

## **Pre-SN neutrino emission from massive stars and its importance for multi-messengers**

Pre-supernova (pre-SN) neutrinos are emitted from a core of massive stars, which are supposed to be progenitors of core-collapse supernovae. Although it was seemed to be difficult to detect pre-SN neutrinos because of their low energy, detection of pre-SN neutrinos comes into view owing to the recent development of detectors. We believe that future detection of pre-SN neutrinos will give us a big impact as much as the historical neutrino events at SN1987A. In this talk, I will introduce two importance of pre-SN neutrino observations: evidence for the theory of stellar evolution and SN alarm. Especially, I focus on the latter. We may detect pre-SN neutrino signals only from our vicinity ( $< 1$  kpc) and a Galactic SN rate is only once per a few hundreds of years, unfortunately, even if we extend the distance to 10 kpc. Therefore, we never miss the next nearby SN. A SN alarm triggered by detection of pre-SN neutrinos will give us an enough time to prepare for other types of observations with SN explosion and contribute to our understanding of SN explosions.

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