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β-Decay properties in the vicinity of ^{78}Ni and their implications on nuclear shell structure far off the β-stability line

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The neutron-rich nuclide $^{78}_{28}Ni_{50}$ is of remarkable interest because of its unverified doubly magic character. The concept of nuclear magicity has been proposed since the discovery of particularly stable nuclei with specific numbers, so-called magic number, of proton and neutron, such as 2, 8, 20, 28, 50, 82, and 126. These numbers were recognized as a consequence of nuclear shell structure and interpreted by a strong spin-orbit interaction coupled with a mean field potential in the nuclei along the b-stability line. Recent experimental studies, however, revealed a drastic change in the shell structure far off the b stability driven by the unique nucleon-nucleon interactions under unbalanced neutron-to-proton ratio. For instance, classical magic numbers in ^{12}Be (N = 8), ^{32}Mg (N = 20), and ^{42}Si (N = 28) were found to disappear whereas new magic numbers emerged in ^{24}O (N = 16) and ^{54}Ca (N = 34). To address the shell evolution around ^{78}Ni, an experiment based on decay spectroscopy was performed at the RIBF facility as part of an EURICA campaign at the end of 2012. Half-lives of 38 neutron-rich nuclei were measured including 12 new half-lives for the nuclei ^{73,74}Fe, ^{76,77}Co, ^{79,80}Ni, ^{81,82}Cu, ^{84}Zn, ^{87}Ga, and ^{87,88}Ge. New b-delayed neutron-emission probabilities (P_n) were also measured for the nuclei ^{78}Ni, and ^{80,81}Cu. Based on the new experimental results, shell evolution and magicities of Z = 28 and N = 50 were investigated in the vicinity of ^{78}Ni.

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