Nuclear structures and β-decay schemes for the Sb, Te, and I nuclides beyond N = 82

B. Moon,[1] C.-B. Moon,[2,*], A. Odahara,[3] R. Lozeva[4]
and for the EURICA U-2013 Campaign Collaboration

[1]Department of Physics, Korea University, Seoul 136-701, Republic of Korea
[2] Department of Display Engineering, Hoseo University, Chung-Nam 336-795, Republic of Korea
[3] Department of Physics, Osaka University, Osaka 560-0043, Japan
[4] IPHC, CNRS, IN2P3 and University of Strasbourg, F-67037 Strasbourg Cedex 2, France

*cbmoon@hoseo.edu

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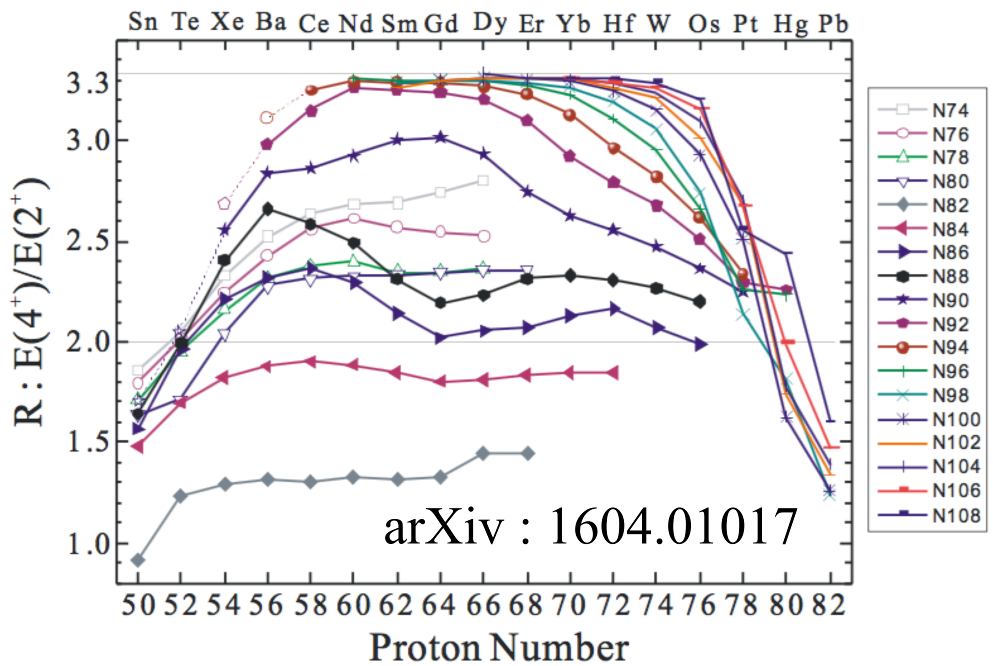

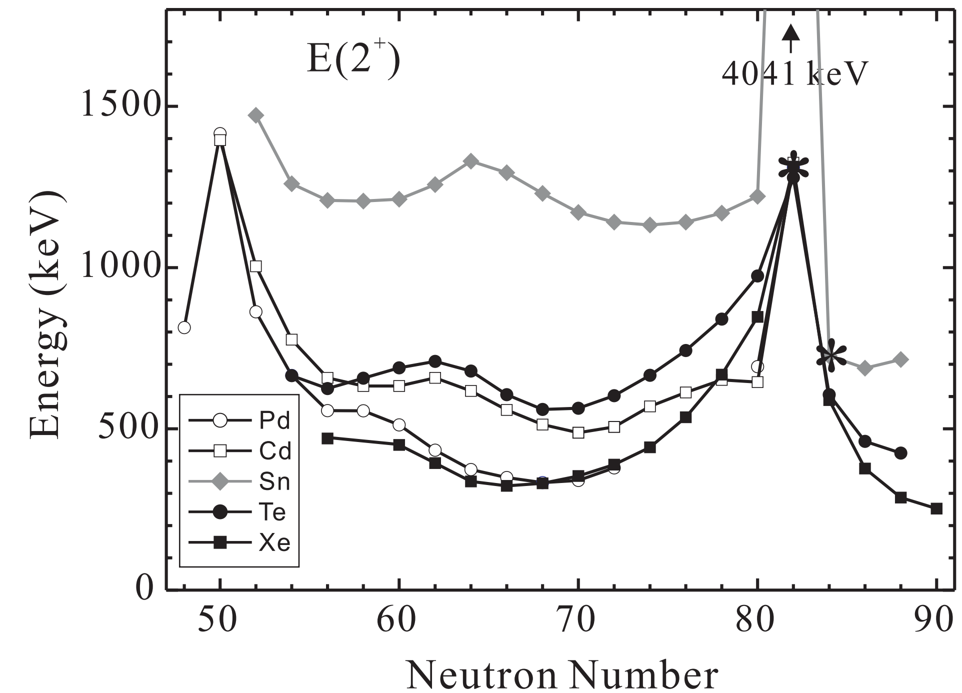

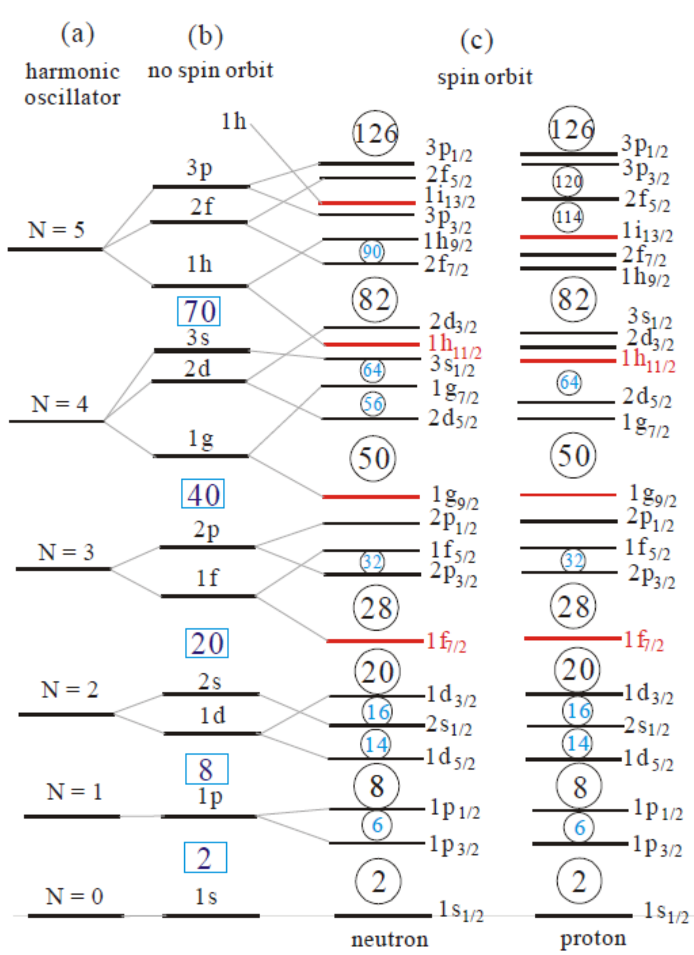

NP1112-RIBF87 : Shape evolution in neutron-rich A~140 nuclei beyond the doubly-magic nucleus ^{132}Sn

The reduction of E(2^+) compared to the N<82 Te isotopes. Predicted to be prolate.[1, 2, 3, 4]

Unexpected low B(E2) value of ^{136}Te contradicted the prediction. Due to the reduction of the neutron-pairing gap and the neutron dominance.[5, 6, 7]

The large difference in E(2+) between ^{134}Te and ^{134}Sn (denoted by *) supports the reduction of the neutron-pairing gap.

The competition between the Gamow-Teller transition and the first forbidden transition.

[1] Phy. Rev. C 69, 051303(R) (2004) [2] Phys. Rev. C 84, 061306(R) (2011) [3] Eur. Phys. J. A 6, 375 (1999) [4] Phys. Rev. C 62, 044315 (2000) [5] Phy. Rev. Lett. 88, 222501 (2002) [6] Phy. Rev. C 66, 054313 (2002) [7] Phys. Rev. C 70, 054313 (2004)

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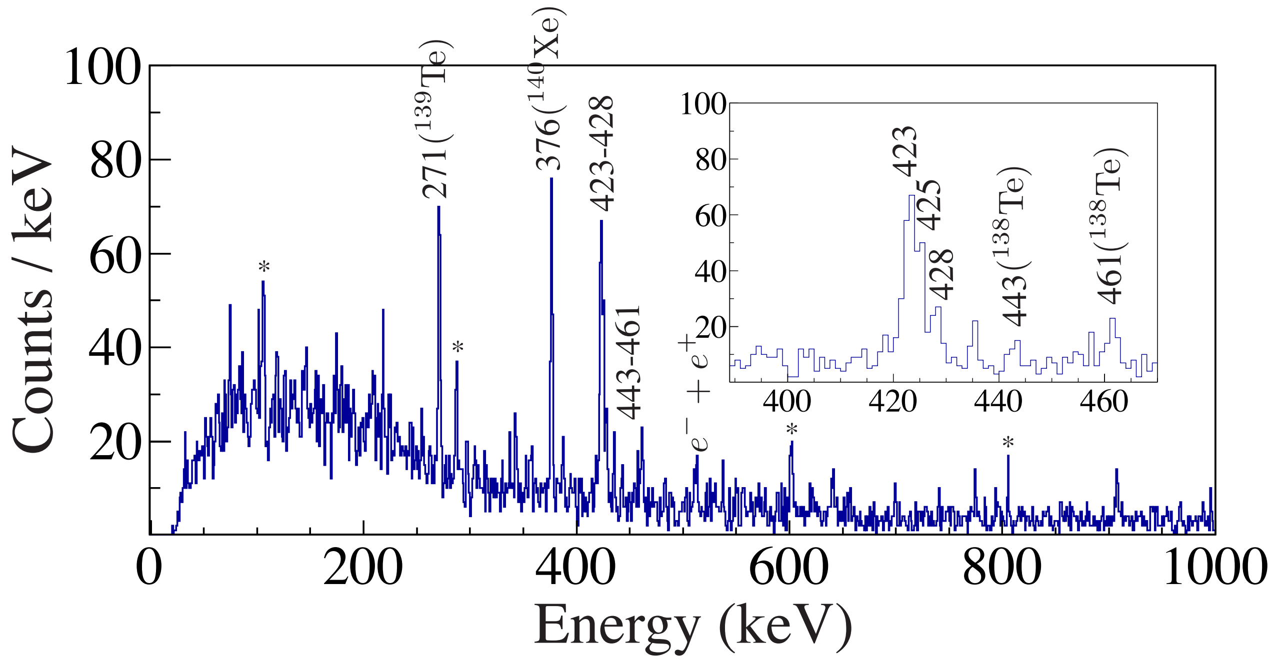
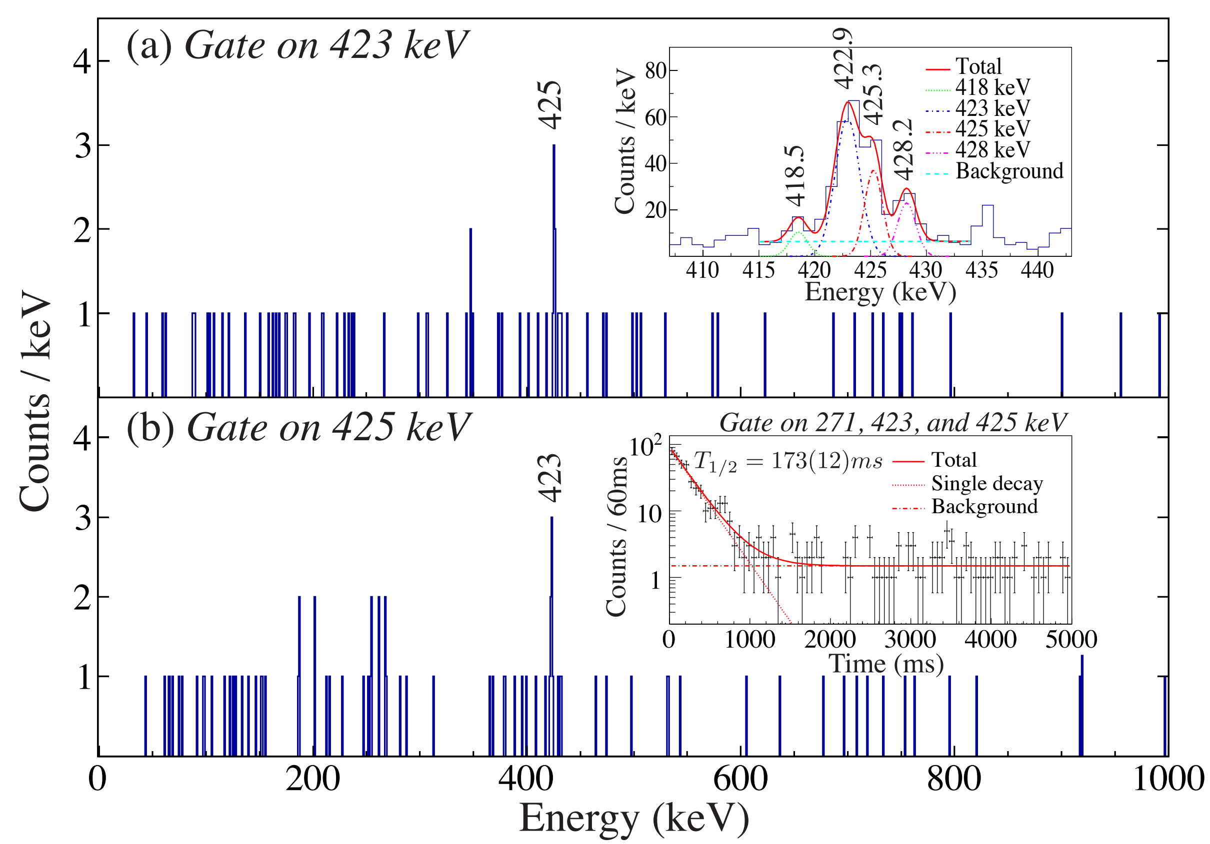
- ^{140}Te Internal Structure



The β-delayed γ-ray singles spectrum and the inset shows the close look of the interest region. 423, 425, and 428 keV photo peaks are candidates for the internal transition. (After the confirmation of the time-different singles spectra.)



The 423- and 428 keV transitions are coincidence each other.
The 428 keV transition does not appear in $\gamma\gamma$ coincidence matrices.
Consider as the transition in ^{139}Te.
No more transition has been assigned.

The half-life was measured by gates on the β-delayed γ-rays, 271-, 423-, and 425 keV. The half-life is assigned as 173(12) ms based on the maximum likelihood method.

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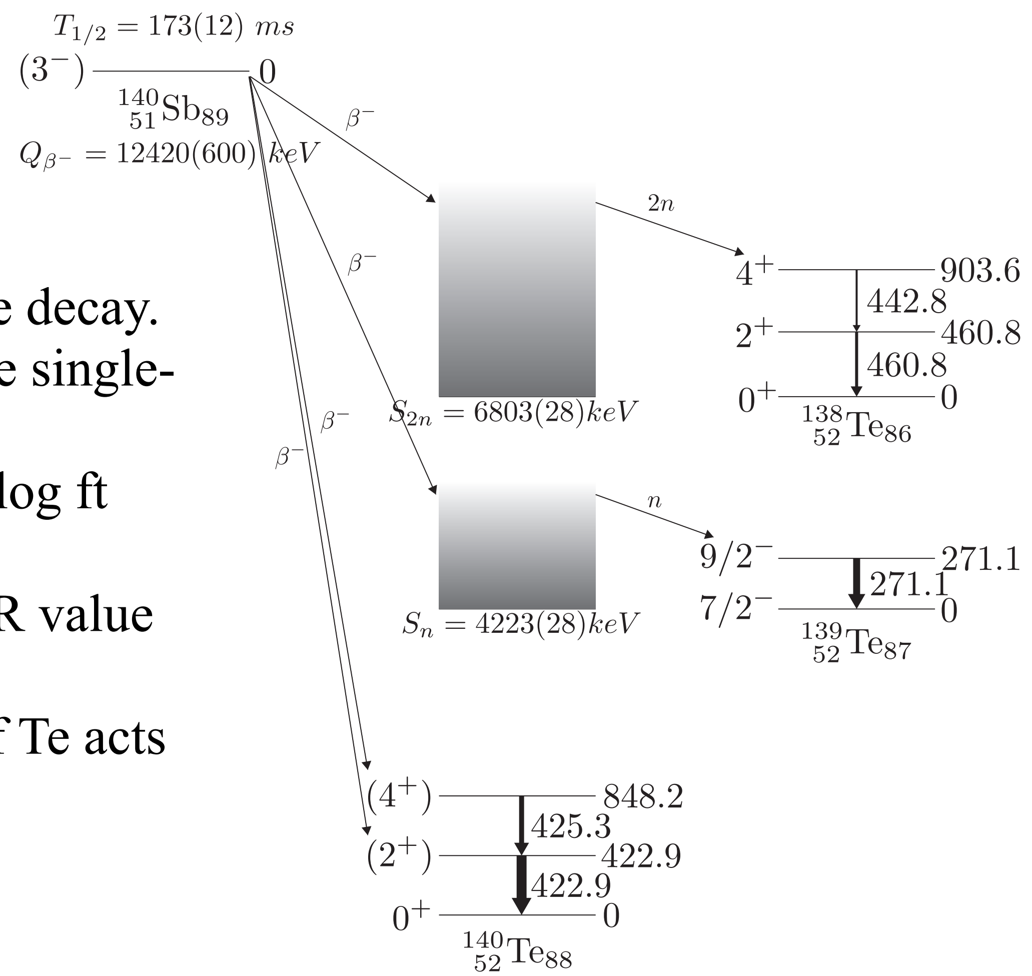
- ^{140}Te Internal Structure

TABLE I. Summary of the β decay of ^{140}Sb: ^{140}Te, ^{139}Te by one-neutron emission, and ^{138}Te by two-neutron emission. Probabilities for the respective decay branch are based on γ-ray measurements. Energies are given in keV. The numbers in parentheses are the errors in the last digit.

Nuclides	Level	log(ft)[a]	I_{β^-}[a]	Observed γ rays; I_γ[b]	Spin-parity
^{140}Te	422.9(3)	6.03(13)	17(3) %	422.9(3); 100(16)	$2^+ \rightarrow 0^+$
	848.2(3)	6.02(16)	14(4) %	425.3(3); 45(12)	$4^+ \rightarrow 2^+$
^{139}Te	271.1(2)		23(4) %	271.1(2); 74(13)	$9/2^- \rightarrow 7/2^-$
^{138}Te	460.8(5)		2.0(8) %	460.8(5); 24(11)	$2^+ \rightarrow 0^+$
	903.6(5)		5.6(2.3) %	442.8(5); 17(12)	$4^+ \rightarrow 2^+$

[a] considering the number of emitted β-rays from implanted ^{140}Sb ions to be 3701(71) by using the decay curve information, and the Q value is 12420 keV.

[b] The unassigned 428 keV γ-ray is excluded.

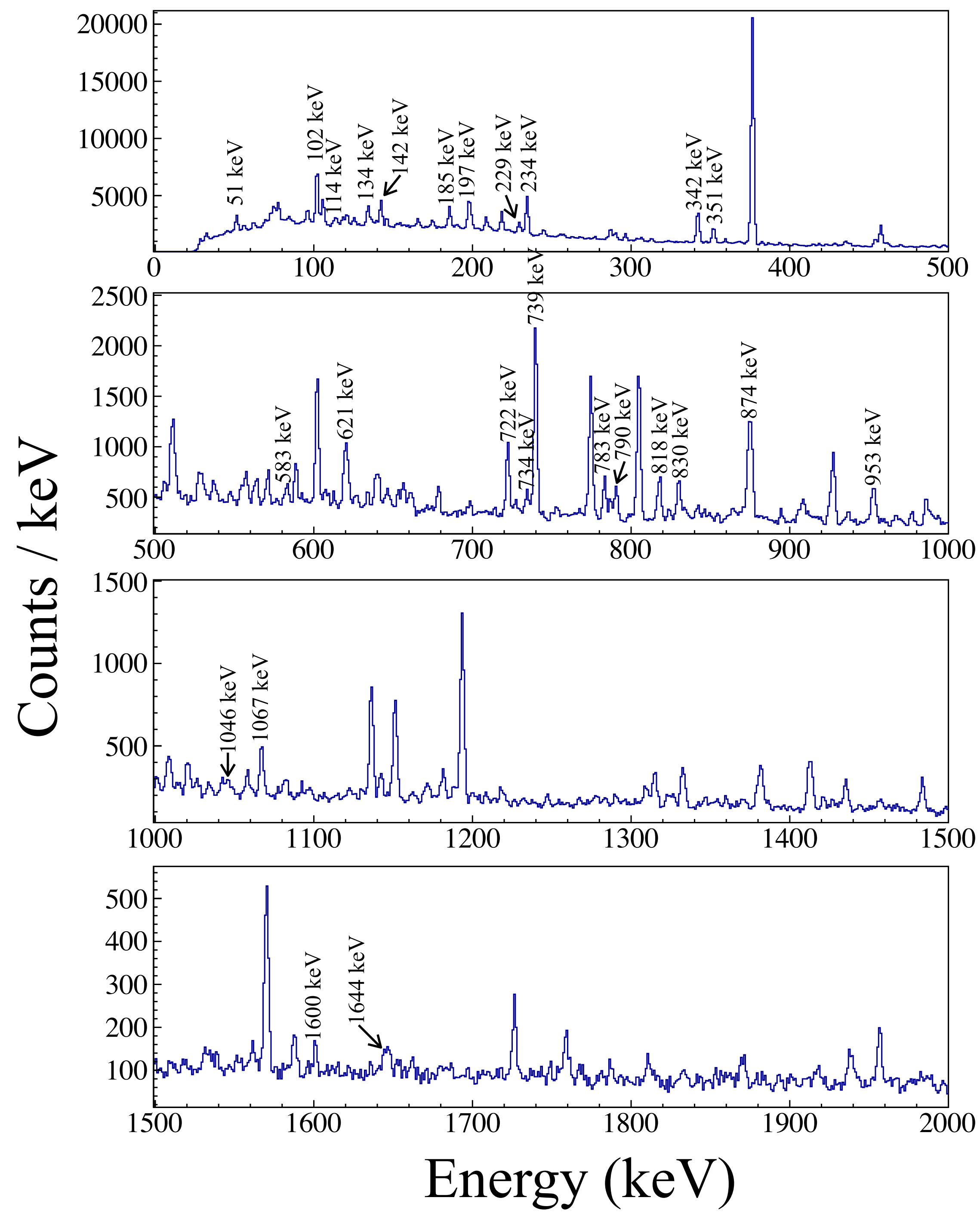


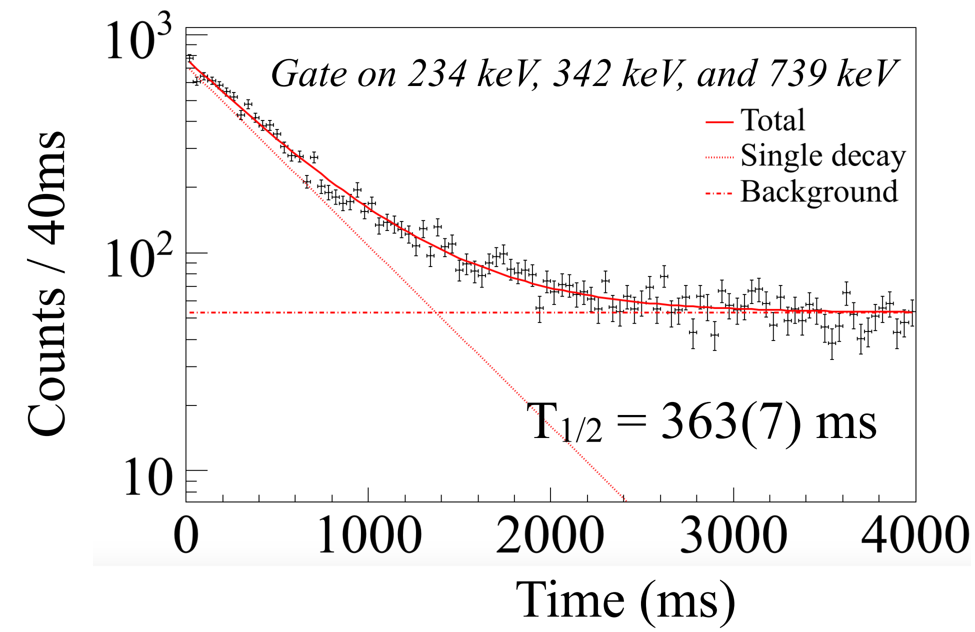
The table represents transition information of the decay.
The first forbidden transition is dominant and the single- and double neutron emissions are significant.
Assigned the ground state of ^{140}Sb based on the log ft analysis.
E(2+) of ^{140}Te is assigned as 422.9 keV and the R value is 2.01.
This nuclide confirmed that the isotopic chain of Te acts as the typical vibrator.

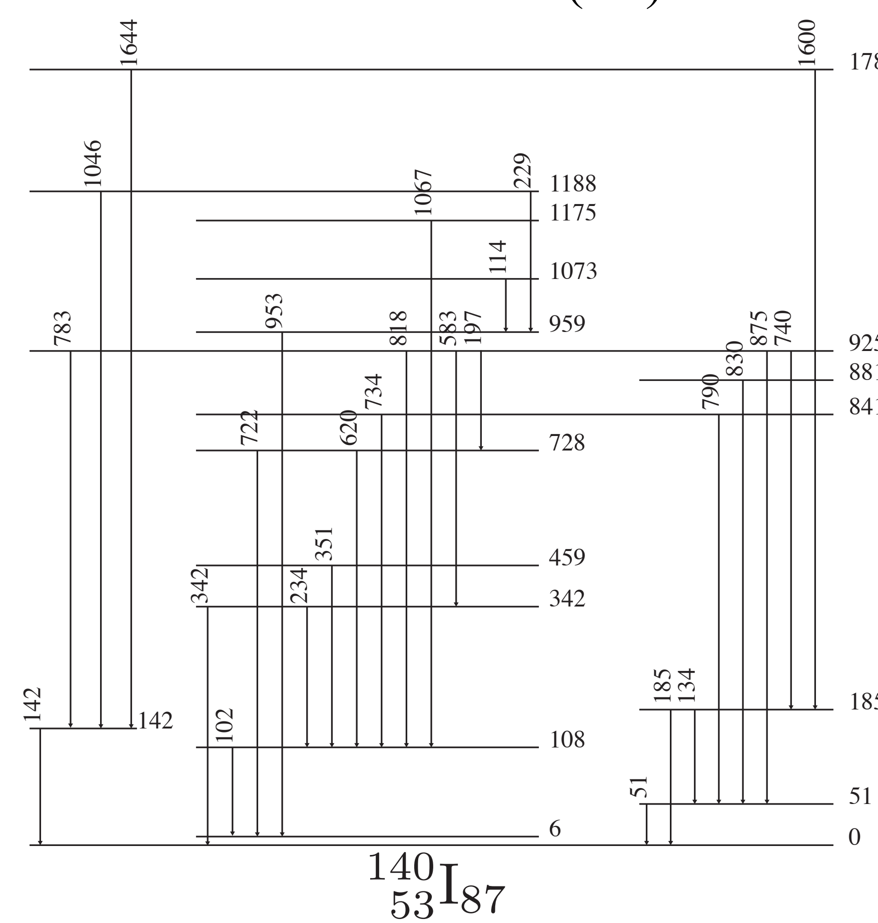
Submitted to PRL…

Experimental Results

- ^{140}I Internal Structure







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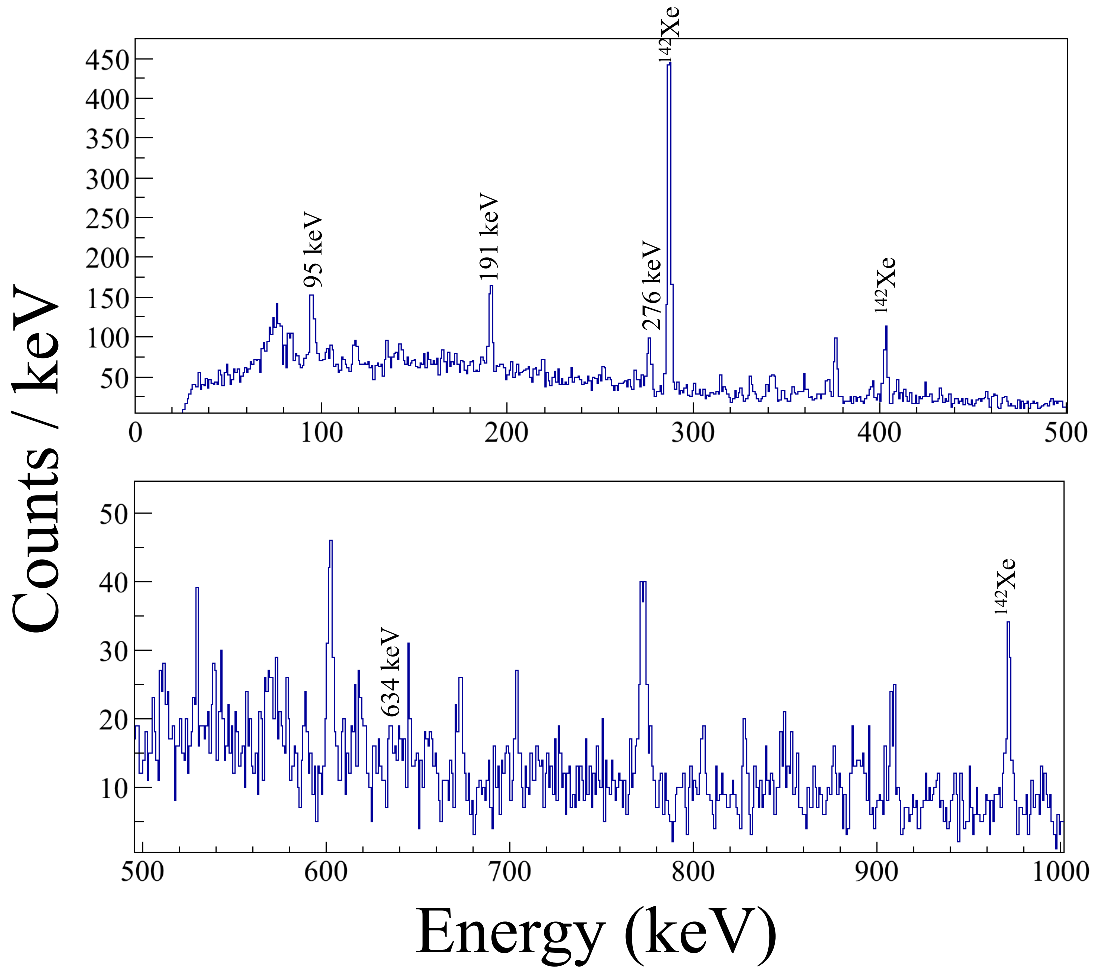

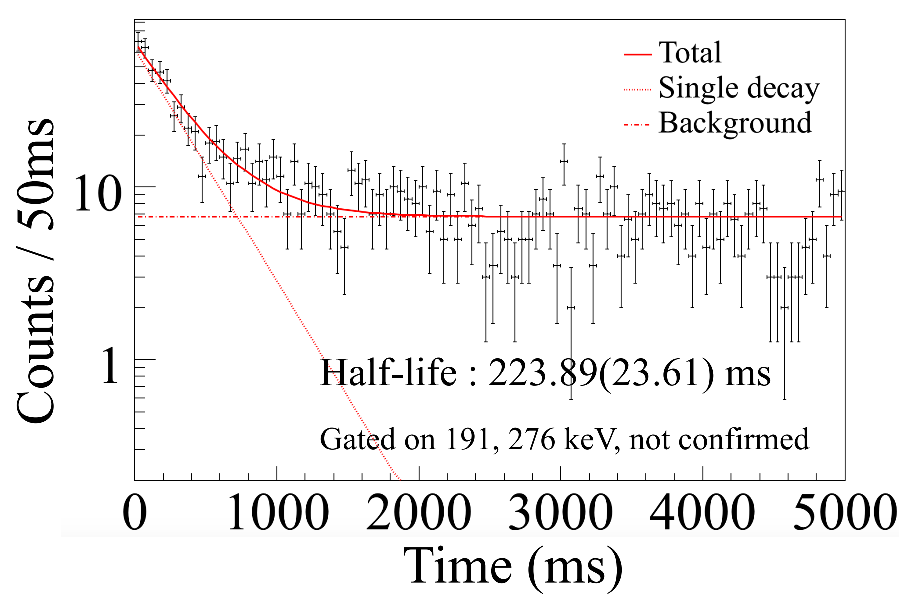

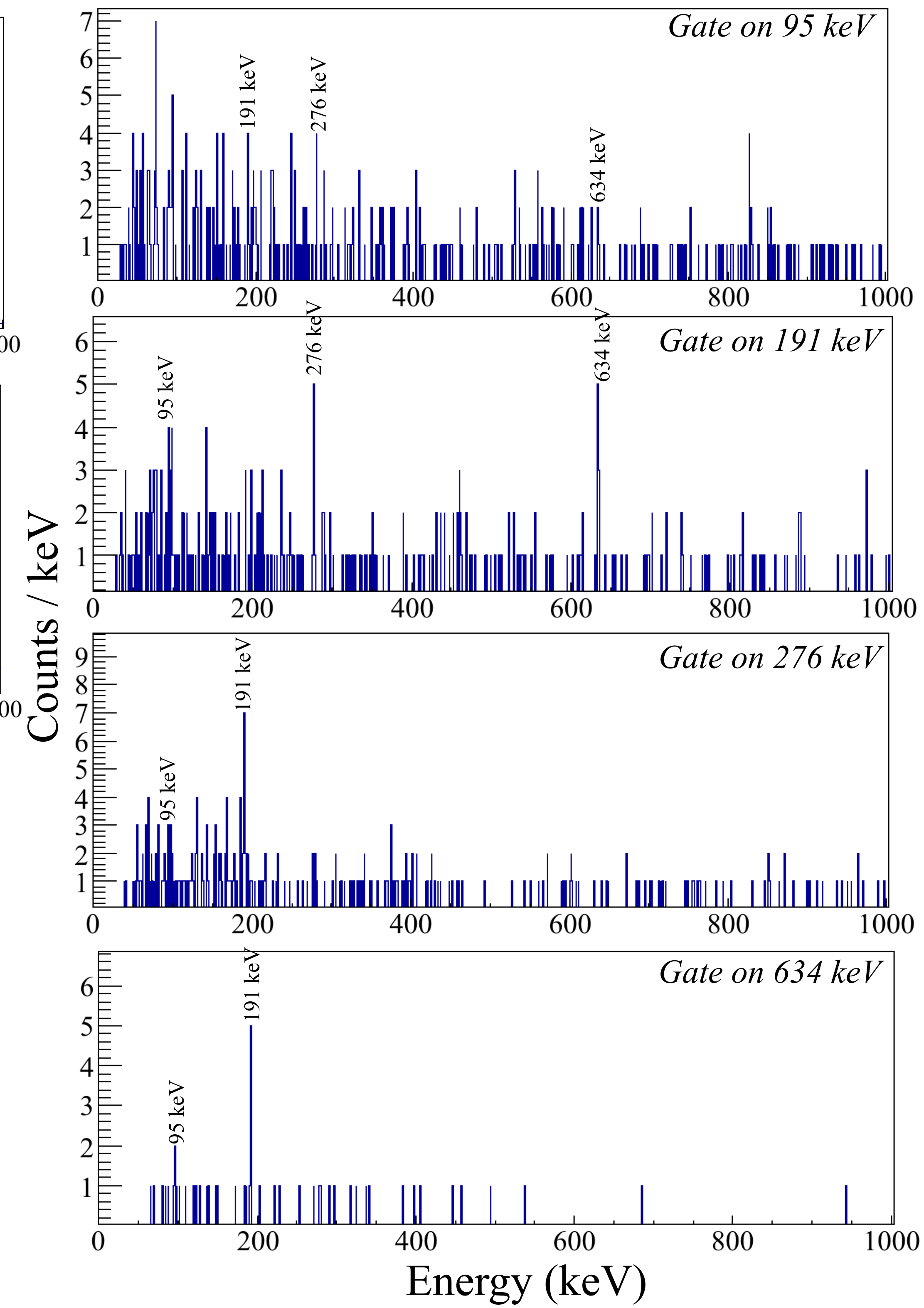

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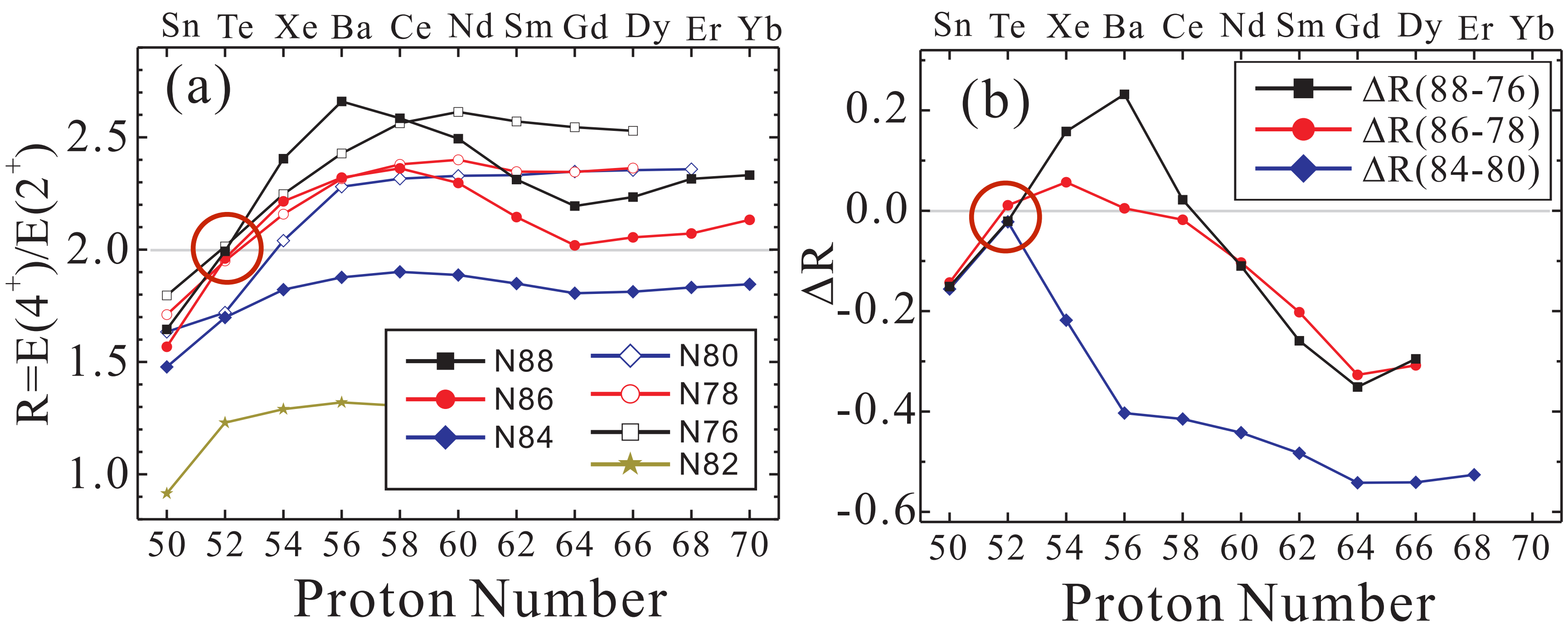
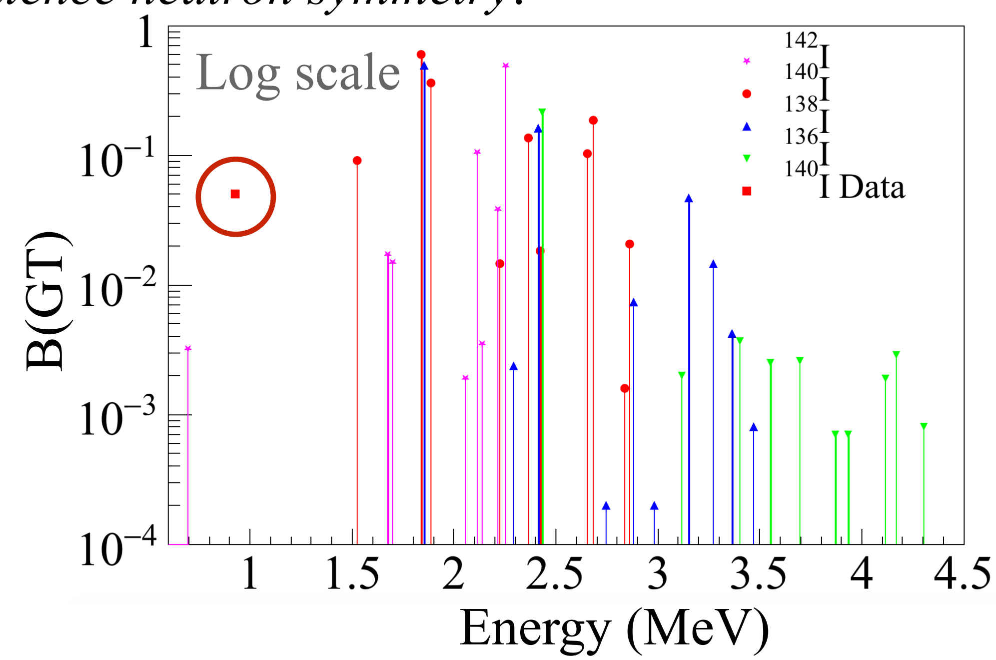


According to our analysis, ^{140}Te with N=88 has its R value with 2.01. This data point confirmed that Te isotopes act as a typical vibrator except at the border of the magic number 82. Figure (b) depicts the R difference between two symmetric isotopes based on the magic number 82. ***Δ***R values of Te isotopes converge at 0. Te isotopes give a symmetrical signature that the same valence space results in a similar collectivity, the *valence neutron symmetry*.

1^+ states, especially the first state, of ^{140}I and ^{142}I are composed of the configuration of $\pi g_{7/2}(d_{5/2})\nu i_{13/2}$ according to the SM calculation. This special configuration generates the low B(GT) value due to the forbidden transition in the β-decay in terms of the spin and the parity. This explains the low B(GT) value of the data point and provides well described configuration of this state.



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- Analyzing data from NP1112-RIBF87, the EURICA U-2013 Campaign, with the region beyond the double magic nucleus Sn.
- Specific Isotopes : ^{138}Sb, ^{140}Sb, ^{140}Te, ^{142}Te (based on the implanted ion.)
- Focused on the β-decay scheme and the internal structure.
- The Te nuclides including the new ^{140}Te isotope act as the typical vibrator.
- The Te nuclide shows a strong symmetric deformation by the valence neutrons(based on N=82).
- The I nuclide starts to form the 1^+ state with the configuration of $\pi g_{7/2}(d_{5/2})\nu i_{13/2}$ as the neutron number increases.
- Due to the special configuration of 1^+ states in the extremely neutron-rich I, the strength of Gamow-Teller transition drastically decreases.

Thank you very much for your attention!

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