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Comparison of Tz=-2 beta decays with their mirror process on Tz=2 nuclei and search for isospin suppressed gamma and proton transitions

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Isospin symmetry is based on the almost identical 'behavior' of proton and neutron in terms of the strong interaction.
However, due to isospin breaking interactions, including electro-magnetic interaction, slight asymmetry is associated with the nuclear structure of mirror nuclei.

We have been studying Tz=\pm 1−>0, Tz=\pm 3/2−>\pm 1/2, and Tz=\pm 2−>\pm 1 mirror Gamow-Teller (GT) transitions as a tool to study the nuclear structure of relevant nuclei in connection with isospin symmetry and isospin selection rules.
The Tz=+1−>0, +3/2−>+1/2, and +2−>+1 GT- transitions have been studied by high-resolution (about 30 keV) \beta- like (3He,t) reactions performed at RCNP, Osaka, while mirror GT+ transitions, in particular for lower Z, pf-shell nuclei, by the \beta+ decays of proton rich unstable nuclei performed at GANIL, Caen and GSI, Darmstadt.
Note that the production rate of the negative Tz nuclei in the Z > 30 region is the largest at BigRIPS @RIKEN.
Since these nuclei are situated on the path of rapid-proton (rp) process, decay study of them are also of astro-physical interest.

Eurica setup in combination with BigRIPS was used to study the GT transitions (and also Fermi transitions) by the \beta decay of Tz= -1, -3/2, and -2 nuclei in the higher Z, pf-shell region (Z=30 - 36). The initial 345 MeV/nucleon 78Kr beam with an intensity up to 300 pnA on the Be target was used for the production of fragments.
It is expected that these near-drip-line nuclei decay with various decay modes due to large decay Q-values. They can be delayed-\gamma, delayed-proton, and even delayed-\gamma-proton. Therefore, measurements of particle decay as well as gamma decay are important.

Produced unstable nuclei were implanted in active stopper, i.e., WAS3ABi setup, for the measurement of \beta rays and delayed-protons. The setup consists of three 1mm thick double-sided Si strip detectors (DSSSD) with each of them having an active area of 60 x 40 mm2 segmented into 60 vertical by 40 horizontal strips. The WAS3ABi setup was surrounded by the EURICA setup consisting of 12 HPGe CLUSTER-detectors of Euroball type for the efficient measurement of \gamma rays.

Owing to the large productive power of unstable nuclei at BigRIPS,

we could observe Tz=-1 nuclei 58Zn, 60Ga, 62Ge, 64As, 66Se, and 70Kr, Tz=-3/2 nuclei 57Zn, 61Ge, 65Se, and 69Kr, Tz=-2 nuclei 60Ge and 64Se. It is decided that all of them will analyzed inside our collaboration.

After performing particle identifications, we started to have precise half-life values. For some of the nuclei, the error-bars have reduced by one-order-of-magnitude due to the good statistics. Reconstruction of \gamma-decay scheme has also started recently.

Presenter: Prof. FUJITA, Yoshitaka (Research Center for Nuclear Physics (Toyonaka), Osaka Univeristy)

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