

Nuclei in the Cosmos (NIC XVII)



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The status and future of nuclear property experiments at CENS

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Observations of astrophysical phenomena, such as the luminosity of X-ray bursts and the abundance pattern of stars, can be explained by nuclear reactions occurring in the stars. It is well known that the nuclear properties of isotopes involved in the nuclear reactions have a direct impact on stellar evolution, such as energy generation, the nucleosynthesis path, and final abundance distribution of the elements. However, because most of the key nuclei constraining the nucleosynthesis models including the rapid proton capture process (rp-process) and the rapid neutron capture process (r-process) are far from stability, our understanding of astronomical observables is still very limited due to large uncertainties in calculated properties of the nuclei and a lack of measurements with radioactive ion beams for the spectroscopic information. One recent sensitivity study, for example, shows the light curve of X-ray bursts is extremely sensitive to (α, p) reactions on proton-rich radioactive nuclei, including $^{14}\text{O}(\alpha, p)^{17}\text{F}$, $^{15}\text{O}(\alpha, \gamma)^{18}\text{Ne}$ and $^{34}\text{Ar}(\alpha, p)^{37}\text{K}$. However, measurement of these reaction cross sections in the laboratory is challenging due to low beam intensities and short lifetimes.

In order to reduce the uncertainties, new experimental studies of nuclear properties with heavy ion radioactive beam accelerators are critical. Moreover, because most of key nuclei allowing us to explore new models of nuclear structure are far from stability, it is only possible to perform the research with powerful rare isotope beam (RIB) facilities. Recent experimental studies of nuclear properties performed by the Center for Exotic Nuclear Studies (CENS), Institute for Basic Science at will be presented as well as new device developments. Future plans on how to take advantage of the existing and new RIB facilities including RAON (Rare isotope Accelerator complex for ON-line experiment) in Korea will also be addressed.

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