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Joint Pre-Supernova Neutrino Monitor with Super-Kamiokande and KamLAND

Neutrinos, almost the smallest objects to our knowledge, however play an important role in the life of massive stars. As a massive star approaching core-collapse supernova, the rate of electron anti-neutrinos ($\bar{\nu}_e$) emission and the $\bar{\nu}_e$ energy are increasing. When such a pre-supernova (pre-SN) star enters the silicon burning phase, which is considered a few days preceding core-collapse, a significant fraction of emitted $\bar{\nu}_e$ exceed the energy threshold for inverse beta decay interactions. This is a chance for both liquid-scintillator detectors (e.g. KamLAND) and water-Cherenkov detectors (e.g. Super-Kamiokande) to capture pre-SN neutrino signals, and thus to issue an early warning of a supernova. KamLAND and Super-Kamiokande have established pre-SN neutrino monitors in 2015 and 2021, respectively. To further improve the sensitivity and warning time ahead of supernova, a joint alert system with the two detectors is developed. We present the structure of the joint alert system, as well as the improvement on sensitivity to pre-SN neutrinos resulted from the combination of the measurements from both experiments.

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