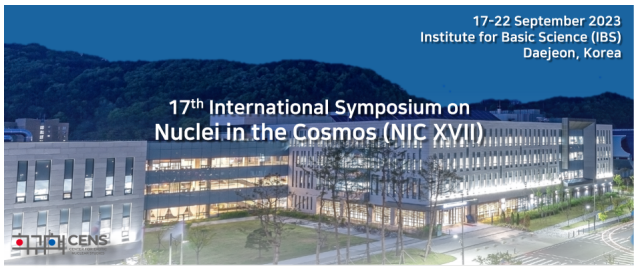

Contribution ID: **88** Type: **Poster**

Constraining Supernova Nucleosynthesis from nu-Mass Hierarchy and the Roles of nu-Nucleus and Radioactive Nuclear Reactions

Tuesday, 19 September 2023 17:30 (5 minutes)

The origin of neutrino mass and mass hierarchy is one of the biggest unanswered questions in physics. In this article, we propose an astrophysical method so that the supernova (SN) ν-process nucleosynthesis, which is consistent with the mass hierarchy constrained from various ν-oscillation experiments, should provide independent observational signals of nucleosynthetic products in the specific nuclei such as ^{138}La, ^{98}Tc, ^{7}Li, ^{11}B and others (so-called ν-nuclei) through the ν-flavor oscillation due to the MSW matter effect and the effect of collective oscillation [1].
Core-collapse SNe emits a huge number of neutrinos which bring valuable observational information on how the neutrinos propagate through the high-density matter and change their flavors and how explosive nucleosynthesis occurs. We found that the still unknown mass hierarchy is imprinted in the nucleosynthetic products of ν-nuclei [1,2]. In this talk, we will discuss the mechanism of SN ν-process nucleosynthesis and try to constrain the mass hierarchy by comparing our theoretical prediction of nuclear abundances and observed values in the meteorites. Among the calculated results, the abundance ratios of ^{7}Li/^{11}B and ^{138}La/^{98}Tc provide exclusively sensitive probes to neutrino mass hierarchy [1]. These ratios are also influenced by the mass cut during the ejection phase of SN materials. These facts provide valuable quantitative tools to constrain the mass hierarchy through precise measurements of nuclear abundances of these ν-nuclei in SiC-X pre-solar grains and comprehensive studies of solar-system abundances. We also found the significance of removing the uncertainties associated with the ν-^{4}He,^{12}C,^{16}O, and ^{20}Ne reaction cross sections with all possible final particle-emission channels being taken into account and the radioactive nuclear reaction rates for ^{11}C$(\alpha, p)^{14}$N and many others for the production of these ν-nuclei. We will discuss these sensitivities and propose a list of ν-A and radioactive nuclear reactions to be studied experimentally and theoretically [3].

[1] Xingqun Yao, T. Kajino, M. Kusakabe et al., Paper-I (2023), to be submitted.
[2] Heamin Ko, D. Jang, M.-K. Cheoun, M. Kusakabe, H. Sasaki, X. Yao et al., ApJ 937 (2022), 2, id.116, 37pp.
[3] Xingqun Yao, T. Kajino, M. Kusakabe et al., Paper-II (2023), to be submitted.

Primary authors: KUSAKABE, Motohiko (Beihang University); KAJINO, Toshitaka (Beihang Univ./NAOJ/Univ. of Tokyo); YAO, Xingqun (Beihang Univ. & National Astronomical Observatory of Japan)

Presenter: YAO, Xingqun (Beihang Univ. & National Astronomical Observatory of Japan)

Session Classification: Poster session (Core-collapse supernovae, mergers and the r-process)

Track Classification: Core-collapse supernovae, mergers and the r-process