Core-Collapse Supernova Neutrinos in JUNO

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On behalf of JUNO

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Neutrino Emissions From CCSN

Messengers from CCSN

Jiangmen Underground Neutrino Observatory

Detection in JUNO

Low energy threshold of LS detector in JUNO:
- $O(100 \text{ keV})$ of global trigger
- $O(10 \text{ keV})$ of multi-messenger (MM) trigger

Pre-SN neutrinos from nearby galactic progenitors:
- IBD golden channel with coincidence signals, mass ordering dependent
- $\nu e$ elastic scattering contaminated by radioactivity and cosmogenic isotopes
- Probe to the advanced stages of stellar evolution

SN burst neutrinos:
- Full flavor detection with multiple channels
- Unique opportunity to detect $\nu_x$ via $\nu p$ ES
- PSD method to distinguish events from $\nu e$ES and $\nu p$ ES
- Low background from other sources within ~10 s time scale
- Probe to the explosion mechanism

Pre-SN neutrinos@0.2kpc, NO

SN burst neutrinos@10kpc
Real-time Monitor for CCSN

Early alerts of CCSN:
- Prompt monitor embedded in electronic board
- DAQ monitor in software with reconstructed events
  - Fast characterization, e.g. SN direction
- Sensitive to pre-SN neutrinos within $O(1 \text{kpc})$ and SN burst neutrinos within $O(100 \text{kpc})$
- Early alerts to astronomy communities, e.g. SNEWS2.0, for follow-up multi-messenger observation

SN data recording:
- 2GB DDR3 memory at GCU to buffer sudden increase of event data size
- Trigger-less recording of SN burst neutrinos, e.g. ± 60 s of SN alert
Diffuse Supernova Neutrino Background

- DSNB in the visible universe, 2-4 IBD events/year expected above energy range of reactor $\bar{\nu}_e$
- Provide information of star formation rate, $\nu$ emission from average CCSNe and BHs
- PSD to suppress background, mainly atmospheric NC neutrinos
- Detection significance~3$\sigma$ after 10 years of data taking in JUNO for $\langle E_{\bar{\nu}_e} \rangle \sim$15MeV

Thank You!