Observation of a Double-humped γ-Ray Fold Distribution in ^{142}Eu

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Fold distributions for the population of nuclei around ^{142}Eu have been deduced from high-spin γ-spectroscopy data obtained with the γ-spectrometer GASP of the Laboratori Nazionali di Legnaro, Italy. The ^{97}Mo + ^{51}V reaction at a beam energy of 238 MeV has been used in the investigation. The target consisted of two ^{97}Mo foils (enrichment 94.2 %) with a total thickness of ≈ 1.0 mg/cm^2. The GASP array was in this experiment equipped with the charged-particle detector array ISIS, made of 40 Si particle telescopes with thicknesses of $\approx$140 μm and $\approx$1 mm for the ΔE and E detectors, respectively. The detection of charged particles allowed to select reaction channels connected with particle emission.

Fold distributions, measured with the inner BGO ball of GASP, have been obtained for the final nuclei $^{142-144}$Gd, $^{140-144}$Eu and ^{140,141}Sm by gating on discrete single γ-lines in the respective nuclei using fold – E_γ matrices. In the analysis p- and α-gated matrices have been used. The fold distributions obtained for the 2pxn reaction channels leading to $^{141-144}$Eu show Gaussian-like distributions with the maxima shifting to lower folds with increasing number of emitted neutrons as expected. However, a completely different picture is found for the αxn channels leading to $^{140-143}$Eu. The centroids of the fold distributions change irregularly with the number of emitted neutrons (α4n: $< F >= 11$; α3n: $< F >= 16$; α1n: $< F >= 15$) and the fold distribution of the α2n channel leading to ^{142}Eu shows a double-humped structure as can be seen in fig. 1. Such a fold distribution has to our knowledge not been reported so far.

To describe the experimental fold distributions the population and depopulation of nuclei excited to high spins and excitation energies in nuclear ractions has been simulated with Monte-Carlo methods. The fold distributions for the ypxn reaction channels can be rather well reproduced assuming a complete fusion reaction mechanism. However, the picture looks different for the αxn channels. Simulation calculations for ^{142}Eu show that the fold distribution for the α2n channel may be understood assuming an incomplete-fusion reaction mechanism.

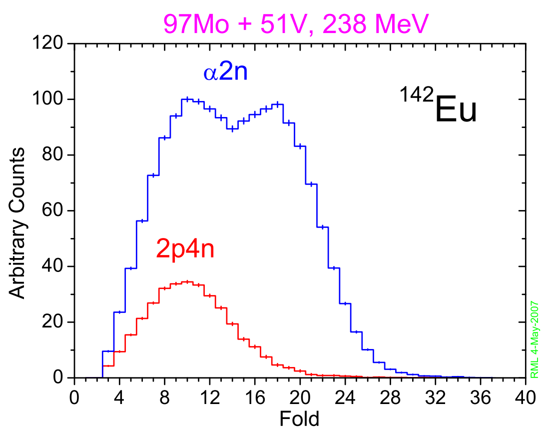

Figure 1: *Experimental fold distributions for ^{142}Eu obtained for the α2n and 2p4n channels in the ^{97}Mo + ^{51}V reaction at 238 MeV.*