UNL Department of Physics and Astronomy presents:

Shining Light on Quantum Materials: From Fundamental Insights to Novel Applications

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

ABSTRACT

Quantum materials provide an exciting platform to understand emergent phenomena in condensed matter systems. Our ability to synthesize these materials with atomic precision opens up new possibilities of engineering novel functionalities and allows us to exploit them in devices for potential applications. Furthermore, by combining synthesis with advanced spectroscopy techniques, we are able to gain insights into these material systems that have remained out of reach of traditional experimental approaches.

In this talk, I will describe an application of such an approach using thin films of an inter-metallic mixed-valence compound, ytterbium trialuminide ($YbAl_3$). I will establish a precise one-to-one correspondence between the change in ytterbium (Yb) valence and a topological transition of the Fermi surface, which is accompanied by an enhancement of the Yb 4*f* density of states (DOS) at the Fermi level. I will show that this leads to a dramatic enhancement of spin hall conductivity in $YbAl_3$ at low temperatures that follows the same temperature scaling as that of the Yb 4*f* DOS, thereby revealing the connection between heavy fermion formation and the observation of giant spin hall conductivity in this compound. I will further show how interactions in this system can be modified by fabricating ultra-thin films and superlattices, where $YbAl_3$ atomic layers are separated by lutetium trialuminide ($LuAl_3$) layers. I will conclude by showing applications of a similar approach in two other inter-metallic systems viz. Heusler compounds and rare-earth monopnictides and outlining future directions in epitaxial quantum inter-metallic thin films.