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Neutron Veto Detector of DarkSide-50 Experiment

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DarkSide-50 is a direct WIMP search underground experiment located at Gran Sasso, Italy. A detector with an active volume containing 50 kg of liquid argon, the DarkSide-50 Time Projector Chamber (TPC). The DarkSide-50 TPC is surrounded by a 30-ton boron-loaded liquid scintillator spherical neutron veto. This neutron veto is immersed in a 1,000 ton ultra-pure water, Cherenkov detector, acting as a muon veto and passive shielding against external neutrons and gammas. In DarkSide-50 experiment, we both actively suppress and measure the rate of neutron-induced background events by using the neutron veto detector. The boron-loaded liquid scintillator detector can detect the prompt coincidence signals coming from neutron thermalization after a neutron leaves TPC, as well as the delayed signal caused by neutron capture reaction with 10B, 1H and 12C. The capability of LSV to remove these neutron backgrounds requires a very high neutron veto efficiency. In order to quantify the response of LSV to neutron signals, neutron source calibrations were conducted in the last few years. One of the campaigns deployed Americium-Beryllium (241Am9Be) source and the other one was accomplished with Americium-Carbon (241Am13C) source. With 241Am9Be source, the neutron capture signals on 10B along with other isotopes in the LSV are studies to give a neutron veto efficiency of capture. However, the neutron from 241Am9Be source is in coincident with γ particles most of the time, which is not a good candidate source for the prompt neutron veto efficiency. To compensate this, 241Am13C source, a much cleaner neutron source, was deployed to study the neutron thermalization signals in the veto prompt region so that the neutron veto efficiency of prompt can be derived, which is a crucial feature of the DarkSide-50 experiment. In this talk, I will give both the calculation of the neutron veto efficiency and the expected radiogenic neutron background events in one year UAr data.

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