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## First observation of beta-delayed gamma-proton decay in $^{56}\text{Zn}$

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We report the observation of a very exotic decay mode at the proton drip-line, the beta-delayed gamma-proton decay, clearly seen in the beta decay of the  $T_z = -2$  nucleus  $^{56}\text{Zn}$  [1]. Here this decay mode, already observed once in the sd-shell [2], is seen for the first time in the fp-shell.

The experiment was performed at the LISE3 facility of GANIL, using a  $^{58}\text{Ni}^{26+}$  primary beam with an average intensity of 3.7 euA, accelerated to 74.5 MeV/nucleon and fragmented on a 200  $\mu\text{m}$  thick natural Ni target. The fragments were selected by the LISE3 separator and implanted into a Double-Sided Silicon Strip Detector 300  $\mu\text{m}$  thick, surrounded by four EXOGAM Ge clovers for gamma detection.

The proton decay of the  $^{56}\text{Zn}$  Isobaric Analogue State is normally expected to be isospin forbidden, however competition between beta-delayed protons and beta-delayed gamma rays has been observed. Similar cases have been seen before. The particularity here is that the states populated in the gamma de-excitation are also proton-unbound, consequently the rare and exotic beta-delayed gamma-proton decay has been observed. In particular, three gamma-proton sequences have been seen after the beta decay [1]. This observation is very important because it does affect the conventional way to determine the Gamow-Teller (GT) transition strength  $B(\text{GT})$  near the proton drip-line, where the general opinion until now was that the  $B(\text{GT})$  is simply deduced from the intensity of the proton peaks. On the contrary, the observed proton intensities are due to both direct feeding and indirect feeding coming from the gamma de-excitation. Thus both gamma and proton decays have been taken into account in the estimation of the Fermi and GT strengths. Evidence for fragmentation of the Fermi strength due to strong isospin mixing is found. The results are compared with the mirror process, the  $^{56}\text{Fe}(3\text{He},t)^{56}\text{Co}$  reaction [3].

The beta-delayed gamma-proton decay may become a common decay mode in heavier, more exotic systems with  $T_z \leq -3/2$ , which will be studied this year at the Radioactive Ion Beam Factory at RIKEN during the EUroball Riken Cluster Array (EURICA) campaign.

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