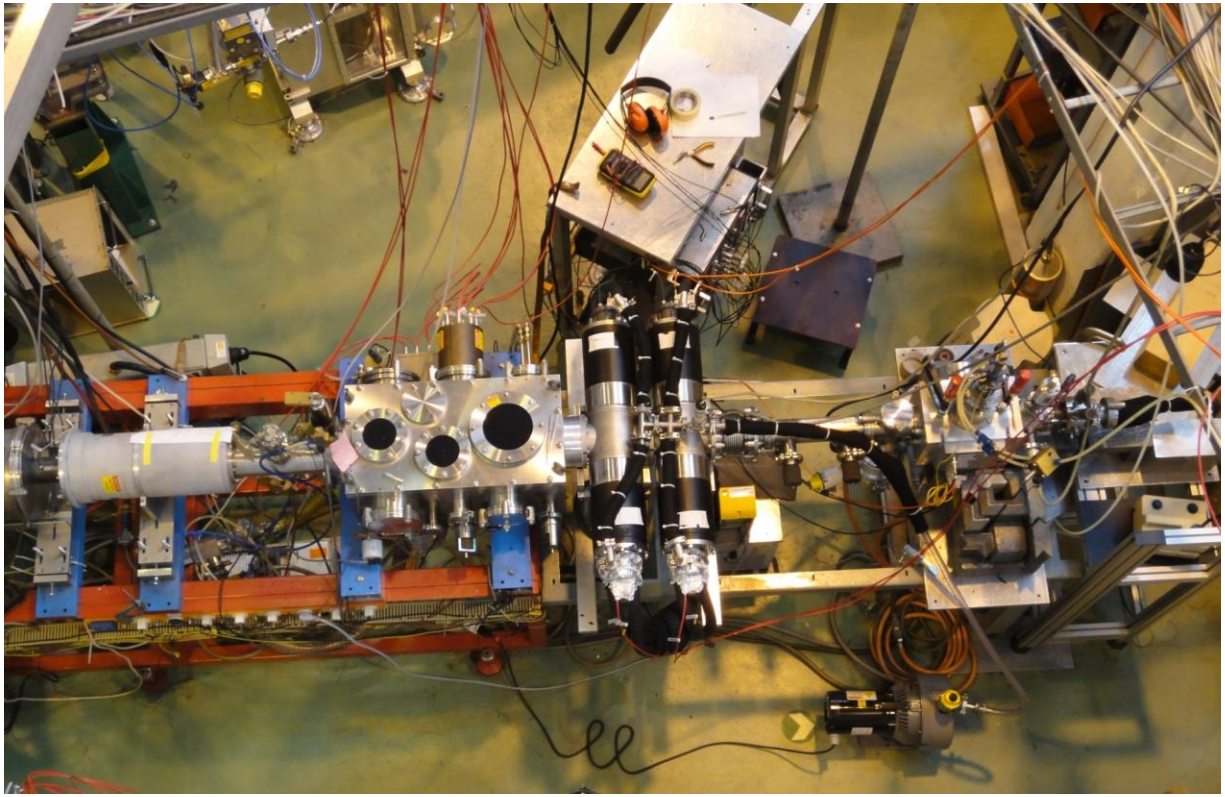
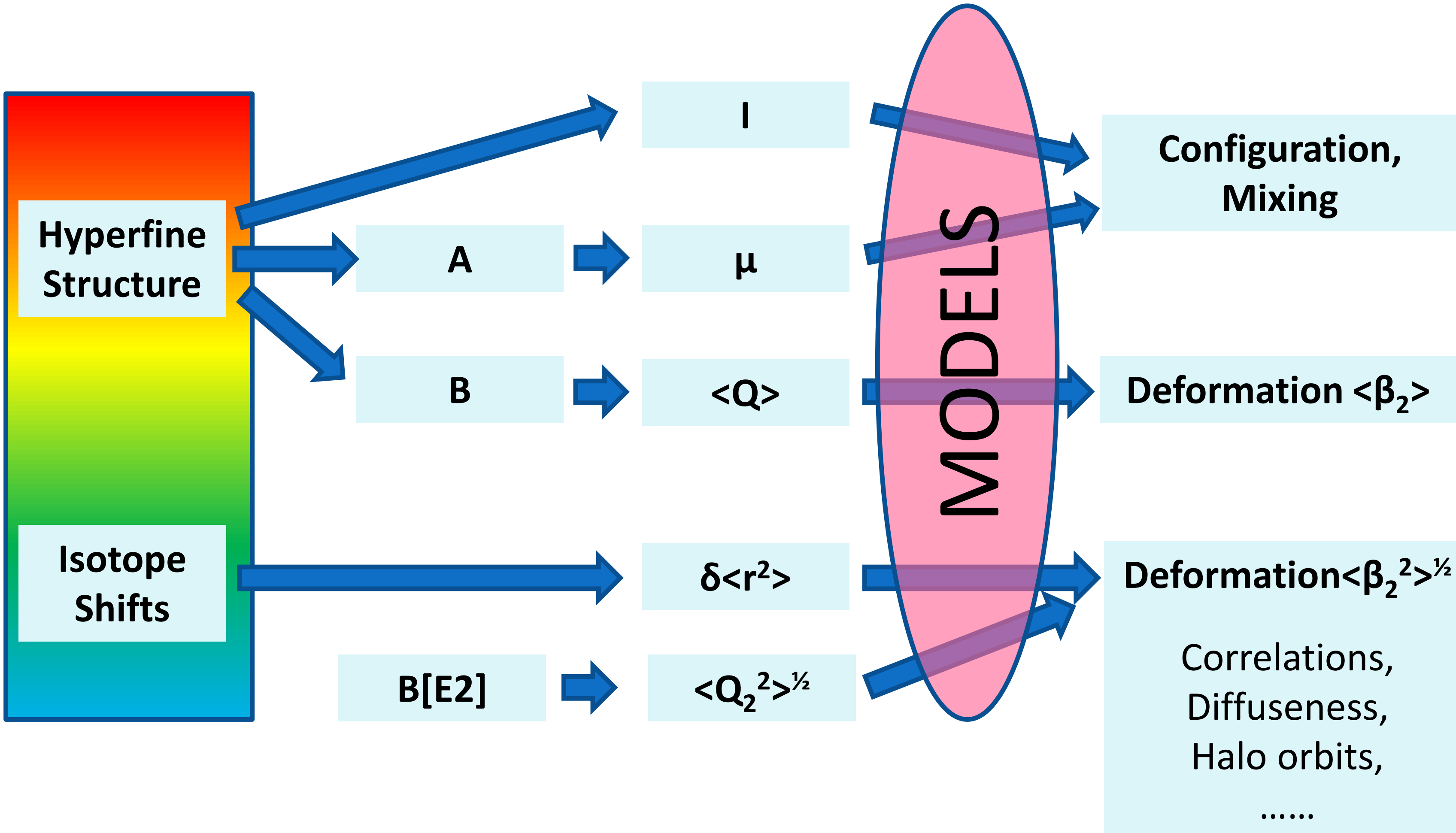
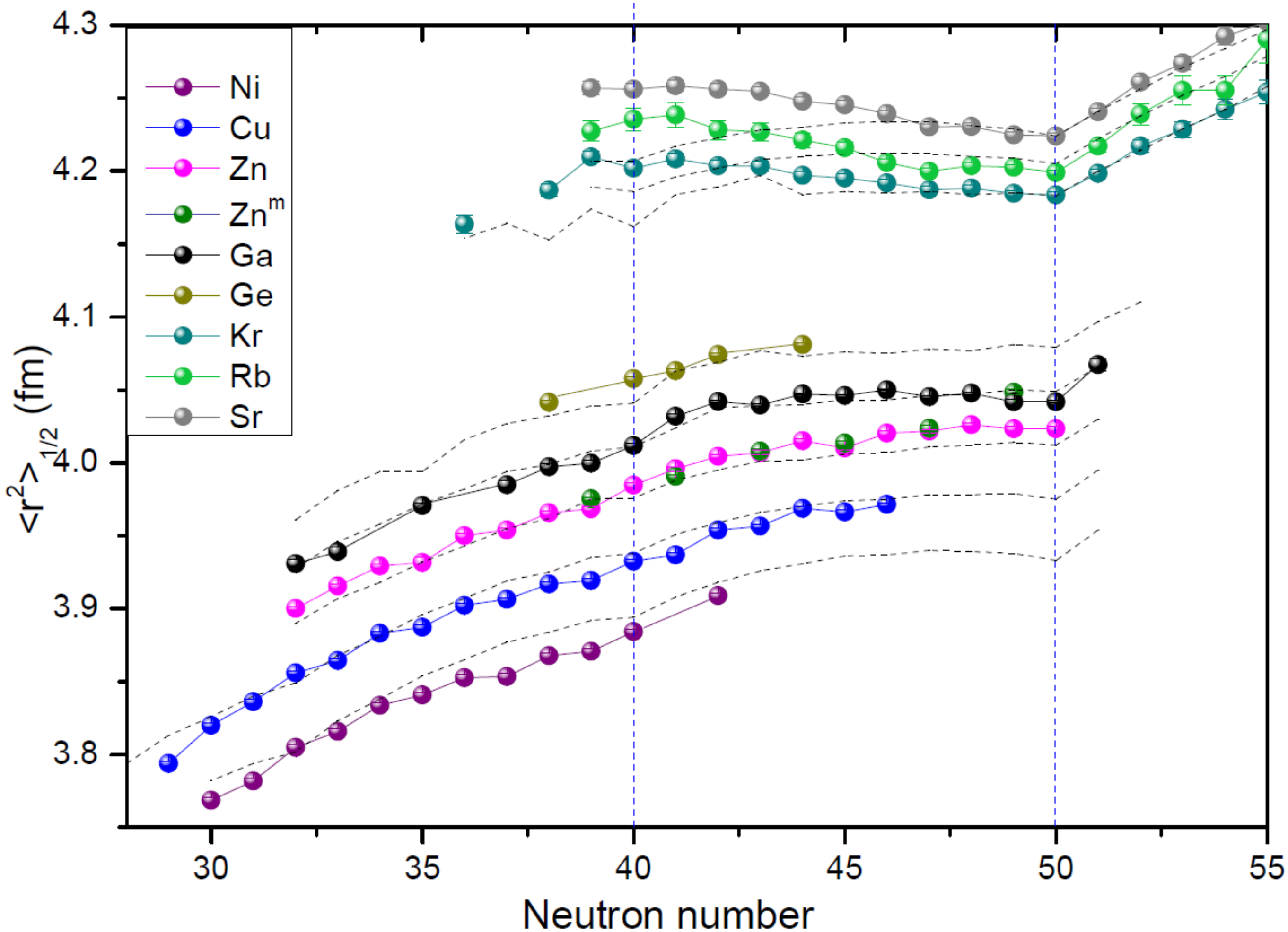
Ground and isomeric state spins, moments and radii of Ge isotopes across the *N*=40 subshell closure via laser spectroscopy at COLLAPS



The Flow of Information



The Landscape



Preliminary results on Ni and Zn

OES in Ge

A	$< r^2 >^{1/2}_{o\mu e}$ [fm]
70	4.038 ± 0.007
72	4.053 ± 0.010
73	4.061 ± 0.007[1])
74	4.075 ± 0.007
76	4.082 ± 0.007

[1]) from muonic atoms; error assumed

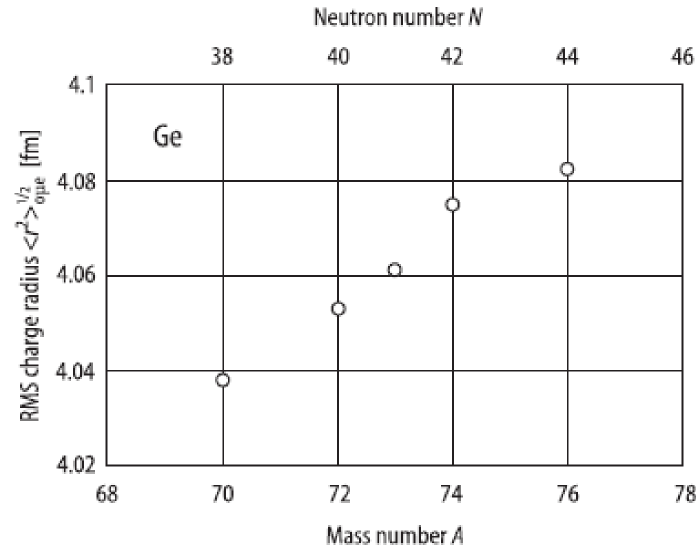
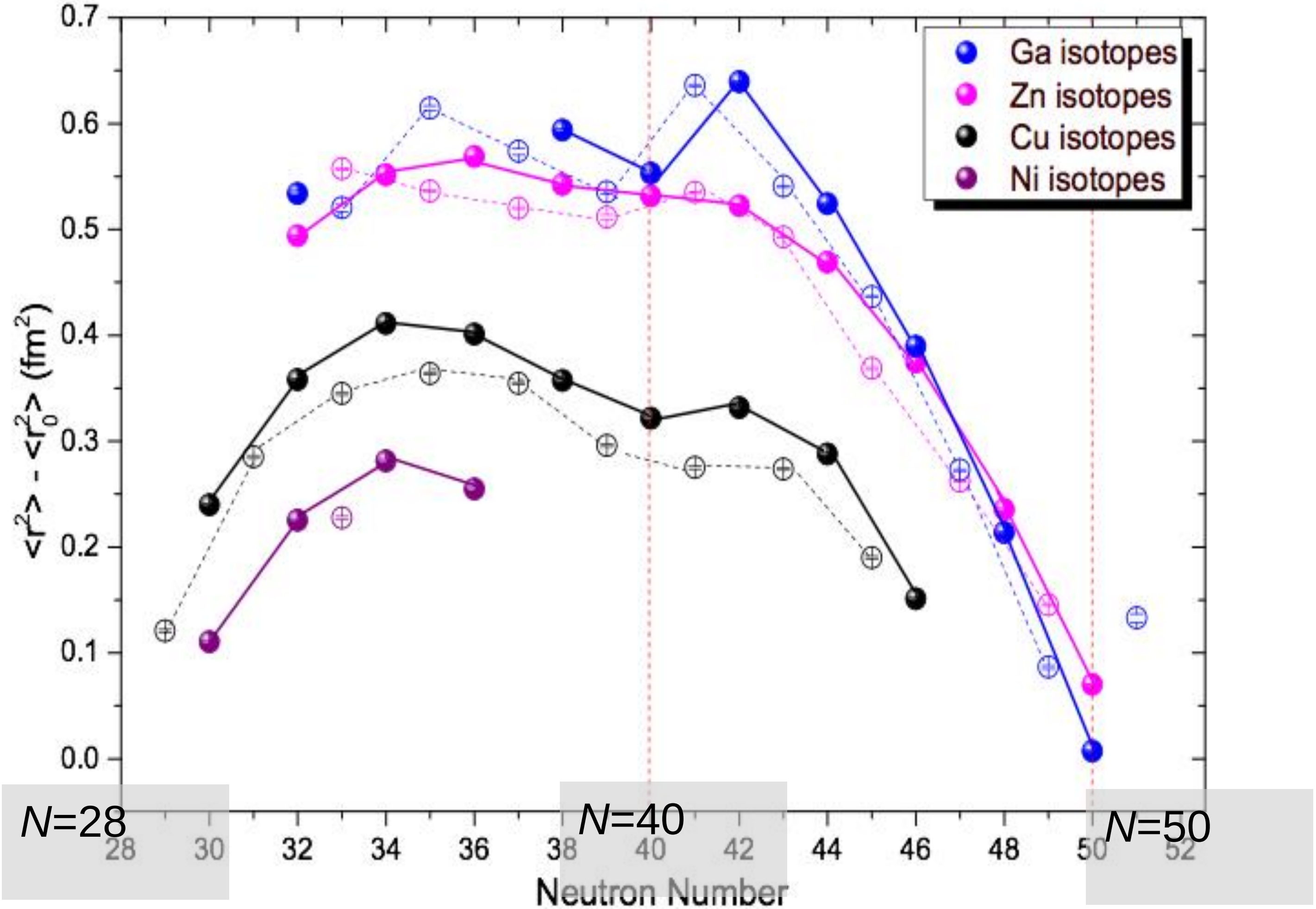


Fig. 4. RMS charge radius $< r^2 >^{1/2}_{o\mu e}$

G. Fricke and K. Heilig, *Nuclear Charge Radii, Landolt-Börnstein–Group I Elementary Particles, Nuclei and Atoms* (Springer, Berlin/Heidelberg, 2004), Vol. 20.

Evolution of the *N*=40 Subshell Closure



The other region of inverted OES

J. Phys. G: Nucl. Part. Phys. **36** (2009) 085102 I Angeli *et al*

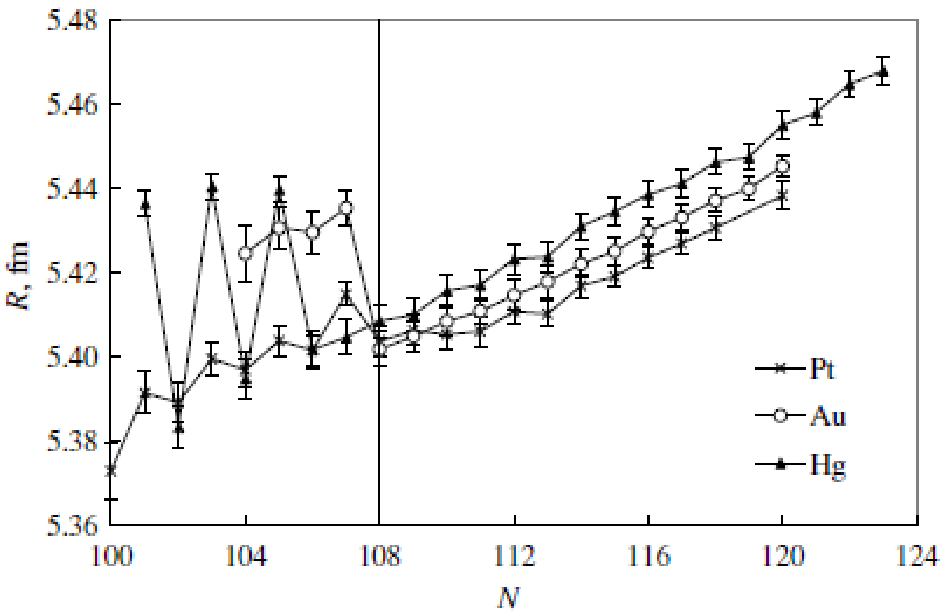


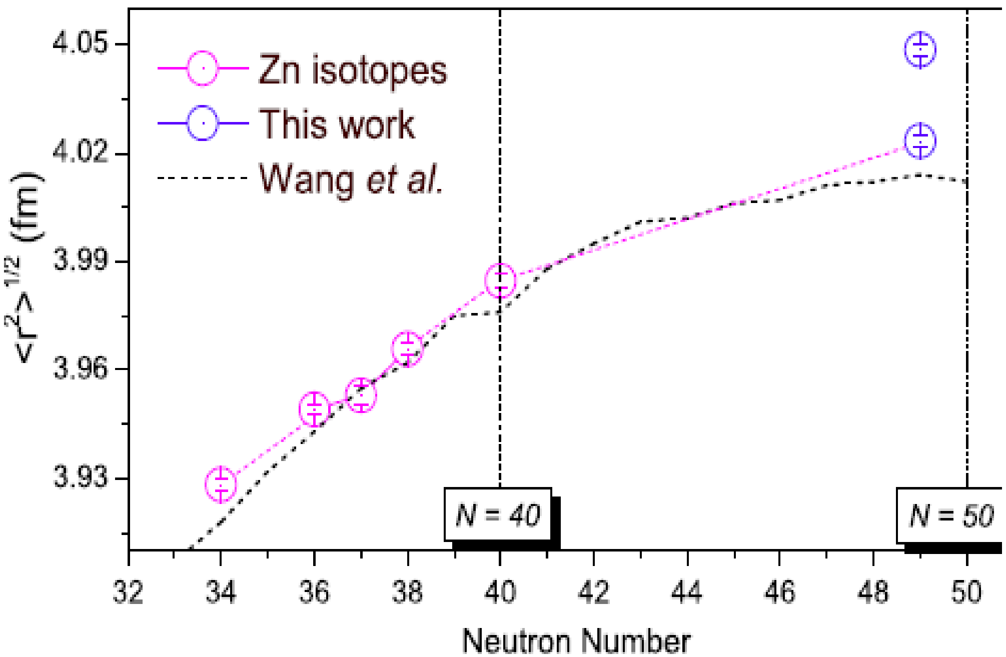
Figure 9. Neutron number dependence of the charge radii for the neighbouring elements Pt, Au and Hg. In the neutron-deficient region with $N < 108$, the sign of the odd–even staggering is inverted from negative (right) to positive (left) [14, 66, 67].

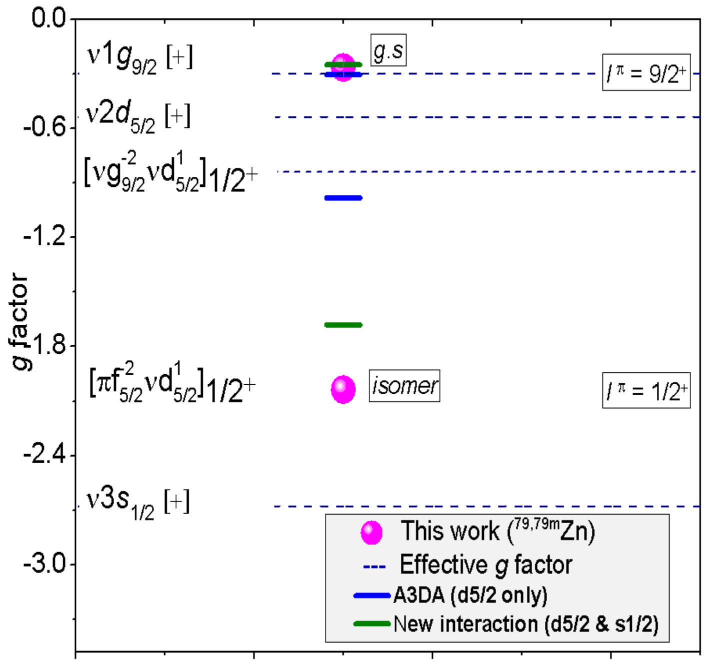
Recent results

PRL **116,** 182502 (2016) PHYSICAL REVIEW LETTERS week ending 6 MAY 2016

Isomer Shift and Magnetic Moment of the Long-Lived $1/2^+$ Isomer in $^{79}_{30}Zn_{49}$: Signature of Shape Coexistence near ^{78}Ni

X. F. Yang,[1,*] C. Wraith,[2] L. Xie,[3] C. Babcock,[2,4] J. Billowes,[3] M. L. Bissell,[3,1] K. Blaum,[5] B. Cheal,[2] K. T. Flanagan,[3] R. F. Garcia Ruiz,[1] W. Gins,[1] C. Gorges,[6] L. K. Grob,[7,6] H. Heylen,[1] S. Kaufmann,[6,8] M. Kowalska,[7] J. Kraemer,[6] S. Malbrunot-Ettenauer,[7] R. Neugart,[5,8] G. Neyens,[1] W. Nörtershäuser,[6] J. Papuga,[1] R. Sánchez,[9] and D. T. Yordanov[10]



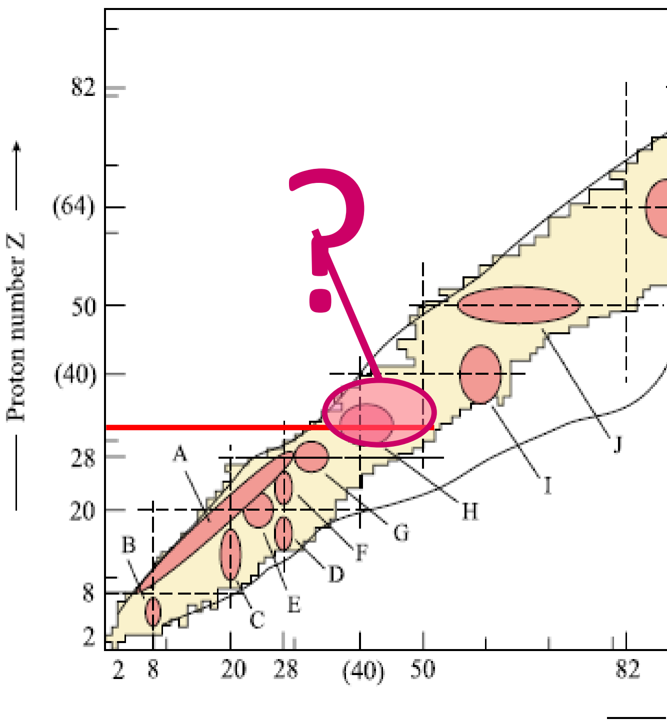


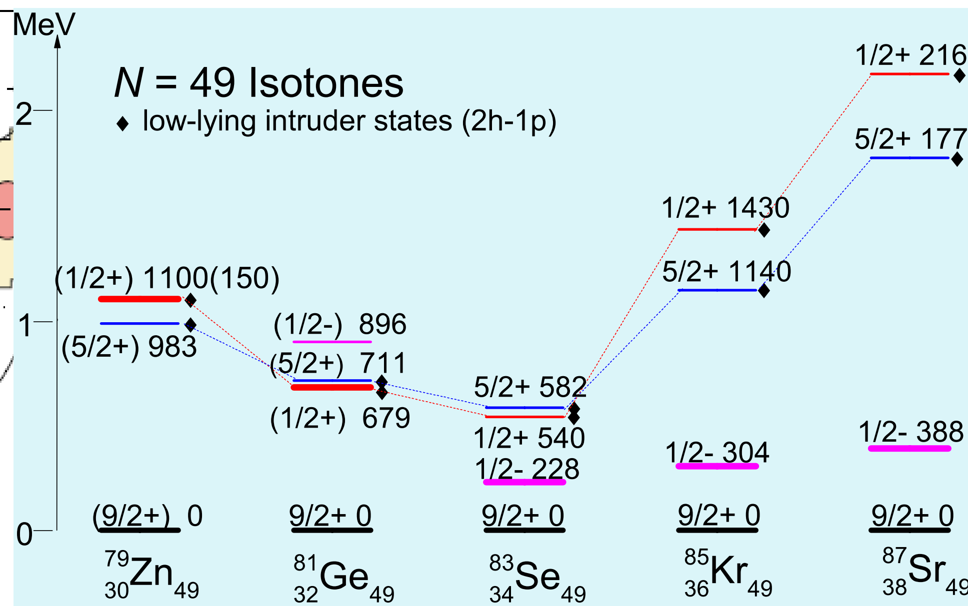
A new region of shape coexistence?

PRL **116,** 182501 (2016) PHYSICAL REVIEW LETTERS week ending 6 MAY 2016

First Evidence of Shape Coexistence in the ^{78}Ni Region: Intruder 0_2^+ State in ^{80}Ge

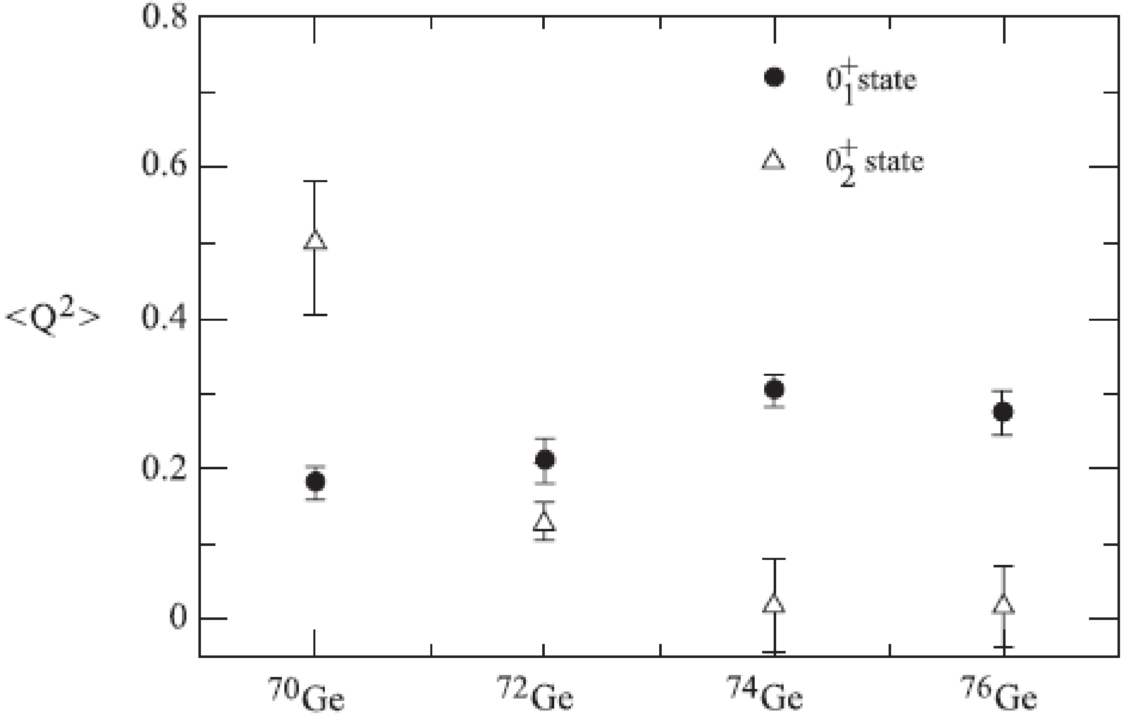
A. Gottardo,[1,*] D. Verney,[1] C. Delafosse,[1] F. Ibrahim,[1] B. Roussière,[1] C. Sotty,[2] S. Roccia,[3] C. Andreoiu,[4] C. Costache,[2] M.-C. Delattre,[1] I. Deloncle,[3] A. Etilé,[5] S. Franchoo,[1] C. Gaulard,[3] J. Guillot,[1] M. Lebois,[1] M. MacCormick,[1] N. Marginean,[2] R. Marginean,[2] I. Matea,[1] C. Mihai,[2] I. Mitu,[2] L. Olivier,[1] C. Portail,[1] L. Qi,[1] L. Stan,[2] D. Testov,[6,7] J. Wilson,[1] and D. T. Yordanov[1]





R. Orlandi et al., Phys. Lett. B 740, 298 (2015).

Ge: Established shape coexistence



Kris Heyde and John Wood, Rev. Mod. Phys., 83 4 (2011)

Transfer reactions:

$$|\Phi^\pi(^A\mathrm{Ge};0_1^+)\rangle = \alpha_A\,|(2p_{3/2})_0^4\rangle + \beta_A\,|(2p_{3/2})_0^2(1f_{5/2})_0^2\rangle,$$

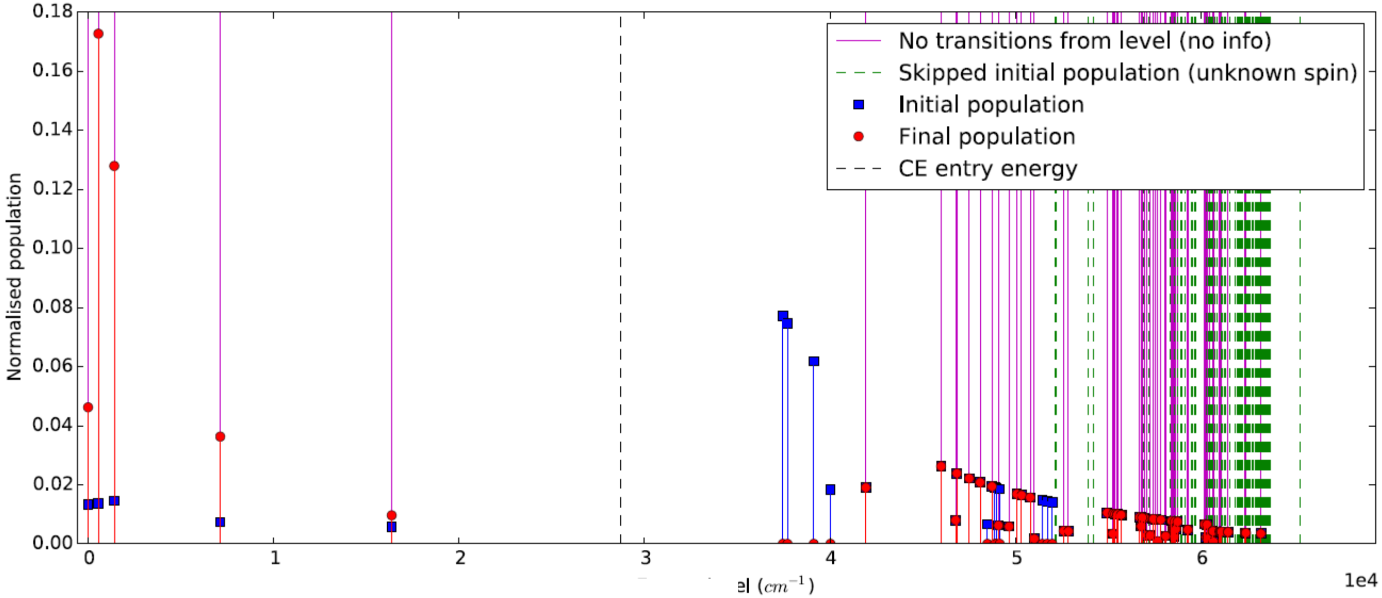
A. M. Van den Berg, Nucl. Phys A **379**, 239 (1982)

OR

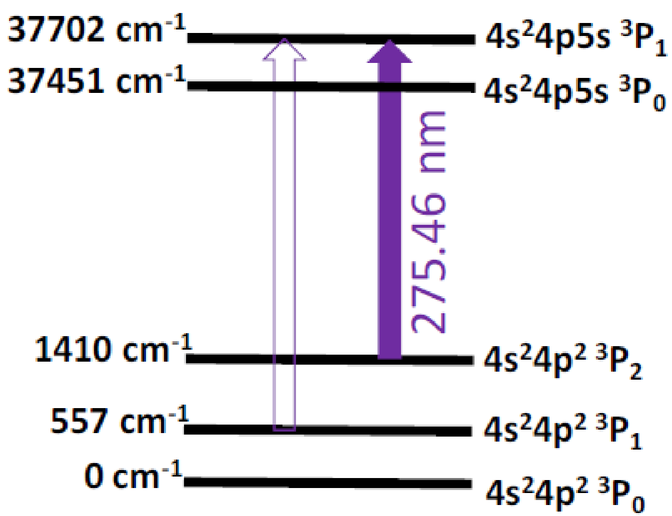
$$|\Phi^\nu(^{70+n}\mathrm{Ge};0_1^+)\rangle = \alpha_n\,|(2p_{1/2})_0^2(1g_{9/2})_0^{n-2}\rangle + \beta_n\,|(1g_{9/2})_0^n\rangle,$$

F. Becker, Nucl. Phys A **388**, 477 (1982)

Ge: Experimental Scheme



Charge exchange of Ge^{+} on K vapour.
(A. Vernon)



ZrO_2 Target
+ atomic Sulfur leak
+ Hot Plasma Ion Source

Shift Request

A	$t_{1/2}$	Yield /uC	Shifts
65	31s	1.4 $x10^5$	1
66	2.3h	$3.5x10^5$	0.5
67	19m	$1.1x10^6$	1
68	271d	$5x10^7$	0.5
69	39h	$5x10^7$	1
70	Stable	-	0.5
71	11d	$3.4x10^7$	1
72	Stable	-	0.5
73 73m	Stable 499ms	- $1.8x10^3$	2.5
74	Stable	-	0.5
75g 75m	83m 48s	$6x10^4$ $1x10^4$	1.5
76	Stable	-	0.5

Total: 11 Online shifts
+ 2 Setup

ISOLDE

COLLAPS

M.L. Bissell[1], X.F. Yang[2], J. Billowes[1], K. Blaum[3], B. Cheal[4], S. Malbrunot-Ettenauer[5], R.F. Garcia Ruiz[1], W. Gins[2], C. Gorges[6], H. Heylen[2], Á. Koszorús[2], S. Kaufmann[6], J. Krämer[6], M. Kowalska[5], G. Neyens[2], R. Neugart[3,7], L. Vázquez[9], W. Nörtershäuser[6], R. Sánchez[8],C. Wraith[4], L. Xie[1], Z.Y. Xu[2], D.T. Yordanov[9].

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reserve

Table 1: Known information for neutron-rich $^{65-76}Ge$, as well as the extrapolated production yield from ZrO_2 target.

Isotopes	Spin	Half-life	μ (μ_N)	$Q_s(b)$	Yield/μC	Required shifts
^{65}Ge	$3/2^-$	30.9s			1.4×10^5	1
^{67}Ge	$1/2^-$	18.9m			1.1×10^6	1
^{69}Ge	$5/2^-$	39.1h	(+)0.735(7)	0.024(5)	5.0×10^7	1
^{71}Ge	$1/2^-$	11.4d	+0.547(5)		3.4×10^7	
^{71m}Ge	$9/2^+$	20.41ms	-1.0413(7)	0.34(5)		1
^{73}Ge	$9/2^+$	stable	-0.8794677(2)	-0.17(3)		
^{73m}Ge	$1/2^-$	499ms			1.8×10^3	2.5
^{75g}Ge	$1/2^-$	82.78m	+0.510(5)		6.0×10^4	
^{75m}Ge	$7/2^+$	47.7s			1.0×10^4	1.5
$^{66-76}Ge$	0^+					
reference						3
Total						11
Stable beam						2