Physics Colloquium

Michigan Technological University

Thursday, March 22, 2012
at 4:00 pm in Room 139 Fisher

Calibrating a Gamma-Ray Observatory

Nathan Kelley-Hoskins
Advisor Petra Hüntemeyer

Abstract: The High-Altitude Water Cherenkov (HAWC) Experiment is a second-generation high sensitivity gamma-ray and cosmic-ray detector being built near Puebla, Mexico. HAWC utilizes the water Cherenkov technique to measure extensive particle showers caused by the interaction of cosmic particles with the atmosphere. The detector is an array of closely packed water tanks instrumented with 4 photo multipliers (PMTs) each. The direction of a gamma ray will be reconstructed using the times when the PMTs in each tank are triggered by particles from a shower. Therefore, the timing calibration will be crucial for reaching a directional resolution as low as 0.1 degrees in right ascension and declination. To achieve this, I have tested a laser calibration system here at Michigan Tech that will be deployed with the HAWC experiment in Mexico this year. The HAWC optical calibration system uses 0.3 ns laser light pulses, directed into optical fiber networks. Each network will use optical fan-outs and switches to direct light to specific tanks, calibrating all 4 PMTs in each tank. In my presentation, I will present the design of the calibration system and a description of its performance.

Calibrating the Response Time of the HAWC Electronics

Hao Zhou
Advisor: Petra Hüntemeyer

Abstract: The HAWC array will consist of 1200 photomultiplier tubes (PMTs) placed in 300 water Cherenkov detectors (water tanks). The accurate relative time between the electronic PMT channels is important for reconstructing the arrival direction of particle showers caused by the interaction of cosmic particles with the atmosphere. However, the response time of the PMT and electronics depends on the light intensity measured by the PMT. To calibrate the response time, a series of laser pulses of different intensities is fired into the tanks, and the time from firing the laser to detecting a signal in the PMT is measured. The measured response time is applied in the angular reconstruction of particle showers. I will present results from first tests of the method with a prototype water Cherenkov detector at Colorado State University.

VAMOS - A Test Experiment for Gamma-Ray Detection at High Altitude

Hugo Ayala
Advisor: Petra Hüntemeyer

Abstract: VAMOS is an engineering array of seven water Cherenkov detectors located at 4100 m on the Sierra Negra plateau in Mexico, the same site that has been selected for the HAWC Gamma-ray observatory to be completed in 2014. The purpose of VAMOS is to 1) proof the viability for building the larger HAWC observatory, an array of 300 such detectors, at such a remote high-altitude site and 2) to test and confirm the data analysis and simulation software that will be used for the larger HAWC array. One of the purposes of the VAMOS array in particular is to test event reconstruction algorithms. This includes finding the direction from which an Extensive Particle Shower caused by the interaction of a Gamma-ray with the earth atmosphere originated. The direction of a shower is found by reconstructing the front of shower particles that strike the detector array. This reconstruction relies heavily on the accuracy of the relative timing between all the detector (i.e. photo multiplier) channels. One way of improving this accuracy is to calculate and apply the so-called time residuals, that is the difference between the measured time of a photo multiplier signal caused by an air shower to the signal time in this channel expected from using all other channels participating in the shower reconstruction. In my presentation, I will describe the air shower reconstruction algorithm used by HAWC and first studies of time residuals with data collected by VAMOS.

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