On the Excitation Energy of the Ground State in the Third Minimum of ^{234}U ◇

A. Krasznahorkay [a], D. Habs, M. Hunyadi [a], D. Gassmann, M. Csatlós [a], Y. Eisermann, T. Faestermann, G. Graw, J. Gulyás [a], R. Hertenberger, H. J. Maier, Z. Máté [a], A. Metz, J. Ott, and P. G. Thirolf

[a] Inst. of Nucl. Res. of the Hung. Acad. of Sci., H-4001 Debrecen, P.O. Box 51, Hungary

In our previous work [1] we reanalyzed the fission resonances measured by Blons *et al.* [2] concerning ^{234}U and showed that the unresolved peaks could be interpreted as being the consequences of HD states lying in the third well of the potential barrier. The aim of the present work was to study the ^{233}U(d,pf)^{234}U reaction with better energy resolution and resolve the HD rotational bands.

The experiment on ^{234}U was carried out with a $E_d = 12.5$ MeV deuteron beam of the Munich Tandem accelerator. The energy of the outgoing protons was analyzed by a Q3D magnetic spectrograph. Fission fragments were detected by two position-sensitive avalanche detectors (PSAD). A typical part of the obtained proton - fission fragment coincidence spectrum is compared to the one published by Blons *et al.* [2] in fig. 1.

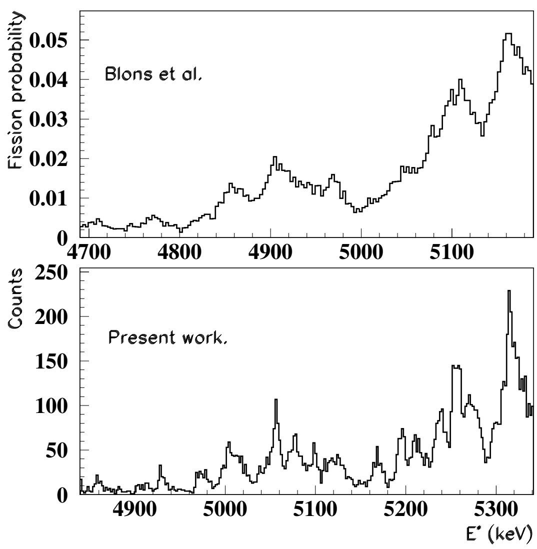

Fig. 1: Part of the proton spectrum measured in coincidence with the fission fragments and compared to the result of Blons *et al.* [2]

The energy resolution has considerably improved. According to our calibration the energy scale had to be shifted by ≈150 keV to achieve consistency. Assuming overlapping rotational bands with the same moment of inertia we fit our experimental results in the same way as we did in our previous work [1]. The result of the fit is shown in fig. 2a). The observed fission resonances are well described with a rotational parameter of $\hbar^2/2\theta = 2.2 \pm 0.2$ keV, which is characteristic to the hyperdeformed nuclear shape. Furthermore the odd parity states 3^- and 5^- occur because of the octupole deformed nuclear shape.

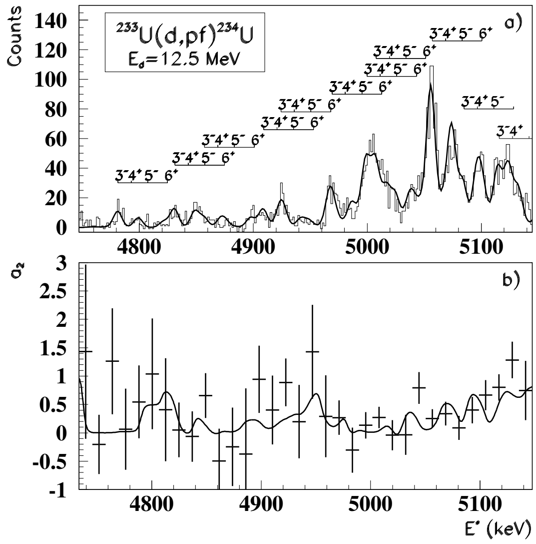

Fig. 2: (a) Part of the measured proton energy spectrum fitted with 11 rotational bands with a common rotational parameter; (b) Experimental fission fragment angular distribution coefficients (discrete symbols) as a function of excitation energy compared to the fitted one (solid line) using K values of 1,3,3,0,2,3,2,3,1,2 and 0.

In order to get information on the spins and K values of the observed rotational bands the angular distribution coefficients of the fission fragments have been calculated and compared to the experimental ones in fig. 2b).

The most strongly excited states in the low-energy ^{233}U(d,pf)^{234}U reaction are the 3^- states. The level density of these states has been compared to the prediction of the back-shifted Fermi-gas formula with parameters determined by Rauscher *et al.* [3]. The energy of the ground state in the third minimum has been deduced by this method for the first time and a value of $E_{III} = 2.65 \pm 0.3$ MeV was obtained, which agrees well with the predicted one for a reflection-asymmetric minimum of $E_{III} = 2.7$ MeV [4].

References

[1] A. Krasznahorkay *et al.*, Phys. Rev. Lett. **80** (1998) 2073
[2] J. Blons *et al.*, Nucl. Phys. **A477** (1988) 231
[3] T. Rauscher *et al.*, Phys. Rev. **C56** (1997) 1613
[4] S. Ćwiok *et al.*, Phys. Lett. **B322** (1994) 304

◇ This work has been supported by DFG under IIC4-Gr 894/2 and The Hungarian Academy of Sciences under HA 1101/6-1, the Hungarian OTKA Foundation No. T23163, and the Nederlandse Organisatie voor Wetenschapelijk Onderzoek (NWO)