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Probing nuclear level densities and γ-ray strength functions via partial reaction cross sections

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Modeling the complex network of reactions that is the astrophysical γ process requires calculating tens of thousands of reaction rates. Level densities and γ-ray strength functions are key parameters in these calculations and one way to probe them is by measuring partial reaction cross sections [1]. Three such experiments focusing on the iron peak region will be reported on. The ^{55}Mn(α,n)^{58}Co^{m+g} and ^{58}Fe(p,n)^{58}Co^{m+g} reactions were investigated using the activation technique. Despite being unable to directly observe the γ-ray transition from the metastable state to the groundstate of ^{58}Co, due to its low energy of 25 keV, the production of ^{58}Co via its metastable state could be disentangled from its production without populating the metastable state first. This was accomplished by identifying the feeding contribution from the metastable state in the electron capture decay of the groundstate. The ratio of the total cross section and the partial cross section associated with the production of the metastable state turns out to be very sensitive to nuclear level information. In addition, first results of an in-beam measurement of the ^{58}Fe(p,γ)^{59}Co reaction will be presented.
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[1] F. Heim *et al.*, *Phys. Rev. C* **103**, 025805 (2021).

Author: MÜLLER, Martin (University of Cologne)

Co-authors: Prof. ZILGES, Andreas (University of Cologne); MACHLINER, Benedikt (University of Cologne); Dr HEIM, Felix (University of Cologne); WÜSTENBERG, Pina (University of Cologne); WILDEN, Svenja (University of Cologne)

Presenter: MÜLLER, Martin (University of Cologne)