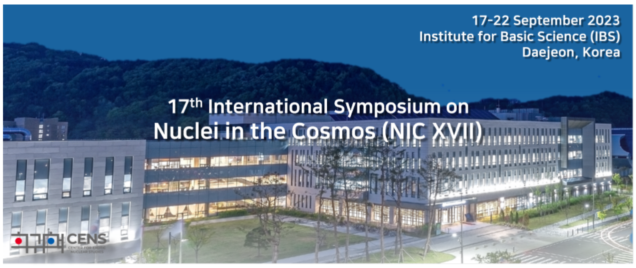

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Astrophysical Reactions Important in r- and νp-processes Measured Using (d,p) Transfer Reactions at OEDO-SHARAQ

Thursday, 21 September 2023 16:45 (15 minutes)

The rapid (*r*) neutron-capture process produces half of the elements heavier than iron and is located on the neutron-rich side of the nuclear chart. Conversely, light nuclei on the neutron-deficient side may be produced in the neutrino-driven rapid-proton capture (*νp*) process. Considering the *r*-process, promising site candidates such as core-collapse supernovae (CCSNe) and neutron star mergers still show large discrepancies between observed and calculated abundances. The calculations rely on neutron-capture cross sections which depend on two reaction processes: direct radiative capture and compound nuclear (CN) mechanism. Neutron capture on ^{130}Sn strongly influences the final abundances around the second and third *r*-process peaks, however, the CN mechanism lacks empirical data. Considering the *νp*-process proposed to occur in the ejecta of CCSNe, this is a promising solution to synthesize isotopes not adequately produced in the rapid-proton (*rp*) capture process, particularly ^{92,94}Mo and ^{94,96}Ru. The ^{56}Ni(n,p)^{56}Co reaction is a crucial branching point between the *νp*- and *rp*- processes and thus governs the abundances of heavier elements, however, its cross section lacks measurement. To address these knowledge gaps of the ^{130}Sn(n,γ) and ^{56}Ni(n,p) reactions, the surrogate technique was employed using (d,p) transfer reactions on ^{130}Sn and ^{56}Ni, respectively, at the BigRIPS-OEDO beamline housed at RIBF in RIKEN, Japan. The radioactive beams were produced and separated by the BigRIPS accelerator. Using OEDO the ^{130}Sn (^{56}Ni) beam was decelerated to ~ 22 (15) MeV/u and focused onto a CD_2 solid target. Light particles were detected at backward lab angles using the TiNA array. Heavy reaction products were momentum-analyzed by the SHARAQ spectrometer and identified using the Bρ-dE-range technique. This approach has a distinct advantage whereby the gamma-emission probabilities of compound nuclear states may be determined with no gamma-ray detection necessary. In this talk, the experimental procedure and preliminary results are presented, with an emphasis on the capabilities of OEDO.

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