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The Shape Method and Status of the Photon Strength Function Database

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Nuclear data in the quasi-continuum have increasingly garnered attention due to their central role in a vast array of applications spanning fields such as isotope production, fission and fusion reactor technologies, non-proliferation, and the fundamental sciences of nuclear astrophysics and nuclear structure. These data are characterized by the photon strength function (PSF) and nuclear level density (NLD), and their measurements have and will continue to play a central role as these are inputs for the statistical Hauser-Feshbach model. This facilitates the extraction of neutron-capture cross-section data even for nuclei where direct measurements are not feasible. Now, PSF and NLD measurements in previously inaccessible regions of the nuclear chart have become possible due to many facilities worldwide offering enhanced or new state-of-the-art research infrastructure. In parallel, several new experimental and analytical techniques have been developed, enabling more reliable PSF and NLD studies. Recognizing the pivotal role of PSFs and NLDs, the International Atomic Energy Agency (IAEA) launched a Coordinated Research Project in 2016 aimed, in part, at establishing a PSF database, an initiative that encompasses measured PSF data and recommended theoretical models.

This presentation will focus on two aspects:
1) I will provide an overview of the recently developed Shape method, which provides an alternative approach to determine the slopes of the PSFs and NLDs extracted from the Oslo-type methods. The Shape method was developed specifically to provide a prescription when s-wave neutron resonance spacing data is unavailable. It utilizes branches of primary γ-ray transitions from a specific excitation-energy region to different low-lying discrete levels. Information about the functional form of the PSF is contained in the measured intensities of these primary branches, allowing for an independent normalization of the slope of PSFs and by extension NLDs [1,2].
2) I will provide an update on the current status, challenges, and perspectives of the PSF database [3], which was initially released in 2019. Numerous new measurements of the PSF have become available since, prompting a substantial update of the PSF database. This updated version is scheduled to be made available in 2024.

[1] M. Wiedeking et al., Phys. Rev. C 104, 014311 (2021).
[2] D. Mücher et al., Phys Rev C. 107, L011602 (2023).
[3] S. Goriely et al., Eur. Phys. J. A 55, 172 (2019).

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