Nucleosynthesis in neutrino-driven, aspherical supernova expsloion of massive stars

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Explosion mechanism of core collapse supernovae (SNe) is still not clearly understood. Multi-dimensional effects are recognized to be important for the explosion, in particular for a progenitor heavier than about $11 M_\odot$ in its main sequence phase [1,2]. Standing accretion shock instability (SASI) is a reliable candidate to initiate bipolar oscillations of a stalled shock. The oscillations trigger strong convection, which pushes the shock to larger radii and leads to longer neutrino exposure and therefore more effective neutrino heating to the postshock gas. Recent two-dimensional simulations of stellar core collapse show that the delayed neutrino-driven mechanism for the SN explosion aided by SASI is likely to cause aspherical explosion of massive stars [3].

We examine explosive nucleosynthesis during neutrino-driven, aspherical SN explosion aided by SASI, based on two-dimensional hydrodynamic simulations of the explosion of a $15 M_\odot$ star. We find that masses of the ejecta and ^{56}Ni correlate with the neutrino luminosity, and ^{56}Ni mass is comparable to that observed in SN 1987A. We find that abundance pattern of the supernova ejecta is similar to that of the solar system, for cases with high explosion energies of $\simeq 10^{51}$ergs, which is comparable to the energy observed in SN1987A and Cas A. We also find that p-nuclei are abundantly produced in the ejecta via γ*-process*, or the photodisintegration of seed nuclei, as in spherical models [4,5,6]. Underproduced nuclei in the spherical model, such as ^{92}Mo, ^{94}Mo, ^{96}Ru, and ^{98}Ru, are also underabundant in our aspherical models. We discuss abundance change via neutrino interactions and denpendence of abundances on nuclear reaction rates.

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