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Background Radiation at JUSL and Simulation of Nuclear Recoils in Liquid Xenon Detectors

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Measurements and Simulation of background radiation
at JUSL and Simulation of Nuclear Recoils due to
Supernova Neutrino-induced neutrons in liquid Xenon
detectors
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Abstract
Rare event search experiments require very careful simulations, in addition to accurate measurements of ambient radiation contribution from radioactive decay and nuclear processes in the surrounding rock components as well as from charged cosmic rays. A new underground laboratory has been set up at 555 m (~1.6 km water equivalent) vertical depth, with the vision of undertaking future experiments like direct dark matter search, neutrino less double-beta decay, etc. I shall present the various measurements and simulation of background for such underground experiments arising from penetrating charged cosmic rays, radiogenic and cosmogenic neutrons, in addition to measurement and shielding studies of gamma background, which in-turn shall serve as the basis of all future rare event search experiments at the underground site. I shall also discuss about investigating the possibilities of detecting core collapse supernova (CCSN) neutrinos by large volume liquid Xenon detectors, designed primarily for direct dark matter search. In addition to giving rise to Coherent Elastic Neutrino Nucleus Scattering (CEvNS) interactions, CCSN neutrinos would undergo charge current (CC) interactions with the Xenon nuclei and consequently produce neutrons inside the liquid xenon tank. These neutrons would in turn produce nuclear recoils through multiple elastic scatterings. This presents an extra-handle, in addition to the CEvNS interactions to detect CCSN neutrinos. I shall discuss that careful simulation of these interactions, to finally compute the observable S1 and S2 signals, reveals that this second channel indeed gives a dominant contribution to the total number of detected nuclear recoil events at the high detector threshold regime. Detection of these second type of events in future large volume detectors like LZ, DARWIN, etc., may give observational handle on the flavour composition of CCSN neutrinos, since this second channel shall only be generated by ves while the CEvNS interactions would arise from all flavours of neutrinos.

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