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The 59Cu(p,α) cross section and heavy element nucleosynthesis in core collapse supernovae

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The heavy element nucleosynthesis is the area of research looking to predict and/or explain the observed abundances of nuclei heavier than iron. The proton rich nuclei are thought to be produced in the in hot environments such as supernovae via proton capture and the photodisintegration processes. But the observed abundances of lighter p-nuclei ^{92,94}Mo and ^{96,98}Ru are not reproduced in the stellar models using these processes [1]. In a recent work, the p process has been suggested as an explanation for the abundances of p-nuclei with A>64 [2]. However, in an end-point nuclear cycle involving Co, Ni, and Cu, the competition between (p,α) and (p,γ) reaction rates on the ^{59}Cu isotope could hinder the reaction flow from proceeding towards heavier elements by cycling the material back [3]. This competition is temperature sensitive and therefore it is crucial to measure the ^{59}Cu(p,α)^{56}Ni reaction cross section in order to obtain the reliable modelling results. In addition to the reaction's importance in understanding the origin of heavy p-nuclei, it is also of key importance for X-ray light curve, and affect the composition of burst ashes on the surface of the neutron star significantly [4].

Currently, there is no direct measurement of the ^{59}Cu(p,α)^{56}Ni reaction cross section. I will present the preliminary results of the first such measurement. The experiment was performed at HIE-ISOLDE facility at CERN in inverse kinematics with high intensity ^{59}Cu beam on CH_2 foil target at 5 different beam energies between 3.6 - 5.0 MeV/u.

References:

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