QPTn9

Padova (Italy)
22-25 May
2018

Signature of the γ-softness in nuclei at the Se-Ge region

Mahmut BÖYÜKATA

Kırıkkale University, Turkey

In this study;

- Focus on the γ-band of some nuclei in the Se-Ge region.
- These nuclei;
  - ^{74}Se, ^{76}Se, ^{78}Se isotopes and
  - ^{66}Ge, ^{68}Ge isotopes
- Their gamma bands show a typical band structure of the γ-softness.
- The experimental levels in γ-band have

  the odd–even couplings

  like (2+), (3+, 4+), (5+, 6+), (7+, 8+), ...

In this study;

- Detail analyzing of γ-band levels for given isotopes.

… with interacting boson model-1 (ibm-1);

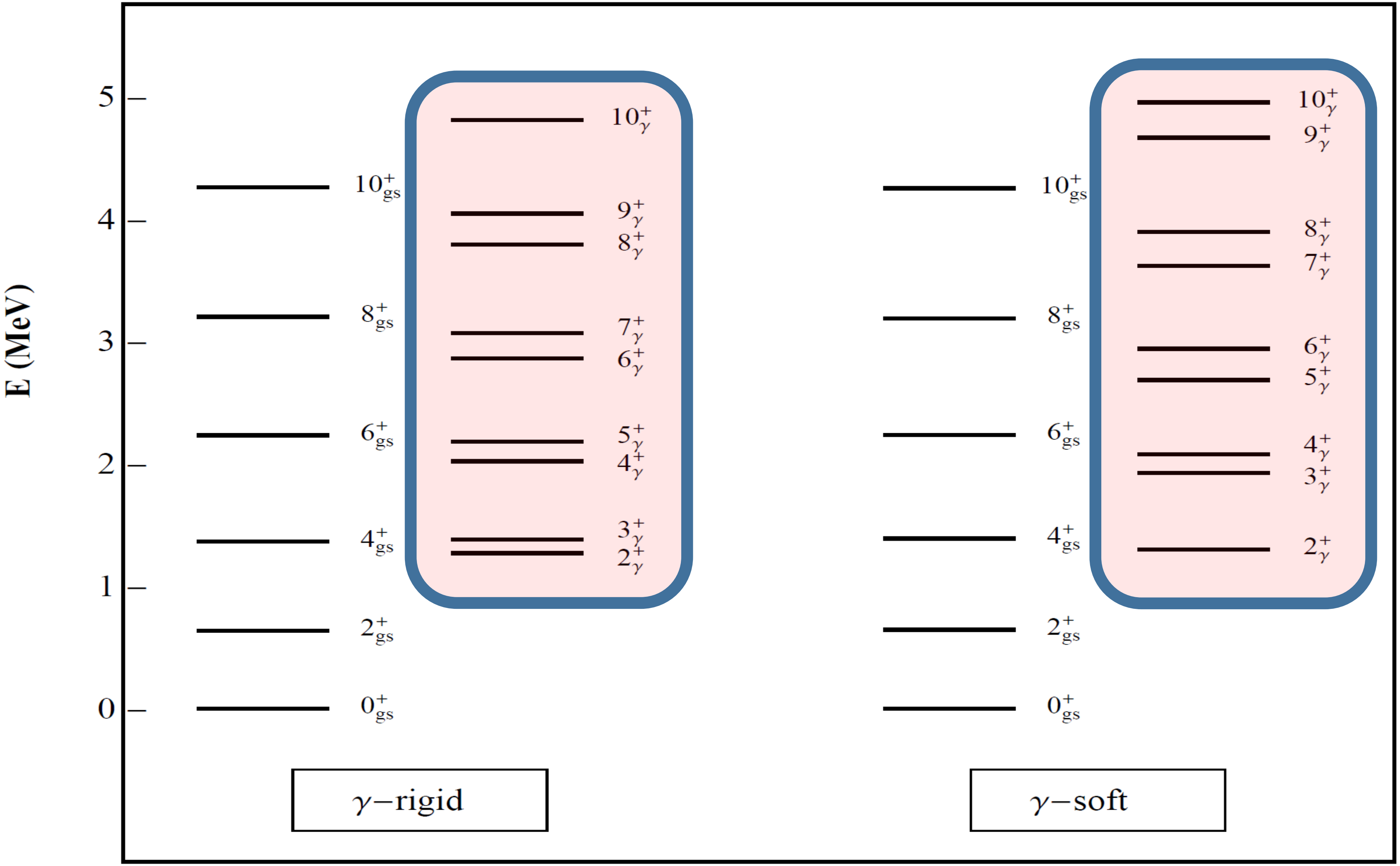
energy levels were calculated and compared experimental data

- The signature splitting S(J) observed in the γ-band.

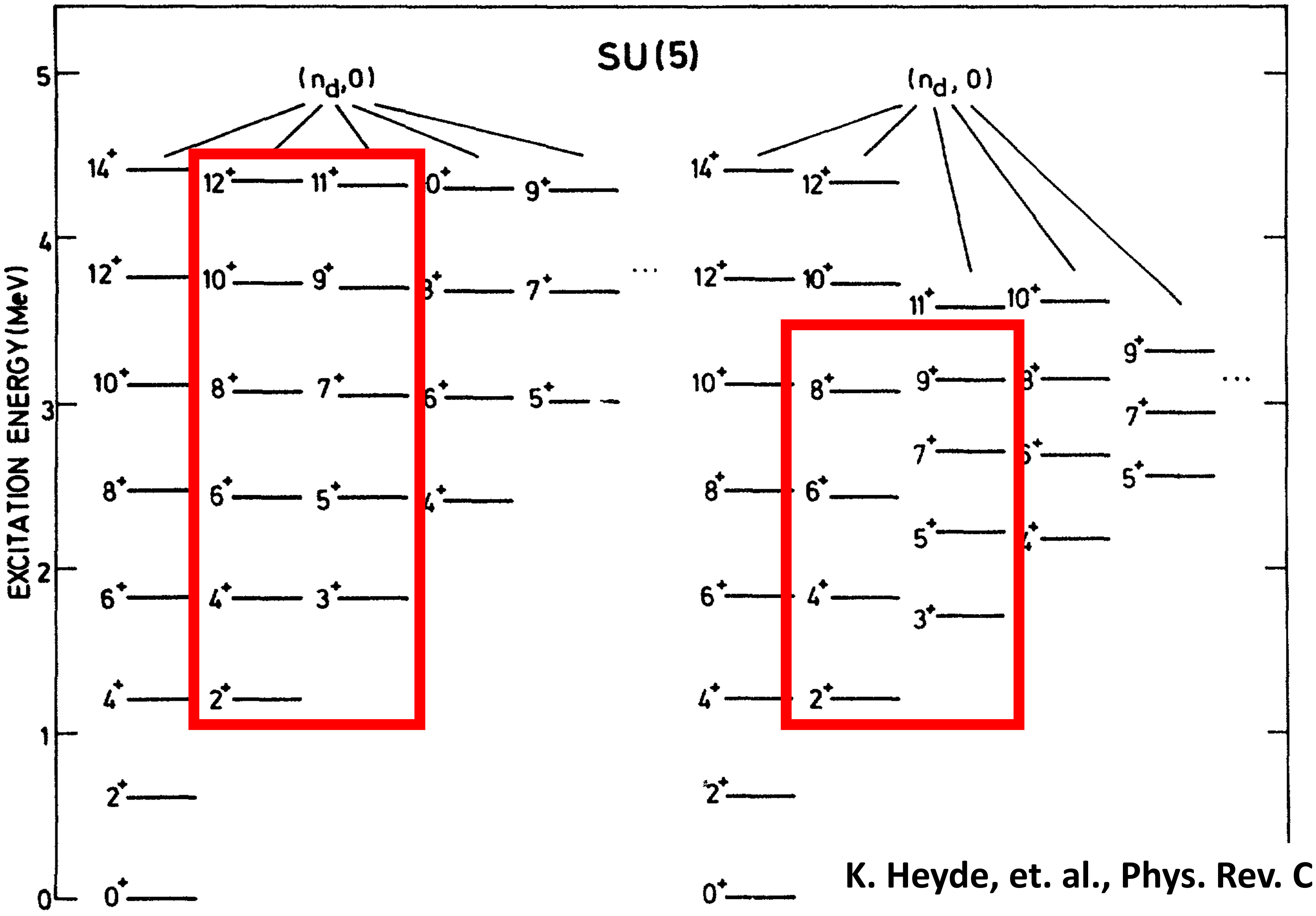
$$S(J) = \frac{E(J) - E(J-1)}{E(J) - E(J-2)} \cdot \frac{J(J+1) - (J-1)(J-2)}{J(J+1) - J(J-1)} - 1$$

N. V. Zamfir, R. F. Casten, Phy. Lett. B 260 (1991) 265.
I. Stefanescu, A. Gelbergb, J. Jolie, P. Van Isacker, P. Von Brentano, et. Al., Nucl. Phys. A 789 (2007) 125.
B. Sorgunlu, P. Van Isacker, Nucl. Phy. A 808 (2008) 27.

γ-rigid & γ-soft

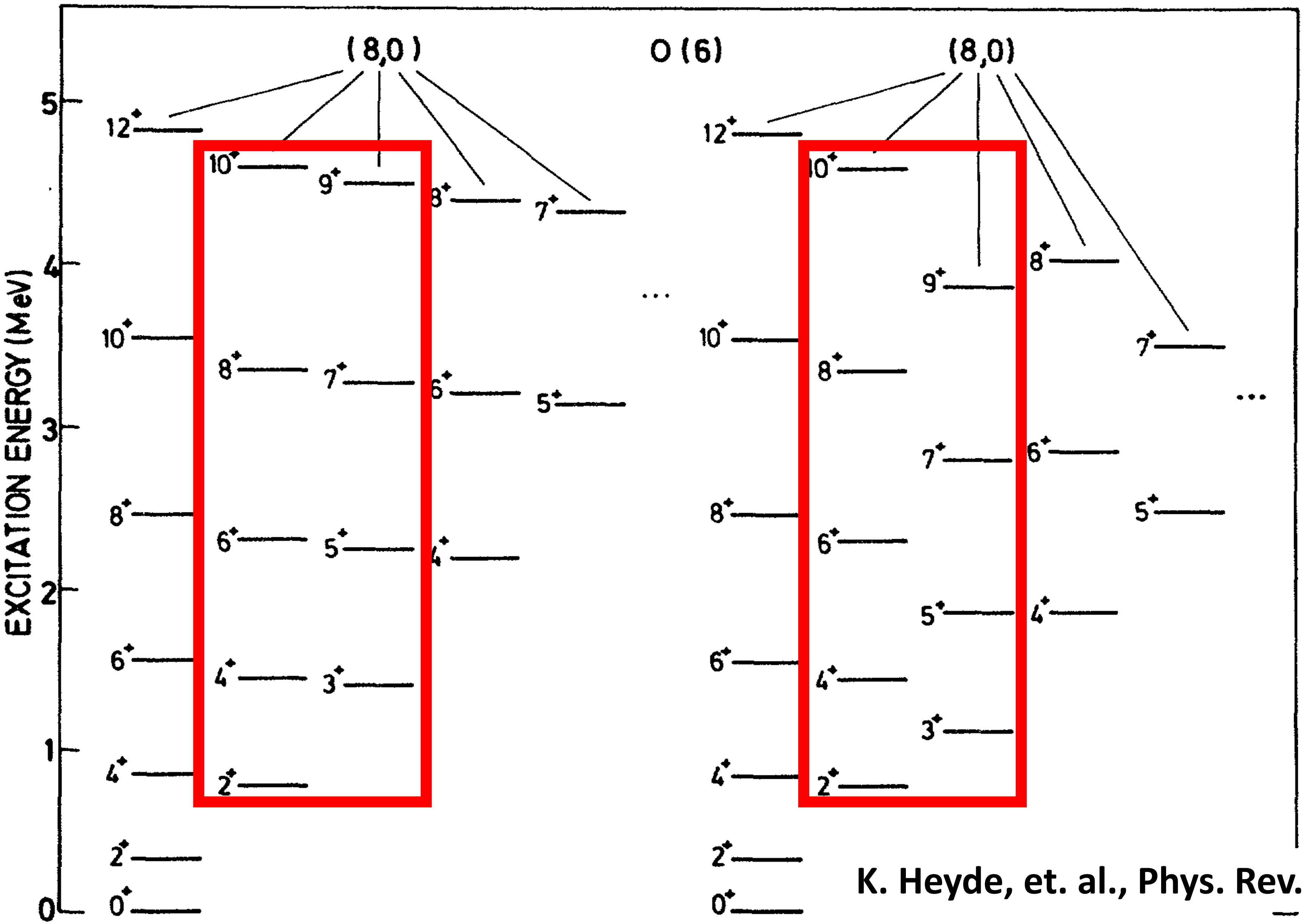


The effect of triaxial term in IBM-1 for U(5)



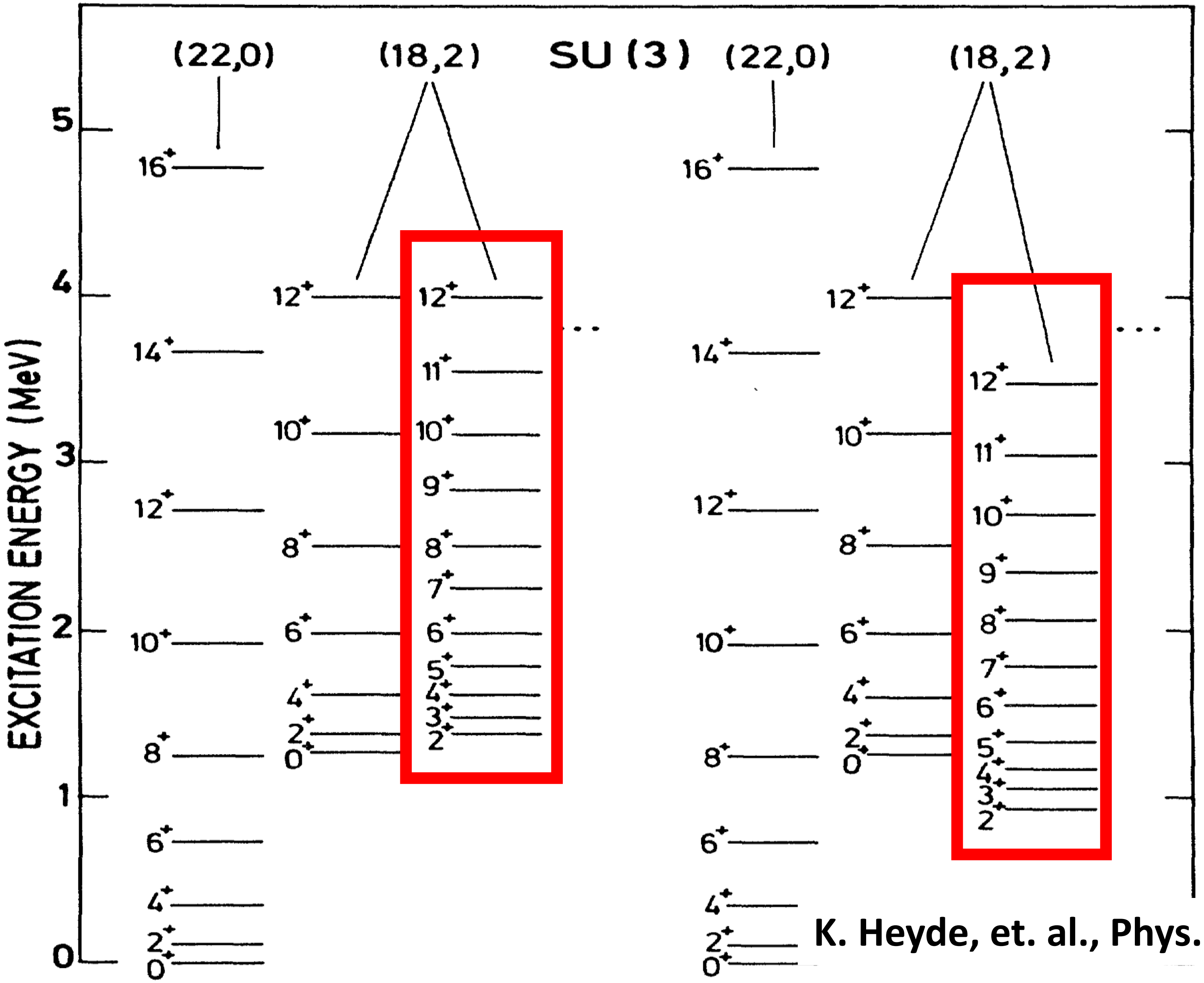
K. Heyde, et. al., Phys. Rev. C 29 (1984) 1420.

The effect of triaxial term in IBM-1 for O(6)

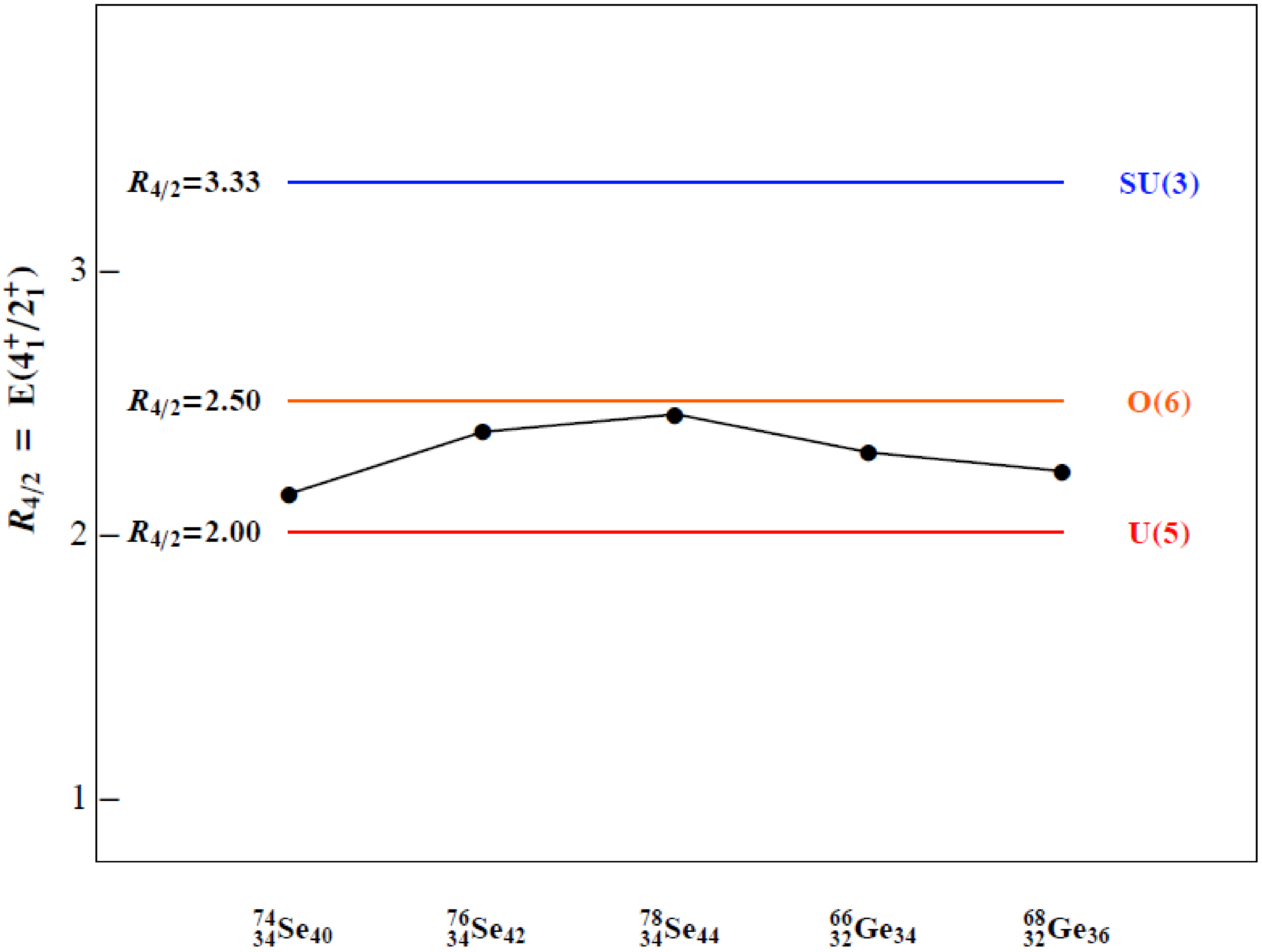


K. Heyde, et. al., Phys. Rev. C 29 (1984) 1420.

The effect of triaxial term in IBM-1 for SU(3)



K. Heyde, et. al., Phys. Rev. C 29 (1984) 1420.



$R_{4/2}$ = E($4_1^+/2_1^+$)
$R_{4/2}$=3.33
SU(3)
$R_{4/2}$=2.50
O(6)
$R_{4/2}$=2.00
U(5)
3
2
1
$^{74}_{34}Se_{40}$
$^{76}_{34}Se_{42}$
$^{78}_{34}Se_{44}$
$^{66}_{32}Ge_{34}$
$^{68}_{32}Ge_{36}$

Hamiltonian

$$\hat{H} = \in \hat{n}_d + a_1 \hat{L}\cdot\hat{L} + a_2 \hat{Q}\cdot\hat{Q}$$

$$\hat{H} = \in \hat{n}_d + a_0 \hat{P}_+ \cdot \hat{P}_- + a_1 \hat{L}\cdot\hat{L} + a_2 \hat{Q}\cdot\hat{Q} + \sum_L v_L [d^+ d^+ d^+]^{(L)} \cdot [\tilde{d}\tilde{d}\tilde{d}]^{(L)}$$

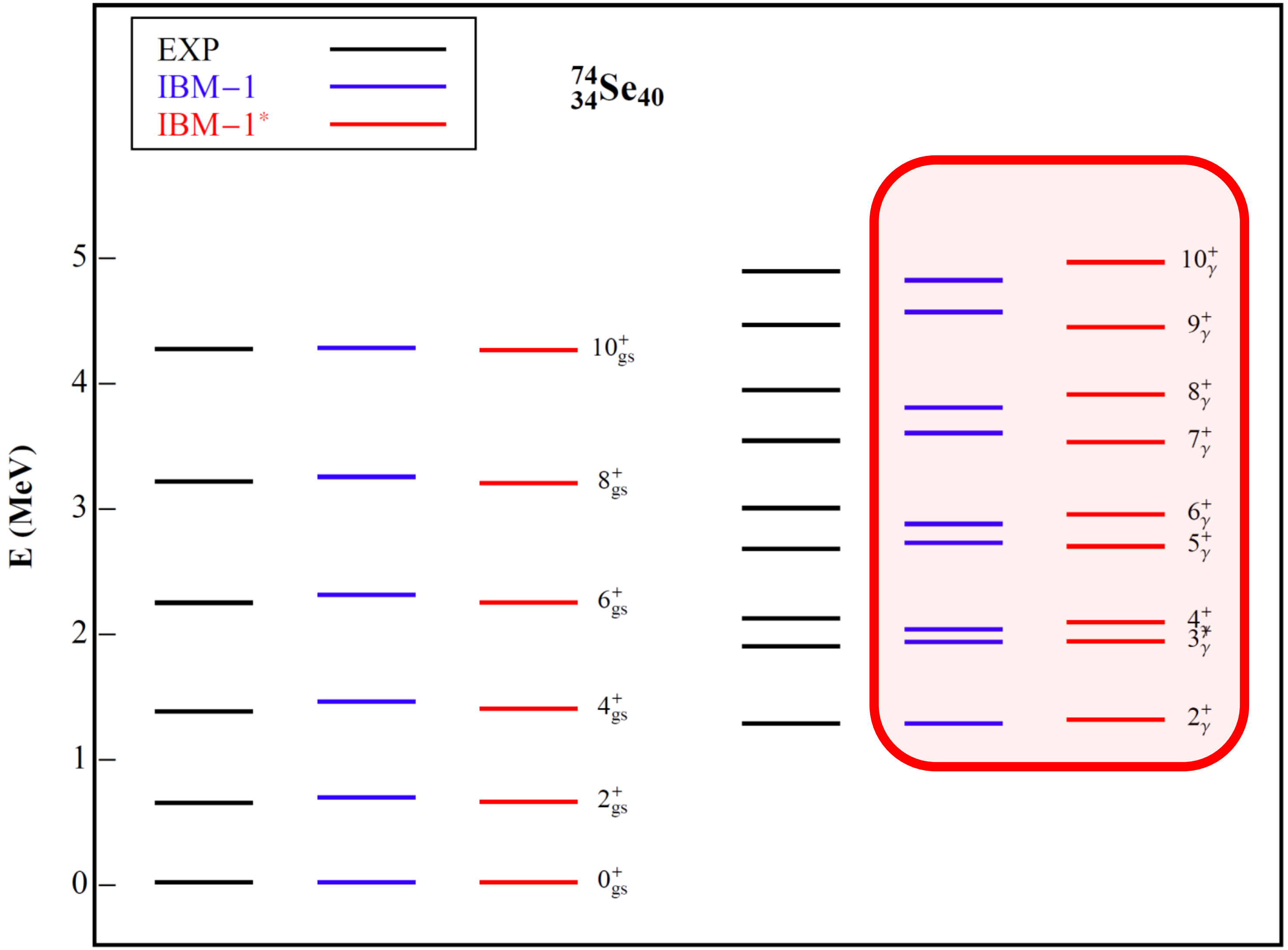
$$\Delta(E) = \sqrt{\frac{1}{N_E}\sum_i \left(E^i_{\mathrm{ex}} - E^i_{\mathrm{th}}\right)^2}$$

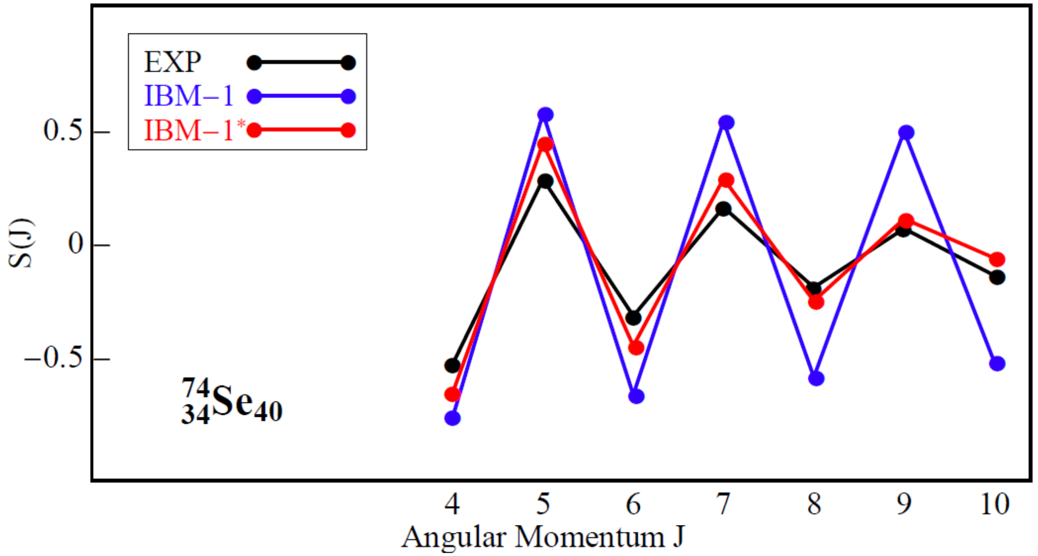
To understand the effect of this ***cubic* term** & to test the γ-softness behavior
Useful way is to look the signature splitting of γ-band within given formula as $S(J)$

$$S(J) = \frac{E(J) - E(J-1)}{E(J) - E(J-2)} \cdot \frac{J(J+1) - (J-1)(J-2)}{J(J+1) - J(J-1)} - 1$$

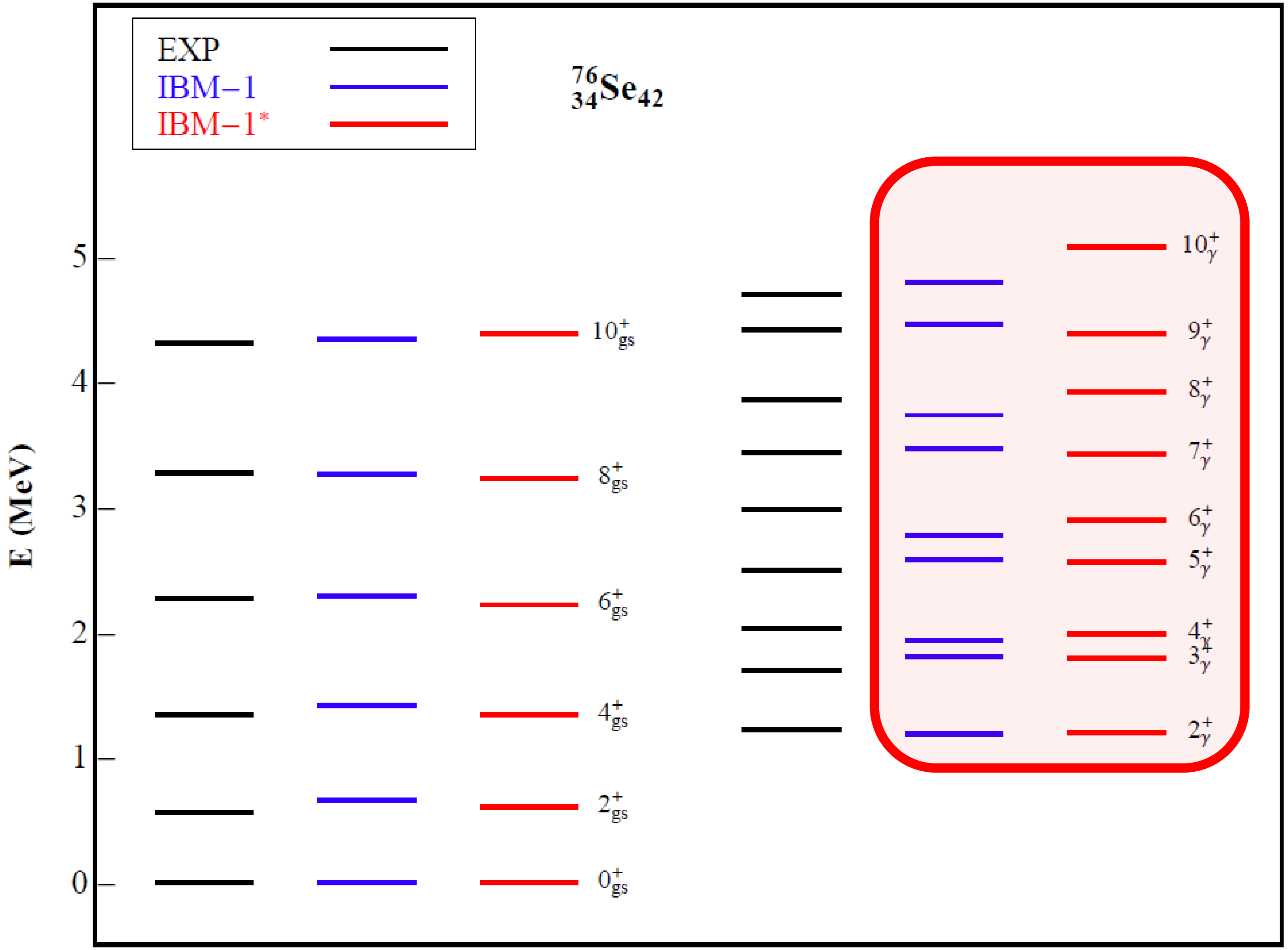
N. V. Zamfir, R. F. Casten, Phy. Lett. B 260 (1991) 265.

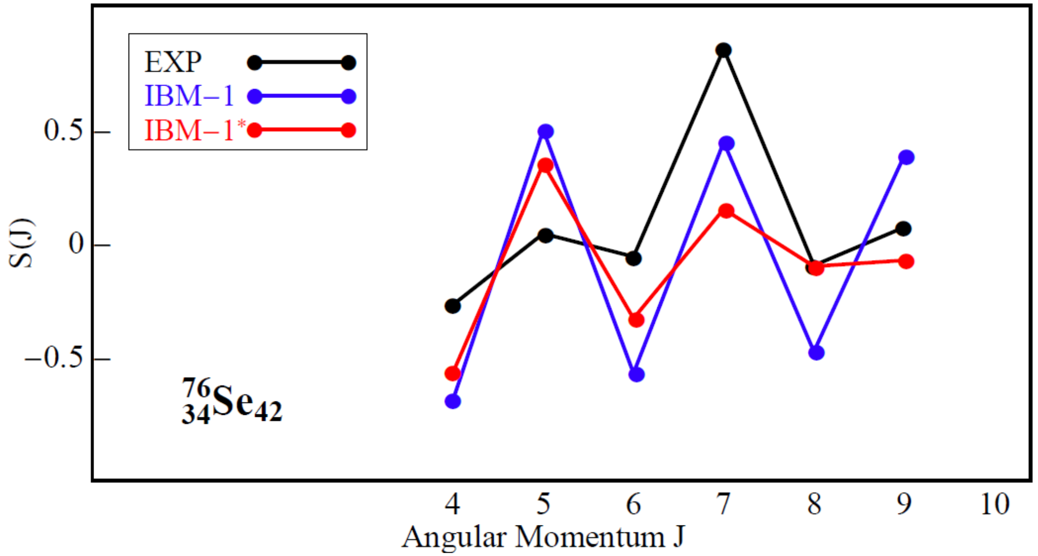
	ϵ	a_0	a_1	a_2	v_3	χ	σ
^{74}Se	0.5667	-	0.0124	0.0034	-	-0.950	0.076
	0.8762	0.1223	0.0105	0.0140	-0.0501	-0.950	0.032



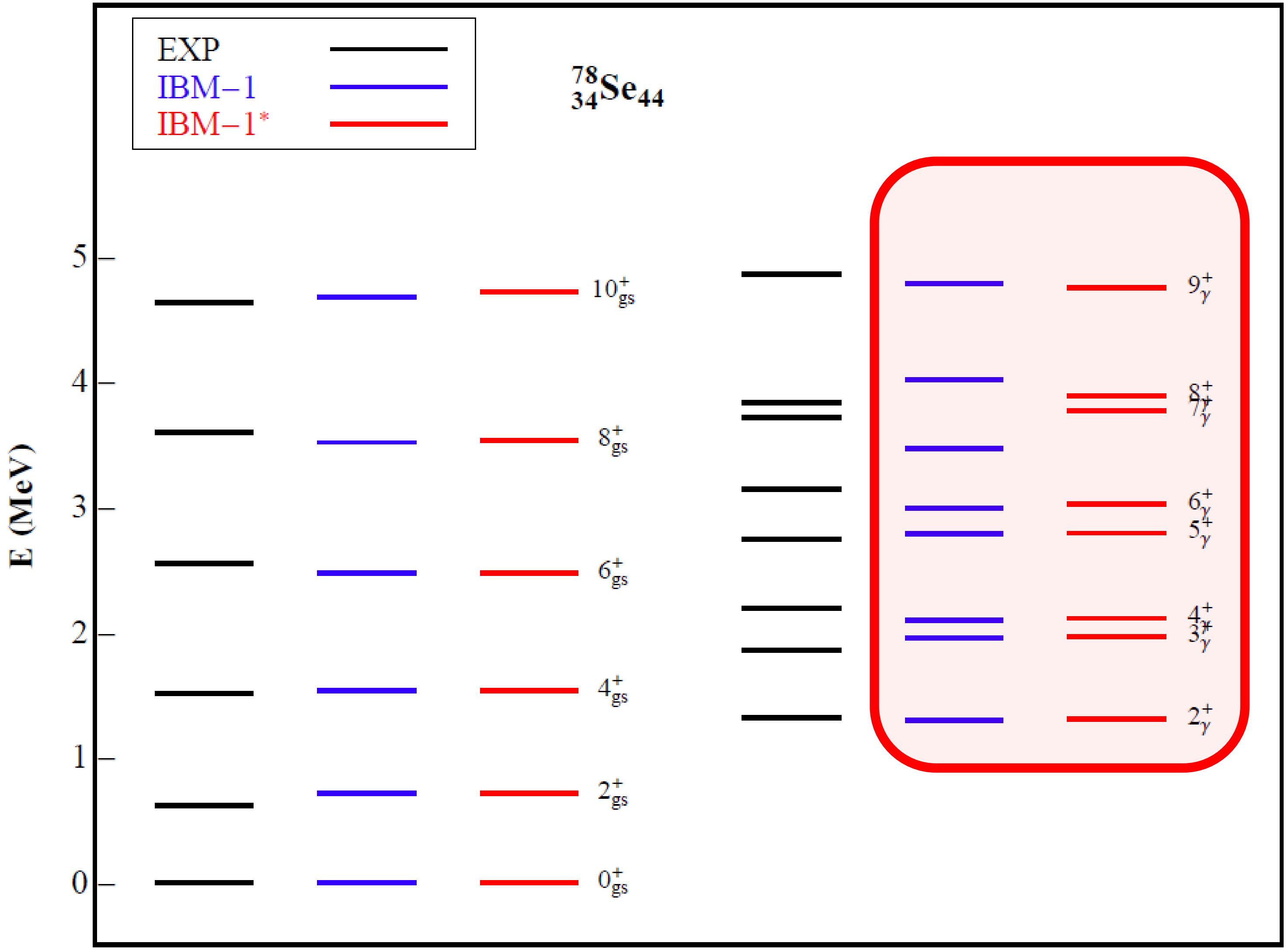


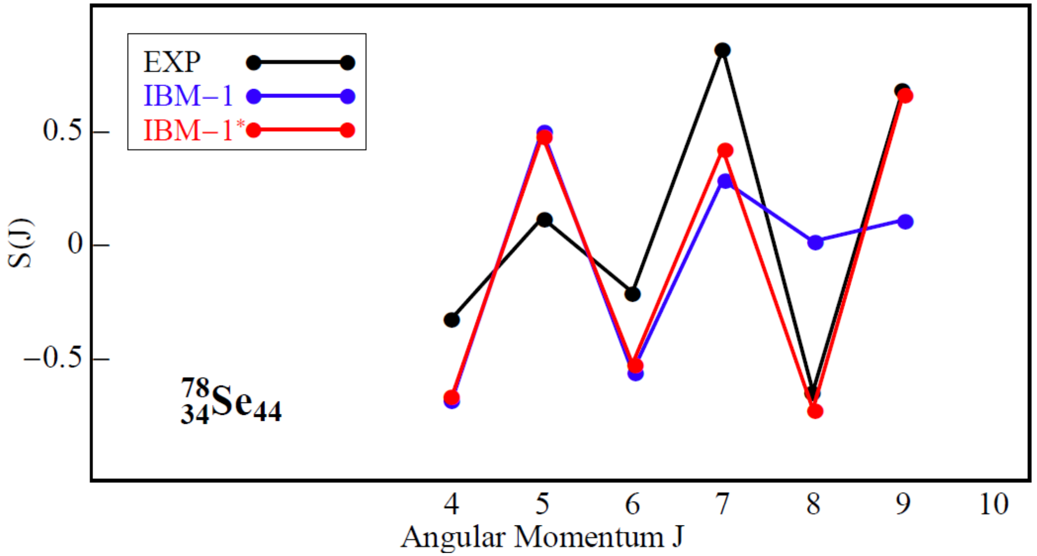
	ϵ	a_0	a_1	a_2	υ_3	χ	σ
^{76}Se	0.5022	-	0.0161	0.0064	-	-0.950	0.092
	0.8530	0.1455	0.0122	0.0112	-0.0776	-0.950	0.056



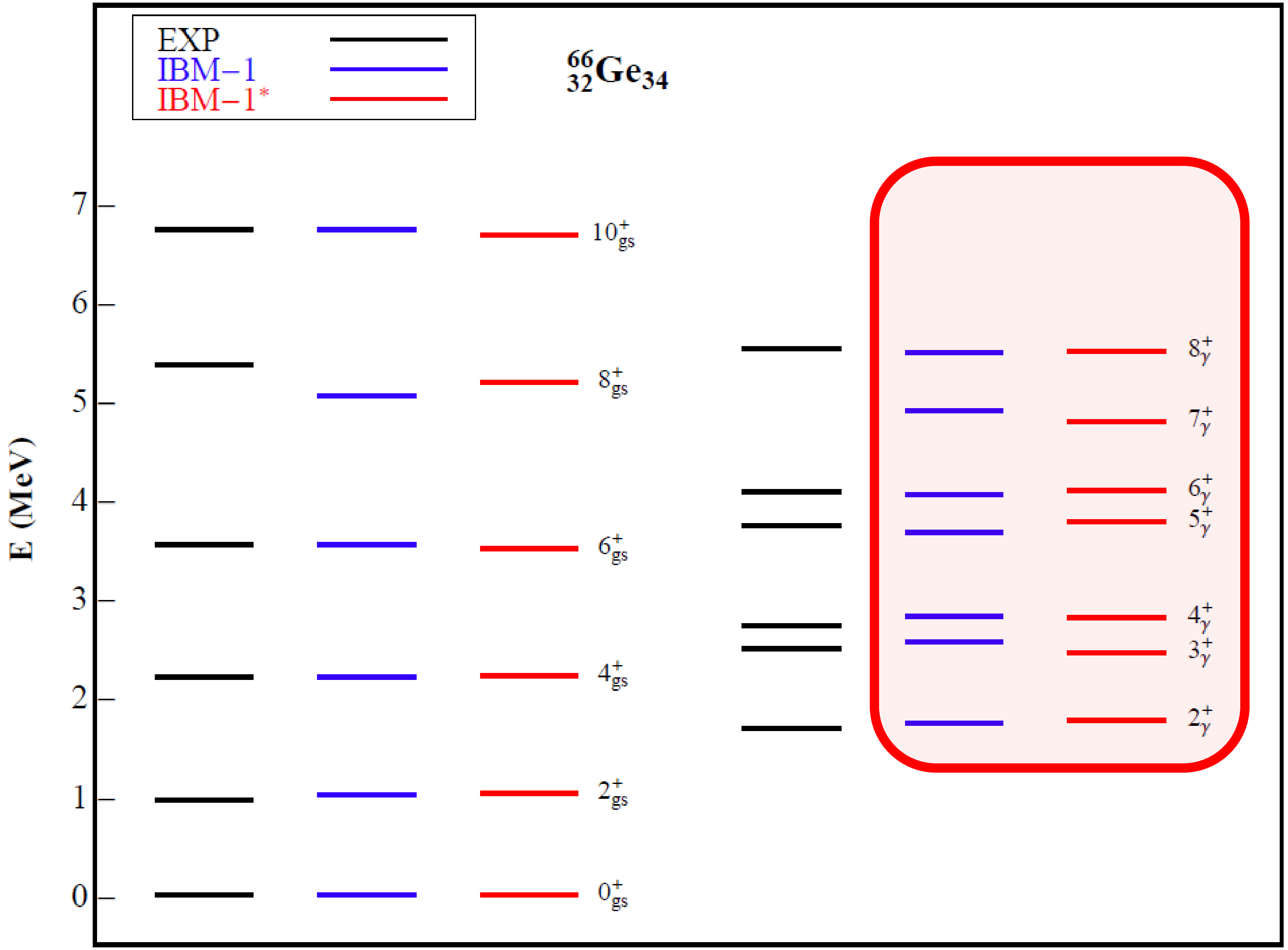


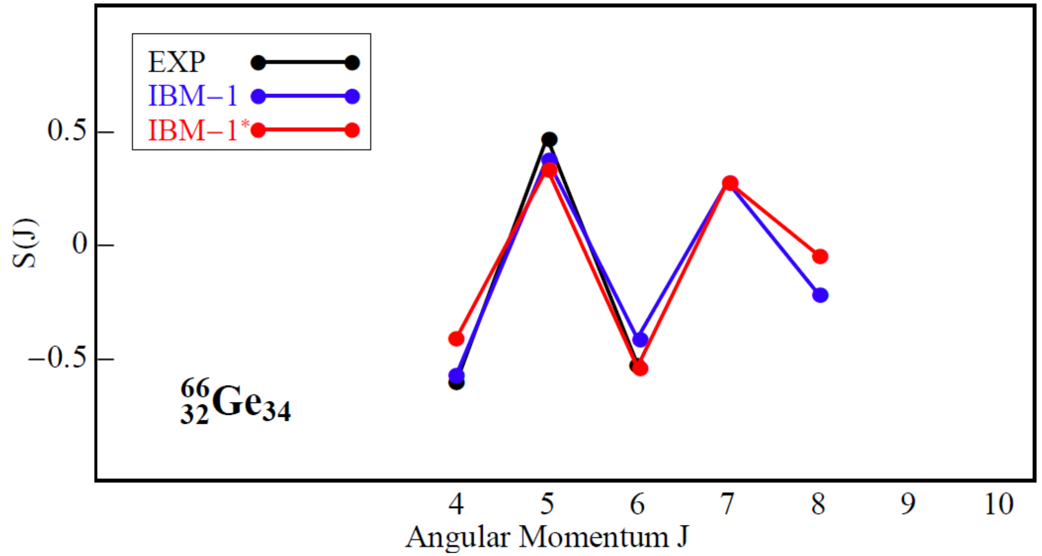
	ϵ	a_0	a_1	a_2	υ_3	χ	σ
^{78}Se	0.5537	-	0.0173	0.0082	-	-0.950	0.092
	0.3955	- 0.1046	0.0166	- 0.0059	-0.0222	-0.950	0.078



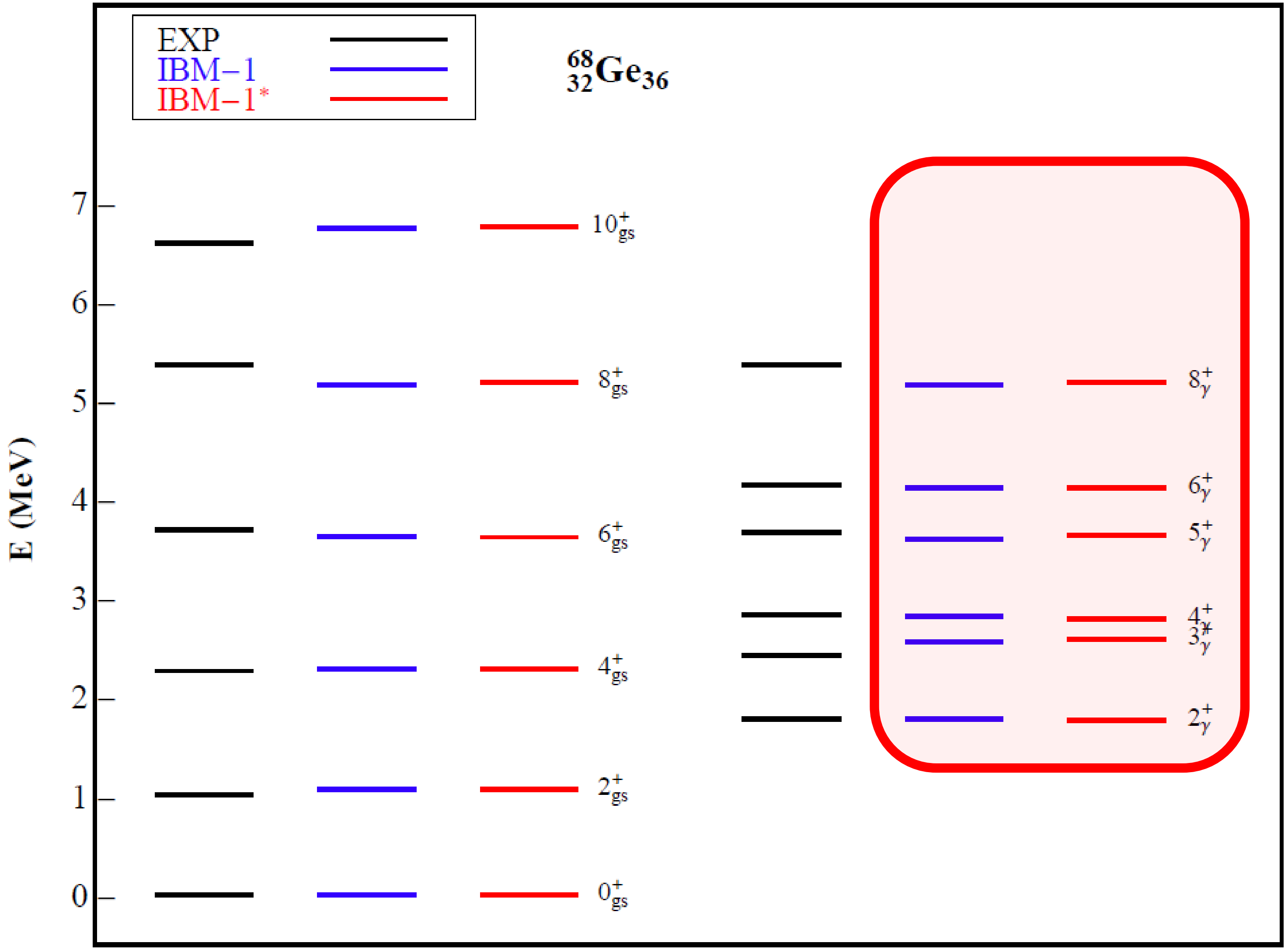


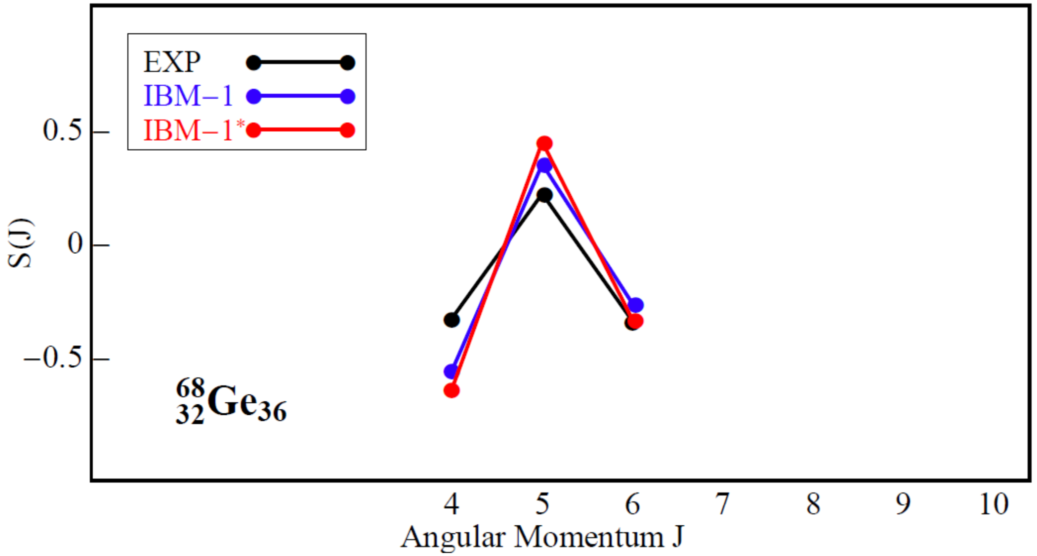
	ϵ	a_0	a_1	a_2	υ_3	χ	σ
^{66}Ge	0.6913	-	0.0335	0.0302	-	-0.500	0.130
	0.5270	- 0.1166	0.0318	0.0264	-0.0390	-0.500	0.099





	ϵ	a_0	a_1	a_2	υ_3	χ	σ
^{68}Ge	0.5788	-	0.0379	0.0566	-	-0.500	0.098
	0.5652	0.0022	0.0390	0.0596	0.0217	-0.500	0.096





$$\hat{H} = \epsilon \hat{n}_d + a_1 \hat{L} \cdot \hat{L} + a_2 \hat{Q} \cdot \hat{Q} + \cdots$$

$$\hat{H} = \epsilon \hat{n}_d + a_0 \hat{P}_+ \cdot \hat{P}_- + a_1 \hat{L} \cdot \hat{L} + a_2 \hat{Q} \cdot \hat{Q} + \sum_L v_L [d^+ d^+ d^+]^{(L)} \cdot [ddd]^{(L)}$$

$$\Delta(E) = \sqrt{\frac{1}{N_E} \sum_i (E^i_{\text{ex}} - E^i_{\text{th}})^2}$$

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THANK YOU VERY MUCH

Email: qptn9@pd.infn.it
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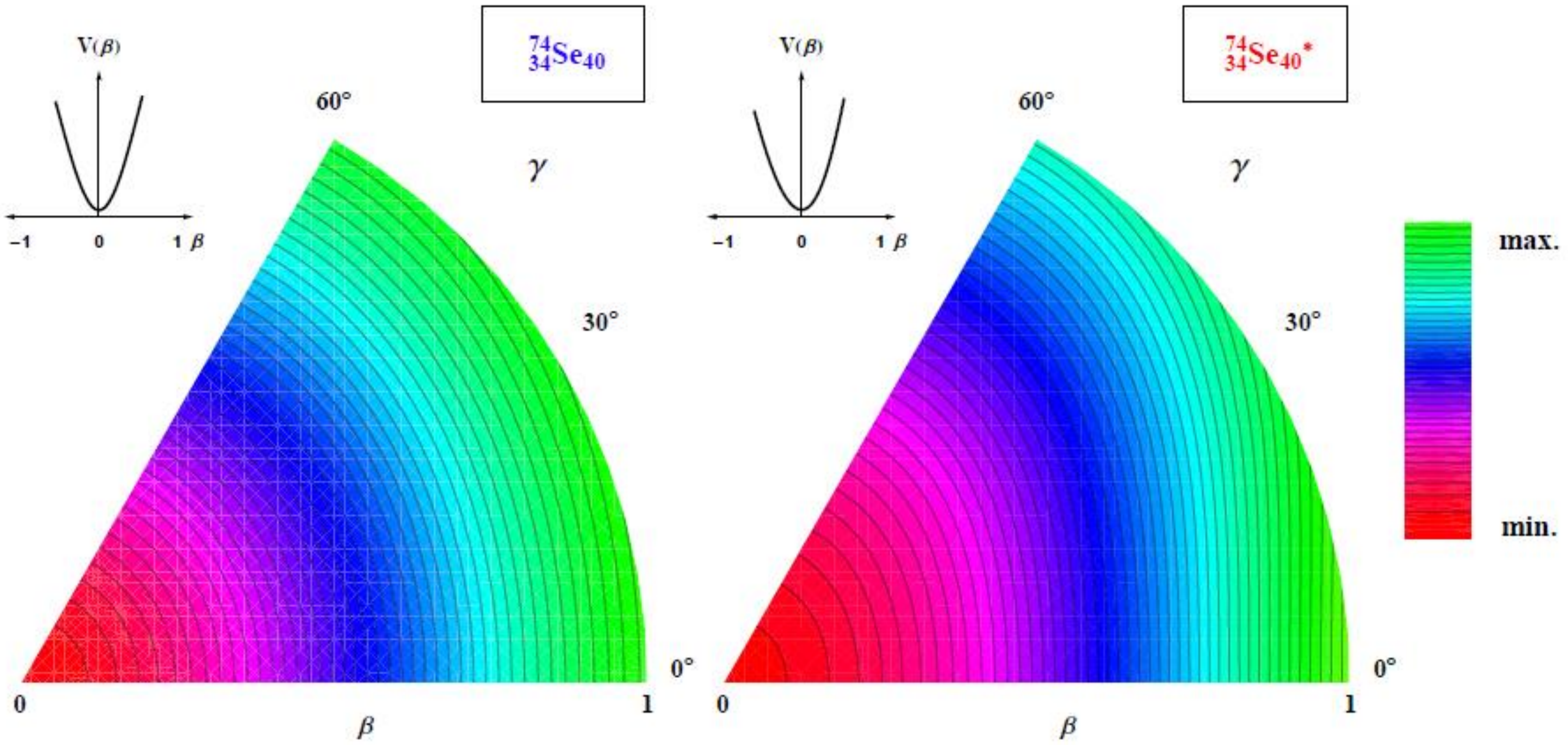
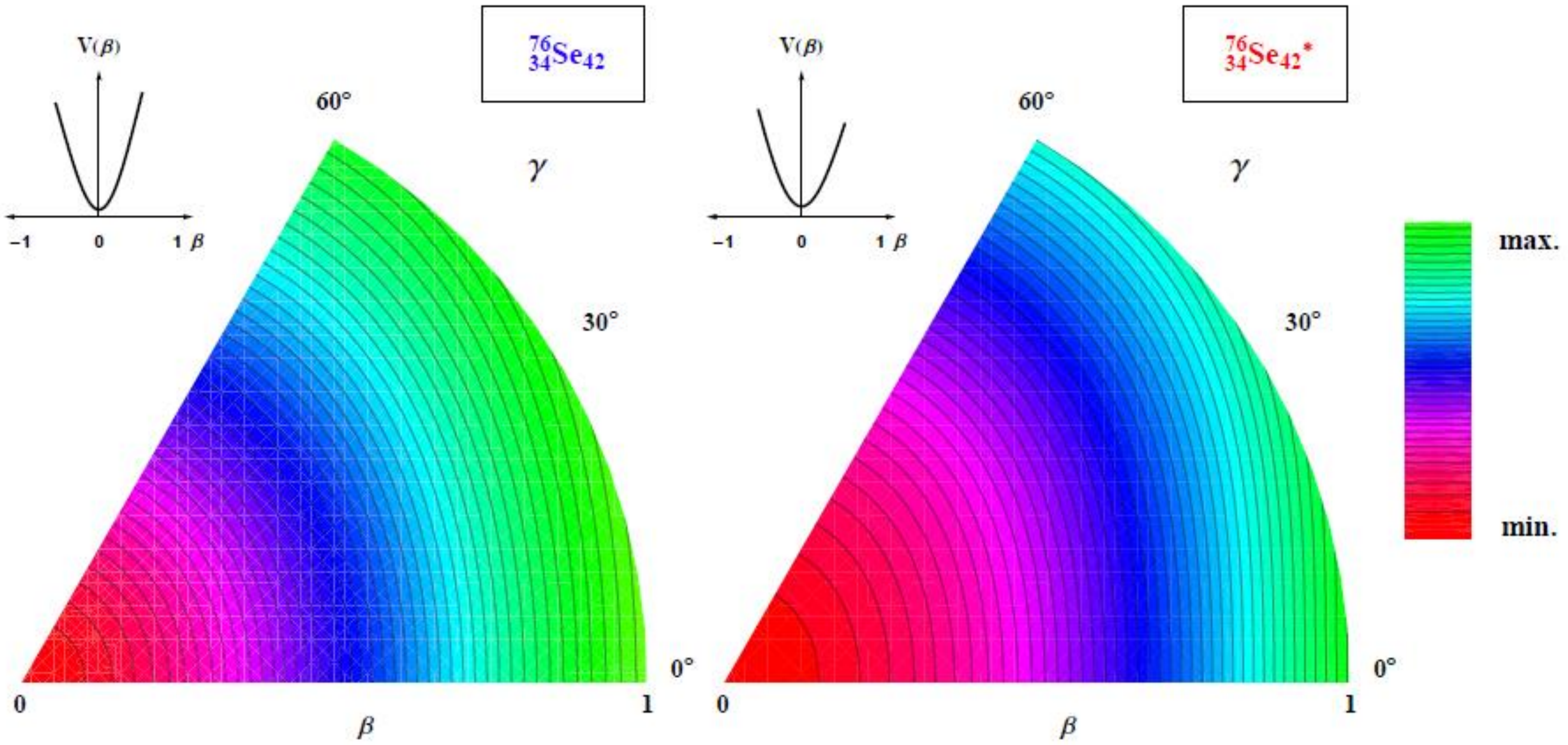
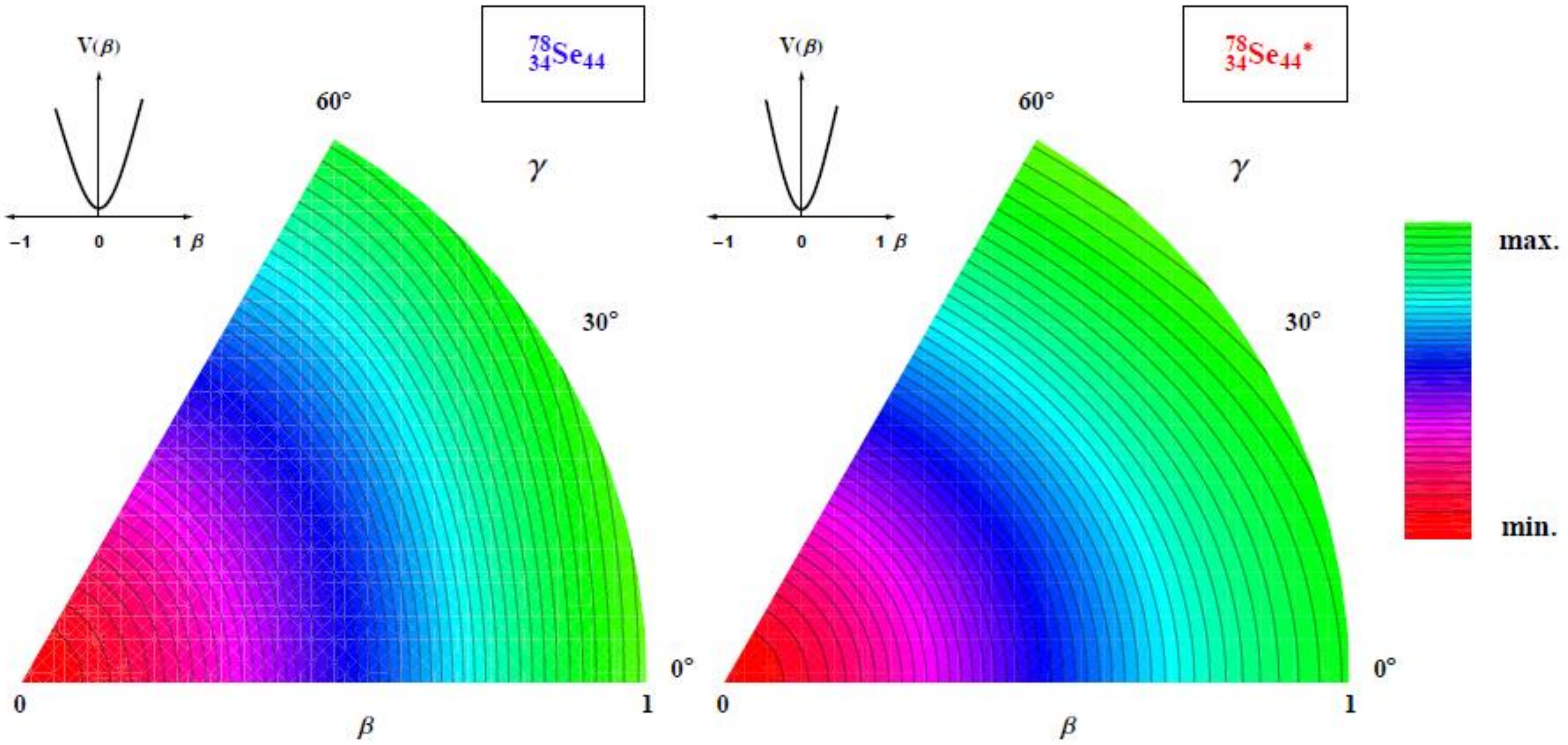
Measured and calculated B(E2) values in units of $10^{-2}\ e^2b^2$ for ^{76}Se.

$J_i^\pi \rightarrow J_f^\pi$	EXP	IBM-1	IBM-1*
$2^+_{gs} \rightarrow 0^+_{gs}$	8.41 (*0.28*)	5.82	7.82
$4^+_{gs} \rightarrow 2^+_{gs}$	13.58 (*0.55*)	9.97	13.41
$6^+_{gs} \rightarrow 4^+_{gs}$	13.00 (*2.21*)	12.43	16.65
$8^+_{gs} \rightarrow 6^+_{gs}$	15.68 (*4.69*)	13.17	17.57
$10^+_{gs} \rightarrow 8^+_{gs}$	9.94 (*3.03*)	12.21	16.26
$2^+_{\gamma} \rightarrow 0^+_{gs}$	0.23 (*0.03*)	0.005	0.02
$3^+_{\gamma} \rightarrow 2^+_{gs}$	0.36 (*0.22*)	0.008	0.03
$4^+_{\gamma} \rightarrow 4^+_{gs}$	4.21 (*1.93*)	6.49	6.33
$4^+_{\gamma} \rightarrow 2^+_{\gamma}$	5.55 (*1.93*)	6.75	8.09
$5^+_{\gamma} \rightarrow 3^+_{\gamma}$	12.81 (*6.34*)	7.36	8.58
$5^+_{\gamma} \rightarrow 4^+_{gs}$	0.90 (*0.47*)	0.008	0.02
$6^+_{\gamma} \rightarrow 4^+_{\gamma}$	5.55 (*4.96*)	9.34	11.31
$7^+_{\gamma} \rightarrow 5^+_{\gamma}$	7.65 (*5.79*)	8.99	10.6
$0^+_{\beta} \rightarrow 2^+_{gs}$	8.99 (*6.07*)	10.48	12.51

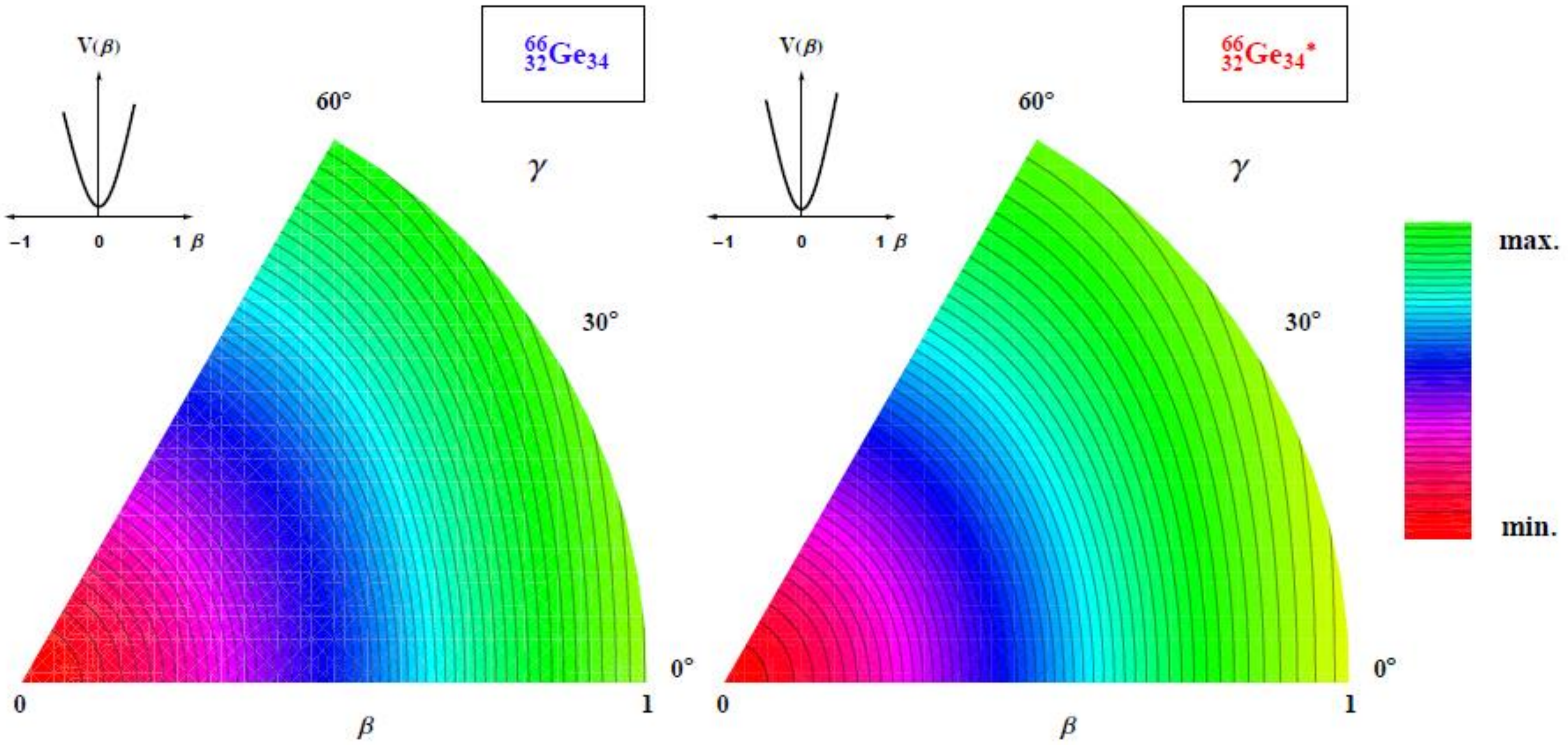

V(β)
−1
0
1 β
$^{74}_{34}Se_{40}$
60°
γ
30°
0°
0
1
β
V(β)
−1
0
1 β
$^{74}_{34}Se_{40}{}^{*}$
60°
γ
30°
0°
0
1
β
max.
min.



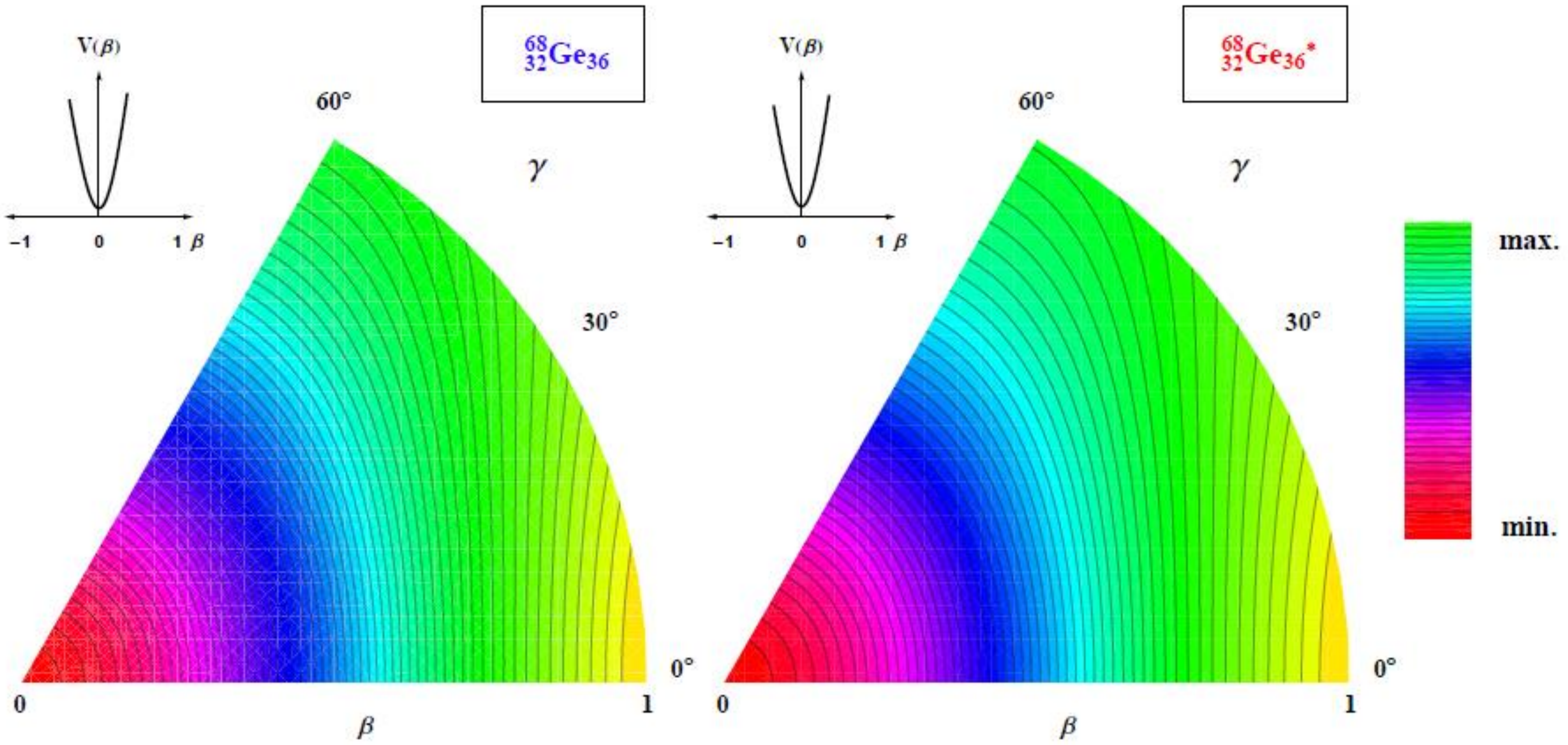
V(β)
−1
0
1 β
$^{76}_{34}Se_{42}$
60°
γ
30°
0°
0
1
β
V(β)
−1
0
1 β
$^{76}_{34}Se_{42}{}^{*}$
60°
γ
30°
0°
0
1
β
max.
min.



V(β)
−1
0
1 β
$^{78}_{34}Se_{44}$
60°
γ
30°
0°
0
β
1
$^{78}_{34}Se_{44}{}^{*}$
max.
min.



V(β)
−1
0
1 β
$^{66}_{32}Ge_{34}$
60°
γ
30°
0°
0
1
β
V(β)
−1
0
1 β
$^{66}_{32}Ge_{34}{}^*$
60°
γ
30°
0°
0
1
β
max.
min.



$^{68}_{32}Ge_{36}$
$^{68}_{32}Ge_{36}{}^{*}$
V(β)
−1 0 1 β
60°
30°
0°
γ
0
1
β
max.
min.