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Pre-Supernova Alarm at Super-Kamiokande and Combined Monitoring with KamLAND

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The Super-Kamiokande (SK) experiment is a neutrino observatory located in Japan. After the loading of gadolinium sulfate octahydrate to water in its detector, the SK experiment entered a new phase, known as SK-Gd. This new phase is characterized by the significant improvement in the experiment's sensitivity to low-energy electron anti-neutrinos, thus providing more reliable data for the study of neutrino sources and interactions. SK-Gd has the potential of detecting yet-unobserved neutrinos from pre-supernova (preSN) stars, which are massive stars at the last evolutionary stage before core-collapse supernova (CCSN). The main cooling mechanism of preSN stars is the neutrino emission through different thermal and nuclear processes such as pair annihilation and beta decay, emitting high fluxes of electron anti-neutrinos. The detection of preSN neutrinos would not only help determine the neutrino mass hierarchy, but it could also provide early warnings for nearby CCSNs. In October 2021, SK launched its pre-supernova alarm. We report the sensitivity of the Super-Kamiokande detector to preSN neutrinos and information regarding the alert system. A combined alarm with the Kamioka Liquid-scintillator Antineutrino Detector (KamLAND) is currently in development to improve the sensitivity of preSN neutrinos and extend early warnings to CCSN. Details of the joint alarm are also presented as well as the expected improvement in the sensitivity for combining the results from both experiments.

Submitted on behalf of a Collaboration?

Yes

Author: Dr NASCIMENTO MACHADO, Lucas (University of Glasgow)

Presenter: Dr NASCIMENTO MACHADO, Lucas (University of Glasgow)

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