R-PROCESS NUCLEOSYNTHESIS IN NEUTRON STAR MERGER WITH NEW FISSION MODEL

Shota Shibagaki[1, 2], Toshitaka Kajino[2, 1], Satoshi Chiba[3], Grant J. Mathews[4]

[1] *Department of Astronomy, Graduate School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan*
[2] *National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan*
[3] *Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology, Ookayama, Meguro-ku, Tokyo, 152-8850, Japan*
[4] *Department of Physics, Center for Astrophysics, University of Notre Dame, Notre Dame, IN 46556, USA*

The astrophysical site for the r-process has not yet been uniquely identified. Neutron star mergers (NSMs) have recently received special attention as production sites for r-process elements. The ejected matter from the NSMs is extremely neutron-rich (Ye<0.1) and the r-process path proceeds along the neutron drip line and enters the region of fissile nuclei. In this situation, theoretical models of nuclear masses and fission modes are quite important.
In this study [1], we carry out r-process nucleosynthesis simulations in the NSMs based on Korobkin's numerical simulation [2]. We here constructed a nuclear reaction network code by setting a new nuclear mass model [3] and a fission fragment distribution model [4].
Our nucleosynthesis simulation shows that the final r-process elemental abundances exhibit very flat pattern for A=90-180 due to several fission cycling in extremely neutron-rich conditions of the NSMs. Combining these results with magnetorotationally driven core-collapse supernovae (CCSNe) that predict successful r-process abundance peaks at A ~ 130 and 195, we find that the NSMs can resolve the underproduction problems of such CCSN model prediction for the elements just below and above the abundance peaks. We discuss relative contributions to the solar-system r-process yields from CCSNe and NSMs, which should constrain the frequency of these astrophysical episodes.

[1] S. Shibagaki, T. Kajino, S. Chiba and G. J. Mathews, in preparation (2014).
[2] O. Korobkin, S. Rosswog, A. Arcones and C. Winteler, Month. Not. Roy. Astro. Soc. 426, 1940 (2012).
[3] H. Koura, T. Tachibana, M. Uno and M. Yamada, Prog. Theor. Phys. 113, 305 (2005).
[4] M. Ohta, et al., in Proc. of Int. Conf. on Nucl. Data for Science and Technology, Nice, France, (2007).