Conversion Electron Spectroscopy in the Superdeformed Minimum of ^{240}Pu* ◇

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A recent measurement of conversion electrons in the second minimum of ^{240}Pu showed some weak but unambigous evidence for low-lying transitions with energies smaller than the clearly visible transitions of the first beta vibrational band at 769.9 keV [4]. Since the Mini-Orange detector system in the experiment was optimized to the energy range were the beta vibrational band was observed (600-800 keV), the detection efficency for the lower-lying lines was insufficient for a clear identification. In order to be able to assign the low-lying transitions to members of excited collective bands, the superdeformed minimum of ^{240}Pu was populated in a new experiment with the ^{238}U(α,2n)^{240f}Pu-reaction at E_α=25 MeV, with a detector system optimized for conversion electrons with energies between 300 and 600 keV. Similar to the previous experiment the detector system consisted of 3 magnetic Mini-Orange spectrometers each combined with a Si(Li)-semiconductor detector behind the Pb-absorbers of the Mini-Orange. By changing the magnetic field between the the wedge shaped magnets of the Mini-Orange, the maximum in the detection efficiency could be shifted to lower energies. The change in the magnetic field strength was adjusted through the variation of the dimensions and number of wedges. While the previous experiments were performed with Mini-Oranges consisting of 6 wedge-shaped $Nd_2Fe_{14}B$-magnets (B=90 ± 5 mT), 5 similar magnets formed the new Mini-Oranges, delivering a toroidal field of B= 80 ± 5 mT. The maximum of the transmission function was shifted from 650 keV in the old setup to about 450 keV in the new experiment.

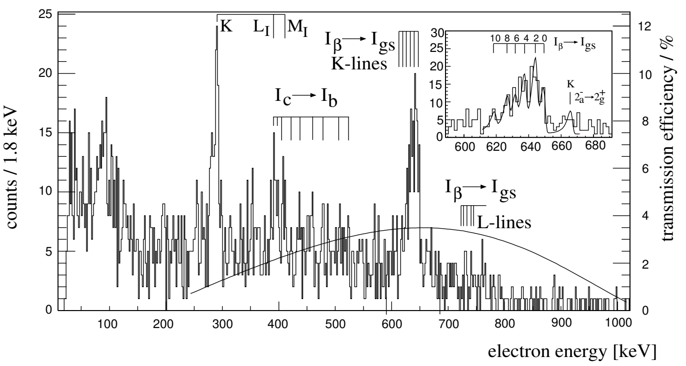

Fig. 1: Conversion electron spectrum in coincidence with delayed fission of ^{240f}Pu. Additionally shown is the transmission efficiency curve obtained from the weighted average of the two experimental setups described in the text. The insert expands the region of the first β-vibrational band.

The data obtained with the old and the new setup were summed after carefully matching the energy calibration and the resulting conversion electron spectrum together with the effective transmission efficiency curve for both measurements is shown in Fig. 1.

The measurement confirmed the already known transitions of the beta vibrational band and increased the statistics of the low-lying E0-transitions (e.g. labelled $I_c \to I_b$ in Fig. 1) [1], which were predicted by the level scheme of a recent γ-spectroscopy measurement [3,4]. Those collective states could be established and from the level-spacing of these states the dynamical moments of inertia could be calculated individually for each band. In summary they are shown together with the dynamical moments of inertia of all other known bands in the second minimum of ^{240}Pu in Fig. 2, where the band labels a-e were taken from Ref. [2].

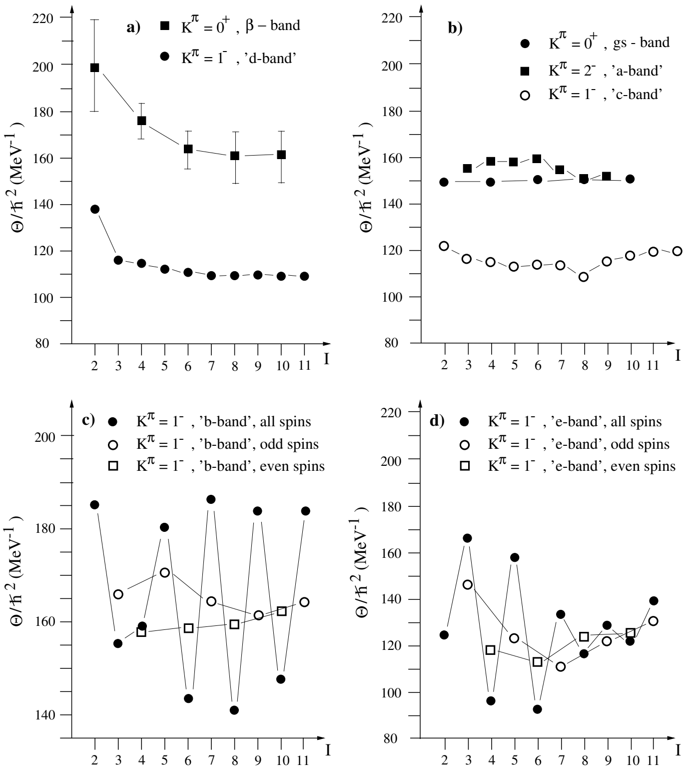

Fig. 2: Dynamic moments of inertia of the excited superdeformed bands in the second minimum of ^{240f}Pu

References

[1] D. Gassmann *et al.*, Phys. Lett. **B497** (2001) 181
[2] P.G. Thirolf *et al.*, Proc. of Int. Symposium on Exotic Nuclear Structures, Debrecen (Hungary), 15-20 May 2000, ed. A. Krasznahorkay, Akademiai Kiado, Budapest
[3] D. Pansegrau *et al.*, Phys. Lett. **B484** (2000) 1
[4] D. Gassmann *et al.*, Jahresbericht 1999, p. 20

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