A SYSTEMATIC THEORETICAL STUDY OF EXPLOSION ENERGIES IN CORE COLLAPSE SUPERNOVAE

Yu Yamamoto, Shoichi Yamada

Science & Engineering, Waseda University

Studying about a half century, we still hold crucial problems to explain observations of core collapse supernovae (CCSNe) in theoretical studies. This situation is due to following diverse physical processes: complex neutrino and nuclear reactions, which affect strongly both presupernovae structures and shock revival stages, uncertaintity in equation of states above the nuclear density and GR effects. These processes are connected with each other and require highly complex and accurate numerical simulations.
Recent studies, however, showed some interesting results (Suwa et al. 2012; Muller et al. 2012; Takiwaki etal. 2013). They concluded that in the neutrino heating mechanism the state-of-art simulations havent answered the lack of explosion energies and nickel masses yet. Our previous work (Yamamoto et al. 2013) support their conclusions and showed the necessity of much earlier explosion after bounce. On the other hand, the progenitor dependence in CCSNe is very subtle problem (Ugliano et al. 2012).
Our present work focused on the dependence of presupernovae structure on CCSNe. We controlled Mcore, M_SiS and M_Si: the core mass, the QSE mass and the total silicon mass respectively. This experimental approach could help us understand what kind of physics play important roles in shock revivals and determining the explosion energies and nickel masses. For the first step, we show how these parameters affect to the mass accretion rate during the core collapse stage.