UNL Department of Physics and Astronomy presents:

Quantum Sensing and Quantum Materials Discovery with the Scanning Tunneling Microscope

PRESENTED BY

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THURSDAY

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4:00 PM

IN JH 136

Refreshments will be served in the JH 1st Floor Vending Area at 3:30

ABSTRACT

The semiconductor roadmaps highlight the quick introduction of 1 nm transistors, exemplifying the ever-advanced miniaturization of active devices down to the ultimate length scales of molecules and atoms.

Nuances in the immediate atomic vicinity become decisive factors for their functioning and strongly influence electronic and magnetic

properties. Further progress will hinge on whether proper tools for the prototyping, discovery and characterization of quantum matter are available. Although the scanning tunneling microscope (STM) offers atomic insight, its energy resolution can be inadequate to detect weak interactions. The introduction of STM based electron spin resonance opened a perspective of how to combine the excellent energy

resolution of ESR with the atomic control of STM. We highlight these developments, mention their limitations, and discuss further work to generalize STM-ESR towards a universal quantum sensor.

To cover the aspect of quantum materials discovery, we introduce an accelerated mapping method that we apply to the band-structure

determination of quantum materials. Our combination of compressive sensing and parallel spectroscopy enables 1000-fold faster

measurements to rapidly provide dependable data against which

theoretical studies can be calibrated and create a massive dataset that can be used as input for big data approaches.

Together, these methods allow for deeper insight into exotic quantum materials' magnetic and electronic properties, ranging from single

molecule magnets, topological materials, field-effect devices, radicals, noncolinear magnetism, superconductors, to strongly correlated

electron systems.