R-process Nucleosynthesis in Magnetically Dominated Core-Collapse Supernovae

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We investigate the r-process nucleosynthesis during magneto-hydrodynamic (MHD) supernova explosion driven by rapid rotations and strong magnetic fields. MHD supernovae are not only very important as the candidate for the magnetar formation sites, but also astronomical r-process sites in astrophysics. Our r-process nucleosynthesis simulations based on the astronomical supernova explosion models who followed the long-term evolution in special relativistic MHD simulations. We perform supernova simulations from the onset of core-collapse to the supernova shock propagation with neutrino cooling process near the core and a realistic nuclear equation of state.

We perform r-process nucleosynthesis simulation for MHD jet supernova models based on the large nuclear reaction network including fully nuclear reactions. We have developed the nuclear reaction network which consists about 4000 isotopes and reactions related to the r-process path. Nuclear reaction networks for r-process study include a lot of unstable nuclei and undetermined reaction rates. Nuclear reaction network include many theoretical data which have a lot of uncertainties, so we construct some kinds of networks which consist of different nuclear data sets. In order to discuss the uncertainties, we also discuss the effects on r-process nucleosynthesis by nuclear physics uncertainties.