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Study of (n, xn γ) Reactions on Tungsten Isotopes : Retrospective and perspectives

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To improve the accuracy of numerical simulations used in the development of nuclear reactors, over the past decade we studied (n, xn) reactions on tungsten isotopes. As this element, because of its physical and chemical properties, is widely used in modern nuclear reactors (and foreseen as a key component in fusion ones).

The IPHC group carried out an experimental program to measure (n, xn gamma) reaction cross sections using the GRAPhEME setup at the JRC-Geel with the GELINA neutron beam facility. The measurements were performed on natural, 182, 183, 184, and 186W targets.

The obtained experimental data, the only available of their kind, provide a comprehensive and constraining test for the predictability of nuclear reaction models. These latter need to accurately describe the reaction mechanism, the nuclear de-excitation process, and the nuclear structure to correctly reproduce the experimental (n, n' γ) cross-sections [1,2].

Preliminary results for even-even isotopes have already been published and discussed [3,4]. Additionally, a glimpse into the study of 183W was provided at the ND 2022 conference [5].

A near future publication will detail the definitive experimental results, compare these to existing models, and identify which ingredients play key roles in these reactions, in particular consider the role of spin distribution in the pre-equilibrium part of the reaction, the description of the discrete levels and continuum, and their coupling.

Building on this work, the next focus will be on the reactions 183W(n, n' γ) and (n, 2n γ). Preliminary results suggest that the recorded data will allow the extraction of almost a dozen cross section. The studied reactions could provide further insights into the reaction mechanism and the predictability of models.

Finally, a future analysis of isotopic targets data will yield information on (n, 2n g) reactions on even-even isotopes. In particular, we will be able to "bridge the gap" from 184 to 182W with (n, n') and (n,2n) cross section on 184W, 183W and 182W. To that end, our goal is to publish the data quickly following the availability of the results with 183W.

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