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Mirror energy and transition strength differences beyond the fp shell. Isomeric decay of 71Kr –71Br

Isospin formalism, which describes the neutron and the proton as two states of the same particle, the nucleon, is amongst the essential descriptive tools of a vast range of nuclear phenomena. The broad success of the isospin symmetry concept belies its broken nature. Not only is the symmetry broken by the proton-neutron mass difference and the Coulomb interaction, but also by the nucleon-nucleon interaction itself. The investigation of isospin symmetry conservation and breaking effects has revealed a wealth of nuclear structure information. The so-called MED, defined by the differences of the excitation energies of analog states, are regarded as a measure of isospin symmetry breaking in an effective interaction that includes the Coulomb force. The MED have been extensively studied for mirror pair nuclei in the upper sd- and the lower fp- shell regions. The remarkable agreement found between experimental data and shell model calculations has allowed a clear identification of the origin of the MED based on the isospin-non conserving Coulomb and strong NN force. One of the open problems concerns the strength of the isospin non conserving NN force in particular for mirror nuclei in the upper part of the fp shell where little experimental data exists. Also the study of E1 transition rates in mirror nuclei, with the determination of the isovector (allowed) and of the induced-isoscalar (forbidden) strength components, offers a sensitive test of the isospin symmetry breaking.

In this LOI we intent to investigate the mirror energy and transition strength differences for the A=71 mirror nuclei. A 33 ns 9/2+ isomeric state is known to exists in 71Br. The same isomeric state is predicted to exist in 71Kr, where non information on the excited states is available, with a lifetime of the order of about 100 ns. We propose therefore to investigate at RIKEN the gamma decay from such isomeric states using the E(U)RIKA set-up in the stopped beam configuration.

Isomeric states in the 71Kr should be populated by in flight fragmentation of 78Kr beam at 345 MeV /nucleon. Fragments will be separated in-flight using the BigRIPS facility. The first stage of the BigRIPS separator will be used to collect and separate fission fragments while the second stage will be used as a spectrometer for particle identification.

Assuming a primary beam intensity of 30 pps of 78Kr we estimate a particle rate of about 50 pps for 71Kr. With a gamma efficiency of the E(U)RIKA spectrometer in the stopped beam configuration of about 15% and an isomeric ratio of 5%, we expect about 500 counts per day in the main E1 transition.

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