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Doubly magic ^{78}Ni as a beta-delayed neutron precursor

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^{78}Ni is a unique doubly magic nucleus far from beta stability line, the only one decaying with β -delayed neutron emission channel. Its decay properties influence the early r-process nucleosynthesis and the beta decays of exotic nuclei north-east of $Z=28$ and $N=50$. Nuclei in the ^{78}Ni region were created with the 345 MeV/u ^{238}U beam reaching nearly 70 part* nanoAmp. Fragmentation products were separated by means of BigRIPS spectrometer at RIKEN (Wako, Japan). The spectroscopy of radiation emitted by beta-delayed neutron precursors was performed using BRIKEN ^3He array [1] modified to achieve larger gamma efficiency [2]. ORNL contributions included 87% of ^3He neutron detection volume and two Ge clovers. The fragment implantation and decay array were consisting of four smaller double-sided Si-strip counters of WASABI complemented by a position sensitive YSO scintillator developed at the UTK. 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. The total rate of identified ^{78}Ni ions was around 65,000, with about 40,000 ions implanted for decay study. Beta-gamma and beta-neutron-gamma decay channels were identified for ^{78}Ni precursor. The P_{1n} branching ratio of about 27(4)% was determined from the analysis [3] of β - $1n$ decay pattern. New levels in ^{78}Cu as well as new level associated with proton $p_{3/2}$ state in $Z=29$ ^{77}Cu were observed. The accepted proposal to study ^{78}Ni decay with the recently commissioned ORNL's Modular Total Absorption Spectrometer at the Facility for Rare Isotopes Beams will be briefly presented.

[1] A. Tarifeño-Saldivia et al., Jour. of Instrum. 12, P04006 (2017).

[2] R. Yokoyama et al., Phys. Rev. C 100, 031302(R) (2019).

[3] B. C. Rasco et al., Nucl. Instrum. Methods. Phys. Res. A 911, 79 (2018).

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