Special Nuclear Seminar

LINKS BETWEEN HIGH-K AND LOW-K STATES IN ^{176}LU AND ^{180}TA

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Nature's heaviest naturally occurring odd-odd isotopes, ^{176}Lu and ^{180}Ta have a pair of high and low-*K* levels at low energies formed by parallel or anti-parallel coupling of the unpaired proton and neutron to give a total projection, $K = | \Omega_p \pm \Omega_n |$.

One manifestation of this is the formation of a long-lived 9^- isomer in ^{180}Ta, the only naturally occurring nuclear isomer, with a lifetime of $\tau_m > 1 \times 10^{16}$ years, 77 keV above the $K^p = 1^+$ short-lived ground state. The opposite situation occurs in ^{176}Lu: it exhibits a long-lived $K^\pi = 7^-$ ground state and a 1^- short-lived isomer at 123 keV. Both nuclei present issues for nucleosynthesis; ^{180m}Ta in terms of its abundance, creation, and survival in stellar environments; ^{176}Lu because, while definitely *s*-process (a possible *s*-process chronometer or thermometer), it could be destroyed through neutron capture to the short-lived b-decaying state, whereas photon excitation via intermediate-*K* states, passing from the 1^- isomeric level to the ground state, or the equivalent transition in the opposite direction, could either increase or decrease its abundance, and that of ^{176}Hf.

I will cover some new results from g-ray spectroscopy that bear on these issues, partly in the context of the relationship between the strong resonances observed in laboratory photo-activation (see, for example, Ref. [1]) and the growing problem of associating these resonances and their properties with specific excited states.

1. D. Belic et al. Phys. Rev. C 65, 035801 (2002).

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