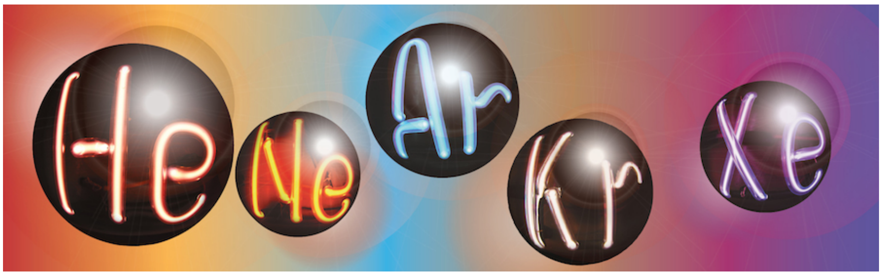

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Supernova Neutrino Detection in LZ

Saturday, 23 September 2017 11:15 (15 minutes)

In the first 10 seconds of a core collapse supernova, almost all of its progenitor's gravitational potential, O(10^{53} ergs), is carried away in the form of neutrinos. These neutrinos, with O(10 MeV) kinetic energy, can interact via elastic neutrino-nucleus scattering depositing O(1 keV) in detectors. Low background dark matter detectors, such as LUX-ZEPLIN (LZ), optimized for detecting low energy depositions, are capable of detecting these neutrino interactions. A 11 $M_\odot$ supernova at 10 kpc, will produce 50-100 neutrino interactions in the 7-tonne liquid xenon active volume of LZ. We adopt a simplified neutrino flux model for a supernova, and use NEST and Geant4-based BACCARAT simulation engines to study energy deposition from and detection of elastic neutrino-nucleus scattering in LZ. Within the first 200 milliseconds after the onset of core collapse, the progenitor undergoes neutronization. This produces a large flash of electron neutrinos. During this time, $\sim$10% of the total number of neutrino interactions are detected. We simulate the response of the LZ data acquisition system (DAQ) and demonstrate its capability and limitations in handling this interaction rate. At later times, the neutrino flux is composed of all flavors equally. We present an overview of the LZ detector, focusing on the benefits of liquid xenon for supernova neutrino detection. We discuss energy deposition and detector response simulations and their results. We present an analysis technique to reconstruct the total number of neutrinos and the time of the onset of the electron neutrino flash.

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