MONTANA STATE UNIVERSITY | College of LETTERS & SCIENCE

Physics Colloquium

Friday, February 26, 2016
4:10 – 5:00 PM
EPS103

High-Field Electron Paramagnetic Resonance Studies of Molecular Nanomagnets

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For studying varied forms of matter, facilities at the National High Magnetic Field Laboratory (MagLab) in Tallahassee, FL, offer scientists from all over the world opportunities to use magnets providing magnetic fields up to 45 T — roughly one million times the earth's magnetic field. Electron Paramagnetic Resonance (EPR) performed at these extremes offers tremendous advantages for problems spanning diverse research fields from condensed matter physics, to chemistry, to biology. Most EPR research worldwide is performed at the X-Band frequency of 9.5 GHz. Specialized commercial instruments exist at K- (25 GHz), Q- (35 GHz) and W-Band (95 GHz), operating to magnetic fields of 6 T. At the MagLab, several home-built, high-field/high-frequency EPR instruments with continuous coverage from ~10 GHz to 1 THz [1]. After an overview of the MagLab EPR facility, the remainder of the talk will focus on molecular nanomagnets - molecules that contain either a single magnetic ion, or multiple exchange-coupled ions that possess a well-defined collective magnetic moment (or spin). These molecules are of interest in terms of their potential use as memory elements in both classical and quantum information processing devices. Results obtained using high-field EPR will be highlighted [2,3], emphasizing discoveries that have contributed to a recent shift away from the study of large magnetic clusters to simpler molecules containing highly anisotropic magnetic ions such as lanthanides or transition metals with unquenched orbital moments. The talk will conclude by describing a strategy for protecting molecular spin qubits against one of the more stubborn sources of decoherence — that of dipolar field fluctuations associated with electron and nuclear spins [4].

[1] https://nationalmaglab.org/user-facilities/emr
[2] J. Liu, E. del Barco, S. Hill, in Molecular Magnets – Physics and Applications, pp 77-110, eds. J. Bartolomé, F. Luis, J. F. Fernández, Springer Series on NanoScience and Technology (Springer-Verlag, Berlin-Heidelberg 2014); also http://xxx.lanl.gov/abs/1302.7305.
[3] K. E. R. Marriott, L. Bhaskaran, C. Wilson, M. Medarde, S. T. Ochsenbein, S. Hill, M. Murrie, Chem. Sci. 6, 6823-6828 (2015)
[4] M. Shiddiq, D. Komijani, Y. Duan, A. Gaita-Ariño, E. Coronado, S. Hill, Nature (accepted, Jan. 2016).

Hosts: Hugo Schmidt, Yves Idzerda, and Rufus Cone, MSU Department of Physics

****** Refreshments served in the EPS second floor atrium at 3:45 ******