Physics Senior Research Oral Presentations

Michigan Technological University

Thursday, April 21, 2011

2:45– 5:00pm

Room 139 of Fisher Hall

Time of Presentation 2:45

The HAWC Data Challenge

Eric Petersen

Adviser: Dr. Petra Huentemeyer

Abstract: A fast simulation has been written to test the sensitivity of the High Altitude Water Cherenkov (HAWC) Observatory to cosmic γ-rays between .1 TeV to 100 TeV. The background is modeled after the GALPROP model, a numerical simulation of gamma and cosmic ray propagation in our Galaxy. In addition to the background, there are various point, extended, and time varying sources with different spectra (eg. Pulsar Wind Nebulae and Gamma Ray Bursts). Response distributions extracted from existing simulated data are used to parametrize the detector. The goal of this work is to provide simulated data for varying time periods (seconds to years) with which the sensitivity of the HAWC instrument and analysis software can be tested for specific astrophysical phenomena.

Time of Presentation 2:58

Whispering Gallery Modes as a Detection Method
for Properties of Acoustically Levitated Water Droplets

Justin Wojdula

Advisor: Claudio Mazzoleni

Abstract: A technique for measuring backscattered light from acoustically levitated and collected water droplets is presented. Whispering gallery modes (WGM's) are detected in droplet scattered light which can be utilized to find the evaporation rate, composition (predicted) and the contact nucleation point of atmospheric droplets. Through the combination of WGM detection, cylindrical acoustic levitator and symmetry matching tuning rod an atmospheric cloud is approximated and analyzed.

Time of Presentation 3:11

In-situ Measurement of Cloud Droplet Lagrangian Properties

Joe Wilm

Advisor: Dr. Raymond Shaw

Abstract: In-situ measurements of cloud droplet size, position, velocity, and acceleration distributions are to be determined through application of digital in-line holography. Holographic microscopy is utilized in order to resolve particle sizes on the order of single microns. Synthetic single particle and particle field holograms are used to test reconstruction code which is then proved through reconstruction of real holograms both magnified and otherwise.

Time of Presentation 3:24

Using Raman Spectroscopy for Medical Diagnosis

Jess West

Advisor: Dr. Jacek Borysow

Abstract: We are developing a non-invasive, low cost device to analyze chemical composition of person's breath for medical diagnosis. The technique utilizes a unique, non-dispersive Raman spectrometer, built around tiny laser diode, interference filters, and an avalanche photo-diode (APD) as a light detector. The diagnosis is based on the detection, in real time, of traces of gases, e.g. hydrogen, in person's breath at levels of few parts per million. As test case, we have demonstrated that presence of molecular nitrogen in the air can be detected with a signal to noise ratio of approximately 15.

Time of Presentation 3:37

An Atomic Absorption Filter for Non-Dispersive Raman Spectroscopy

Matt Guthrie

Advisor: Jacek Borysow

Abstract: We are developing the method and apparatus suitable for the discrimination of two closely spaced spectral lines. The essential part of this apparatus is an atomic absorption filter based on cesium vapor placed in a strong inhomogeneous magnetic field. This apparatus may be used for the detection of isotopes and isotopic ratios by Raman spectroscopy. In particular, our objective is the diagnostic determination of the $^{13}CO_2$:$^{12}CO_2$ ratio in a test sample for the detection of stomach ulcers.