Core-Collapse Supernova Neutrinos in JUNO

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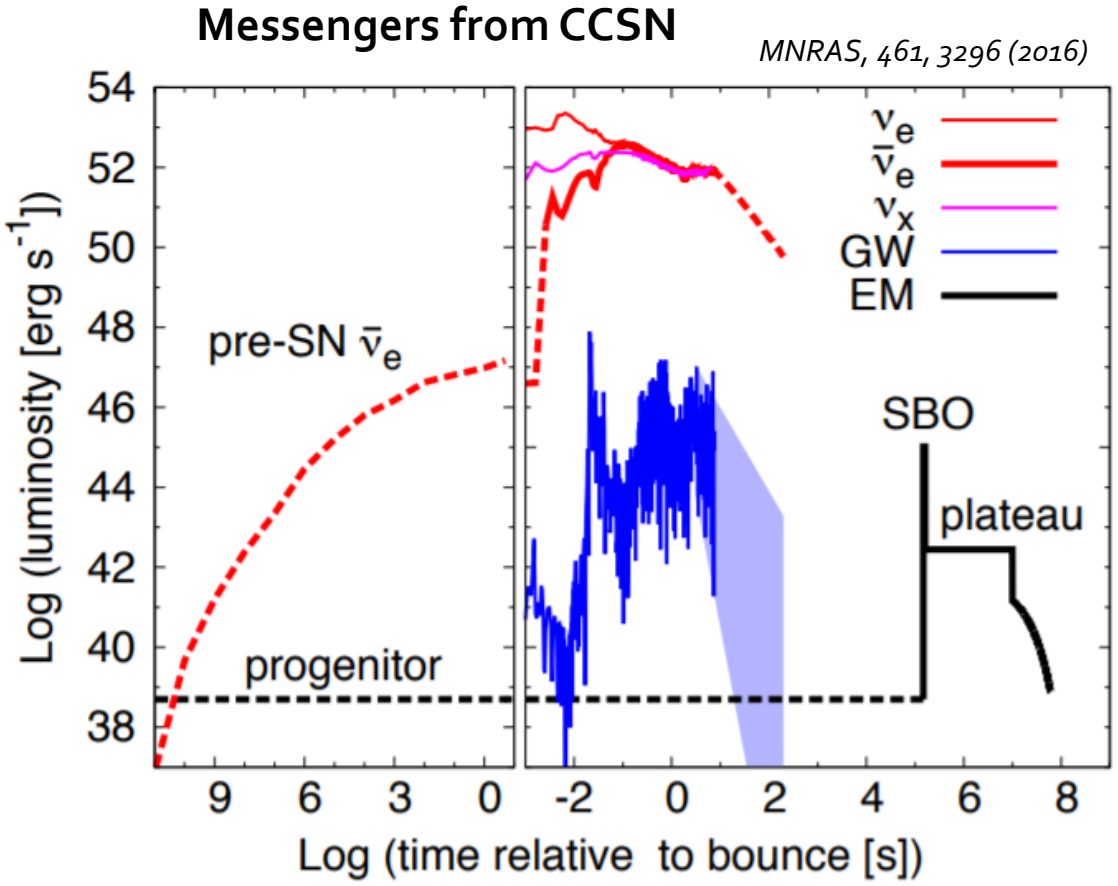
On behalf of JUNO

Workshop on Neutrino Telescopes, 2021

Neutrino Emissions From CCSN



Jiangmen Underground Neutrino Observatory

Detection in JUNO

Low energy threshold of LS detector in JUNO:

- *O*(100 keV) of global trigger
- *O*(10 keV) of multi-messenger (MM) trigger

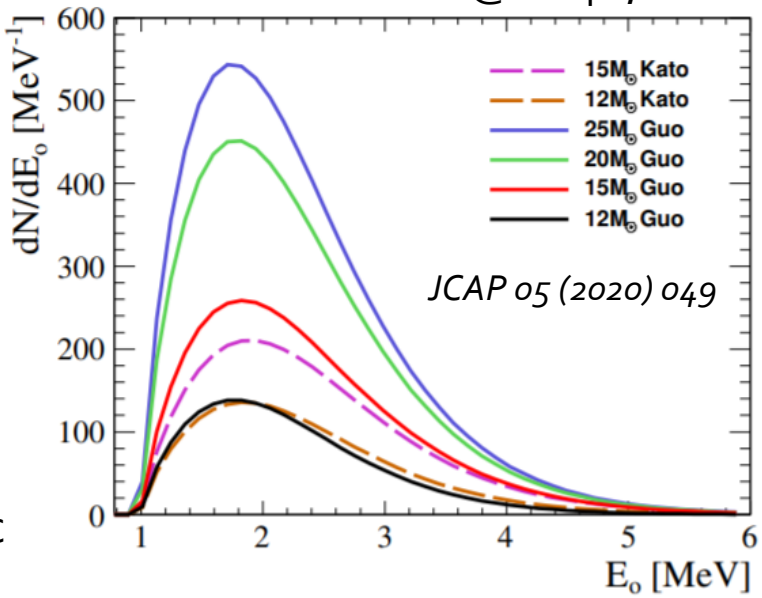
Pre-SN neutrinos from nearby galactic progenitors:

- IBD golden channel with coincidence signals, mass ordering dependent
- νe elastic scattering contaminated by radioactivity and cosmogenic isotopes
- Probe to the advanced stages of stellar evolution

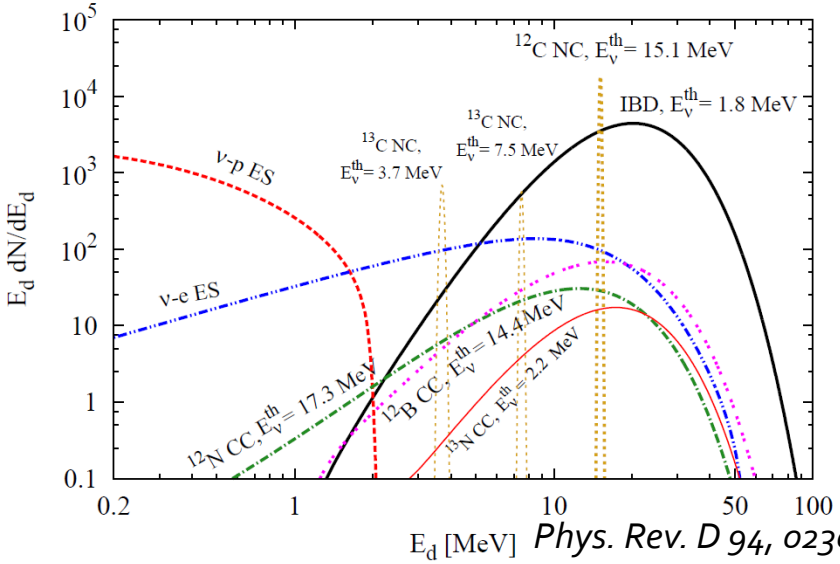
SN burst neutrinos:

- Full flavor detection with multiple channels
- Unique opportunity to detect ν_x via νp ES
- PSD method to distinguish events from νeES and νp 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

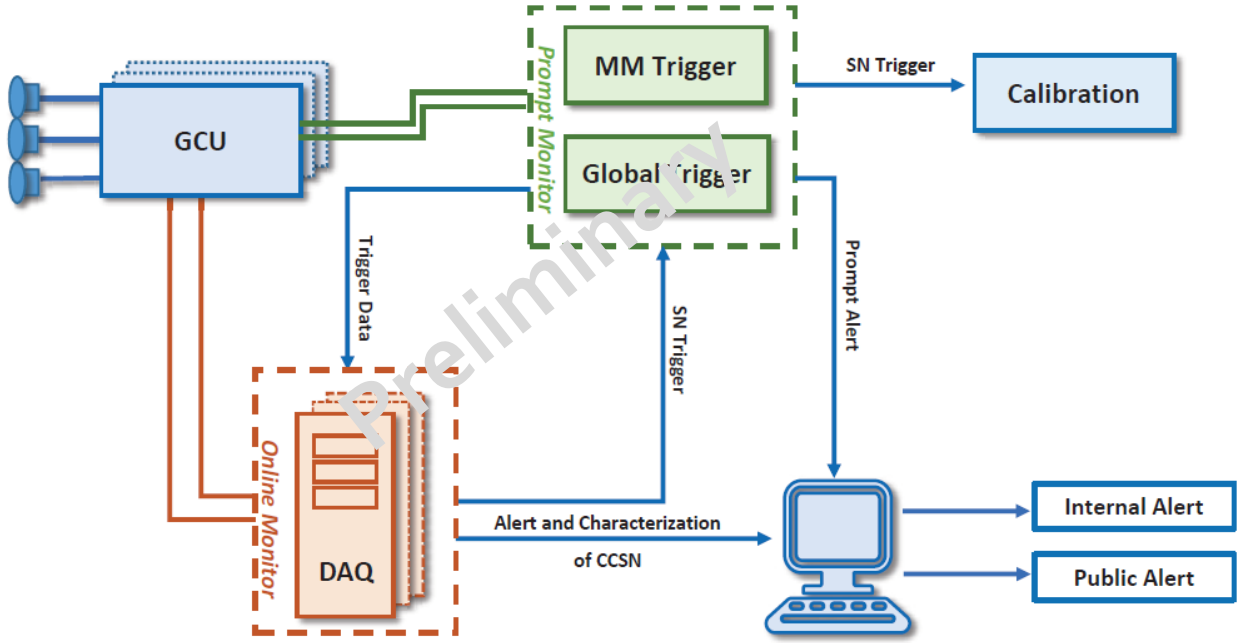


Phys. Rev. D 94, 023006 (2016)

Real-time Monitor for CCSN

Early alerts of CCSN:

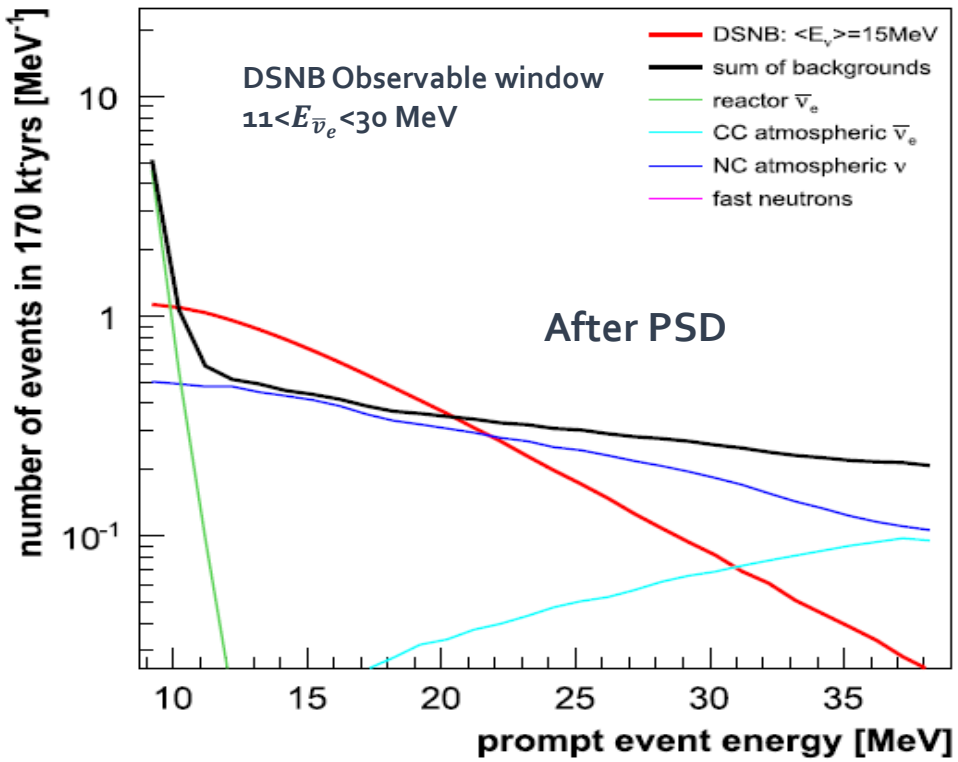
- Prompt monitor embedded in electronic board
- DAQ monitor in software with reconstructed events
  - ✓ Fast characterization, e.g. SN direction
- Sensitive to pre-SN neutrinos within *O*(1 kpc) and SN burst neutrinos within *O*(100 kpc)
- Early alerts to astronomy communities, e.g. SNEWS2.0, for follow-up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



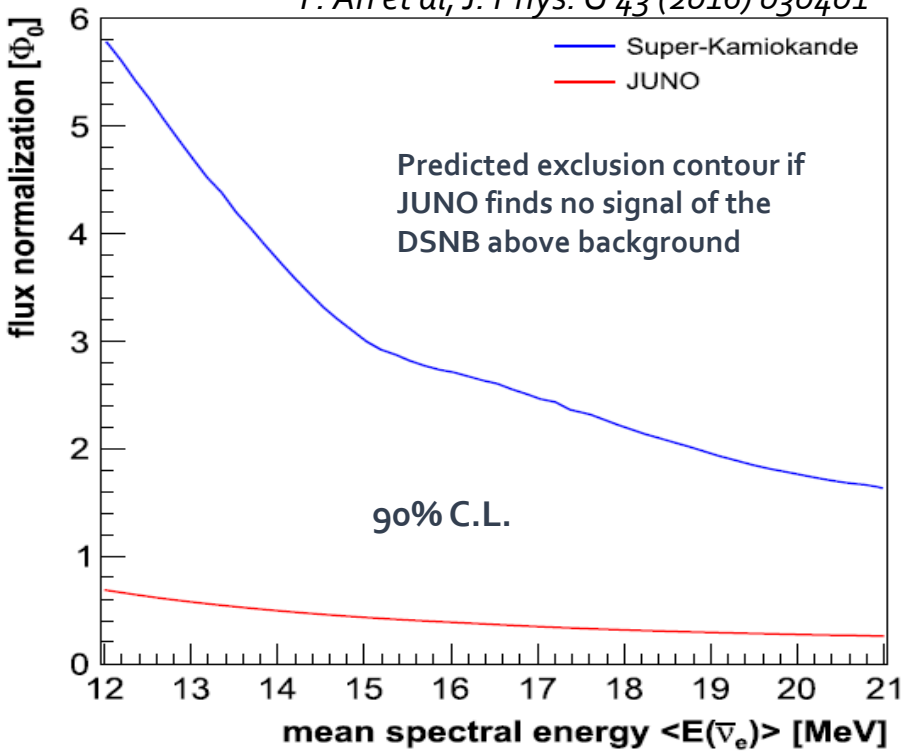
SN data recording:

- 2GB DDR3 memory at GCU to buffer sudden increase of event data size
- Trigger-less recording of SN burst neutrinos, e.g. $\pm$ 60 s of SN alert

Diffuse Supernova Neutrino Background



F. An et al, J. Phys. G 43 (2016) 030401



- 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, ν emission from average CCSNe and BHs..
- PSD to suppress background, mainly atmospheric NC neutrinos
- Detection significance~3σ after 10 years of data taking in JUNO for $\langle E_{\bar{\nu}_e} \rangle$~15MeV

Thank You !