2 - 21 In-beam γ-ray Spectroscopy of Mn Isotopes around N=40

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There have been extensive studies on even-Z nuclei in the region near ^{68}Ni, the $N \sim$40 "island of inversion", while the information on odd-Z nuclei is still scarce. Experimental information on ^{65,67}Mn has not been available. In 2014, a series of in-beam measurements around ^{68}Ni were carried out by the SEASTAR collaboration and much new information has been obtained.

The experiment was performed at the Radioactive Isotope Beam Factory. A ^{238}U primary beam (345 MeV/u) impinged on a ^{9}Be primary target for the production of the secondary RI beams at the entrance of the BigRIPS separator. These isotopes then impinged on a thick liquid hydrogen target (LH2). The nuclei of interest were created via nucleon removal interaction in the target. The particle identification before and after the LH2 target

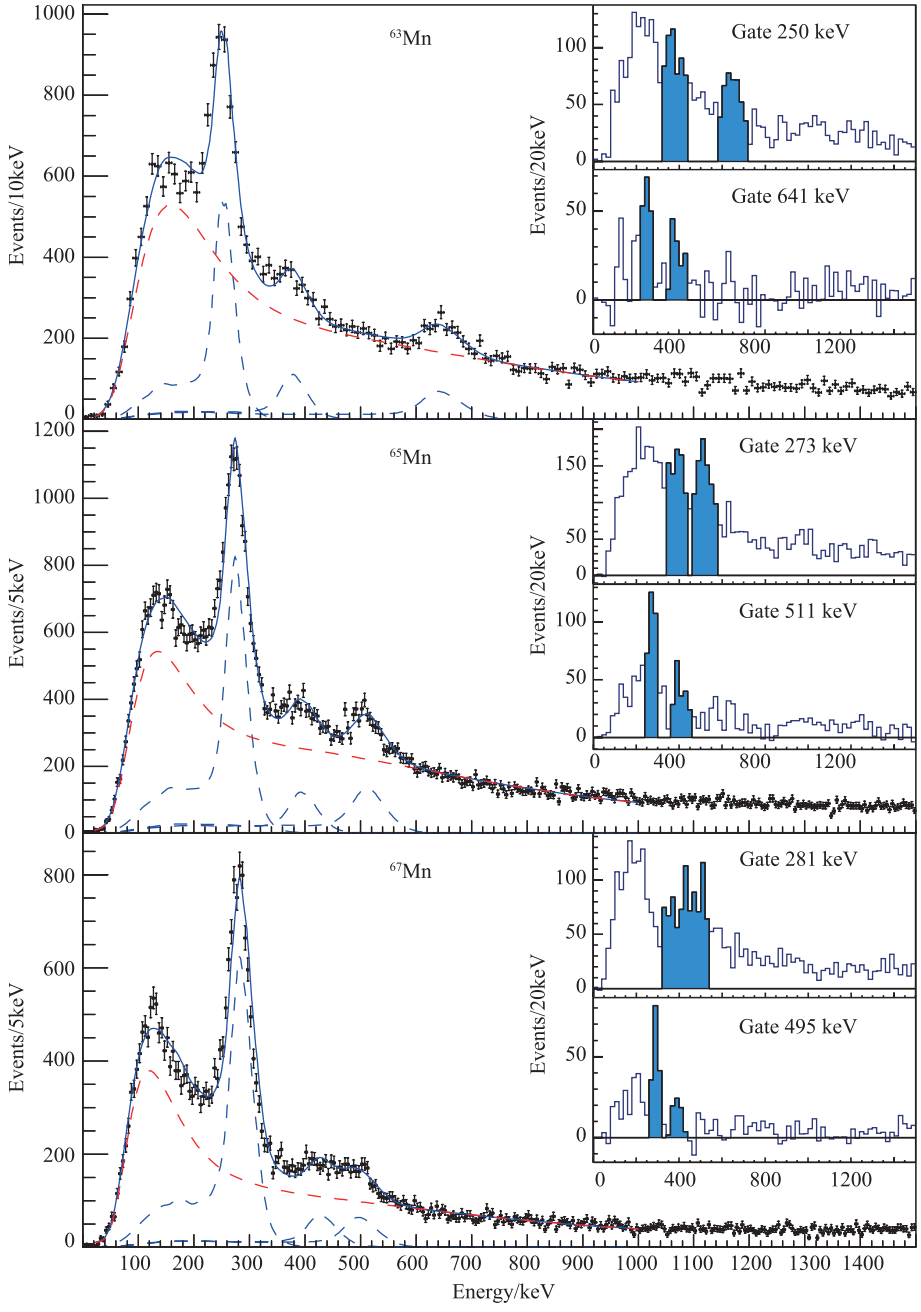

Fig. 1 (color online) Doppler-corrected γ-ray spectra of ^{63,65,67}Mn. The blue dotted curves are the response functions, the red dotted curves correspond to the fitting of the background. Their γ-γ coincidence spectra are displayed in the corner of their spectra.

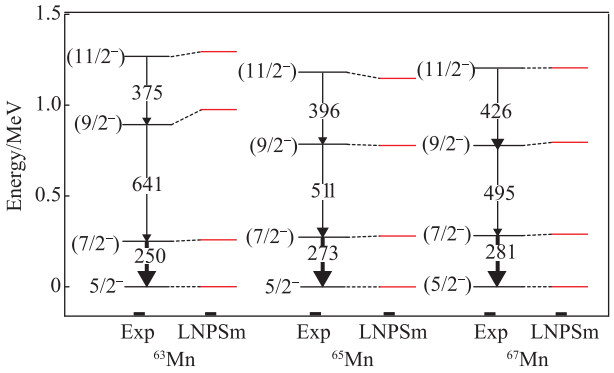

Fig. 2 (color online) Theoretical results (red solid line) of the levels below 1.5 MeV along the Mn isotopes chain in comparison with the experimental data (black solid line) of this work.

were performed by $B\rho$-ΔE-TOF method on an event-byevent basis in the BigRIPS and ZeroDegree spectrometers.

The event-by-event Doppler-corrected γ-ray spectra are given in Fig. 1. With the experimental data, level schemes have been established in ^{65,67}Mn for the first time while the result of ^{63}Mn is consistent with previous one[1]. Similar level schemes of this Mn isotopes chain consisting of a level sequence of 11/2-, 9/2-, 7/2- and 5/2-, connected by I→(I-1) M1/E2 transitions, have been identified. The experimental results of ^{63,65,67}Mn are reproduced very well by large-scale shell model calculations with LNPS-m interactions[2], as shown in Fig. 2.

References

[1] T. Baugher, A. Gade, R. V. F. Janssens, Phys. Rev. C, 93(2016)014313.

[2] C. Santamaria, C. Louchart, A. Obertelli et al., Phys. Rev. Lett., 115(2015)192501.

2 - 22 Fine Structure in the α Decay of ^{223}U

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Isotope ^{223}U synthesized and identified[1,2]. α energy of 8 780(40) keV and a half-life of 55(10) μs. The α energy was calculated by subtracting known α energy of ^{219}Th from measured decay sum energy of ^{223}U and its daughter ^{219}Th.

Based on the advanced digital pulse processing technique, a new measurement for α-particle energy and half-life of ^{223}U was performed at the gas-filled recoil separator, Spectrometer for Heavy Atoms and Nuclear Structure (SHANS). The isotope ^{223}U was produced in the fusion-evaporation reaction ^{187}Re(^{40}Ar, p3n)^{223}U. Evaporation residues (ERs) were implanted into a double-sided silicon strip detector and identified from ER-α1-α2-α3 correlations. The advanced digital pulse processing technique was applied to register the α-decay information on short-lived isotopes.

The α energies of mother-daughter coincidences for the main isotopes produced in the ^{40}Ar + ^{187}Re/^{186}W reactions are shown in Fig. 1. Three α lines of ^{223}U with α-particle energies of 8.753(17) MeV, 8.892(19) MeV and 8.993(17) MeV were observed. They were attributed to transitions from the ground state of ^{223}U to low-excited states and ground state of ^{219}Th. The decay half-life of ^{223}U was determined to be $57(^{14}_{9})$ μs. Decay scheme proposed to ^{223}U is shown in Fig. 2.

Using the new experimental results, hindrance factors[3] and reduced α-emission widths[4,5] of ^{223}U α transitions were deduced. Based on the hindrance factor of α transition into the 244(25) keV level in the daughter nucleus ^{219}Th, spin and parity of $7/2^+$ for this level were assigned. Spin and parity of the 103(25) keV level in the ^{219}Th was tentatively supposed to be $11/2^+$ by means of systematics of α transitions populated in the low-lying levels of ^{217}Ra and ^{215}Rn[6]. From the tendency of reduced α-decay widths in the $N = 131$ isotones, the onset of deformation in the nuclear structure for $Z \geq 88$ isotones is discussed.