

## Effects of neutrinos on supernova nucleosynthesis

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A huge number of neutrinos are emitted from a neutron star at the core-collapse supernova (SN) explosion. These neutrinos interact with nucleons and nuclei, and proton and neutron abundances are affected via charged-current (CC) reactions of electron neutrinos and antineutrinos in the inner region of SNe. As a result, some of light proton-rich nuclei (p-nuclei) are produced in a proton-rich condition realized by those SN neutrino reactions. Production of  ${}^7\text{Li}$  and  ${}^{11}\text{B}$  occurs in an outer region of the SN, i.e., C-rich and He-rich layers. It has been suggested that neutrino oscillations in SNe significantly affect yields of  ${}^7\text{Li}$  and  ${}^{11}\text{B}$  in core-collapse SNe. During the propagation of neutrinos from the proto-neutron star, their flavors change. As a result, the CC neutrino reaction rates of  ${}^{12}\text{C}$  and  ${}^4\text{He}$  are affected. In this talk, we show updated results on the neutrino process nucleosynthesis in SNe. Neutrino spallation cross sections for  ${}^4\text{He}$  and  ${}^{12}\text{C}$  are corrected, and new reactions for production of  ${}^{98}\text{Tc}$  and  ${}^{92}\text{Nb}$  are included in our calculation. Initial abundances involving heavy s-nuclei are derived from a new calculation of the SN 1987A progenitor. We analyze a dependence of SN yields of  ${}^7\text{Li}$  and  ${}^{11}\text{B}$  on the neutrino mass hierarchy in several stellar locations. In the normal hierarchy case, the CC reaction rates of electron neutrinos are enhanced, and yields of proton-rich nuclei including  ${}^7\text{Be}$  and  ${}^{11}\text{C}$  are increased. In the inverted hierarchy case, the CC reaction rates of electron antineutrinos are enhanced, and yields of neutron-rich nuclei including  ${}^7\text{Li}$  and  ${}^{11}\text{B}$  are increased. We also find that the presupernova s-process abundances and metallicity affect the yields since the neutron abundance during SN nucleosynthesis are determined by the s-process abundances.

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