Physics Colloquium

Michigan Technological University

Thursday, April 5, 2012
4:00 pm in Room 139 Fisher

Sensitivity of Boron Nitride Nanotubes
Toward Biomolecules of Different Polarities
Saikat Mukhopadhyay
Advisor: Prof. Ravi Pandey

Abstract: In this talk, the effect of molecular polarity on the interaction between a boron nitride nanotube (BNNT) and amino acids will be discussed within the framework of density functional theory. Three representative amino acids, namely, tryptophan (Trp), a nonpolar aromatic amino acid, and asparatic acid (Asp) and argenine (Arg), both polar amino acids are considered for their interactions with BNNT. The polar molecules, Asp and Arg, exhibit relatively stronger binding with the tubular surface of BNNT. The binding between the polar amino acid molecules and BNNTs is accompanied by a charge transfer, which suggests the stabilization of the bio-conjugated complex is mainly governed by electrostatic interactions. Our results predict the possibility of modulation of the BNNT band gap via adsorption of Trp on BNNT. Interestingly, however, no change in band gap of BNNT is noted for the polar molecules Asp and Arg. The predicted higher sensitivity of BNNTs compared to carbon nanotubes (CNTs) toward amino acid polarity suggests BNNTs to be a better substrate for protein immobilization than CNTs. *In collaboration with: Ralph H. Scheicher, Shashi P. Karna*

Laboratory Studies of Ice Nucleation Efficiencies
of Mineral Dusts in the Contact Mode
Kristopher Bunker
Advisor: Dr. Will Cantrell

Abstract: Understanding how ice is formed is a major outstanding challenge in predicting weather and climate. Of the known initial ice formation pathways (homogeneous, deposition, immersion, condensation, and contact), the least understood is contact nucleation. There is ample evidence of ice initiation in clouds in the temperature range -15 to -20 C. Laboratory studies, however, show that mineral dusts, the most prevalent known natural ice nuclei, are not effective in the immersion/condensation mode for temperatures above ~ -25 C. Ice nucleation in the contact mode has been hypothesized as a possible mechanism for ice initiation at relatively high temperatures. This presentation will highlight recent preliminary experimental results conducted at Michigan Technological University that were designed to address this hypothesis. Two common mineral dusts were investigated as contact ice nuclei and were selected by their electrical mobility using a Differential Mobility Analyzer.

Muon Production Depth from the Ground Particle Information:
an Approach to Discriminate the Exotic Cosmic Ray Events from the Normal Ones
Niraj Dhital
Advisor: Dr. Brian Fick

Abstract: Interactions of ultrahigh energy cosmic ray particles with the atmospheric nuclei have potential to produce new exotic elementary particles. These particles sometimes can affect the overall development of extensive air showers, depending on their nature of further interaction. From the information of timing and position of the particles that reach the ground, longitudinal evolution of extensive air showers can be studied. Among the particles that reach the ground, muons are the most useful ones, as they preserve the information about their production depth. After reconstruction of the production depth of muons arriving on the ground and applying the necessary corrections, we can study the longitudinal development of shower. This longitudinal shower profile is useful to discriminate the exotic cosmic ray events from the normal ones.

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