A new approach to estimate spin distributions & fitting the gSF: Finally the end of the many parameter nightmare?

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Nuclear level densities (NLD) and γ-ray strength (γSF) functions are essential quantities in various fields of basic and applied research involving nuclear matter. From microscopic calculations and structure research to nuclear reactor models and astrophysical applications a good knowledge of these parameters determines fundamental properties of the systems.

The current state of approaches to two challenges encountered in the extraction of the NLD and γSF using the Oslo Method will be presented. We will focus on the extraction of the results for ^{240}Pu in the quasi-continuum, that have been extracted from the (d,p) reaction – however it is expected that the approaches are of general applicability and interest.

Aspect 1: Spin Distributions

The Oslo Method used data from surrogate reactions, oftentimes (d,p), to simultaneously extract the nuclear level density (NDL) and gamma-ray strength function (gSF) of the residual nucleus. In the extraction procedure we need to make an assumption on the spin distribution of the nucleus. This is a challenge in itself. However, with light ion reactions, and in particular (d,p) we may not populate the high spins present in the nucleus. We attempt to estimate and quantize the effect of this. The calculations of the spins populated in the (d,p) are based on the non-elastic part of the deuteron breakup cross section, using within the distorted-wave Born approximation. We will present the current states of the calculations and problems we still face in the implementation.

Aspect 2: Fitting the γSF

Whenever we try to determine a function with many free parameters it is challenging to determine the best parameters, let alone the connected statistical uncertainties and covariances. In the parametrization of the γSF extracted for ^{240}Pu below the particle separation threshold we face this situation. We will present the first results using a minimum χ^2 method that is approximately independent of the input estimate.