Contribution ID: **27** Type: **Oral talk - Experiment**

Evidence for DM-like anomalies in neutron multiplicity spectra

Wednesday, May 18, 2022 2:00 PM (25 minutes)

Most terrestrial Dark Matter searches employ Direct Detection by looking for recoils from elastic scattering of Weakly Interacting Massive Particles. However, if the weakly interacting Dark Matter particles exist and interact with ordinary matter, such a WIMP-Baryon interaction may disintegrate both the WIMP and the baryon nucleus in the process. Such an event would send out gamma-rays and particles in all directions. A heavy target nucleus, such as Pb, would release many neutrons and protons. Part of the energetic protons would undergo (p,n) and (p,2n) reactions on the surrounding nuclei, further increasing the number of the emitted neutrons. For WIMP masses over 10 GeV/c2, one would expect emissions exceeding 100 neutrons. Although the WIMP self-annihilation cross-section must be small, such an intense neutron burst would provide a distinct signature detectable with a sensitive detector system in a low-background underground laboratory. Since the bulk of ambient neutrons come from cosmic-ray muons, it is essential to go deep underground or use a muon veto.

We have now analyzed neutron multiplicity spectra collected by three independent underground experimental setups: NEMESIS [1-3], NMDS [4], and ZEPLIN-II [5]. Interestingly, there are small but consistent anomalies in the neutron spectra from all three measurements. Adjusted for differences in neutron detection efficiencies, the positions of the anomalies agree very well. Also, the intensities match when corrected for the acquisition time and detection geometry. Therefore, while separately the three measurements are inconclusive when analyzed together, they exclude a statistical fluke to better than one in a million level.

With a five times larger target mass, six times the number of neutron detectors, dedicated lepton counters, and an improved muon veto, the proposed NEMESIS upgrade should confirm the anomalies' existence, multiplicity, and intensity above the 5σ discovery level.

[1] W.H. Trzaska et al., J. Phys.: Conf. Ser. 2156 012029. http://doi.org/10.1088/1742-6596/2156/1/012029

[2] W.H. Trzaska et al., PoS(ICRC2021)514, https://pos.sissa.it/395/514/pdf

[3] M. Kasztelan et al., PoS(ICRC2021)497, https://pos.sissa.it/395/497/pdf

[4] T.E. Ward, private communication, and AIP Conference Proceedings 842, 1103 (2006).

[5] H. M. Araujo et al., https://arxiv.org/abs/0805.3110 [hep-ex].

Primary authors: TRZASKA, Wladyslaw Henryk (University of Jyvaskyla); WARD, Thomas (TechSource Incorporated/DOE-NE); ENQVIST, Timo (University of Jyvaskyla); SZABELSKI, Jacek (NCBJ); KSZTELAN, Marcin (NCBJ); JEDRZEJCZAK, Karol (NCBJ); LOO, Kai (University of Mainz); SLUPECKI, Maciej (Helsinki Institute of Physics); USOSKIN, Ilya (Oulu University); PUPUTTI, Julia (Oulu University); BARZILOV, Alex (UNLV); JOUTESNVAARA, Jari (Oulu University); KUUSINIEMI, Pasi (University of Jyvaskyla); OSSI, Kotavaara (Oulu University); ORZECHOWSKI, Jerzy (NCBJ)

Presenter: TRZASKA, Wladyslaw Henryk (University of Jyvaskyla)

Session Classification: Parallel

Track Classification: Indirect dark-matter searches