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On the missing yield of in-beam radiative proton-capture cross section measurements relevant to the p process

The p process nucleosynthesis is responsible for the creation of around 35 low-abundant nuclides which lie in the neutron-deficient side of the isotopic chart [1]. The modeling of the p process consists of around 20,000 reactions involving around 2,000 nuclides, including photodisintegration reactions such as (γ,p), (γ,a) and (γ,n). Their inverse reactions, related by the reciprocity theorem, can be studied in accelerator facilities to estimate relevant reaction rates. Thus, accurate cross section measurements of radiative-capture reactions inside the astrophysically relevant energy range (Gamow window) are particularly important for the estimation of the corresponding reaction rates in stellar environments. One of the methods, called the in-beam angular distribution method [2,3] has been extensively used for the determination of such cross sections. While the method provides a very good means of measuring the cross sections, transitions that are beyond the detection limit of each setup are not considered in the analysis, which results in a missing yield on the final value of the measured cross section. In this work, an attempt to quantify this missing yield is presented using the FIFRELIN code [4] for the reaction 112Cd(p,γ)113In [3]. FIFRELIN employs a Monte Carlo Hauser-Feshbach framework based on Bečvár's algorithm [5] and is able to model the de-excitation of every isotope from an initial excitation energy and provide an estimate for both the discrete and the continuous part of the de-excitation spectrum. The corrected results are compared with results measured by the more accurate activation method [6].

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