Contribution ID: **59** Type: **not specified**

Dark Sector Particle Searches at Rare Nuclear Isotope Accelerator Facilities

Tuesday, May 24, 2022 4:36 PM (23 minutes)

Recent discoveries of a new scalar boson, the gravitational wave and the black hole greatly advance our understanding of the nature of the universe. The 95% of the universe, however, is yet to be uncovered. Of these is the dark matter thought to make up about a quarter of the universe. Dark matter has been searched both directly and indirectly. Direct searches have hard bounds in the low mass regime due primarily to the radioactive impurities in the detector active materials. Recent theoretical advances and precision neutrino experimental facilities under development present an opportunity to expand dark sector particle searches in accelerators. The unprecedented proton beam power and precision detection capabilities make it possible. Many nuclear rare isotope facilities either ready for operation or close to be completed also possess similar advantages in search of dark sector particles in a different kinematic regime, providing synergistic opportunities. The primary challenges in this endeavor, however, are the backgrounds from neutral particles, in particular the beam related neutrons. In this talk, I will present a case study at a rare nuclear isotope facility, in particular the Axion-Like Particle (ALP) and present a methodology and a strategy to overcome the challenges. I will discuss the search sensitivity of the ALP and demonstrate the feasibility for dark sector particle searches at the rare nuclear isotope facilities.

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Session Classification: Electroweak