Beta-neutron-gamma spectroscopy of beta-delayed neutron emitters around doubly-magic ^{78}Ni

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The experiment focused on beta-neutron-gamma spectroscopy of βn-emitters nuclei around ^{78}Ni has been performed during 10 days in November 2017 at RIKEN. Exotic nuclei produced with the 345 MeV/nucleon ^{238}U beam reaching nearly 70 particle-nA and ^{9}Be target, were studied by BRIKEN Collaboration[1] by means of BigRIPS. BRIKEN array has been modified in comparison to its first round of experiments, in order to achieve larger gamma efficiency. The AIDA implantation and decay array has been replaced by four smaller double-sided Si-strip counters of WASABI[2] and complemented by a position sensitive detector based on YSO scintillator developed at the UTK. It allowed us to move two Ge clovers of ORNL CLARION array few cm closer to the ion implantation and decay counters increasing gamma counting efficiency. This hybrid setup has kept its high efficiency for detecting beta-delayed neutrons.[1] The BigRIPS setting was maximized for the transmission of ^{82}Cu. Isotopes between ^{61}V–^{69}V up to ^{95}Br–^{97}Br were produced and identified. In comparison to the first run,[3] the counting statistics for most exotic ions was increased by about an order of magnitude, *e.g.*, over 60,000 ^{78}Ni ions were produced and new Co to Ga isotopes were observed in the particle identification plot.[4] The on-line results for the gamma spectra recorded after the implantation of ^{78}Ni fragments are presented in Fig. 1. On should note an intense 283 keV gamma transition observed in the correlation with beta and one neutron signals. It identifies new lowest energy level at 284 keV in ^{77}Cu, not observed through the recent extensive study of ^{77}Ni beta-gamma decay identifying the lowest $(3/2^+)$ state at 293 keV.[5] It points to the discovery potential and selectivity of experiments adding efficient neutron detection to the beta-gamma counting. On-line evaluation pointed to the evidence for a gamma transition observed in the decays of ^{81}Cu and ^{82}Cu and interpreted as the de-excitation of the $1/2^+$ state to the $5/2^+$ ground state in the $N = 50$ isotone ^{81}Zn, compare $N = 50$ ^{83}Ge structure[6] studied through ^{83}Ga and ^{84}Ga decays. New data on the observed beta-gamma and beta-xn-gamma correlations together with newly measured half-lives and beta-delayed xn branching ratios will be used to verify and further develop the modeling of nuclear structure evolution and following beta decay properties at and beyond $N = 50$ shell closure.

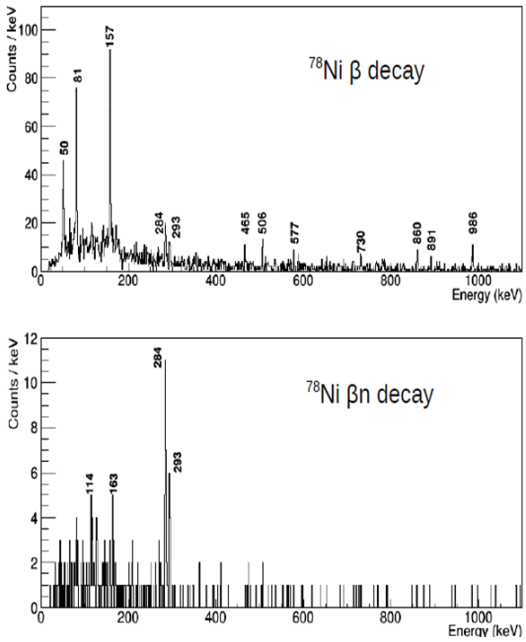

Fig. 1. Low-energy part of gamma spectra following ^{78}Ni decay. Upper part displays beta-gamma data, while lower panel selects beta-1n-gamma correlations (on-line analysis P. Vi and J. Liu).

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