



Contribution ID: 87

Type: Oral presentation

Deviations from the Porter-Thomas distribution due to non-statistical γ decay

Tuesday, October 7, 2025 2:30 PM (30 minutes)

Random Matrix Theory provides a comprehensive framework for the description of complex, chaotic quantum systems [1,2]. It is exploited across various domains of physics as for instance in the statistical treatment of nuclear reactions within the Hauser-Feshbach formalism [3]. One important aspect in the practical application of Hauser-Feshbach codes is the fluctuation property of partial transition widths. Experimentally, the applicability of so-called Porter-Thomas (PT) fluctuations [4] has been extensively studied in thermal neutron capture experiments [5]. Former analyses of the nuclear data ensemble (NDE) of neutron resonances [5] validate the PT distribution. Recent studies and thorough reanalyses of the NDE revealed significant deviations from PT predictions [6] partially explained by non-statistical γ decays. Neutron resonances provided a vast amount of precision data on fluctuation properties of nuclear resonances. However, no experimental data exist, to date, for width fluctuations *below* neutron separation thresholds. This region is particularly interesting because it contains the onset of the quasicontinuum region. There, the nuclear spectra transition from a few individual states at low excitation energies to an ensemble of states at high excitation energies. The latter are assumed to be well described by the ansatz of the Hauser-Feshbach statistical model. In this contribution, we introduce a new method for the study of fluctuations of partial transition widths based on nuclear resonance fluorescence experiments with quasimonochromatic linearly-polarized photon beams below particle separation thresholds [7]. Assuming χ^2 -distributed partial transition widths, average branching ratios of internal γ decay transitions are related to the degree of freedom ν of the χ^2 distribution. Recent studies with ^{150}Nd result in a degree of freedom of $\nu = 1.93(12)$ in clear disagreement with the PT distribution [8,9]. The recent findings will be discussed in the context of non-statistical effects in the γ -decay behavior that are potentially connected to the survival of good K quantum numbers in the covered excitation-energy region.

This work is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB-1245, Project-ID 460150577 - ZI 510/10-1, and Project-ID 499256822 - GRK-2891 "Nuclear Photonics", by the State of Hesse under the grant "Nuclear Photonics" within the LOEWE program (LOEWE/2/11/519/03/04.001(0008)/62), by the BMBF under grant number 05P21RDEN9. Furthermore, this work is supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under grants DE-SC0023010, DE-FG02-97ER41041 (UNC), and DE-FG02-97ER41033 (Duke, TUNL), and by the UK-STFC (Grant No. ST/P005101/1).

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Session Classification: Session III