Band Structure in Fission-fragment Nuclei: ^{115,117}Ag

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Silver fission fragments were studied by careful analysis of spontaneous-fission gamma data from our 252Cf thick-source GAMMASPHERE measurements of year 2000. Both signature partners of a rotational band built on the $7/2^+$ isomeric levels of ^{115}Ag and ^{117}Ag are identified up to spins of 21/2 and 29/2, respectively. In both nuclei the spacing regularly increases going up the band to the 21/2 level. The higher continuation, seen only in ^{117}Ag, has decreased spacing, suggesting a band- crossing to a state of greater deformation. Using the Nilsson single-particle level diagram (Fig. 1 of J. Skalski et al.[1]) the obvious assignment for the $7/2^+$ band is the up-sloping [413 7/2]. The band crossing above 21/2 may be to a down-sloping Coriolis-mix of Nilsson orbitals [422 3/2] and [420 _]. There is a pronounced doublet structure in these bands, which we suggest is an indicator of softness toward triaxiality (soft gamma-vibrational mode.) The nearby region studied theoretically by J. Skalski et al.[1] shows triaxial tendencies for even-even nuclei, so it is reasonable that the odd-A nuclei adjoining their region of study might also show triaxiality. The simplest picture for understanding the observed doublet structure is that a triaxial nuclear shape will tend to quench the orbital motion (in this case the $g_{9/2}$ orbital below the band crossing and the $g_{7/2}$ above.) A more traditional band-mixing explanation would explain the doublets as arising from a second-order $\Delta K=2$ mixing to the irregularly-spaced band of the [440 _] orbital. The sign of the signature splitting is that expected for a j=9/2 orbital. It is interesting to look at another of our collaboration's papers, Zhu et al.[2], a study of ^{107}Ru. The odd-parity band going up to spin 31/2 also has a pronounced doublet structure. In this case the sign of the signature splitting is opposite to the Ag isotopes and is that expected for a j=11/2 orbital, the $h_{11/2}$.

We also see parts of other bands in the Ag isotopes, one of which may be an yrast continuation of the ground band [301 _]. We observe levels from spin 13/2 up to 21/2 of this band. In ^{115}Ag we have a candidate for a gamma-vibrational band built on the $7/2^+$ isomeric state. We tentatively assign the bandhead at 285.5 keV as 11/2+. It has only small signature splitting. In both Ag isotopes we have just above 2 MeV bands that seem to be a cascade of M1 transitions with unobservable crossovers. These could be candidates for 3-quasiparticle tilted-axis cranking model bands[3] with the unpaired quasi-particles partly in down-sloping and partly in up-sloping Nilsson orbitals. Another closely-related theoretical approach of interest is Ohtsubo and Shimizu's "Tilted Axis Cranking to a System of One-Quasiparticle Coupled to a Triaxial Rotor."[4]

Footnotes and References

A paper on this Ag work was sent to Phys. Rev. C.

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