

UNIVERSITY OF TEXAS AT DALLAS - DEPARTMENT OF PHYSICS

PHYSICS SEMINAR

<http://www.utdallas.edu/physics/lectures/info/>

Monday, July 16, 2007; 1:30-3:00 PM
Room: FN 2.106

Location, Location, Location: How Disorder Determines the Magnetic Properties of Nanomaterials

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Textbooks explain magnetism in terms of infinite pieces of well-ordered materials that exhibit phase transitions when magnetic correlation lengths approach sample dimensions. Materials are classified into a limited number of magnetic phases with simple dependences on temperature and magnetic field. Happily, most magnetic materials are far from being that simple.

Introducing chemical or structural disorder creates magnetic clustered states – highly local, magnetically ordered regions that then compete with each other to develop a more global order. Reducing characteristic lengths to the nanometer scale creates different local environments for atoms at surfaces and grain boundaries and, when the particles or grains are nanosized, these atoms can dominate the macroscopic magnetic properties.

I will use examples from our lab's recent research to illustrate our work in understanding the role of disorder in magnetism, including: an explanation of the anomalous dependence of the blocking temperature on nanoparticle size in MnO; how the ferromagnetic Laves-phase-alloy GdAl₂ changes into a magnetic glass with increasing disorder; and how different types of disorder common to different fabrication methods can be quantitatively parameterized and then related to macroscopic magnetic behavior.

About the speaker: Diandra Leslie-Pelecky earned the Ph.D. in condensed matter physics from Michigan State University in 1991 for work in two- and three-dimensional multi-layered spin glasses. Following postdoctoral work in the glass transition and chemically synthesized magnetic nanoparticles, she became an Assistant Professor in the Department of Physics & Astronomy and the Center for Materials Research and Analysis at the University of Nebraska – Lincoln in 1996 and an Associate Professor in 2002. Her research is funded by the Nebraska Research Initiative, the National Institutes of Health, the Department of Energy and the National Science Foundation. Her current research in nanostructured magnetism focuses on understanding the fundamental properties of disordered magnetic rare-earth alloys. In collaboration with Vinod Labsetwar at the University of Nebraska Medical Center, she is developing magnetic nanoparticles for MRI and drug delivery. Their development of a magnetic carrier carrying multiple anti-cancer drugs that can be targeted to tumors using magnetic fields has been featured by the National Cancer Institute's Alliance for Nanotechnology News. In addition to research, she directs Project Fulcrum, a NSF-funded GK-12 program that teams math, science and engineering graduate students with elementary and middle-school teachers to improve student achievement in math and science.