Quasi–particle and collective magnetism in high-K isomers

N. Stone[1]

[1]*Department of Physics and Astronomy,*
University of Tennessee, Knoxville, TN 37831 USA

K-Isomeric states in isotopes of elements between Lutetium (Z= 71) and Tungsten (Z = 74) and the bands built upon them have been the subject of many experimental and theoretical investigations. In this talk I will briefly report recent experimental work on measurement of the magnetic dipole moment of the $37/2^-$ K-isomer in ^{177}Hf and of E2/M1 mixing ratios in transitions between levels of bands built upon the $23/2^+$ isomer and the $9/2^-$ single quasi-particle state in this isotope. The magnetic moments of band-head (I = K) states in the collective model are given by

$$\mu = g_K.[I^2/(I+1)] + g_R[I/(I+1)]$$

where g_K is the combined quasi-particle *g*-factor and g_R is the collective *g*–factor. The new results will form the basis for a discussion of the accuracy of additivity in prediction of the g_K values of high-K multi-quasi-particle states in this region. Using additivity as a principle to estimate g_K more widely opens the possibility to explore the variability of g_R using measured values of $|g_K - g_R|$ from in-band branching ratios. The g_R parameter (given by the ratio $I_p/I_p + I_n$ where I_p, I_n are the proton and neutron contributions to the total moment of inertia) is influenced by pairing, which acts to reduce, independently, both the proton and neutron contributions to the total moment of inertia. Pairing is blocked by the presence of quasi-particle excitations. With pairing neglected, g_R reduces to the simple ratio *Z/A*. However *gR* has sensitivity to the degree of blocking of each nucleon type and can vary above and below this value.

The high-K isomers provide the ideal region to explore this hitherto neglected sensitivity. Results from a review of the literature will be reported to demonstrate the sensitivity of g_R to single and multiple combinations of quasi-proton and quasi-neutron excitations. The deduced value of the parameter g_K has been widely used to aid identification of the quasi-particle make-up of different high-K isomers in the same nucleus, based on measurements of $|g_K - g_R|$, assuming a single value of g_R. Lack of regard for the variability of g_R can give rise to considerable error in g_K and possible mis-identification.

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