Physics Senior Poster Session

Michigan Technological University

Thursday, April 10, 2008

2:00 – 4:00pm

Fisher Hall Atrium (near the Aftermath)

Numerical Calculation of the Yeh Band Gap in Birefringent One Dimensional Magnetophotonic Crystals
Matt Hansen, Physics Senior
Advisor: Dr. Miguel Levy

Abstract: Photonic crystals are periodic, repeating structures whose properties influence the propagation of photons through the crystal. The periodic nature of the crystal creates forbidden energy bands known as photonic band gaps. An incident photon whose energy lies within a band gap of the crystal can not propagate in the crystal. Photons outside the band gap have a corresponding Bloch wave number and are allowed to propagate in the crystal. Mathematical calculations of the dispersion relation in such photonic crystals indicate that near where the fast and slow light branches should "intersect" on the dispersion relation chart, a photonic band gap forms instead. We call these specific band gaps "Yeh band gaps" in honor of their discoverer, and are the focus of this research. Yeh band gaps to date have been too small to measure experimentally; in this research a computer program was developed to calculate the size of these Yeh band gaps, with the goal of finding a crystal configuration resulting in a large Yeh band gap.

Dispersion and Characterization of Multiwalled Carbon Nanotubes
Robert Niffenegger, Physics Senior
Advisor: Dr. Yoke Khin Yap

Abstract: Carbon Nanotubes (CNTs) have the potential to become the most versatile material ever discovered, with applications in computers, materials and as sensors. However, they are still too hard to control to make much outside of the lab practical. A common method of controlling and dispersing CNTs is aqueous solution but, CNTs have a very low solubility in conventional solvents [4]. In water the CNTs cling together forming tangled bunches from the strong Van Der Waals attraction among the CNTs [5]. This makes measurement of physical properties such as electrical properties of a single carbon nanotube difficult. This poster shows results of an easy and simple surfactant assisted dispersion in ethanol and attempts to measure the I-V curve of multiwalled carbon nanotubes.

Horizontal Attenuation Model at the Pierre Auger Observatory
Katie Thorne, Physics Senior
Advisor: Dr. Brian Fick

Abstract: Determining the sourced of ultra high energy cosmic rays is the motivation for my research. The Pierre Auger Observatory calibration is one of the pioneering groups dedicated to searching for the source of ultra high energy cosmic rays. The Observatory consists of ground based water tank detectors and fluorescence detectors. The fluorescence detectors determine the energy of the cosmic rays based on the amount of ultra violet light emitted by the incoming particle. This process is called a cosmic ray shower. The Horizontal Attenuation Monitor (HAM) measures the “clarity” of the atmosphere during the cosmic ray showers. I am currently working on modifying HAM in order to optimize the “clarity” measurements of the atmosphere. I’ve incorporated a diffraction grating based measurement device that allows for multiple wavelengths to be studied at once. The preliminary results appear to be promising.

Correlation between Shower Front Curvature and Primary Particle Composition of Extensive Air Showers
Benjamin C. Gookin, Physics Senior
Advisor: Dr. Brian Fick

Abstract: Ultra High Energy Cosmic Rays (UHECR) are particles that are extra galactic in origin, which have an energy greater than 10 EeV. This is seven orders of magnitude larger than the expected collision energies in the LHC. When these particles enter the atmosphere, they interact and create Extensive Air Showers (EAS) via pair production and Bremsstrahlung radiation. The Pierre Auger Observatory records these EAS using florescence detectors and water-Čerenkov detectors on the ground. Figuring out the primary particle composition is of great importance so that we may understand how these particles are accelerated to these vast energies. As of now, the main method of determining the primary composition relies on the florescence detectors. These detectors only work on moonless, clear nights. Therefore, to be able to use the water-Čerenkov detectors to determine the composition would allow constant monitoring of composition for all EAS. This is a study to see if shower front curvature, a measurement taken by the water-Čerenkov detectors, could be used in determining the primary particle composition.

Exchange Reaction Rates of Deuterium Oxide and Gaseous Hydrogen
Benjamin Meier, Physics Senior
Advisor: Dr. Jacek Borysow

Isotopic purity of hydrogen isotopes is critical for proper operation of nuclear fusion reactors, especially in the future International Thermonuclear Experimental Reactor (ITER) project. Tritium, deuterium, and hydrogen react readily with each other. The goal of this study is to measure the exchange rates of reactions between deuterized water and hydrogen by monitoring the production of water and partially deuterized water as a function of time.

Nonlinear Wavefunction Solutions as Coherence Improvement in Quantum Computing Media
Anthony Hegg, Physics Senior
Advisor: Dr. Bryan Suits

Heterogeneous Ice Nucleation with Organic Compound Monolayers
Alexandria Blanchard, Physics Senior
Advisor: Dr. Will Cantrell

Determination of the 2006 Fireball Rate from Continuous CCD Fisheye Monitoring
Jennifer Huyck, Applied Physics Senior
Advisor: Dr. Robert Nemiroff

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