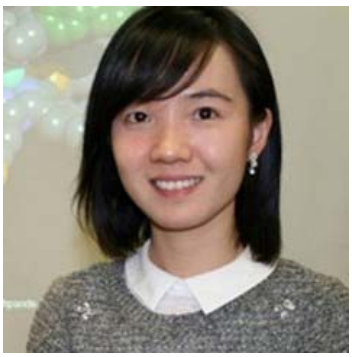

Operating Molecular Machines, Engineer 2D Materials, and Investigating Quantum Information Science in Molecular Networks

The invention of Scanning Tunneling Microscopy (STM) brings a revolutionary impact on the nanoscience and nanotechnology. Operated with the mechanism of quantum tunneling effect, STM images materials at the highest spatial resolution with atomic accuracy, probes the local electronic features, and manipulate matter at atomic/molecular scale.

This talk will cover how we can utilize a low temperature STM system to investigate and operate various molecular machines, construct molecular networks, engineer 2D materials, and investigate quantum information science in the area of spin interactions within domains in a molecular network as well as building artificial lattice and molecular networks with various topological orders.

Topics will cover: 1) A control over the rotation directions of a standalone molecular motor using inelastic tunneling electrons from the STM tip, and a robust molecular propeller for the unidirectional rotation on metal surfaces. 2) Manipulation of a molecular machine network where synchronized rotation of all molecular motors in the network has been realized by using the electric field from the STM tip. 3) Negative differential resistance in the charge density wave phase of 1T-TaS2 has been induced by creating atomic level defects via STM manipulation. 4) After externally apply controlled amount of bending strain on MoS2, atomic stretch and ripples on materials was observed by STM. Strain amount, which is obtained by images of atomic resolution, together with the scanning tunneling spectroscopy reveal that MoS2 became less semiconducting with reduced bandgaps under higher strain. 5) For the future research direction concerning explorations of the molecular machine networks, a proposal for investigating spin interactions within the network will be discussed. I will also demonstrate how to build similar 2D molecular networks and artificial lattice in search for novel quantum phenomena.