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**Core-collapse supernovae, r-process nucleosynthesis, and the physics of unstable nuclei**

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Recent findings of r-process elements in extremely metal- poor stars are considered to be clear evidence that these heavy elements are created in explosive astrophysical phenomena such as core-collapse supernovae. Accumulated observational data suggest further that there might be more than one episode responsible for the r-process nucleosynthesis. These observed facts are the important clues to identify the astrophysical origin of r-process elements, and furthermore strengthen the motivation to clarify the explosion mechanism of core-collapse supernovae.
I discuss two aspects of supernova physics in this invited talk:
First, I discuss that the r-process depends on the outcome of supernova explosions from various progenitor masses through hydrodynamical mass ejection mechanism, thermodynamic conditions of the neutrino-driven winds, and others. We demonstrate that the nuclear reactions of neutron-rich nuclei in the light mass region play the crucial roles in the r-process.
Secondly, I discuss recent progress and continuing efforts in understanding explosion mechanism of core-collapse supernovae, in the light of nuclear physics of unstable nuclei. The data table of relativistic equation of state (EOS), which we have constructed by adopting the data of unstable nuclei such as neutron-skin thickness, enables us to study the influence of EOS in modern supernova simulations. I report on how the supernova dynamics is different each other with the new EOS table and the conventional set of EOS. I also reveal the thermal evolution of central core at late stage and the resulting signals of supernova neutrinos. I stress that the different compositions including neutron-rich nuclei would appear in supernova cores, so that they might change the electron-capture and neutrino- reaction rates to help successful explosions. I discuss current needs and possible extensions of nuclear physics in supernova simulations.