Data-driven projected WIMP sensitivity of XENONnT Experiment with neutron Veto

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中性子反同時計測検出器を含めたXENONnT実験のデータを用いたWIMP感度評価

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Abstract

Cosmology and observations of the universe strongly suggest the existence of dark matter, especially Weakly Interacting Massive Particle (WIMP), direct scattering has not yet been detected.

One of the world leading direct WIMP search, the XENONnT experiment completed the commissioning and almost ready to release its first science run results. The XENONnT detector is able to discriminate most of the electron recoil background events with light and charge signals. A neutron background is the one of the most serious in the rest background sources.

We introduced new water Cherenkov detector to veto the neutrons as an upgrade from XENON1T experiment.With the commissioning data, data-driven simulation is constructed. The simulation physics on Geant4 framework is tuned up with independent beam experiment. The optical behavior in the detector is calibrated with the optical calibrations as reflective material reflectivity including effects of water absorption and reflection at PMT surface. The unknown PMT collection efficiencies and other effects to drop the photons are also calibrated with source calibration. Finally, the simulation framework constructs waveforms with the format of the observed data, which is able to apply the real analysis chain.

Applying a tagging algorithm, the neutron tagging efficiency is evaluated.
In addition, systematic uncertainty for tagging efficiency is conservatively estimated. With the simulation, we evaluated amounts of the backgrounds and obtained WIMP sensitivity for the XENONnT experiment.The sensitivity of the XENONnT experiment to the Spin independent (dependent) WIMP, including the nVeto detector, is obtained.