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Charged particle capture and elastic scattering experiments relevant to the astrophysical p-process

Gy. Gyürky[1]

[1] *Institute for Nuclear Research (Atomki), Debrecen, Hungary*

Contact email: *gyurky@atomki.mta.hu*

The explanation of the origin of the heavy, proton rich isotopes (the so-called p-nuclei) is a long-standing problem of nuclear astrophysics. These isotopes are not produced by neutron capture reactions in the s- and r-processes and their synthesis requires special conditions. Although different processes are considered which might contribute to the p-isotope nucleosynthesis, models are not able to reproduce well the p-isotope abundances as observed in the solar system. These processes are in general referred to as the astrophysical p-process.

Perhaps the most important sub-process of the p-process is the so-called gamma-process which operates through gamma-induced reactions on pre-existing heavy seed nuclei in an explosive astrophysical event. Huge reaction networks are involved in gamma-process models and the necessary reaction rates are taken from theory in lack of experimental information. If the theoretical reaction rates are not accurate, this may contribute to the poor predictive power of the gamma-process models. The experimental check of the relevant reaction rates is therefore very important. This can be achieved by the cross section measurement of the gamma-induced reactions or, preferably, of the inverse particle induced reactions.

For reactions involving alpha particles the uncertainty of the reaction rate calculations is especially high. Therefore, huge experimental effort was devoted recently to the measurement of alpha-induced reaction cross sections. Moreover, the alpha-nucleus optical potential, which is one of the most important source of uncertainty in the calculations, can be studied directly with alpha elastic scattering experiments. Experimental details of such measurements will be shown in this talk as well as some of the results and their consequences.