Contribution ID: **32** Type: **Invited oral contribution**

Highly deformed states, clusterization and fission in the actinide region

Wednesday 12 October 2005 11:00 (30 minutes)

The predicted variety of exotic nuclear shapes, and heavy clusterizations in the actinide region still represent big challenges for the contemporary experimental investigations.

Recently, the fission probability as a function of the excitation energy has been measured with high energy resolution using the (d,pf) reaction on different targets in order to study exotic nuclear shapes. The resonances could be described as being members of rotational bands with moments of inertia characteristic to super- and hyperdeformed nuclear shapes [1-4].

For the first time the depth of the third potential minimum was experimentally determined by applying a method of the statistical level density analysis of band head energies [2,4]. The method was tested in the case of the well known second potential minimum [3]. A rather deep third minimum was found in 234U (EIII=3.1(4) MeV) as well as in 236U (EIII=2.7(4) MeV) [4] in agreement with recent theoretical expectations [5].

The excitation energy of the lowest-lying hyperdeformed transmission resonance and the energy dependence of the fission isomer population probability allowed us to determine the height of the inner fission barrier and also its penetrability parameter for 236U. In this way the long lasting uncertainties in determining the height of the inner potential barrier in Uranium isotopes ('Thorium anomaly') was resolved in the picture of the triple-humped fission barrier [4].

The possibility of heavy clusterization in such highly deformed states was also investigated by measuring the mass and energy distributions of the ejected charged particles as a function of the excitation energy nearby the fission resonances corresponding to hyperdeformed nuclear states.

An overview of the field, our latest experimental results and future plans will be presented.

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Session Classification: Evolution of nuclear structure, shapes, and fission

Track Classification: Evolution of nuclear structure, shapes, and fission