Old Dominion University
Department of Physics

Colloquium

Thursday, February 28, 2019

"Uncovering the Interactions Behind Quantum Materials"

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Abstract:

The realization and manipulation of macroscopic quantum phenomena in materials has the potential to radically change our technological landscape; giving rise to scalable quantum computers, advanced devices and ushering in the era beyond silicon. However, fundamental to these envisaged applications is a mastery of quantum materials such as superconductors, quantum-spin-liquids and topological materials which act as their fundamental building blocks. Ideally, we would know exactly what interactions and conditions give rise to these phenomena and design materials suitable for applications however, such an understanding yet eludes us. Instead we are stuck digging around in the phase space of known quantum materials slowly uncovering pertinent details to their design, filling in pieces of our incomplete picture. In this presentation, I will discuss some of my work towards this goal and how we can develop vitally needed new strategies to find and design quantum materials. Starting with unconventional superconductivity, I will show how work in low dimensional systems (e.g. quasi-two-dimensional iron-pnictides and quasi-one-dimensional chromium-arsenides) has advanced our understanding and how my efforts have helped uncover fundamental mechanisms in these systems which are important input for microscopic theories. Next, I will discuss frustrated magnetic materials and their potential for realizing new physics, focusing on a little studied system of rare-earth pyrogermanates which exhibit a novel 'local-Ising' type magnetism – a unique order which can give rise to exotic quasi-particles such as magnetic monopoles. Finally, I will present my vision for a roadmap to how we can use some of my results, a close focus on materials and theory overlap as well as new computational tools to advance the discovery of new quantum materials.

Presentation: ECSB 1202 @ 3:00 pm (Engineering & Computational Science Building)
Refreshments: ECSB Atrium @ 2:30 pm

All interested persons are cordially invited to attend.