Poster Session 1

Commons East, Easel 65

11:00 AM to 1:00 PM

Developing Pulse Rejection Techniques to Reduce Backgrounds in the Search for Neutrinoless Double-Beta Decay

Matthew Stortini, Senior, Physics: Comprehensive Physics
Mentor: Jason Detwiler, Physics
Mentor: Clint Wiseman, CENPA

Is the neutrino its own anti-particle? This is a question physicists do not have the answer to, but if a process known as neutrinoless double-beta decay were observed then it could be said with certainty that the neutrino is indeed its own anti-particle. In an attempt to search for said process, researchers at UW have joined forces with researchers from a number of other institutions to form the group known as LEGEND (Large Enriched Germanium Experiment for Neutrinoless Double-Beta Decay). The source used for this experiment that undergoes double beta-decay is Germanium-76. This source is also used for the detector itself. When a beta decay happens in the detector a pulse proportional to the energy of the electrons emitted is produced. If these electrons have all the energy available from the decay, then it will be known that no neutrinos are present. What makes things tricky is that if this process occurs it does so with a half-life greater than $10^{2}6$ years. Thus, counting rates for this process will be very low, and very low backgrounds will be needed to effectively carry out the experiment. Currently at UW we are working on developing pulse rejection techniques that will allow us to get rid of unwanted background events that our detectors measure. The project I'm presenting on involves aiming a collimated alpha source at our detector, and the goal is to develop techniques that allow us to reject pulses resulting from alpha decays. A number of other collimated sources are also aimed at the detector in order to study rejecting the pulses that they give rise to. In order to help design this experiment I am running simulations in the Geant4 based application "g4simple" to determine collimator dimensions and materials that will work best for different radiation sources.

Session 1K

Physics: Fundamental and Applied

Session Moderator: Alejandro Garcia, Physics

MGH 254

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

An Internal Scanning Cryostat for High Purity Germanium Detectors

Tim Mathew, Senior, Physics: Comprehensive Physics
Mentor: Jason Detwiler, Physics
Mentor: Clint Wiseman, CENPA
Mentor: Gulden Othman, Physics

High purity germanium (HPGe) detectors are an important technology in several leading experimental searches for dark matter and neutrinoless double beta decay. Understanding the interaction of various types of radiation on the different surfaces of HPGe detectors is essential to developing methods to reject unwanted signals from radioactive background sources. I have taken a leading role in the construction and use of the Collimated Alphas, Gammas, and Electrons (CAGE) test stand at the University of Washington, whose goal is to evaluate the response of an HPGe detector to different types of radiation on its various surfaces. CAGE is a vacuum cryostat with an internal system of motors that move a radiation source while keeping the detector active. It requires the operation of a liquid nitrogen cryostat, vacuum pump, temperature sensors, and various radioactive sources, all of which must be integrated into a single data acquisition (DAQ) system. We are currently constructing this system, fabricating and installing parts, and are planning to take initial data with the HPGe detector in the summer. In this talk I will present the current status of the CAGE detector, as well as preliminary data from radiation signals in the detector.

SESSION 1K

PHYSICS: FUNDAMENTAL AND APPLIED

Session Moderator: Alejandro Garcia, Physics
MGH 254
12:30 PM to 2:15 PM

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Temperature Study of a NaI[Tl] Crystal Scintillator Detector

Keira Hansen, Junior, Physics: Comprehensive Physics
Mentor: Jason Detwiler, Physics
Mentor: Clint Wiseman, CENPA

Here at the University of Washington we are characterizing one ton of NaI[Tl] crystal scintillator detectors for use in the COHERENT project. NaI[Tl] scintillating crystals detectors work by producing photons from the kinetic energy of charged particles passing through the scintillating material. COHERENT aims to detect coherent elastic neutrino-nucleus scattering, a novel interaction between neutrinos and matter that was first observed less than two years ago. It employs a large scale of scintillator detectors in order to record these events at an appreciable scale. Our characterization campaign allows us to group crystals with similar outputs by voltage which will determine the setup of our detectors once at ORNL. During this characterization, the crystals exhibited behaviors that correlated with the ambient temperature of the lab. The temperature dependence was first noticed during voltage gain characterization tests taken at different times of the day in the uncontrolled temperature environment of our lab. We expect the gain of our crystals to fit to a curve function, which breaks down if data is taken at different times of the day. The goal of this study is to understand the impact of temperature dependencies on our characterization campaign, and in particular to derive a relationship between voltage gain and temperature. I will present the data gathered toward this goal, and also our larger body of data on the relationship between light yield, voltage gain, peak resolution, and waveform rise time, as well as the techniques used to re-characterize previous crystals gain curve based on the derived relationship from this study.