^{76}Ge(^{19}F,4nγ) 2010He15

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 114, 1293 (2013)	1-Sep-2013

E(^{19}F)=80 MeV from the HI-13 tandem accelerator at the China Institute of Atomic Energy; 96% enriched, 2.2 mg/cm^2 thick ^{76}Ge target evaporated onto 10 mg/cm^2 Pb backing; 14 Compton-suppressed HPGe detectors (four at 90°, five at 48° and five at 132°); measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma(\theta)$(DCO) (DCO values unstated in 2010He15).

Theoretical interpretation is given in terms of weak coupling between a $g_{9/2}$ proton and ^{90}Zr core states (for low E), and multi-particle excitations for high-energy states.

^{91}Nb Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	Comments
0.0[@]	9/2$^+$		
2034.0 *8*	(17/2$^-$)	3.76 μs *12*	J$^\pi$,$T_{1/2}$: from Adopted Levels. deexcitation of this isomer not studied by 2010He15.
2290.4[@] *3*	13/2$^+$		
3110.0[@] *5*	17/2$^+$		
3466.4[@] *6*	21/2$^+$		
4096.5 *7*	19/2$^-$		
4350.9[@] *6*	21/2$^+$		
4848.0[@] *7*	23/2$^+$		
5034.0[@] *8*	(25/2$^+$)		
5183.9[&] *6*	(23/2$^+$)		
5455.3[@] *8*	(27/2$^+$)		
5543.0[a] *6*	(21/2$^-$)		
6087.9[&] *7*	(25/2$^+$)		
6273.3[a] *7*	(25/2$^-$)		J$^\pi$: inconsistent with proposed D 730γ deexcitation to (21/2$^-$) 5543. J=(19/2 to 23/2) if J(5543) is correct.
6518.3[@] *8*	(29/2$^+$)		
6918.8[a] *8*	(27/2$^-$)		
7437.6[@] *8*	(31/2$^+$)		
8099.2[@] *9*	(33/2$^+$)		
8630.2?[#] *13*			
8846.2[@] *13*	(37/2$^+$)		
9437.2?[#] *17*			
10137.2 *20*			

[†] From least-squares fit to Eγ (by evaluator), assigning 1 keV uncertainty to all data; no uncertainty was stated by the authors.

[‡] Authors' proposed values. Based on measured DCO ratios and comparison with neighboring odd-a nuclides.

[#] Order of the 531γ-807γ-700γ cascade is not established, thus, alternative energy values are possible for the intermediate levels if the order differs from that shown in the level scheme in figure 1 of 2010He15.

[@] Band(A): sequence based on g.s..

[&] Band(B): sequence based on (23/2$^+$).

[a] Band(C): sequence based on (21/2$^-$).

^{76}Ge(^{19}F,4nγ) 2010He15 (continued)

$\gamma(^{91}Nb)$

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	Comments
185.8 *3*	17 *9*	5034.0	$(25/2^+)$	4848.0	$23/2^+$	D	Mult.: (D) from DCO=0.6 *3*. authors propose M1.
254.4 *3*	23 *5*	4350.9	$21/2^+$	4096.5	$19/2^-$	D	Mult.: D from DCO=0.56 *18*. M1 given in the authors′ email reply, but E1 is implied by authors′ level scheme.
356.4 *3*	57 *8*	3466.4	$21/2^+$	3110.0	$17/2^+$		Mult.: (Q) from DCO=1.3 *6*; authors propose E2.
421.1 *3*	36 *8*	5455.3	$(27/2^+)$	5034.0	$(25/2^+)$		Mult.: DCO=1.8 *9*. E2 indicated in the authors′ email reply, but ΔJ=1 In their proposed level scheme.
497.1 *3*	82 *9*	4848.0	$23/2^+$	4350.9	$21/2^+$		Mult.: DCO=1.3 *7*. authors propose M1.
531[#]		8630.2?		8099.2	$(33/2^+)$		
607.5 *3*	15 *9*	5455.3	$(27/2^+)$	4848.0	$23/2^+$		Mult.: DCO=2.5 *10*. authors propose E2. coincident with 356γ, 884γ and 919γ, but not with 421γ.
645.5 *3*	9 *3*	6918.8	$(27/2^-)$	6273.3	$(25/2^-)$	D	Mult.: D from DCO=0.62 *24*. authors propose M1.
661.6 *3*	52 *8*	8099.2	$(33/2^+)$	7437.6	$(31/2^+)$		
700[#]		10137.2		9437.2?			
730.3 *3*	10 *3*	6273.3	$(25/2^-)$	5543.0	$(21/2^-)$		Mult.: D from DCO=0.58 *24*. authors propose M1, but their level level scheme requires a ΔJ=2 transition, inconsistent with DCO.
747[#]		8846.2	$(37/2^+)$	8099.2	$(33/2^+)$		
807[#]		9437.2?		8630.2?			
819.6 *3*	100 *10*	3110.0	$17/2^+$	2290.4	$13/2^+$		Mult.: DCO=1.6 *5*; authors propose E2.
884.5 *3*	33 *6*	4350.9	$21/2^+$	3466.4	$21/2^+$		DCO=0.8 *3* Mult.: E1 shown in the authors′ email reply, but a ΔJ=0, Δπ=No transition is implied by authors′ level scheme.
904.0 *3*	5.7 *23*	6087.9	$(25/2^+)$	5183.9	$(23/2^+)$	(Q+D)	Mult.: DCO=1.3 *3*. E2 shown in the authors′ email reply, but M1+E2 seems more likely based on authors′ level scheme (where ΔJ=1, Δπ=No).
919.4 *3*	27 *5*	7437.6	$(31/2^+)$	6518.3	$(29/2^+)$		Mult.: E2 listed in the authors′ email reply, but ΔJ=1 from authors′ level scheme, so M1+E2 seems more likely. DCO=1.2 *6* is too imprecise to enable a definitive assignment.
1063.0 *3*	15 *7*	6518.3	$(29/2^+)$	5455.3	$(27/2^+)$	D	Mult.: D from DCO=0.48 *16*. authors propose M1.
1717.4 *3*	10 *5*	5183.9	$(23/2^+)$	3466.4	$21/2^+$	D	Mult.: D from DCO=0.35 *17*. authors propose M1.
1982.1 *3*	67 *8*	7437.6	$(31/2^+)$	5455.3	$(27/2^+)$		Mult.: D from DCO=0.43 *20*. however, M1 is shown in the authors′ email reply and E2 is required by authors′ level scheme. coincident with 356γ, 422γ and 884γ, but not with 919γ.
2062.5 *3*	21 *5*	4096.5	$19/2^-$	2034.0	$(17/2^-)$		DCO=1.4 *6* Mult.: DCO=1.4 *6*. E2 shown in the authors′ email reply, but their level scheme indicates a ΔJ=1 transition, making M1+E2 more likely.
2076.5 *3*	15 *4*	5543.0	$(21/2^-)$	3466.4	$21/2^+$	D	Mult.: D from DCO=0.40 *15*. M1 shown in the authors′ email reply, but E1 required by authors′ level scheme. However, DCO seems far too low for a D, ΔJ=0 transition.
2290.4 *3*	89 *9*	2290.4	$13/2^+$	0.0	$9/2^+$	Q	Mult.: Q from DCO=1.2 *3*; authors propose E2.

[†] From e-mail reply on Oct 24, 2010 from C. He (first author of 2010He15), unless otherwise stated.

[‡] DCO values correspond to 48°(132°) and 90° geometry with gates on ΔJ=2, Q transitions. Expected ratios are≈1.0 for ΔJ=2, Q and≈0.6 for ΔJ=1, D transitions. assignments are taken from e-mail reply of Oct 24, 2010 from C. He (first author of 2010He15), except as noted; based on indicated DCO ratios, but those data cannot determine Δπ and many have such large uncertainties that even ΔJ assignments become difficult. IT should also be noted that several assignments given in the email reply

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$\gamma(^{91}Nb)$ (continued)

are inconsistent with the authors' level scheme (as noted here for the relevant transitions).
[#] From level-scheme Figure 1 of 2010He15. Order of the 531γ-80γ7-700γ cascade is not established.

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Level Scheme

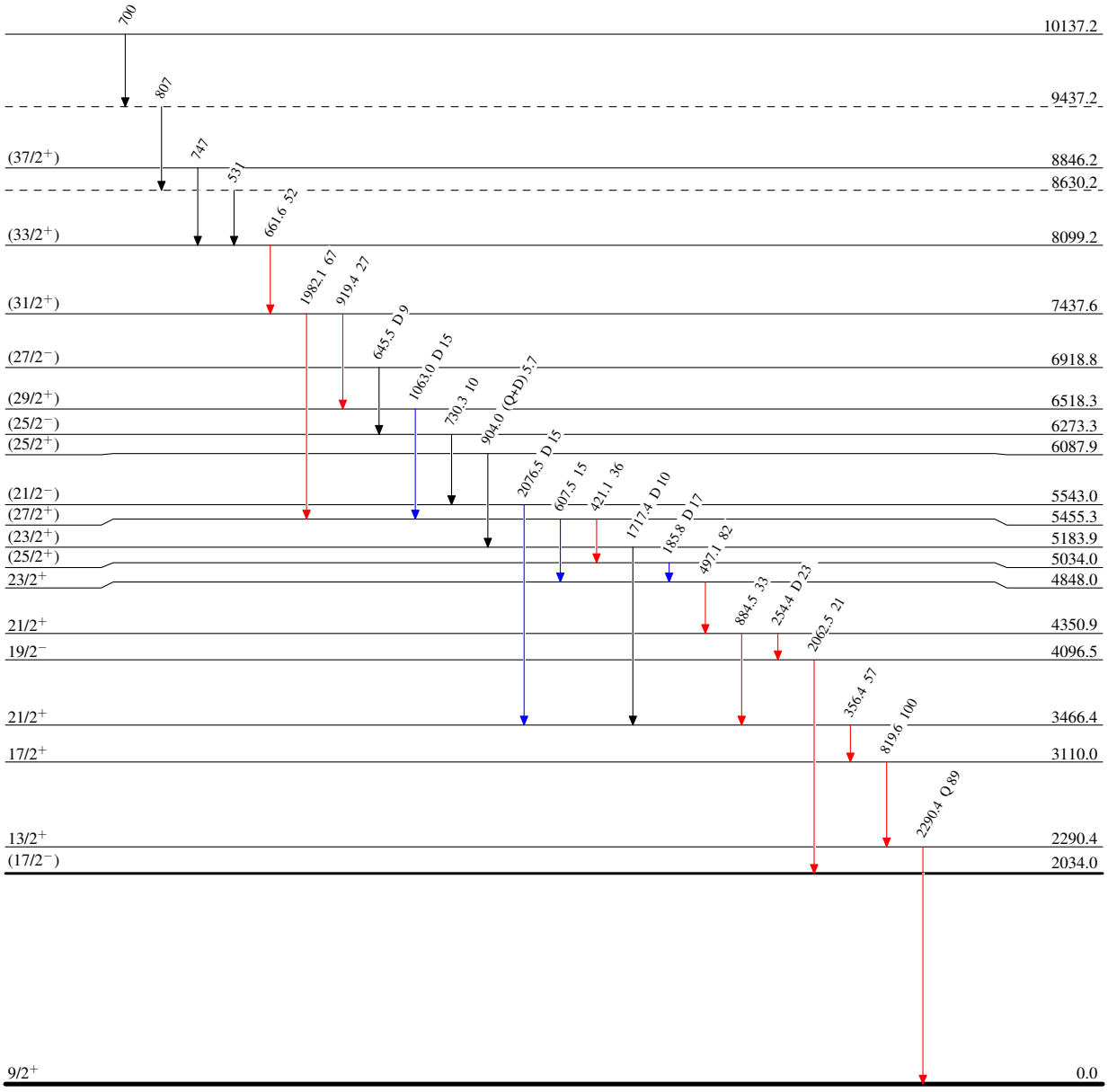
Intensities: Relative I_γ

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

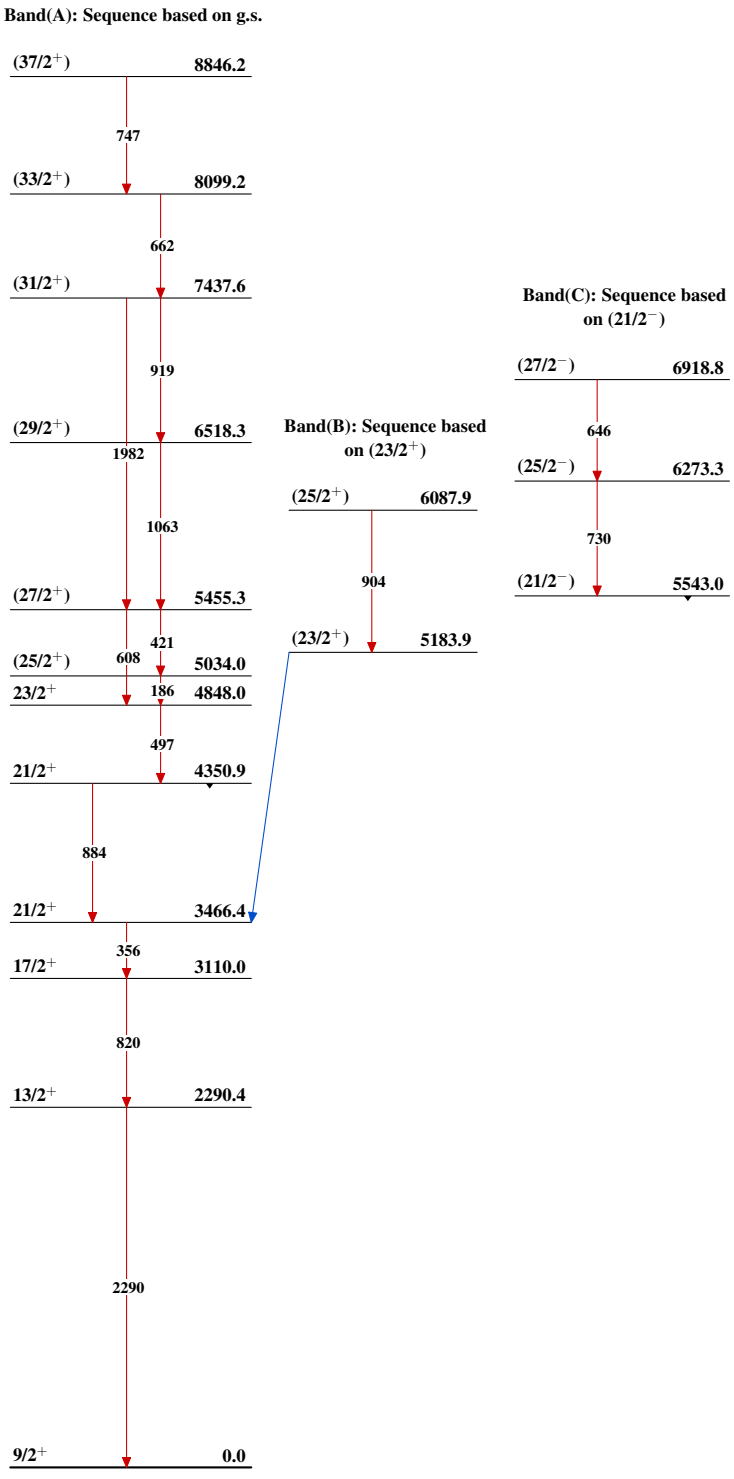
$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



$^{91}_{41}Nb_{50}$

^{76}Ge(^{19}F,4nγ) 2010He15



$^{91}_{41}Nb_{50}$