K-Isomers as a Probe of Nuclear Structure and Advanced Applications

Filip G. Kondev

Argonne National Laboratory (on behalf of gsfma90 and gsfma112 collaborations)

A characteristic feature of deformed rare-earth nuclei in the region near A∼180 is the presence of long-lived, meta-stable states that are frequently called "K-Isomers". The long lifetimes arise from the large reorientation of the projection of the angular momentum on the symmetry axis (the K quantum number) with a simultaneous preservation of the axial symmetry.

Recent results from experiments aimed at studying exotic isomers at ATLAS, Argonne National Laboratory and at the Heavy Ion facility of the Australian National University will be presented. The emphasis will be on the structure of the isomers and their associated collective bands. The latter will be used to reveal some interesting nuclear structure effects, such as the interplay between collective motion (involving the whole nucleus) and individual nucleon dynamics, and the step-wise collapse of the pairing correlations in nuclei. Results on similar K-isomers in A∼130 nuclei will be also outlined. These nuclei are less deformed and more susceptible to shape changes, shape co-existence and triaxiality than the well-deformed cases known in the A∼180 region. Such differences will affect both the decay transition strengths (and therefore lifetimes) and also the likelihood of isomers occurring in the odd-A nuclei since their properties may change significantly due to effects from the odd particle. Finally, a possible application of the $T_{1/2}$=31 yr, $K^{\pi}=16^{+}$ isomer in ^{178}Hf and the $T_{1/2}$=160 d, $K^{\pi}=23/2^{-}$ isomer in ^{177}Lu as a simulated energy release device, as well as the astrophysical relevance of long-lived isomers in ^{180}Ta and ^{176}Lu, will be also discussed.

Email: kondev@anl.gov