

Physics Summer Research at IUPUI

Study of Magnetic Nanostructures by Molecular Beam Epitaxy Growth

Prof. R. Cheng

Magnetic nanostructures, such as nanoparticles, nanowires and thin films are playing an important role in electronic sensors and devices. Our research is focused on the synthesis and characterization of newly designed magnetic nanoscale materials. Students will participate in the development of an e beam evaporator facility as well as the fabrication and measurements using modern surface science techniques such as scanning tunneling microscopy (STM).

Optical Spectroscopy of Quantum Dots

Prof. R. S. Decca

The project involves understanding the nature of the interaction between “quantum dots”. Quantum dots are very small particles (about 1/10,000th of a human hair in size) that are expected to have significant applications in science and technology. The students will be exposed to a variety of experimental techniques and equipment used in the frontiers of nanoscience (the science of the ultrasmall).

Magnetic Properties of Spin Systems

Prof. Y. Joglekar

Magnetic materials have tremendous practical applications in today's technology-driven world. Investigations of their properties have led to better hard-drives, medical imaging techniques such as the MRI, and so on. This project will focus on properties of two- and three-dimensional magnets. We will simulate the behavior of these magnets using Monte-Carlo methods. The project will involve systematically generating and analyzing the data using a program written in C, comparing the data with experimental results available, and extending the results to nano-magnets in which their size affects the magnetic properties. Expertise in calculus, algebra, trigonometry is necessary and experience with C programming is preferred.

Physical Studies of Biological Membranes

Prof. H. I. Petrache

Biological membranes have very interesting physical properties. Students will learn how to prepare membrane samples in the laboratory and how to measure their properties by using x-ray scattering and ion-channel currents. A number of experiments are interdisciplinary and will be in collaboration with researchers from the School of Medicine. A theoretical project is also available. Students will be encouraged to formulate many questions and to draw conclusions based on their own work.

Computational Analysis of Biomolecular Flexibility and Dynamics

Prof. A.J. Rader

A research opportunity in computational biophysics investigating the motions and related functions of enzymes using computer simulations is available. This project would require using computer programming skills to enhance existing simulation methods and analyze simulation data. A primary goal is a quantitative comparison of different simulated pathways and motions.

Biophysical Studies of Membranes

Prof. S.R. Wassall

A thin membrane that is <5 nm in thickness surrounds cells. It is comprised of lipids and proteins arranged in domains or patches of specific composition, formed because the molecules possess differential affinity for each other. Our research applies biophysical techniques, particularly magnetic resonance, to investigate the lipid-driven formation of domains in well-defined model membranes. A student recruited to our laboratory would focus on cholesterol and vitamin E, two influential lipid molecules that preferentially segregate into organizationally distinct domains.

Coarse-grained model development of proteins

Prof. M. Betancourt

Proteins are natural molecular machines that carry out most functions in living organisms. They have a wide variety of structural and physical properties, which to date are still a challenge to model. Simplified models to carry out computer simulations of some of the most complex protein processes are needed. Toward this goal, students will carry out simulations of some of these processes using current computational methods to improve and test new simplified protein models. A strong interest in learning and programming using languages such as C, C++, Perl, or Python is required.

Please visit our research pages at
<http://www.physics.iupui.edu/staff.html>