Physics Senior Research Oral Presentations

Michigan Technological University

Thursday, April 19, 2012
3:30 – 5:00pm
Room 139 in Fisher Hall

Decreasing Aerodynamic Drag by Altering Tortuosity

Mark Ingram
Advisor: J. Allen

The aerodynamic drag on blunt objects is greater than the drag on streamlined bodies due to the disruptions in flow caused by the leading edge. We have performed experiments in which the tortuosity of samples were altered, using of fibrous samples and measured the resulting drag in a wind tunnel. Our tests show that the magnitude of the drag can be decreased As a result, implementing materials with lower toruosities into automotive, construction and recreational products could help reduce costs while increasing efficiency and speed.

Computational Examination of the Stability of Chitanium

Greg Lau
Advisor: R. Pandey

Materials found in nature tend to be optimized for their purpose. In this study, I combine two naturally occurring material structures in an attempt to synthesize a new, unique material. Chitin is used to form an amino acid and then combined with other natural amino acids to form a new protein. As this is difficult to perform in experiment, the component molecules are examined computationally for stability and structure. They are found to be stable and conducive to forming the final molecule, Chitanium. However, the process proves to be endothermic, as expected by the lack of existence in nature.

Balanced Detection of Squeezed Light Generated through third-order Nonlinear Processes

Justin Holmes
Advisor: K.F. Lee

Four-wave mixing in a nonlinear optical medium can produce a signal made up of correlated photon pairs. This signal has the additional property of reduced uncertainty in the magnitude of its complex amplitude at the cost of increased uncertainty in phase. We used a pulsed laser in optical fiber with a high third-order Kerr coefficient to generate this squeezing effect. We then employed a noise-measurement technique called balanced homodyne detection to confirm the reduced noise level of the squeezed signal relative to a coherent signal.

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Heterogeneous Ice Nucleation by Mineral Dust
Xin xin (Zoe) Fan
Advisor: W. Cantrell

Ice in clouds is an important part of the climate system. For instance, ice affects the ways in which clouds interact with solar and terrestrial radiation, which plays a critical role in determining Earth's equilibrium radiative temperature. The amount of ice in clouds is affected by how it nucleates. Water mixed with mineral dust is rather common in clouds, which leads to higher freezing temperatures (as compared to pure water). Heterogeneous nucleation is usually taken to be a function of the surface area of the catalyzing substance. I have investigated freezing of water catalyzed by Arizona Test Dust and have found that some dust particles are better nuclei than others. I will discuss freezing rates for different densities of dust dispersed in water.

Calibration of Photomultiplier Tubes for the High Altitude Water Cherenkov Experiment

Edward Leonard, Jr.
Advisor: P. Hüntemeyer

The High Altitude Water Cherenkov (HAWC) Experiment is a gamma ray observatory currently being built at 4100m elevation near Puebla, MX. The observatory will consist of 300 water Cherenkov detector tanks, each of which will contain four photomultiplier tubes (PMTs) to detect the Cherenkov radiation from the charged particles in an extensive air shower moving through the tanks. The calibration of these PMTs is crucial in reconstructing the original gamma ray. One method to accomplish this is via afterpulsing in the PMTs. The method will be described as will results from first studies of this phenomenon in VAMOS (an engineering array at the HAWC experimental site) that suggest that using afterpulses in PMTs is a viable method.

A Computational Analysis Of Raman Spectra Across An Impure Tungstenite Crystal
Peter Solfest
Advisor: J. Jaszczak

The Raman spectra across a sample of Tungstenite doped with Molybdenum from Crevoladossola Quarry, Italy exhibits several intriguing features. Relative to the spectrum of pure Tungstenite , the peaks in the sample from Crevoladossola are broader. New peaks are also apparent. We simulated systems of Molybdenum doped into Tungstenite with CRYSTAL09, yielding peaks and their corresponding modes exhibited by the Raman spectrum. Furthermore, the mass of tungsten was computationally varied to identify the features of the spectra which were attributable to the electronic structure as opposed to the mass variation within the mixed system. The vibrational modes responsible for the changes in the Raman spectra were thus identified.