Measurements of new beta-delayed neutron emission properties around doubly magic ^{78}Ni

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The measurement of new beta-delayed (multi) neutron emission (βxn) properties for nuclei near doubly-magic ^{78}Ni has been performed in May 2017 at RIKEN. Exotic nuclei produced with the 345 MeV/nucleon ^{238}U beam and ^{9}Be target, were studied by means of BigRIPS and using the world-largest array of ^{3}He counters BRIKEN,[1] a highly segmented array of Silicon detectors AIDA[2] and 2 Ge clovers. This hybrid setup has nearly 70% efficiency for detecting one neutron having up to 1 MeV and over 50% for 5 MeV energy. The BigRIPS setting was maximized for the transmission of ^{84}Zn. The isotopes between ^{74}Co-^{78}Co up to ^{97}Kr-^{100}Kr were produced and identified. This 3-day run with 30 to 50 particle-nA beam intensity yielded over 7000 ^{78}Ni ions implanted into AIDA (analysis A. Tolosa-Delgado). The ^{77}Cu test case resulted in β1n branching ratio P_{1n} = 29(1)% in a good agreement with the known value of 30.3(22)%.[3] The β1n and β2n values for ^{86}Ga decay[4] known as 60(10)% and 20(10)%, respectively, were obtained more precisely as 59(3)% and 16(1)%, see Fig. 1. Over 20 new P_{1n} values have been measured. Predicted β2n decay mode[5,6] has been inspected in over 14 isotopes yielding for the first time P_{2n} values, *e.g.*, for the activities of ^{84}Zn, ^{87}Ga, ^{89}Ge, ^{90}As and ^{91}As. New half-lives ($T_{1/2}$) have been measured using selective time and space correlation between ion, beta, and neutron signals, see ^{87}Ga decay in Fig. 1. New data on the βxn branching ratios together with newly measured half-lives will be used to verify and further develop beta decay modeling,[7] in particular modeling of the competition of the β1n/2n decay modes. Large set of new P_{xn} and $T_{1/2}$ values, obtained near and beyond doubly-magic waiting point nucleus ^{78}Ni, will help to develop further the analysis of heavy nuclei production within the astrophysical r-process, occurring, *e.g.*, at the merging neutron star environment.[8] *Preliminary data analysis was performed by N. Brewer, B. Rasco and R. Yokoyama.*

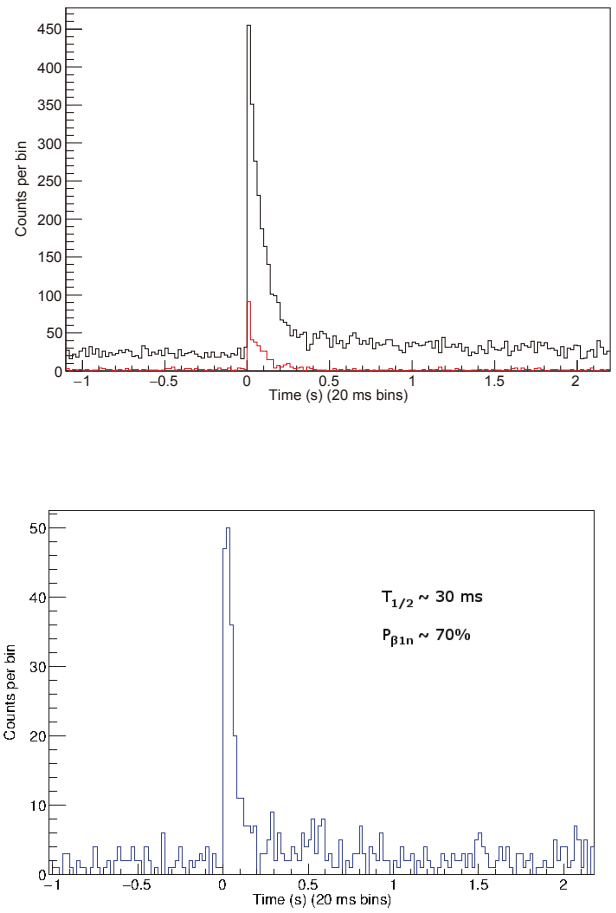

Fig. 1. (upper panel) Decay pattern of 1n (in black) and 2n (in red) events in coincidence with β-emission following identified ^{86}Ga ion implantation into AIDA; (lower panel) decay pattern of β1n events in the decay of identified ^{87}Ga ions in AIDA.

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