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Supernova Neutrino Detection with LHAASO-MD

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The core-collapse supernova releases a tremendous number of neutrinos, which can provide insight into many research areas, including particle physics, astrophysics, nuclear physics, and cosmology. We can detect the signal through a positron produced from the inverse beta decay (IBD) interaction between the electron antineutrino and water. The Large High Altitude Air Shower Observatory Main detector (LHAASO-MD) with 51-kton water can serve this purpose. The MD detectors have been designed to have a scattered layout as well as spatial uniformity. We have designed a dedicated supernova trigger system in the data acquisition system to take advantage of these unique detector characteristics. The large numbers of MeV-scale supernova burst neutrinos can be observed from a collective rise in all photomultiplier rates on top of the dark noise. This system effectively suppresses the cosmic ray background, optimizes the neutrino detection sensitivity, and realizes the supernova neutrino detection by optimizing the online trigger, data acquisition, and offline data analysis at LHAASO. The trigger system is estimated to be fully sensitive to 1987A-type supernova bursts throughout most of the Milky Way and can eventually help LHAASO join the SuperNova Early Warning System (SNEWS).

Keywords

supernova; neutrino ; inverse beta decay ; LHAASO; trigger

Collaboration

Lhaaso

other Collaboration

Subcategory

Experimental Methods & Instrumentation

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