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Identification of T = 2 isobaric analog state in ^{52}Co and its impact on the understanding of β^+-decay properties of ^{52}Ni

- Introduction
- Heavy ion storage ring CSRe & IMS
- Mass of IAS in ^{52}Co and β^+ decay of ^{52}Ni
- Summary

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1. Introduction

Previous investigations on the β decay of ^{52}Ni

1) L. Faux et al., Phys. Rev. C 49, 2440 (1994).
2) C. Dossat, et al., Nucl. Phys. A792, 18(2007).
3) S. D. A

2) C. Dossat, et al., Nucl. Phys. A792, 18(2007).

Results:

- β-delayed proton and gammas measured,
- Decay level scheme of ^{52}Ni established.
- T=2 Isobaric analog state (IAS) in ^{52}Co identified

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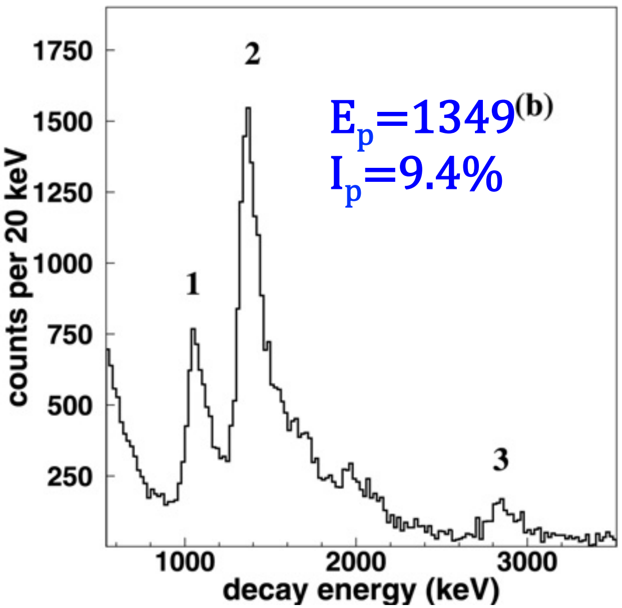
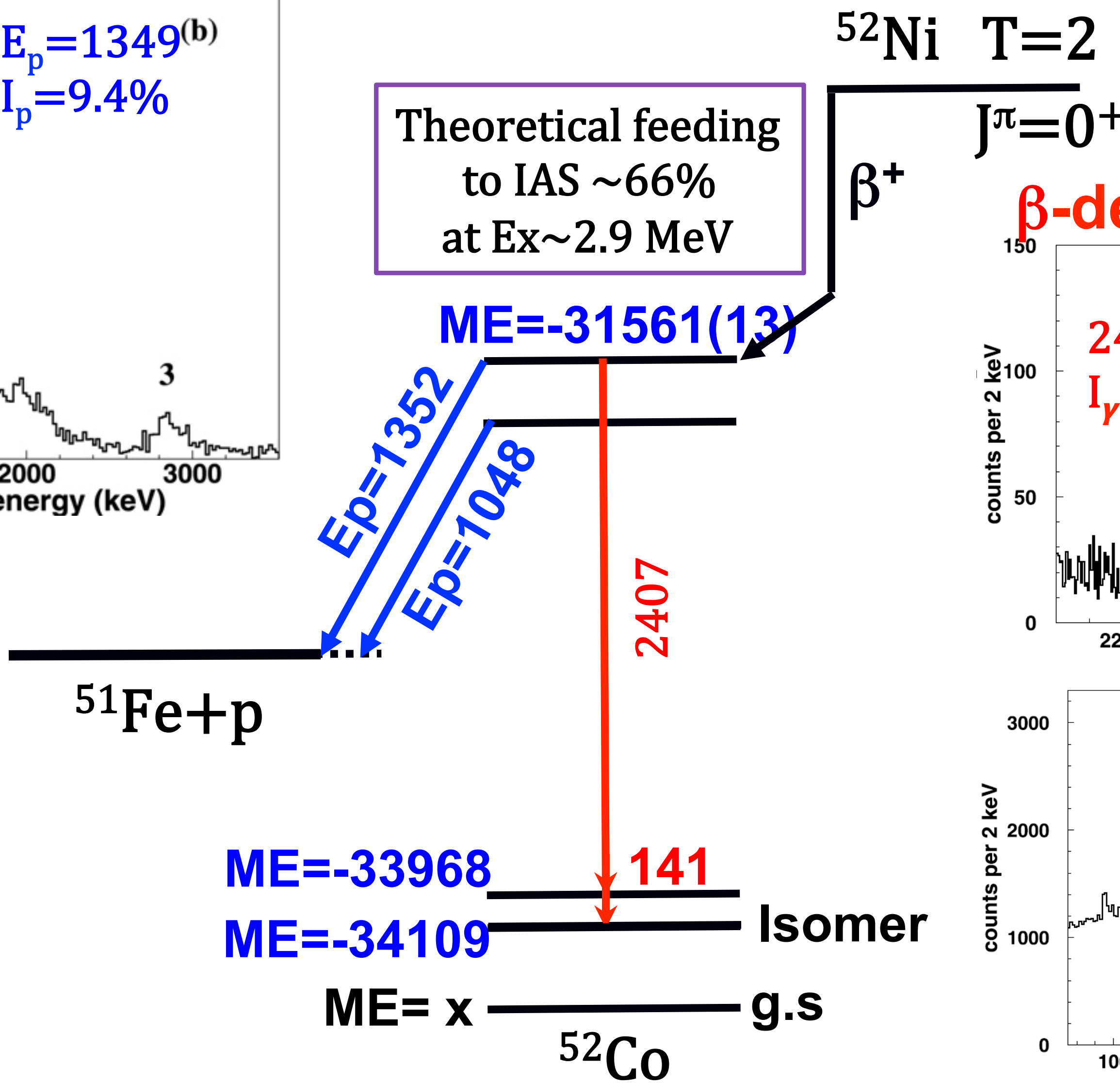
…… there is still a puzzule !

1. Introduction

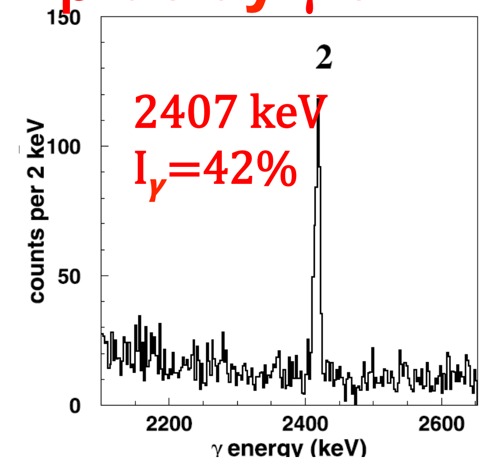
β-delayed protons of ^{52}Ni

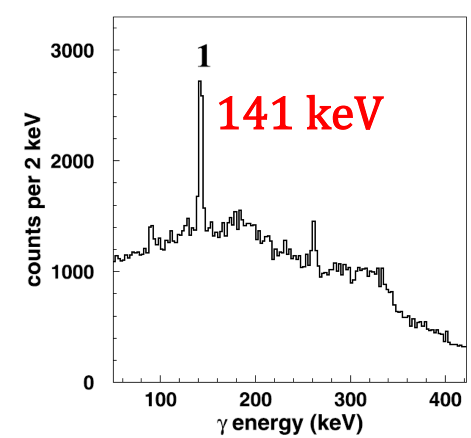


Existing information



β-delay γ of ^{52}Ni

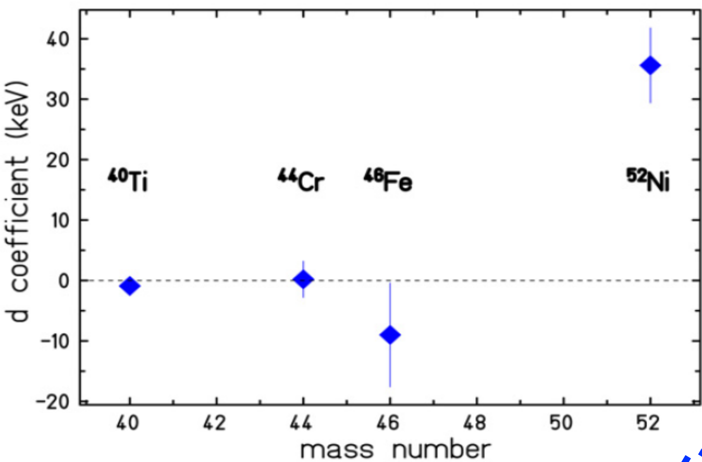


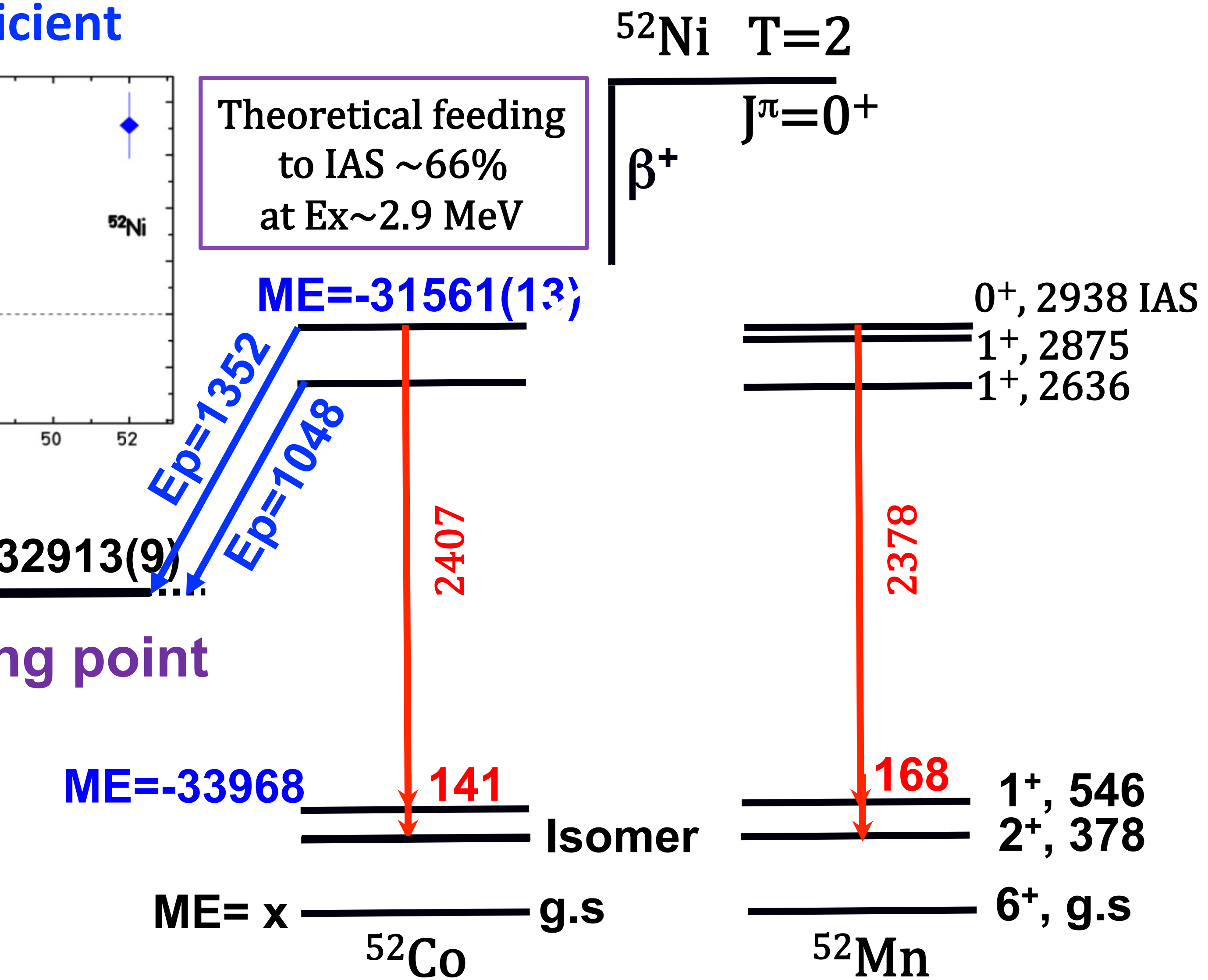


1. Introduction

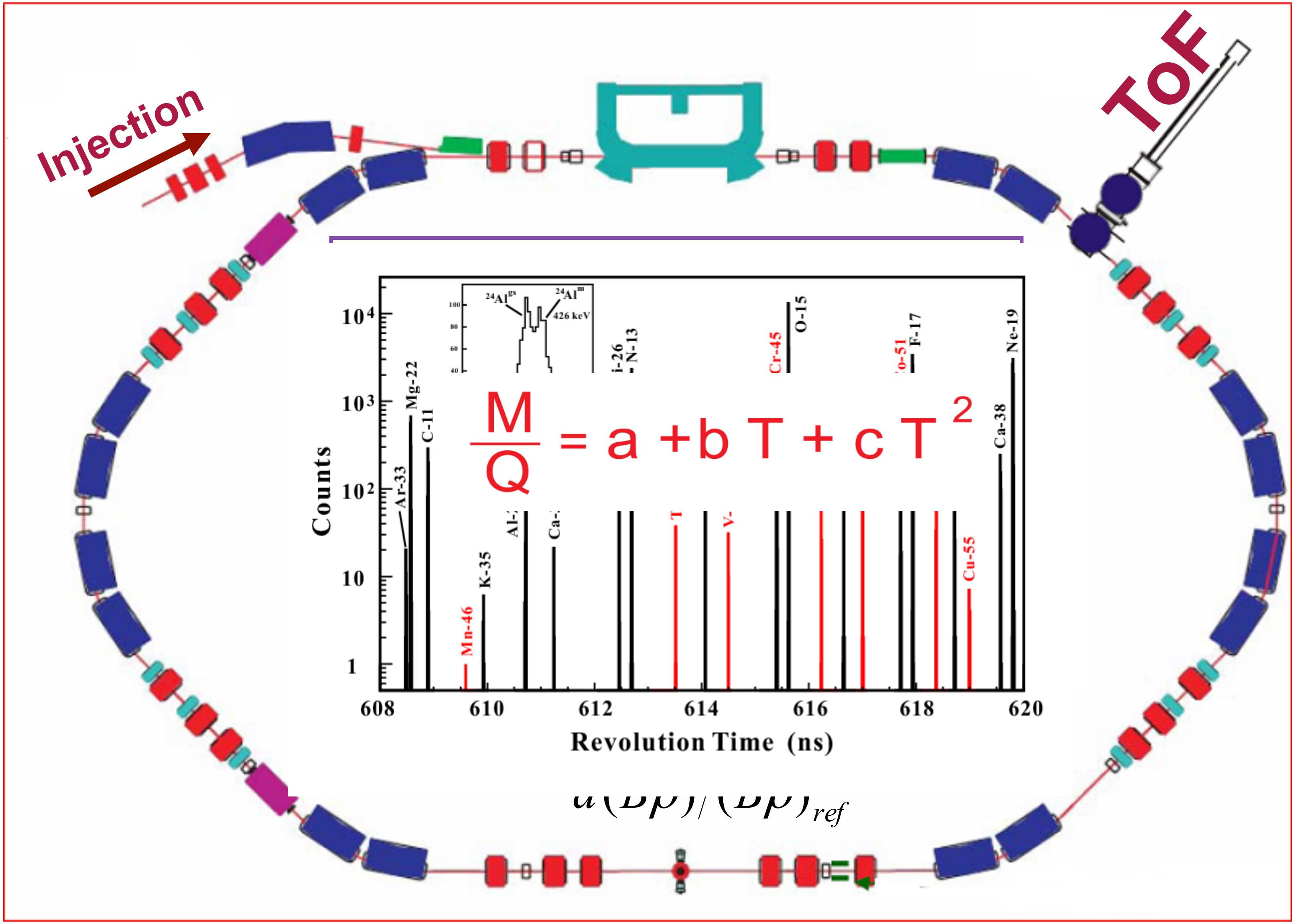
$$M(T,A,T_3) = a(T,A,) + b(T,A)T_3 + c(T,A)T_3^2 + d(T,A)T_3^3$$

IMME d-coefficient





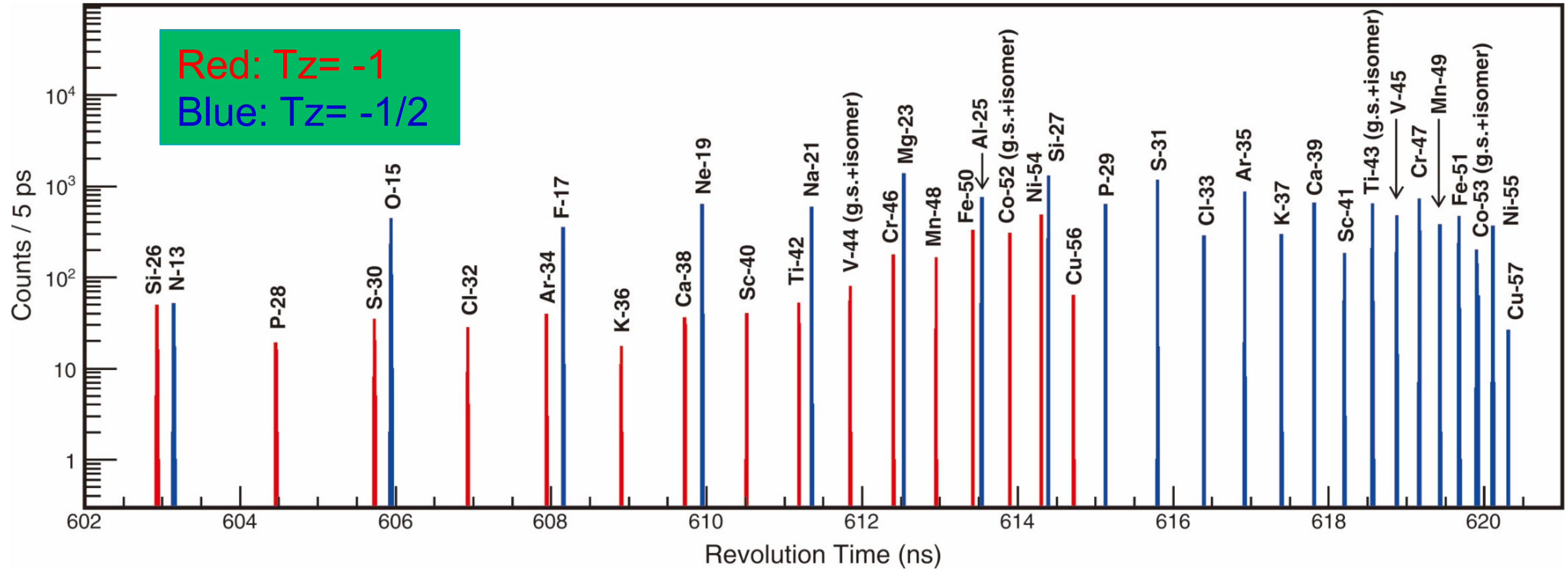
2. Heavy ion storage ring CSRe & IMS

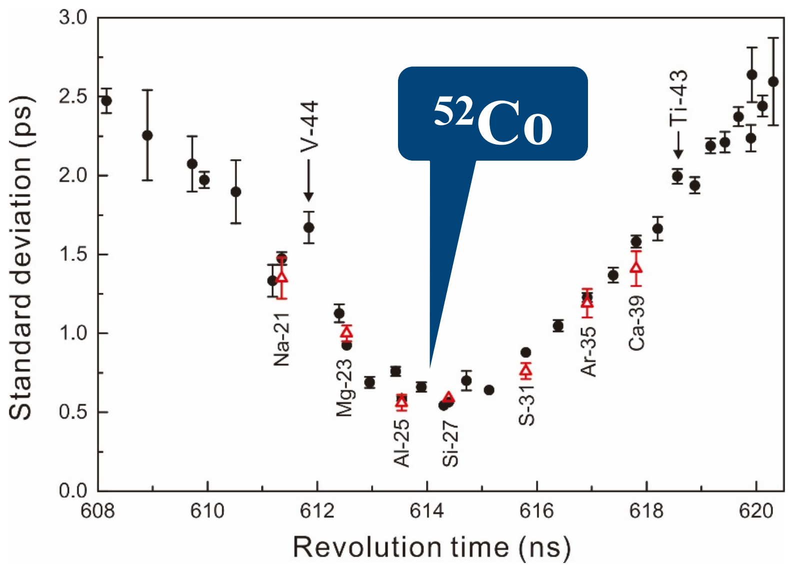


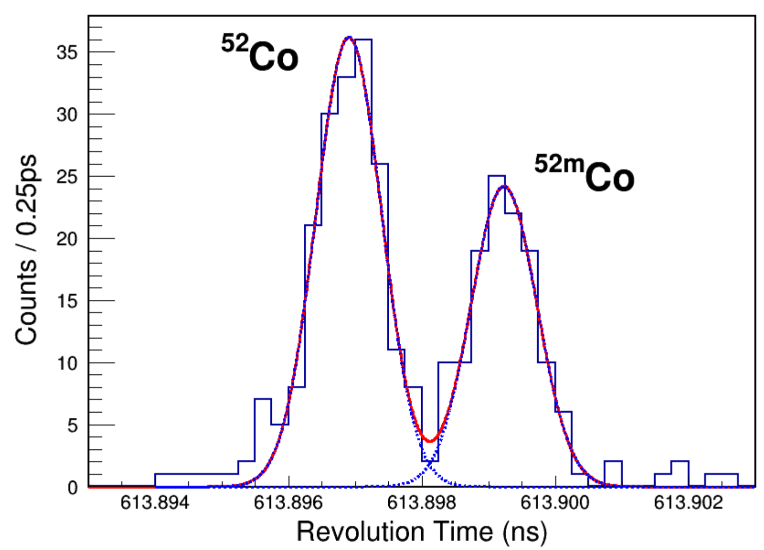
$$\frac{M}{Q} = a + bT + cT^2$$

Isochronous mass stpectrometry

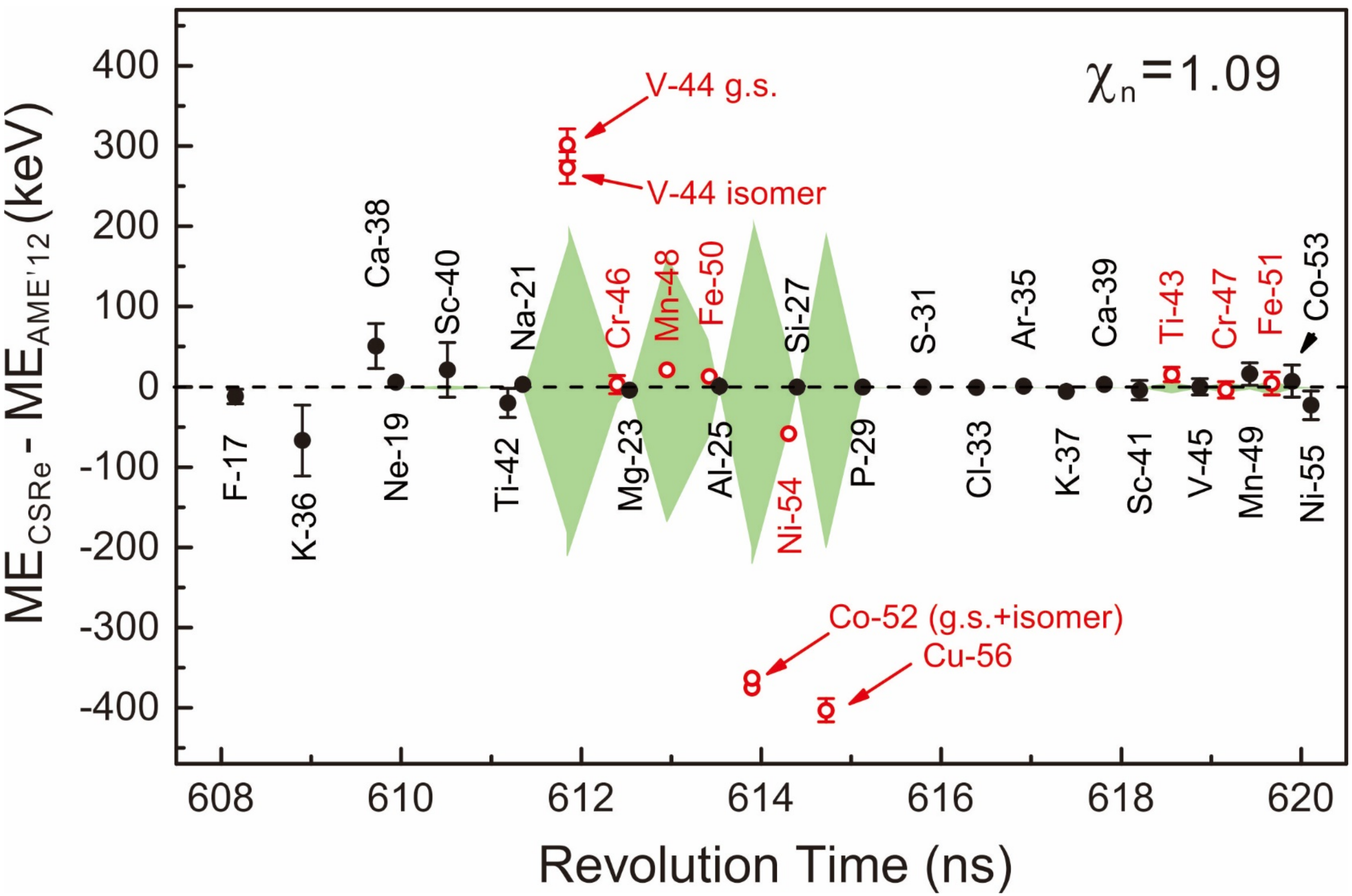
^{58}Ni beam: revolution time spectrum





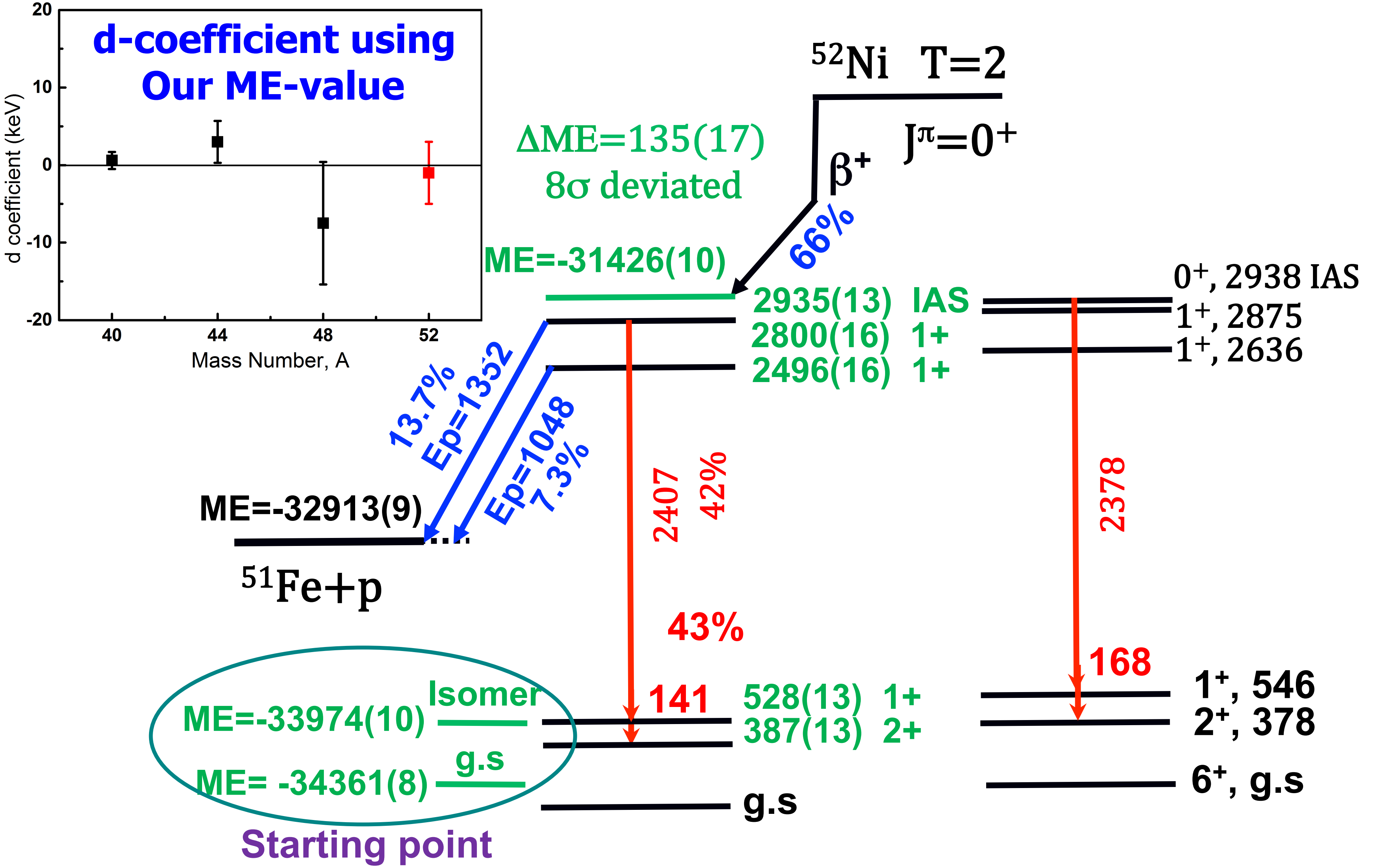


^{58}Ni beam: Mass Excesses of Tz = -1 nuclei



ME(^{52g}Co)=-34361(8) keV, ME(^{52m}Co)=-33974(10) keV

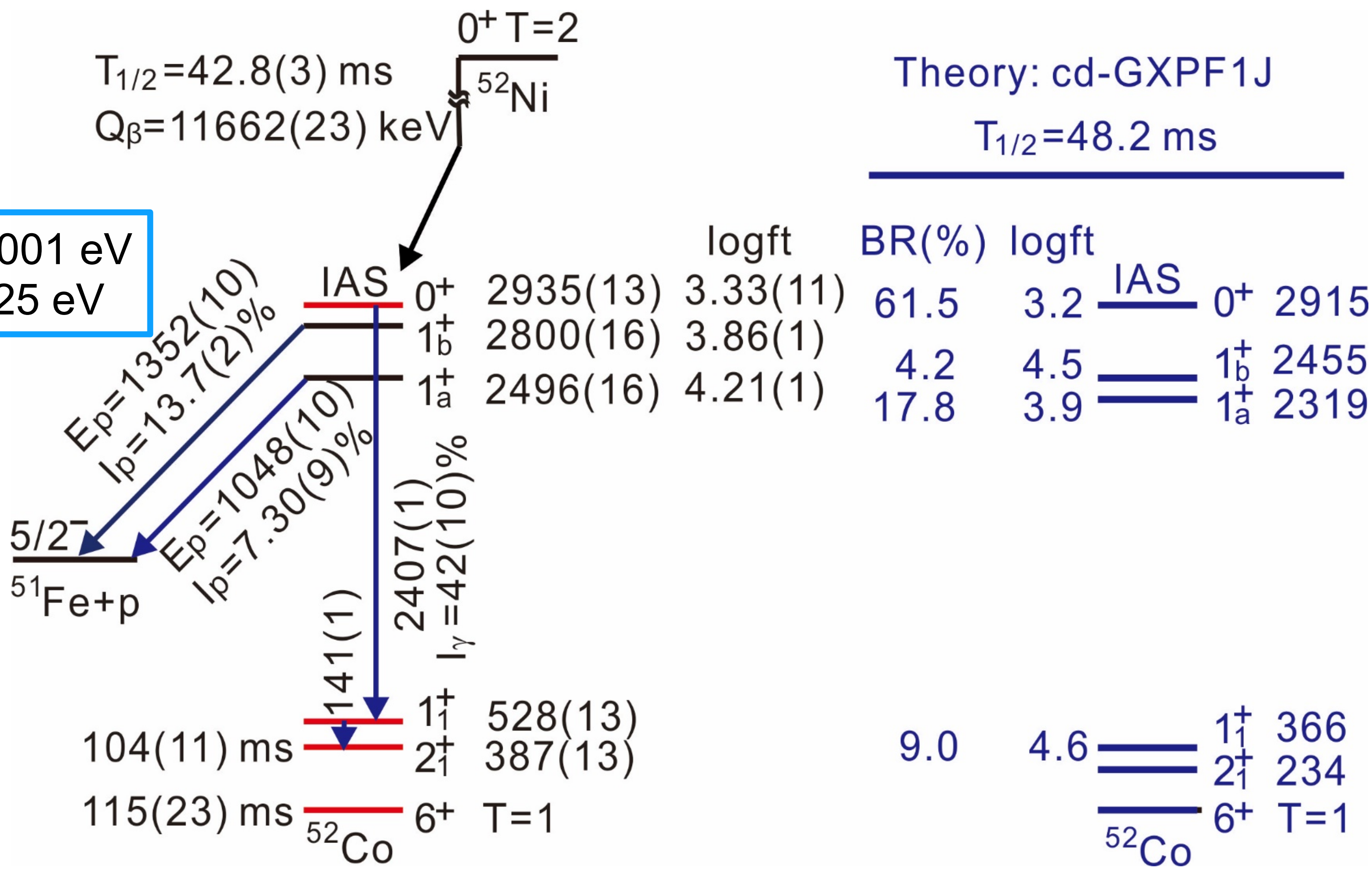
3. Mass of IAS in ^{52}Co and β^+ decay of ^{52}Ni



3. Mass of IAS in ^{52}Co and β^+ decay of ^{52}Ni

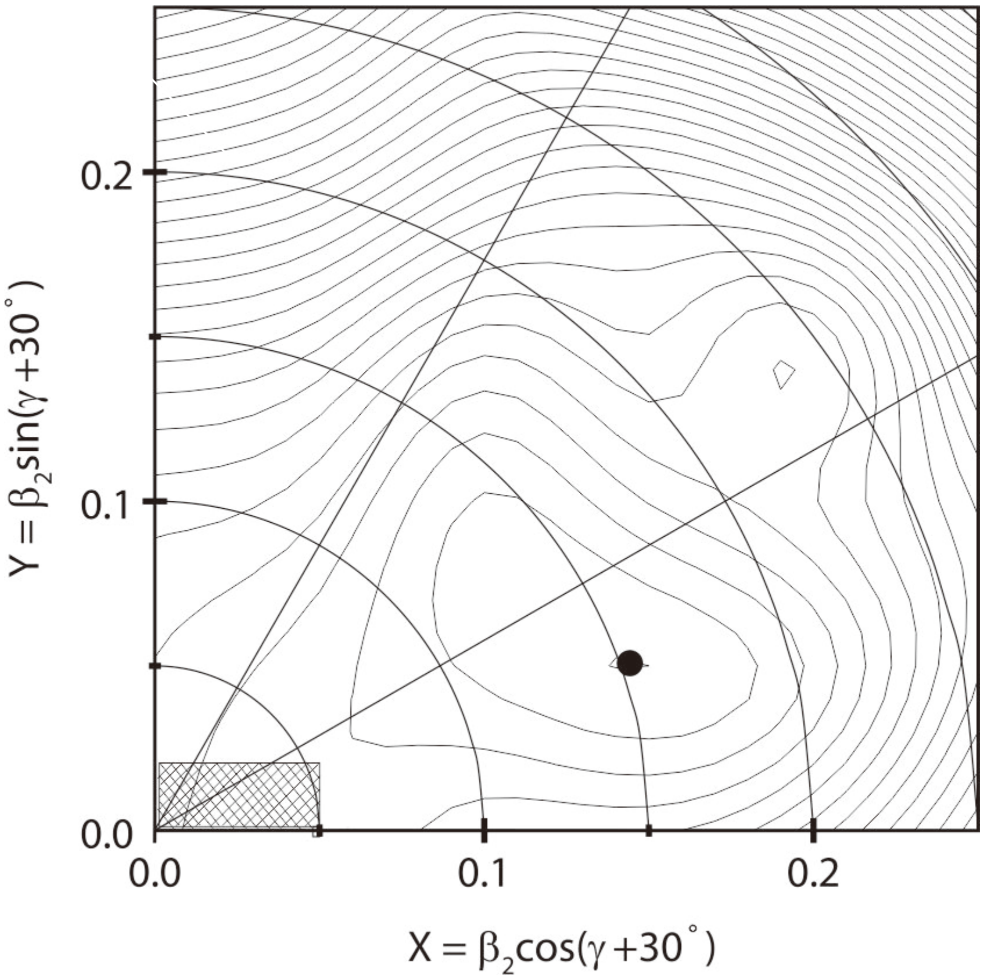
Comparison with theoretical calculations

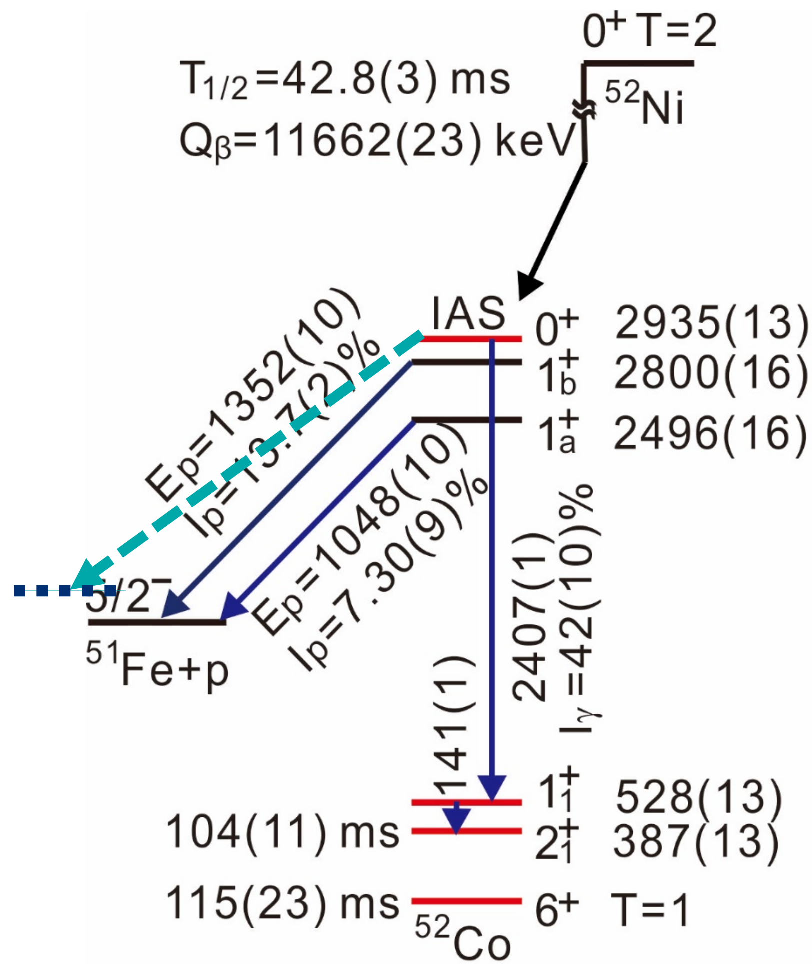
Γp=0.0001 eV
$\Gamma\gamma$=0.25 eV



3. Mass of IAS in ^{52}Co and β^+ decay of ^{52}Ni

Potential energy surface calculations for ^{51}Fe





4. Summary

- Masses of $^{52g,52m}Co$ measured for the first time with σ ~10 keV.
- The T=2, $J^{\pi}=0^{+}$ IAS in ^{52}Co was newly assigned:
  ----- question conventional identification of IASs from β-p method
  ----- masses of the T=2 multiplet fit well into the IMME
  ----- Mirror symmetry satisfied
- IAS in ^{52}Co decays predominantly via γ-transitions while the proton emission is negligibly small (due to very low isospin mixing in the IAS)
- Shape coexistence in ^{51}Fe was proposed in order to explain the details of the β^{+}-decay branching ratios of ^{52}Ni.

4. Summary

H. S. Xu Y. H. Zhang, X. L.Tu, X. L. Yan, M. Wang. X. H. Zhou,Y. J. Yuan, J. W. Xia, J. C. Yang, X. C.Chen, G. B. Jia, Z. G. Hu, X. W. Ma, R. S. Mao, B. Mei, P. Shuai, Z. Y. Sun, S. Kubono, S. T. Wang, G. Q. Xiao, X. Xu, Y. D. Zang, H. W. Zhao, T. C. Zhao, W. Zhang, W. L. Zhan (IMP-CAS, Lanzhou, China)

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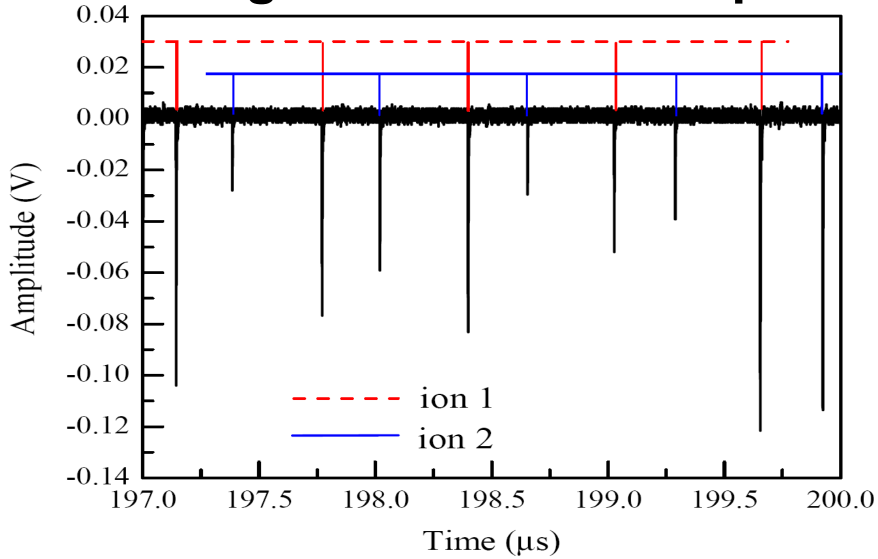
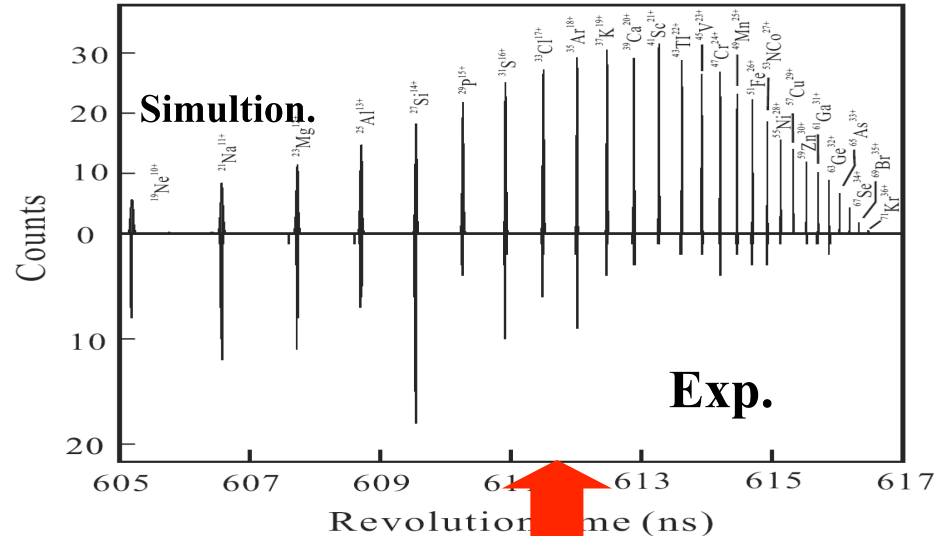
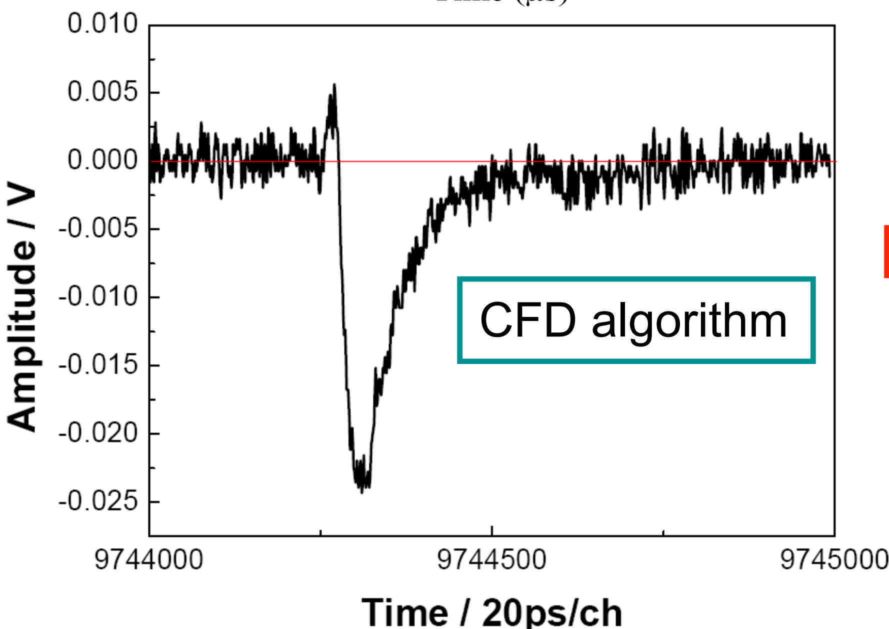
Procedure of Data analysis

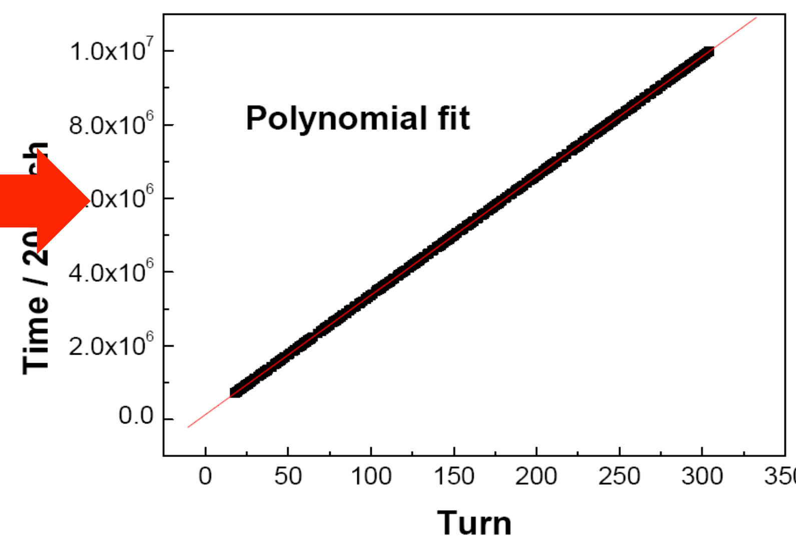
Signals in Oscilloscope



Ion identification







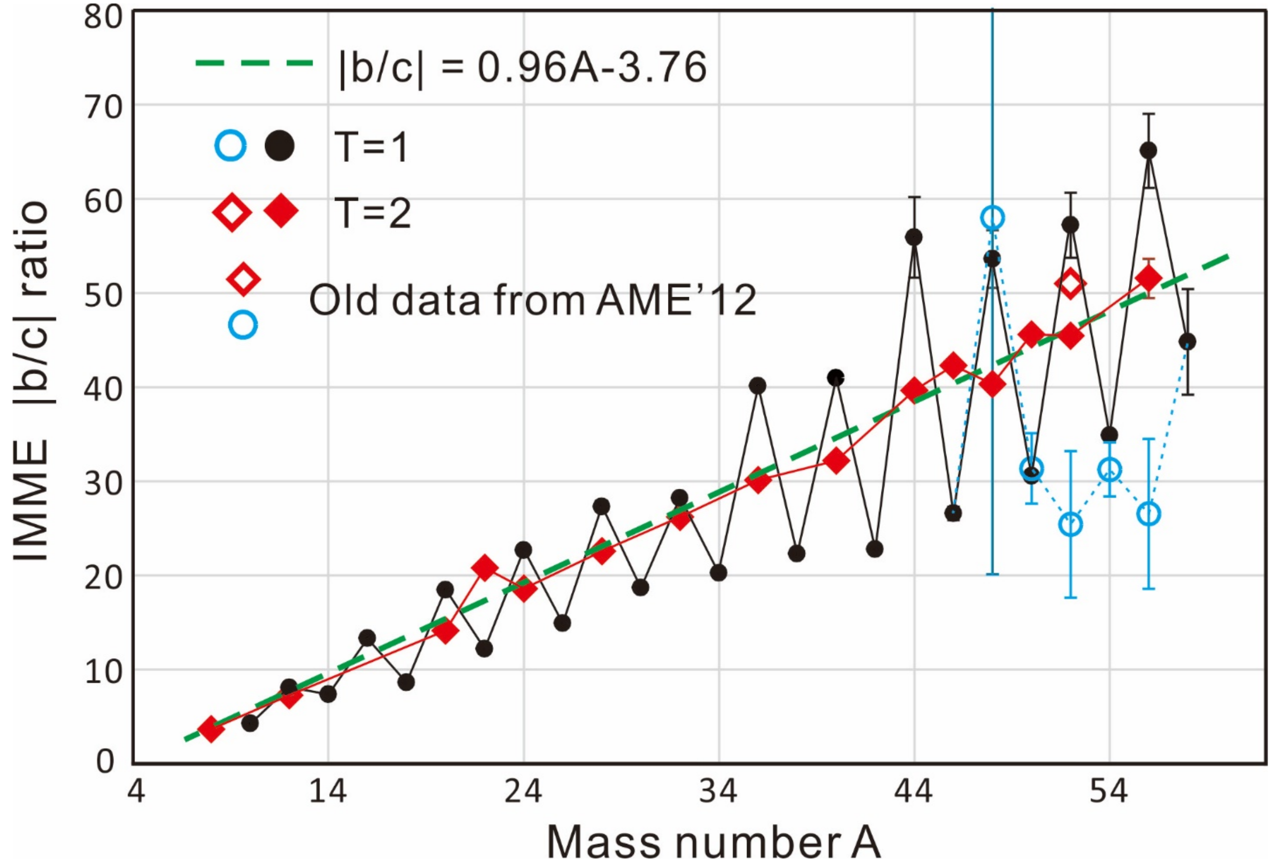
^{58}Ni beam: Mass Excesses of Tz = -1 nuclei

Atom	N	σ_t (ps)	FWHM (keV)	ME_{CSRe} (keV)	$ME_{\mathrm{AME'12}}$ (keV)	δME (keV)
^{44}V	68	1.24	391	−23818(20)	−24120(180)	302
^{44m}V	49	1.27	100	−23584(24)	−23850(210)#	266
^{46}Cr	195	1.13	373	−29471(11)	−29474(20)	3(23)
^{48}Mn	198	0.68	242	−29299(7)	−29320(170)	21(170)
^{50}Fe	342	0.76	277	−34477(6)	−34490(60)	13(60)
^{52}Co	194	0.66	246	−34361(8)	−33990(200)#	−371(200)#
^{52m}Co	129	0.75	277	−33974(10)	−33610(220)#	−364(220)#
^{54}Ni	688	0.54	226	−39278(4)	−39220(50)	−58(50)
^{56}Cu	64	0.70	276	−38643(15)	−38240(200)#	−403(200)#
^{45}V	687	1.94	651	−31885(10)	−31885.3(9)*	0.5(10)
^{47}Cr	1083	2.19	791	−34565(10)	−34561(7)	−4(12)
^{49}Mn	561	2.21	816	−37607(14)	−37620.3(24)*	13(14)
^{51}Fe	760	2.37	932	−40198(14)	−40202(9)	4(17)

3. Mass of IAS in ^{52}Co and β^+ decay of ^{52}Ni

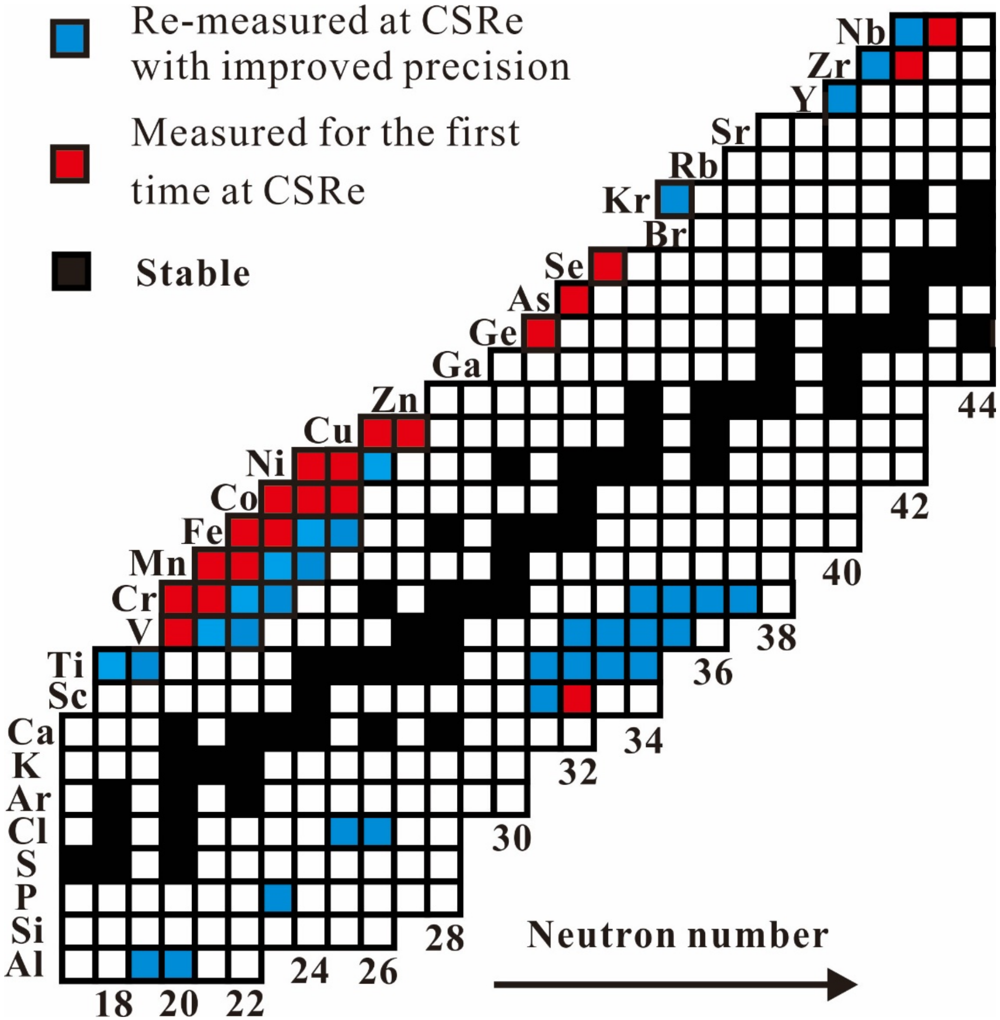
$$M(T,A,T_3) = a(T,A,) + b(T,A)T_3 + c(T,A)T_3^2$$

Systematics of b/c ratios of IMME



4. Summary

Beams: ^{56}Ni, ^{78}Kr, ^{86}Kr, ^{112}Sn



Precision
10^{-6}~10^{-7}
(5-200 keV)

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13. W. Zhang et al., NIM A 756, 1 (2014)
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