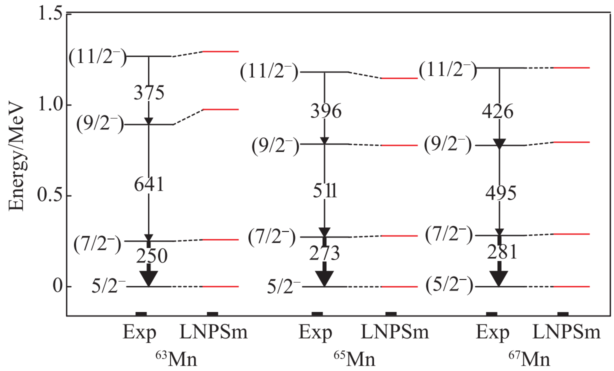

Fig. 2 (color online) Theoretical results (red solid line) of the levels below 1.5 MeV along the Mn isotopes chain in comparison with the experimental data (black solid line) of this work.

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.

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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.

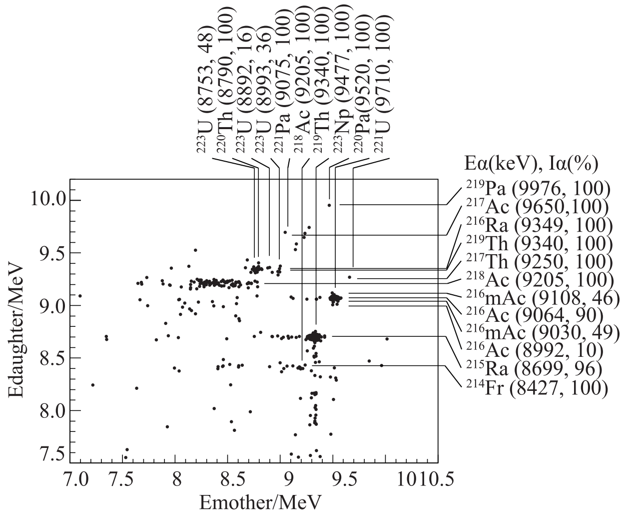

Fig. 1 α-particle energies of mother-daughter coincidences observed in the time windows of 200 ns $\leq \Delta T(ER-\alpha_1) \leq$ 10 ms and 200 ns $\leq \Delta T(\alpha_1-\alpha_2) \leq$ 10 ms, position window of ≤1 mm.

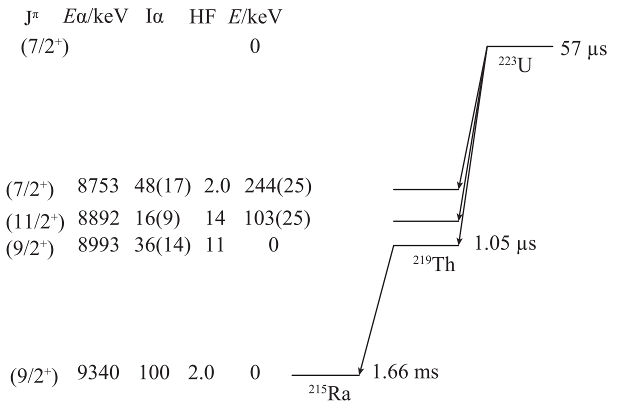

Fig. 2 A schematic representation of α transitions from ground state of ^{223}U into few levels of ^{219}Th. See text for details.

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2 - 23 Study of the Octupole Deformation Properties in ^{224}U Using the RDT Method

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The nuclear reflection asymmetry is attributed to octupole correlation, *i.e.* the coupling between single-particle orbits with opposite parities and $\Delta l = \Delta j = 3$ near the Fermi surface. The strongest correlations tend to occur just above closed shells, namely at particle (proton or neutron) numbers 34 ($g_{9/2}\otimes p_{3/2}$ coupling), 56 ($h_{11/2}\otimes d_{5/2}$ coupling), 88 ($i_{13/2}\otimes f_{7/2}$ coupling) and 134 ($j_{15/2}\otimes g_{9/2}$ coupling). An overview of the experimental and theoretical evidence for octupole correlations is given in Ref. [1]. The strongest octupole correlations are predicted by the HFB calculation to be in the uranium isotopes with $N\sim$134. Improved total Routhian surface calculations[2] show that the ground states of ^{222,224,226}U have static octupole deformations and the most favorable case for stable octupole deformation appears to be ^{224}U, which is consistent with previous predictions[3]. An experiment for studying the octupole properties in ^{224}U was carried out at ANL(Argonne National Laboratory).

The ^{20}Ne(^{208}Pb,4n) reaction at 109 MeV was used to populate the excited states of ^{224}U and the digital GAMMASHERE + FMA + MCP +DSSD[4] setup was used to identify the strongest γ-rays of ^{224}U in this experiment. The production cross-section of ^{224}U was expected to be around 1 μb based on the HIVAP calculations. A 0.4 mg/cm^2 thick ^{208}Pb target was used. The average beam current was about 30 pnA and lasted 6 d.

The digital data acquisition system which can record the signal waveforms was used, and utilized the RDT(recoil decay tagging)[5] technique and waveform analysis[6] method were utilized to identify ^{224}U unambiguously. Specifically waveform analysis can give accurate energy and half-life of α decay of ^{224}U. Contrast to traditional method, the advantage of waveform analysis method is embodied in extracting the single energy from superposition signals (waveforms). An example of superposition waveforms shown in Fig. 1. The resolved α energy spectrum is shown in Fig. 2 and obviously the statistics is very low. The statistics of the correlated γ is too low for γ-γ coincidence analysis. The much lower statistics than expected is most likely due to that the ^{224}U recoils were not transported