Presentation text

Slide 3

The standard model of elementary particles classifies the four fundamental forces and elementary particles in our universe. Several phenomena are not described by this model. One of them is Dark matter which is supposed to make up for 27% of our universes energy but is very hard to detect. One class of particles that ís described in this model are the neutrino's. Neutrinos are a type of fermions that are produced in several processes. One of these processes in in particle accelerators. They exist in three different neutrino flavors: muon neutrinos, tau neutrinos and electron neutrinos. They were consideren massless, but the interaction between different neutrino flavors leads to neutrino oscillations, proving they do have mass. Because neutrinos's and dark matter do not easily interact with other particles, it is quite hard to detect them. To do so, we use Time projection chambers as detectors.

These are chambers usually filled with liquid xenon for DM detection and liquid argon for neutrino detection. This is because they are dense, non-reactive materials that have scintillation properties. When a neutrino or DM particle weakly interacts with the argon or xenon, it produces a charge particle. When a charge particle passes through the liquid they ionize it generating scintillation light (S1). Under the influence of an electric field, the charged particles drift towards the TPCs anode. Due to collisions with the gas phase they can generate more charged particles resulting in the secondary scintillation (S2). This provides information about the particle's track and energy.

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The biggest neutrino detector is DUNE which stand for deep underground neutrino experiment and is being constructed right now. It is located at the sanford underground reseraarch facility and is 1300 km away from the fermilab where neutrinos are being produced due to the proton accelarator. These neutrinos travel underground in the direction of the DUNE detector.

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The scintillation light wavelength of liquid argon that is generated in DUNE is around 127 nm which is in the UV range. It is important to know how this scintellation light interacts with the materials inside DUNE before it reaches the sensors. To do so, we have three samples for which we will test the optical properties under UV light. These samples are copper from the charge readout plane, aluminium form the cryostat and a third sample that I do not yet have information from.

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The first problem we attacked in the comissioning phase was the vacuum. The vacuum did not reach its full potential. The lowest it got was xxx mBar. We wanted to find out if this was because of a disfunctional pressure sensor or leak in the VUV chamber. We got the pressure sensor tested by the mechanical department and they proved it was working correctly. We then disconnected the monochromator from the vacuum chamber and attached the pressure sensor directly to the monochromator as shown in this photo. The final pressure was significantly lower in this setup, suggesting that a possible leak might indeed be in the vacuum chamber, or the connection to the vacuum chamber.

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The second part of the setup we needed to solve was the digitizer. We wanted to start by measuring the dark count of teh SiPM's in the vacuum chamber. The prolem we experienced was that we could not read out the data. The digitizer showed an error because the trigger rate was too high and it could not process all the data. This problem was solved last week. Instead of putting the trigger on the signal, we attached an external trigger al 1000 Mh. For every trigger, we measure the data for xxx nanoseconds. The results of one of these data chunks are shown here. What I am doing now is fitting and correcting for the baseline and calculating the dark count rate. We suspect there might be light present in the vacuum chamber because one of the openings did not have correct coverages in mano's setup which is temporarily solved with tape and aluminium foil. I will verify this by calculating which ADC peaks that account for more than one photon and compare this with the probablity of this occuring in dark count so I can estimate the amount of light present.