

On the Elusive Links Between High-K and Low-K States in ^{176}Lu and ^{180}Ta

Monday, June 10, 2013 3:00 PM (20 minutes)

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 consequence of this is the formation of a long-lived 9^- state in ^{180}Ta , the only naturally occurring nuclear isomer, with a lifetime of $t_m > 1 \times 10^{16}$ years, 77 keV above the $K^\pi = 1^+$ 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; ^{180}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 beta-decaying state. Furthermore, 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 . (See Refs. [1,2], for example.)

The presentation will cover some recent results [3,4] from gamma-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. [5]) and the nuclear structure problem of associating these resonances and their properties with specific excited states.

1. P. Mohr, F. Kappeler, R. Gallino, Phys. Rev. C 75, 012802(R) (2007).
2. P. Mohr et al., Phys. Rev. C 79, 045804 (2009)
3. G. D. Dracoulis et al. Phys. Rev. C, 81, 011301(R) (2010)
4. G. D. Dracoulis and G.J. Lane, to be published
5. D. Belic et al. Phys. Rev. C 65, 035801 (2002).

Primary author: Prof. DRACOULIS, George (Australian National University)

Presenter: Prof. DRACOULIS, George (Australian National University)

Session Classification: Session 3