PL9902449

Search for Exotic Shapes in $^{165\text{-}167}$Hf

J. Domscheit[1], D.R. Jensen[2], H. Hübel[1], G.B. Hagemann[2], B. Herskind[2], G. Sletten[2], M. Bergström[2], P. Varmette[2,3], B.S. Nielsen[2], W. Ma[3], S. Frattini[4], F. Demaria[4], A. Maj, F. Camera[4], A. Bracco[4], B. Million[4], D. Napoli[5], B.M. Nyako[6], D.T. Joss[7], and M. Aiche[8]

[1]*University of Bonn, Germany;* [2]*NBI Copenhagen, Denmark;* [3] *Mississippi State University, USA;* [4]*INFN Milano, Italy;* [5]*LNL Legnaro, Italy;* [6] *ATOMKI Debrecen, Hungary;* [7]*University of Liverpool, UK;* [8] *University of Bordeaux, France*

In the region of the light mass Lu and Hf isotopes shape coexistence has been predicted theoretically at high angular momentum. Calculations of potential energy surfaces show minima at normal deformation, superdeformation with pronounced triaxiality ($\gamma \approx 20°$) and hyperdeformation. The, presumably, triaxial superdeformed shapes have been found experimentally in Lu isotopes [1-3] and in ^{168}Hf [4]. However, it has so far not been possible to identify the hyperdeformed states.

We have performed an experiment to search for exotic shapes in $^{165\text{-}167}$Hf by use of a very cold near-symmetric reaction. High-spin states were populated in the ^{74}Ge + ^{96}Zr reaction with a Ge beam of 310 MeV from the ALPI accelerator at LNL Legnaro. A total of 3.96×10^9 coincidences with $F \geq 5$ unsuppressed Ge-detector events was measured with the *EUROBALL* spectrometer. The coincidences were sorted into three-dimensional (cube) and four-dimensional (hypercube) arrays using RADWARE. Several search routines are applied to look for new bands in $^{166\text{-}168}$Hf. The preliminary analysis revealed several candidates for weak band structures which are presently under further investigation. In addition, it was sorted a so-called 4D-rotational plane of fourfold event which satisfies the equations: $|(E_1 - E_2) - (E_2 - E_3)| < \delta$ and $|(E_1 + E_4) - (E_2 + E_3)| < \delta$. This method emphasises the rotational band structures significantly. This 2D-matrix shows several indications for bands with different moments of inertia. Seven new normal deformed and three high-K bands have been found in ^{166}Hf. The ground band has been extended to spin 32^+, and the three other formerly known bands (the AB-band, the AE-band and the AF-band) have also been extended to spin 40^+, 41^- and 40^+ respectively. The new seven bands would in the left side of Fig. 1 be situated between the high-K band and the four other bands shown. There seems to be an upper limit over which no rotational bands are observed. As a consequence of the extensions of the AE-, AB- and AF-bands a new alignment begins to show up at a frequency of $\omega \approx 500$ keV. This increase in aligned angular momentum is probably due to the break up of a pair of protons in the $h_{11/2}$-subshell. Further analysis is in progress.

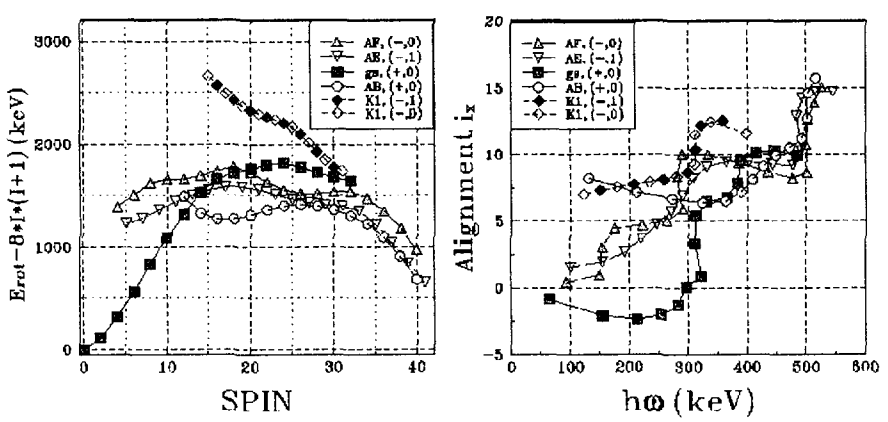

Fig. 1: Left: the excitation energies of the four known now extended bands and the new high-K band as a function of spin relative to a rigid rotor. Right: the alignment of the same five bands.

References:

1. W. Schmitz et al., Nucl. Phys. **A539** (1992) 112; Phys. Lett. **B303** (1993) 230;
2. H. Schnack-Petersen et al., Nucl. Phys. **A594** (1995) 175;
3. S. Törmänen et al., Il Nouvo Cim. **111A** (1998), and Phys. Lett. **B** (submitted);
4. B. Herskind et al., to be published; P.G. Varmette, previous contribution.