(HI,xnγ):SD 1993Ha19,1991Rz01,1990He14

	History		
Туре	Author	Citation	Literature Cutoff Date
Full Evaluation	Yu. Khazov, A. Rodionov and G. Shulvak	NDS 136, 163 (2016)	14-Jul-2016

1995Sc31: 102 Ru(48 Ca,4n γ), E=203 MeV; measured E γ , I γ , $\gamma\gamma$ coin. 146 Gd; deduced SD band levels, J^{π} . EUROGAM I spectrometer.

1991Rz01,1990He14 (also 1987He16,1990Li32): ¹¹⁰Pd(⁴⁰Ar,4n γ), E=175 MeV; measured $\gamma\gamma$ coin., sum spectra, DSAM. ¹⁴⁶Gd; deduced levels, J^{π} , T_{1/2}, SD band structure, intrinsic quadrupole moments. OSIRIS spectrometer.

1993Ha19: ¹²²Sn(²⁹Si,5n γ) E=155 MeV; measured E γ , I γ , $\gamma\gamma$ coin., DCO ratios. ¹⁴⁶Gd; deduced, γ multiplicities, J^{π} , levels, SD bands. Compton-suppressed HPGe detector array, 4π BGO ball. Cranked shell-model-Strutinsky calculations.

1996La23: ¹⁰⁰Mo(⁵¹V,p4n γ) E=230 MeV; measured $\gamma\gamma\gamma$, $\gamma\gamma\gamma$ (particle) coin. GAMMASPHERE array with Microball for particle detection. No definite evidence for band structure.

2001Cl05: ¹²²Sn(²⁹Si,5n γ), E=155 MeV; measured E γ , I γ , $\gamma\gamma$ coin, lifetimes, DSAM. ¹⁴⁶Gd; deduced SD band levels, J^{π} , intrinsic quadrupole moments. GAMMASPHERE array with Microball for particle detection.

Two superdeformed SD-1 and SD-2 bands are identified in ¹⁴⁶Gd nuclide firmly; the SD-3 band may belong to ¹⁴⁶Gd or ¹⁴⁷Gd.

146Gd Levels

E(level) [†]	\mathbf{J}^{π}	Comments
0.0	0^{+}	
0.0+x [@]	J1 [‡]	J^{π} : $J^{\pi}_{1}=33^{-}$. Additional information 1.
826.3+x [@] 3	J1+2	
1704.3+x [@] 5	J1+4	
2634.8+x [@] 5	J1+6	
3618.0+x [@] 5	J1+8	
4656.6+x [@] 6	J1+10	
5750.0+x [@] 7	J1+12	
6898.8+x [@] 7	J1+14	
8100.0+x [@] 8	J1+16	
9350.3+x [@] 9	J1+18	
10648.1+x [@] 9	J1+20	
11993.2+x [@] 10	J1+22	
13386.9+x [@] 11	J1+24	
14833.1+x [@] 12	J1+26	
16331.6+x [@] 14	J1+28	
17885.3+x [@] 17	J1+30	
0.0+y ^{&}	J2#	J^{π} : $J^{\pi}_{2}=32^{-}$. Additional information 2.
806.2+y& <i>3</i>	J2+2	
1663.2+y& 5	J2+4	
2571.7+y ^{&} 6	J2+6	
3532.8+y& 6	J2+8	
4549.0+y& 6	J1+10	
5621.2+y& 7	J2+12	
6749.0+y& 7	J2+14	
7933.8+y& 8	J2+16	
9176.4+y& 9	J1+18	
10475.7+v ^{&} 9	J1 + 20	

(HI,xnγ):SD 1993Ha19,1991Rz01,1990He14 (continued)

¹⁴⁶Gd Levels (continued)

Comments

E(level) [†]	\mathbf{J}^{π}	
11832.6+y& 10	J1+22	
13246.0+y ^{&} 11	J2+24	
14718.7+y ^{&} 13	J2+26	
16248.6+y& 15	J1+28	
17830.6+y& 19	J1+30	
$0.0+z?^{a}$	J3	Additional information 3.
958.5+z? ^a 5	J3+2	
1964.6+z? ^a 8	J3+4	
3029.5+z? ^a 10	J3+6	
4153.0+z? ^a 13	J3+8	
5328.7+z? ^a 15	J3+10	
6554.3+z? ^a 18	J3+12	
7832.3+z? ^a 23	J3+14	
9155+z? ^a 3	J3+16	
10524+z? ^{<i>a</i>} 4	J3+18	

[†] Calculated using transition energies.

^{\ddagger} from 1993Ha19. All J's could be shifted by two units jointly. From theoretical analysis, 1993Ra07 suggests J=31 or 33.

Population of normal states of J=29, 27 and 26 by the band (1995Sc31) suggests J>31.

[#] from 1993Ha19. All J's could be shifted by two units jointly. From theoretical analysis, 1993Ra07 suggests J=30 or 32. 1995Sc31 suggests J>31, presumably from population of normal states by the SD band.

^(a) Band(A): SD-1 BAND (1995Sc31,1990He14,1993Ha19,2001Cl05). Percent population=0.65 *19* (1993Ha19) in ¹²²Sn(²⁹Si,5n γ), ≈ 1 (1990He14) in ¹¹⁰Pd(⁴⁰Ar,4n γ). Q(intrinsic)=13.9 *4* (2001Cl05), 12 2 (1990He14).

[&] Band(B): SD-2 BAND (1995Sc31,1991Rz01,1993Ha19,2001Cl05). Percent population=0.39 *12* (1993Ha19) in ¹²²Sn(²⁹Si,5n γ), ≈ 0.7 (1991Rz01) in ¹¹⁰Pd(⁴⁰Ar,4n γ). Q(intrinsic)=13.9 *3* (2001Cl05), 8 *2* (1992StZU).

^a Band(C): SD-3 BAND (?) (1995Sc31). This band belongs to ¹⁴⁷Gd or ¹⁴⁶Gd (1995Sc31). Population=1/8 of SD-1 (1995Sc31).

E_{γ}^{\dagger}	$I_{\gamma}^{\dagger\ddagger}$	E _i (level)	\mathbf{J}_i^{π}	E_f	\mathbf{J}_f^π	Mult.#
806.2 3	0.51 5	806.2+y	J2+2	0.0+y	J2	
826.3 <i>3</i>	0.61 5	826.3+x	J1+2	0.0+x	J1	
857.0 [@] 3	0.68 6	1663.2+y	J2+4	806.2+y	J2+2	
878.0 <i>3</i>	0.71 8	1704.3+x	J1+4	826.3+x	J1+2	
908.5 <i>3</i>	0.89 9	2571.7+y	J2+6	1663.2+y	J2+4	
930.5 2	0.84 7	2634.8+x	J1+6	1704.3+x	J1+4	
958.5 <i>5</i>	1.00 16	958.5+z?	J3+2	0.0+z?	J3	
961.1 <mark>&</mark> 2	1.00 7	3532.8+y	J2+8	2571.7+y	J2+6	
983.2 2	0.91 5	3618.0+x	J1+8	2634.8+x	J1+6	
1006.1 6	0.84 14	1964.6+z?	J3+4	958.5+z?	J3+2	
1016.2 2	0.91 7	4549.0+y	J1+10	3532.8+y	J2+8	
1038.6 <i>3</i>	1.00 6	4656.6+x	J1+10	3618.0+x	J1+8	E2
1064.9 6	0.94 16	3029.5+z?	J3+6	1964.6+z?	J3+4	
1072.2 2	0.78 8	5621.2+y	J2+12	4549.0+y	J1+10	
1093.4 <i>3</i>	0.92 5	5750.0+x	J1+12	4656.6+x	J1+10	E2
1123.5 8	0.73 16	4153.0+z?	J3+8	3029.5+z?	J3+6	
1127.8 <i>3</i>	0.77 7	6749.0+y	J2+14	5621.2+y	J2+12	
1148.8 2	0.81 5	6898.8+x	J1+14	5750.0+x	J1+12	E2

 $\gamma(^{146}\text{Gd})$

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			2	⁄(¹⁴⁶ Gd)	(continued)
$I_{\gamma}^{\dagger \ddagger}$	E _i (level)	\mathbf{J}_i^{π}	E_f	J_f^π	Mult. [#]
0.69 16	5328.7+z?	J3+10	4153.0+z?	J3+8	
0.73 8	7933.8+y	J2+16	6749.0+y	J2+14	
0.60 4	8100.0+x	J1+16	6898.8+x	J1+14	E2
0.64 18	6554.3+z?	J3+12	5328.7+z?	J3+10	
0.73 7	9176.4+y	J1+18	7933.8+y	J2+16	
0.52 4	9350.3+x	J1+18	8100.0+x	J1+16	E2
0.49 17	7832.3+z?	J3+14	6554.3+z?	J3+12	
0.51 5	10648.1+x	J1+20	9350.3+x	J1+18	E2
0.60 7	10475.7+y	J1+20	9176.4+y	J1+18	
0.59 17	9155+z?	J3+16	7832.3+z?	J3+14	
0.47 5	11993.2+x	J1+22	10648.1+x	J1+20	E2
0.55 6	11832.6+y	J1+22	10475.7+y	J1+20	
0.30 17	10524+z?	J3+18	9155+z?	J3+16	
0.37 6	13386.9+x	J1+24	11993.2+x	J1+22	
0.37 5	13246.0+y	J2+24	11832.6+y	J1+22	
0.23 4	14833.1+x	J1+26	13386.9+x	J1+24	
0.20 4	14718.7+y	J2+26	13246.0+y	J2+24	
0.24 5	16331.6+x	J1+28	14833.1+x	J1+26	
0.13 3	16248.6+y	J1+28	14718.7+y	J2+26	
0.16 5	17885.3+x	J1+30	16331.6+x	J1+28	
0.12 4	17830.6+y	J1+30	16248.6+y	J1+28	
	$\begin{array}{r} I_{\gamma}^{\dagger\ddagger}\\ \hline 0.69 \ 16\\ 0.73 \ 8\\ 0.60 \ 4\\ 0.64 \ 18\\ 0.73 \ 7\\ 0.52 \ 4\\ 0.49 \ 17\\ 0.51 \ 5\\ 0.60 \ 7\\ 0.59 \ 17\\ 0.47 \ 5\\ 0.55 \ 6\\ 0.30 \ 17\\ 0.37 \ 6\\ 0.37 \ 5\\ 0.23 \ 4\\ 0.20 \ 4\\ 0.24 \ 5\\ 0.13 \ 3\\ 0.16 \ 5\\ 0.12 \ 4\\ \end{array}$	$\begin{array}{c c} I_{\gamma}^{\dagger\ddagger} & E_i(\text{level}) \\ \hline 0.69 \ 16 & 5328.7+z? \\ 0.73 \ 8 & 7933.8+y \\ 0.60 \ 4 & 8100.0+x \\ 0.64 \ 18 & 6554.3+z? \\ 0.73 \ 7 & 9176.4+y \\ 0.52 \ 4 & 9350.3+x \\ 0.49 \ 17 & 7832.3+z? \\ 0.51 \ 5 & 10648.1+x \\ 0.60 \ 7 & 10475.7+y \\ 0.59 \ 17 & 9155+z? \\ 0.47 \ 5 & 11993.2+x \\ 0.55 \ 6 & 11832.6+y \\ 0.30 \ 17 & 10524+z? \\ 0.37 \ 6 & 13386.9+x \\ 0.37 \ 5 & 13246.0+y \\ 0.23 \ 4 & 14833.1+x \\ 0.20 \ 4 & 14718.7+y \\ 0.24 \ 5 & 16331.6+x \\ 0.13 \ 3 & 16248.6+y \\ 0.16 \ 5 & 17885.3+x \\ 0.12 \ 4 & 17830.6+y \\ \end{array}$	$\begin{array}{c c} I_{\gamma}^{\dagger\ddagger} & E_i(\text{level}) & J_i^{\pi} \\ \hline 0.69\ 16 & 5328.7+z? & J3+10 \\ \hline 0.73\ 8 & 7933.8+y & J2+16 \\ \hline 0.60\ 4 & 8100.0+x & J1+16 \\ \hline 0.64\ 18 & 6554.3+z? & J3+12 \\ \hline 0.73\ 7 & 9176.4+y & J1+18 \\ \hline 0.52\ 4 & 9350.3+x & J1+18 \\ \hline 0.49\ 17 & 7832.3+z? & J3+14 \\ \hline 0.51\ 5 & 10648.1+x & J1+20 \\ \hline 0.60\ 7 & 10475.7+y & J1+20 \\ \hline 0.60\ 7 & 10475.7+y & J1+20 \\ \hline 0.59\ 17 & 9155+z? & J3+16 \\ \hline 0.47\ 5 & 11993.2+x & J1+22 \\ \hline 0.55\ 6 & 11832.6+y & J1+22 \\ \hline 0.30\ 17 & 10524+z? & J3+18 \\ \hline 0.37\ 6 & 13386.9+x & J1+24 \\ \hline 0.37\ 5 & 13246.0+y & J2+24 \\ \hline 0.23\ 4 & 14833.1+x & J1+26 \\ \hline 0.20\ 4 & 14718.7+y & J2+26 \\ \hline 0.24\ 5 & 16331.6+x & J1+28 \\ \hline 0.13\ 3 & 16248.6+y & J1+28 \\ \hline 0.12\ 4 & 17830.6+y & J1+30 \\ \hline \end{array}$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\frac{Y(^{146}\text{Gd})}{\begin{array}{c}169} \frac{I_{\gamma}^{\dagger \ddagger}}{0.69} \frac{E_{i}(\text{level})}{16} \frac{J_{i}^{\pi}}{5328.7+z?} \frac{J_{i}^{\pi}}{33.10} \frac{E_{f}}{4153.0+z?} \frac{J_{f}^{\pi}}{33.8+y} \frac{I_{2}+16}{3328.7+z?} \frac{I_{2}+14}{33.1+z} \frac{I_{2}+14}{33.8+y} \frac{I_{2}+16}{338.8+x} \frac{I_{2}+14}{33.8+y} \frac{I_{2}+16}{338.8+x} \frac{I_{2}+14}{33.8+y} \frac{I_{2}+16}{338.8+x} \frac{I_{2}+14}{33.8+y} \frac{I_{2}+16}{338.8+y} \frac{I_{2}+18}{338.8+y} \frac{I_{2}+24}{338.8+y} \frac{I_{2}+28}{338.8+y} \frac{I_{2}+28}{338.8+y} \frac{I_{2}+28}{338.8+y} \frac{I_{2}+28}{338.8+y} \frac{I_{2}+28}{338.8+y} \frac{I_{2}+28}{338.8+y} \frac{I_{2}+28}{338.8+y} \frac{I_{2}+28}{338.8+y} \frac$

(HI,xnγ):SD 1993Ha19,1991Rz01,1990He14 (continued)

[†] From 1995Sc31. $E\gamma$'s and $I\gamma$'s are also available from 1990He14 and 1993Ha19 for SD-1 band and from 1991Rz01 and 1993Ha19 for SD-2 band. In the majority, $E\gamma$'s agree within the uncertainty limits, and some of $I\gamma$'s differ irregular up to 1.5.

[‡] Intensities are relative within each band.

[#] Stretched quadrupole from $I\gamma(34^{\circ}/146^{\circ})/I\gamma(90^{\circ})$ ratios (1987He16).

[@] 855.7 3 (1993Ha19).

[&] 963.0 4 (1993Ha19).

^a 1186.1 5 (1993Ha19).

^b 1299.4 7 (1993Ha19).

^c 1343.0 5 (1993Ha19).

^d 1360.2 10 (1993Ha19).

^e 1417.2 10 (1993Ha19).

(HI,xnγ):SD 1993Ha19,1991Rz01,1990He14

	Leg	end
	Level Scheme	$I < 20\% \times Imax$
	Intensities: Relative Ly	$I_{\gamma} < 2.70 \times I_{\gamma}$ $I_{\gamma} < 10\% \times I^{max}$
		$I_{\gamma} \leq 10\% \times I_{\gamma}$ $I_{\nu} > 10\% \times I^{max}$
		$1\gamma > 10\% \wedge 1\gamma$
	2	
J3+18		10524+z
12 - 16		0155
<u>J3+10</u>	Y	<u>9155+z</u>
<u>J3+14</u>	···· · ·······························	<u>7832.3+z</u>
<u>J3+12</u>	t	<u>6554.3+z</u>
<u>J3+10</u>	- - - - - - - - - - -	<u>5328.7+z</u>
<u>J3+8</u>	V 9 8	<u>4153.0+z</u>
<u>J3+6</u>		<u>3029.5+z</u>
<u>J3+4</u>		<u>1964.6+z</u>
<u>J3+2</u>		<u>958.5+z</u>
<u>J3</u> <u>I1+30</u>	=	 -17830.6+v
J1+28		16248.6+y
J2+26		14718.7+y
J2+24		13246.0+y
J1+22		11832.6+y
J1+20		10475.7+y
I1+18		9176.4+y
12+16		7933 8+v
12+14		6749 0+y
J2+14 J2+12		5621 2+v
<u>J2+12</u> 11+10		4549 0±v
12+8		3532.8+v
J2+6		2571.7+y
J2+4		1663.2+y
J2+2		806.2+y
$\frac{J2}{11+20}$		17995 2 J X
J1+30 J1+28		<u> </u>
J1+26		14833.1+x
J1+24		13386.9+x
J1+22		11993.2+x
J1+20		10648.1+x
J1+18		9350.3+x
J1+16		8100.0+x
J1+14		6898.8+x
J1+12		5750.0+x
J1+10		4656.6+x
J1+8		3618.0+x
J1+6		o ^o 2634.8+x
<u>J1+4</u>		1704.3+x
<u>J1+2</u> I1		826.3+x 0.0±v
		0.01X
0^{+}		0.0

 $^{146}_{\ 64}\text{Gd}_{82}$

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$(HI,xn\gamma):SD$ 1993Ha19,1991Rz01,1990He14

		Band(C): SD-3 BAND (?) (1995Sc31)
		<u>J3+18</u> <u>10524+z</u>
		J3+16 ¹³⁶⁹ 9155+z
		J_{3+14}^{1322} 7832.3+z
		13+12 1278 6554 $3+7$
		13 ± 10 1226 5328 7 ± 7
		<u>13+8</u> <u>1176</u> <u>4153</u> 0+7
	Band(B): SD-2 BAND	$\frac{13+6}{1124} - \frac{1124}{3029} \frac{3029}{5+7}$
	(1995Sc31,1991Rz01,	$J_{3+4} = 1065 1964.6+z$
	1993Ha19,2001Cl05)	J3+2 1006 958.5+z
	J1+30 17830.6+y	$J3 _{958} _{0.0+z}$
	J1+28 ¹⁵⁸² 16248.6+y	
	J2+26 ¹⁵³⁰ 14718.7+y	
	J2+24 ¹⁴⁷³ 13246.0+y	
	J1+22 ¹⁴¹³ 11832.6+y	
	J1+20 ¹³⁵⁷ 10475.7+y	
	J1+18 ¹²⁹⁹ 9176.4+y	
	J2+16 ¹²⁴³ 7933.8+y	
	J2+14 1185 6749.0+y	
	J2+12 1128 5621.2+y	
	J1+10 1072 4549.0+y	
Band(A): SD-1 BAND	$\frac{J_{2+8}}{I_{2+6}} = \frac{1016}{961} = \frac{3532.8 + y}{2571} = \frac{1016}{7 + y}$	
(1995Sc31,1990He14, 1993Ha19,2001Cl05)	J2+4 908 1663.2+y	
····, ···,	J2+2 857 806.2+y	
<u>J1+30 17885.3+x</u>	J2 806 0.0+y	
J1+28 1554 16331.6+x		
$\frac{J1+26}{4} \frac{1498}{14833.1+x}$		
J1+24 ¹⁴⁴⁶ 13386.9+x		
J1+22 ¹³⁹⁴ 11993.2+x		
J1+20 1345 10648.1+x		
J1+18 1298 9350.3+x		
J1+16 ¹²⁵⁰ 8100.0+x		
J1+14 ¹²⁰¹ 6898.8+x		
J1+12 1149 5750.0+x		
J1+10 1093 4656.6+x		
J1+8 1039 3618.0+x		
$\frac{J1+0}{I1+4} \xrightarrow{980} 2634.8+x}{930} = 1704.3+x}$		
J1+2 878 826.3+x		
J1 826 0.0+x		

 $^{146}_{64}\text{Gd}_{82}$