Online Proceedings

Poster Session 2

MGH 258, Easel 188

1:00 PM to 2:30 PM

Axion Haloscope: Electric Tiger

Yujin Park, Senior, Physics: Comprehensive Physics, Astronomy
Mentor: Gray Rybka, Physics

Astrophysical measurements indicate that the universe has three main constituents: the ordinary matter, dark matter, and dark energy. Ordinary matter is the matter that we see in our daily lives and only contributes a small percentage of the total matter of the universe, while the dark matter takes up 84.5% of the total mass of the universe. There are several candidates for what dark matter could possibly be, one of which is a particle called the axion. The axion may be detected using a device called ”axion haloscope”, in which axion dark matter resonantly converts to a microwave photon when interacting with the magnetic field. These resulting photons can be detected with low noise electronics. The Electric Tiger is an ”axion haloscope”, an experiment made up of a waveguide. The waveguide is a rectangular box which contains dielectrics positioned at equal distances within the cavity, with the distance between the dielectrics retracting or extending. Changing the distances between the dielectrics makes the device sensitive to the detection of the axion signal in the magnetic field for a range of possible axion signals. The preliminary results of this experiment will detect or exclude axion dark matter in the previously unexplored range of masses for the axion particle.

Poster Session 4

Commons East, Easel 55

4:00 PM to 6:00 PM

Magnetic Field Stability Analysis Using ESR in Project 8 Phase II Experiment

Shirley Chen, Senior, Physics: Applied Physics
Mentor: Mathieu Guigue, Physics
Mentor: Gray Rybka, Physics

A neutrino is a neutral massless particle in the Standard Model of particle physics. However, this conflicts with observations of neutrino oscillations that require neutrinos to have nonzero masses. This conflict motivates a direct measurement of neutrino mass. The Project 8 Research Collaboration’s approach to direct neutrino mass measurement utilizes a developed technique called Cyclotron Radiation Emission Spectroscopy (CRES). In CRES, the energy of a single electron in a uniform magnetic field determines the frequency of the electromagnetic radiation emitted by the gyrating electron. For a precise measurement of electron energy, knowledge of the field’s value and stability is essential. Project 8 uses electron spin resonance (ESR) probes to monitor the magnetic field’s stability. This work aims at quantifying the contribution from the magnetic field fluctuations to the error budget on a neutrino mass measurement. I will present my analysis of the Project 8 ESR data to measure fluctuations within the magnetic field, such as drift, with a least-squares analysis method, providing an in-depth look in the stability of the field.