Compound nucleus spin distribution for $^{64}\text{Ni} + ^{100}\text{Mo}$

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In the last decades, a number of measurements have been performed to understand the fusion reaction dynamics and to obtain an experimental representation of the barrier distribution $D_b$ using precisely measured fusion excitation functions [1]. As an alternative approach to this the employment of the compound nucleus (CN) spin distribution $\sigma_\ell$ (SD) was proposed [2]:

$$D_b = \frac{dT(E')}{dE'}$$

with

$$E' = E - \frac{\ell(\ell + 1)}{2\mu R_b^2}$$

and

$$\sigma_\ell(E) = T_\ell(E, \ell)(2\ell + 1)\pi \lambda^2,$$

where $T$ is the transmission as a function of the spin $\ell$ or the energy $E'$ as defined above, $\mu$ the reduced mass of the colliding system, $\lambda$ the de Broglie wavelength and $R_b$ the barrier radius.

To explore aspects like the fusion-fission competition, the role of deformation in fusion of a heavy system and the possible effect of the $Z=82$ shell closure on enhancing the fold spectrum with respective characteristic $\gamma$ transitions. In an earlier measurement at the Argonne/Notre Dame Crystalball integral ER data had been obtained with some limitations in accuracy for spin and cross section assignment [4]. These fold distributions are converted into multiplicity distributions using the response function of the detector array. Finally the multiplicity distributions are converted to $\sigma_\ell$ distributions using eq. 2 in Ref. [3]. The comparison of the SDs at the three measured beam energies is shown in Fig. 1. It is observed that the high spin tail of the SD becomes steeper and steeper with increasing beam energy. With increasing beam energy fission starts competing with ER production and the partial wave with higher spin end up as fission which results in cutting of the SD at the high spin end. The extraction of $D_b$ from those spin distributions is presently being pursued and will be reported soon.

References