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## **Pre-supernova neutrino alarm at KamLAND and its extension to an combined system with SK**

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Pre-supernova neutrinos are released by thermal pair production and/or weak interaction prior to supernovae. These neutrinos can offer a unique possibility for early alarm system prior to supernovae for astronomical detectors, including gravitational wave detectors and neutrino detectors.

KamLAND is a 1-kiloton liquid scintillator neutrino detector located in Japan that employs delayed coincidence selections of inverse beta decay to detect anti-electron neutrinos with low background condition.

Its capability to detect pre-supernova neutrinos from nearby stars has been leveraged for an early warning system since 2015.

The original system was optimized using the only theoretical model at the time.

In this poster, we present re-optimization of the system with latest theoretical models and new possibilities to use time evolution of expected signal.

The SK-Gd experiment, in which Gd is added to Super Kamiokande, is also sensitive to pre-supernova neutrinos. We also show a combined alarm system with SK-Gd experiment, which plays a key role to improve detectable range and alarm time.

### **Submitted on behalf of a Collaboration?**

Yes

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