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Model-independent reconstruction of full flavor supernova neutrino spectra in future large liquid-scintillitor detectors

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The fortunate observation of neutrino events from the SN1987A explosion in the Large Magellanic Cloud is a milestone in both neutrino physics and neutrino astronomy. The sparse data, however, can't provide us the accurate energy spectra of supernova neutrinos. Currently many worldwide neutrino detectors runnning or under construction have better detection capbilities of core collapse supernova neutrinos. For example the future liquid-scintillator detector with a 20kton designed fiducial mass of JUNO, can register about 5000 events from the inverse beta decay given a typical SN at 10kpc. Here we propose a model-independent combined method gathering the events from inverse beta decay, neutrino-proton elastic scattering as well as neutirno-electron elastic scattering to unfold the true energy spectra of full flavor supernova neutrinos directly. Many different numerical models are also applied to check the validity of the method. Furthermore, even for a more complicated scenario with flavor conversion, this combined method shows a great potential to reconstruct the true neutrino spectra emitted from the core of supernove. One trial with flavor conversion from MSW resonance effect at the enevolope of supernova is illustrated in this work.

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