^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01

Type	Author	History Citation	Literature Cutoff Date
Update	Balraj Singh		26-Jul-2005

Additional information 1.

2005Ha05: E=200 MeV. Measured Eγ, $\gamma\gamma$, $\gamma\gamma(\theta)$, lifetimes with the Gammasphere array which consisted of 102 HPGe detectors. Lifetime measurements were made using the Doppler-shift attenuation method (DSAM). In a second experiment of the same reaction at E=205 MeV, linking transitions were sought after by mounting four targets onto a target wheel which was rotated in phase with the frequency of the ATLAS linear accelerator such that a greater beam current could be delivered without degrading the targets. Measured Eγ, Iγ, $\gamma\gamma$ with the Gammasphere array of 100 Ge detectors.

2003Dj01: E=194 MeV. Measured Eγ, Iγ, $\gamma\gamma$ with the Gammasphere array, which contained 100 Compton-suppressed Ge detectors. The primary objective of the experiment was to observe rotational levels built on the high-K isomers in ^{174}Hf.

^{174}Hf Levels

The weak population of the SD-5, SD-6, SD-7 and SD-8 bands did not permit an accurate measurement of their quadrupole measurement (2005Ha05). Triaxial nature of all the highly deformed bands listed here is not established due to the lack of linking transitions.

E(level)	J^{π}[†]	Comments
x[‡]	J>23	J^{π}: from 2003Dj01.
726+x[‡]	J+2	
1490+x[‡]	J+4	
2310+x[‡]	J+6	
3177+x[‡]	J+8	
4095+x[‡]	J+10	
5065+x[‡]	J+12	
6090+x[‡]	J+14	
7172+x[‡]	J+16	
8313+x[‡]	J+18	
9515+x[‡]	J+20	
10779+x[‡]	J+22	
12105+x[‡]	J+24	
13495+x[‡]	J+26	
14948+x[‡]	J+28	
16460+x?[‡]	J+30	
y[#]	J1>24	J^{π}: from 2003Dj01.
755+y[#]	J1+2	
1548+y[#]	J1+4	
2394+y[#]	J1+6	
3293+y[#]	J1+8	
4248+y[#]	J1+10	
5263+y[#]	J1+12	
6340+y[#]	J1+14	
7480+y[#]	J1+16	
8684+y[#]	J1+18	
9953+y[#]	J1+20	
11288+y[#]	J1+22	

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^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01 (continued)

^{174}Hf Levels (continued)

E(level)	J^{π}[†]	Comments
12688+y[#]	J1+24	
14154+y[#]	J1+26	
15684+y[#]	J1+28	
z[@]	J2>22	J^{π}: from 2003Dj01.
702+z[@]	J2+2	
1456+z[@]	J2+4	
2237+z[@]	J2+6	
3078+z[@]	J2+8	
3968+z[@]	J2+10	
4909+z[@]	J2+12	
5905+z[@]	J2+14	
6960+z[@]	J2+16	
8065+z[@]	J2+18	
9291+z[@]	J2+20	
10578+z[@]	J2+22	
11927+z[@]	J2+24	
13339+z[@]	J2+26	
14814+z?[@]	J2+28	
u[&]	J3>28	J^{π}: from 2003Dj01.
855+u[&]	J3+2	
1759+u[&]	J3+4	
2708+u[&]	J3+6	
3703+u[&]	J3+8	
4748+u[&]	J3+10	
5846+u[&]	J3+12	
7001+u[&]	J3+14	
8217+u[&]	J3+16	
9495+u[&]	J3+18	
10839+u[&]	J3+20	
12250+u[&]	J3+22	
13728+u?[&]	J3+24	
v[a]	J4	
723+v[a]	J4+2	
1492+v[a]	J4+4	
2309+v[a]	J4+6	
3177+v[a]	J4+8	
4096+v[a]	J4+10	
5069+v[a]	J4+12	
6099+v[a]	J4+14	
7186+v[a]	J4+16	
8333+v[a]	J4+18	
9542+v[a]	J4+20	
10810+v[a]	J4+22	
12150+v[a]	J4+24	
13541+v[a]	J4+26	
w[b]	J5	

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^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01 (continued)

^{174}Hf Levels (continued)

E(level)	Jπ†	E(level)	Jπ†	E(level)	Jπ†	E(level)	Jπ†
802+w[b]	J5+2	10476+w[b]	J5+20	5549+s[c]	J6+12	2570+t[d]	J7+6
1661+w[b]	J5+4	11871+w[b]	J5+22	6666+s[c]	J6+14	3512+t[d]	J7+8
2550+w[b]	J5+6	13331+w?[b]	J5+24	7844+s[c]	J6+16	4502+t[d]	J7+10
3491+w[b]	J5+8	s[c]	J6	9086+s[c]	J6+18	5550+t[d]	J7+12
4493+w[b]	J5+10	810+s[c]	J6+2	10389+s[c]	J6+20	6660+t[d]	J7+14
5558+w[b]	J5+12	1650+s[c]	J6+4	11755+s[c]	J6+22	7837+t[d]	J7+16
6684+w[b]	J5+14	2543+s[c]	J6+6	t[d]	J7	9079+t[d]	J7+18
7884+w[b]	J5+16	3489+s[c]	J6+8	818+t[d]	J7+2	10387+t[d]	J7+20
9146+w[b]	J5+18	4491+s[c]	J6+10	1672+t[d]	J7+4	11740+t[d]	J7+22

† Spins of 23, 24, 22 and 28 are suggested in 2003Dj01 as lower limits for bands 1, 2, 3 and 4, respectively, based upon the adjustment of the alignments of the ^{174}Hf bands, so that they were approximately equal to those of the ^{163}Lu bands.

‡ Band(A): Triaxial (?) SD-1 band (2005Ha05,2003Dj01). Q(transition)=13.8 *+3−4* (2005Ha05). Band intensity=1.1 *3* of the total population of ^{174}Hf channel (2003Dj01).

Band(B): Triaxial (?) SD-2 band (2005Ha05,2003Dj01). Q(transition)=13.5 *+2−3* (2005Ha05). SD-2 and SD-3 bands have a combined intensity of 0.9 *4* of the total population of ^{174}Hf channel (2003Dj01).

@ Band(C): Triaxial (?) SD-3 band (2005Ha05,2003Dj01). Q(transition)=13.0 *+8−4* (2005Ha05). SD-2 and SD-3 bands have a combined intensity of 0.9 *4* of the total population of ^{174}Hf channel (2003Dj01).

& Band(D): Triaxial (?) SD-4 band (2005Ha05,2003Dj01). Q(transition)=12.6 *8* (2005Ha05). Band intensity=0.3 *2* of the total population of ^{174}Hf channel (2003Dj01). Due to the low intensity and contamination in the coincidence gates, this band was tentatively assigned to ^{174}Hf by 2003Dj01. Higher statistics from the experiments in 2005Ha05 confirm the assignment of SD-4 band to this nucleus.

[a] Band(E): Triaxial (?) SD-5 band (2005Ha05).

[b] Band(F): Triaxial (?) SD-6 band (2005Ha05).

[c] Band(G): Triaxial (?) SD-7 band (2005Ha05).

[d] Band(H): Triaxial (?) SD-8 band (2005Ha05).

γ(^{174}Hf)

Linking transitions are observed in 2005Ha05 between TSD-3 and TSD-6, but they are due to an accidental degeneracy.

Since linking transitions between SD bands in ^{174}Hf were not observed in either 2005Ha05 or 2003Dj01, only lower limits of branching ratios near the bottom of the structures could be determined in 2005Ha05. These lower limits are 21, 13, 11, 7, 18, 15 and 5 for the SD-2 to SD-8 bands, respectively.

E_γ†	I_γ#	E_i(level)	J_i^π	E_f	J_f^π
702	0.30 *20*	702+z	J2+2	z	J2>22
723		723+v	J4+2	v	J4
726	0.45 *10*	726+x	J+2	x	J>23
754	0.52 *15*	1456+z	J2+4	702+z	J2+2
755	0.60 *10*	755+y	J1+2	y	J1>24
764	0.67 *10*	1490+x	J+4	726+x	J+2
769		1492+v	J4+4	723+v	J4+2
781	0.60 *15*	2237+z	J2+6	1456+z	J2+4
793	0.75 *10*	1548+y	J1+4	755+y	J1+2
802		802+w	J5+2	w	J5
810		810+s	J6+2	s	J6

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^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01 (continued)

$\gamma(^{174}Hf)$ (continued)

E_γ †	I_γ #	E_i(level)	J_i^π	E_f	J_f^π	Comments
817		2309+v	J4+6	1492+v	J4+4	
818		818+t	J7+2	t	J7	
820	1.00 *10*	2310+x	J+6	1490+x	J+4	
840		1650+s	J6+4	810+s	J6+2	
841	1.00 *10*	3078+z	J2+8	2237+z	J2+6	
846	0.85 *20*	2394+y	J1+6	1548+y	J1+4	
854		1672+t	J7+4	818+t	J7+2	
855	0.60 *20*	855+u	J3+2	u	J3>28	
x855						E_γ: from figure 4(b) of 2005Ha05; authors identify this γ-ray as an apparent transition from SD-1 to normal-deformed states.
859		1661+w	J5+4	802+w	J5+2	
867	0.85 *10*	3177+x	J+8	2310+x	J+6	E_γ: 868 in figure 4(b) of 2005Ha05; 867 elsewhere.
868		3177+v	J4+8	2309+v	J4+6	
889		2550+w	J5+6	1661+w	J5+4	
890	0.90 *10*	3968+z	J2+10	3078+z	J2+8	
893		2543+s	J6+6	1650+s	J6+4	
898		2570+t	J7+6	1672+t	J7+4	
899	0.90 *10*	3293+y	J1+8	2394+y	J1+6	
904	0.85 *15*	1759+u	J3+4	855+u	J3+2	
918	1.00 *20*	4095+x	J+10	3177+x	J+8	
919		4096+v	J4+10	3177+v	J4+8	
941	0.80 *10*	4909+z	J2+12	3968+z	J2+10	
941		3491+w	J5+8	2550+w	J5+6	
942		3512+t	J7+8	2570+t	J7+6	
946		3489+s	J6+8	2543+s	J6+6	
949	0.75 *15*	2708+u	J3+6	1759+u	J3+4	
955	0.95 *10*	4248+y	J1+10	3293+y	J1+8	
970	0.87 *10*	5065+x	J+12	4095+x	J+10	
973		5069+v	J4+12	4096+v	J4+10	
990		4502+t	J7+10	3512+t	J7+8	
995	1.00 *15*	3703+u	J3+8	2708+u	J3+6	
996	0.80 *10*	5905+z	J2+14	4909+z	J2+12	
1002		4493+w	J5+10	3491+w	J5+8	
1002		4491+s	J6+10	3489+s	J6+8	
1015	1.00 *10*	5263+y	J1+12	4248+y	J1+10	
1025	0.92 *10*	6090+x	J+14	5065+x	J+12	
1030		6099+v	J4+14	5069+v	J4+12	
1045	0.70 *15*	4748+u	J3+10	3703+u	J3+8	
1048		5550+t	J7+12	4502+t	J7+10	
1055	0.50 *10*	6960+z	J2+16	5905+z	J2+14	
1058		5549+s	J6+12	4491+s	J6+10	
1065		5558+w	J5+12	4493+w	J5+10	
1077	0.77 *10*	6340+y	J1+14	5263+y	J1+12	
1082	0.73 *10*	7172+x	J+16	6090+x	J+14	
1087		7186+v	J4+16	6099+v	J4+14	
1098	0.75 *15*	5846+u	J3+12	4748+u	J3+10	
1105	0.27 *20*	8065+z	J2+18	6960+z	J2+16	
1110		6660+t	J7+14	5550+t	J7+12	
1117		6666+s	J6+14	5549+s	J6+12	
1126		6684+w	J5+14	5558+w	J5+12	
1140	0.55 *15*	7480+y	J1+16	6340+y	J1+14	
1141	0.62 *15*	8313+x	J+18	7172+x	J+16	
1147		8333+v	J4+18	7186+v	J4+16	
1155	0.45 *20*	7001+u	J3+14	5846+u	J3+12	
1177		7837+t	J7+16	6660+t	J7+14	
1178		7844+s	J6+16	6666+s	J6+14	
1200		7884+w	J5+16	6684+w	J5+14	

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^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01 (continued)

$\gamma(^{174}Hf)$ (continued)

E_γ [†]	I_γ [#]	E_i(level)	J_i^π	E_f	J_f^π	Comments
1202	0.40 *15*	9515+x	J+20	8313+x	J+18	
1204	0.50 *15*	8684+y	J1+18	7480+y	J1+16	
1209		9542+v	J4+20	8333+v	J4+18	
1216[‡]	0.25 *20*	8217+u	J3+16	7001+u	J3+14	E_γ: 1218(?) in 2003Dj01.
1226[‡]		9291+z	J2+20	8065+z	J2+18	
1242		9086+s	J6+18	7844+s	J6+16	
1242		9079+t	J7+18	7837+t	J7+16	
1262		9146+w	J5+18	7884+w	J5+16	
1264	0.28 *15*	10779+x	J+22	9515+x	J+20	
1268		10810+v	J4+22	9542+v	J4+20	
1269	0.30 *20*	9953+y	J1+20	8684+y	J1+18	
1278[‡]		9495+u	J3+18	8217+u	J3+16	
1287[‡]		10578+z	J2+22	9291+z	J2+20	
1303		10389+s	J6+20	9086+s	J6+18	
1308		10387+t	J7+20	9079+t	J7+18	
1326	0.17 *17*	12105+x	J+24	10779+x	J+22	E_γ: 1328 in figure 4(b) of 2005Ha05; 1326 elsewhere.
1330		10476+w	J5+20	9146+w	J5+18	
1335	0.20 *20*	11288+y	J1+22	9953+y	J1+20	
1340		12150+v	J4+24	10810+v	J4+22	
1344[‡]		10839+u	J3+20	9495+u	J3+18	
1349[‡]		11927+z	J2+24	10578+z	J2+22	
1353		11740+t	J7+22	10387+t	J7+20	
1366		11755+s	J6+22	10389+s	J6+20	
1390[‡]		13495+x	J+26	12105+x	J+24	
1391		13541+v	J4+26	12150+v	J4+24	
1395		11871+w	J5+22	10476+w	J5+20	
1400[‡]		12688+y	J1+24	11288+y	J1+22	
1411[‡]		12250+u	J3+22	10839+u	J3+20	
1412[‡]		13339+z	J2+26	11927+z	J2+24	
1453[‡]		14948+x	J+28	13495+x	J+26	
1460[@]		13331+w?	J5+24	11871+w	J5+22	
1466[‡]		14154+y	J1+26	12688+y	J1+24	
1475[‡@]		14814+z?	J2+28	13339+z	J2+26	
1478[‡@]		13728+u?	J3+24	12250+u	J3+22	
1512[‡@]		16460+x?	J+30	14948+x	J+28	
1530[‡]		15684+y	J1+28	14154+y	J1+26	

[†] All transitions are assigned to ^{174}Hf as they are all seen in coincidence with the ground-state band of this nucleus in 2005Ha05 and 2003Dj01. Values for SD-1, SD-2, SD-3 and SD-4 bands are from 2003Dj01, except for the highest transitions which are reported in 2005Ha05 only. Data for other SD bands are from 2005Ha05.

[‡] Transitions taken from 2005Ha05; the details are are to be published in fothcoming papers.

[#] Relative intensities within each band, values are read from intensity plots in 2003Dj01.

[@] Placement of transition in the level scheme is uncertain.

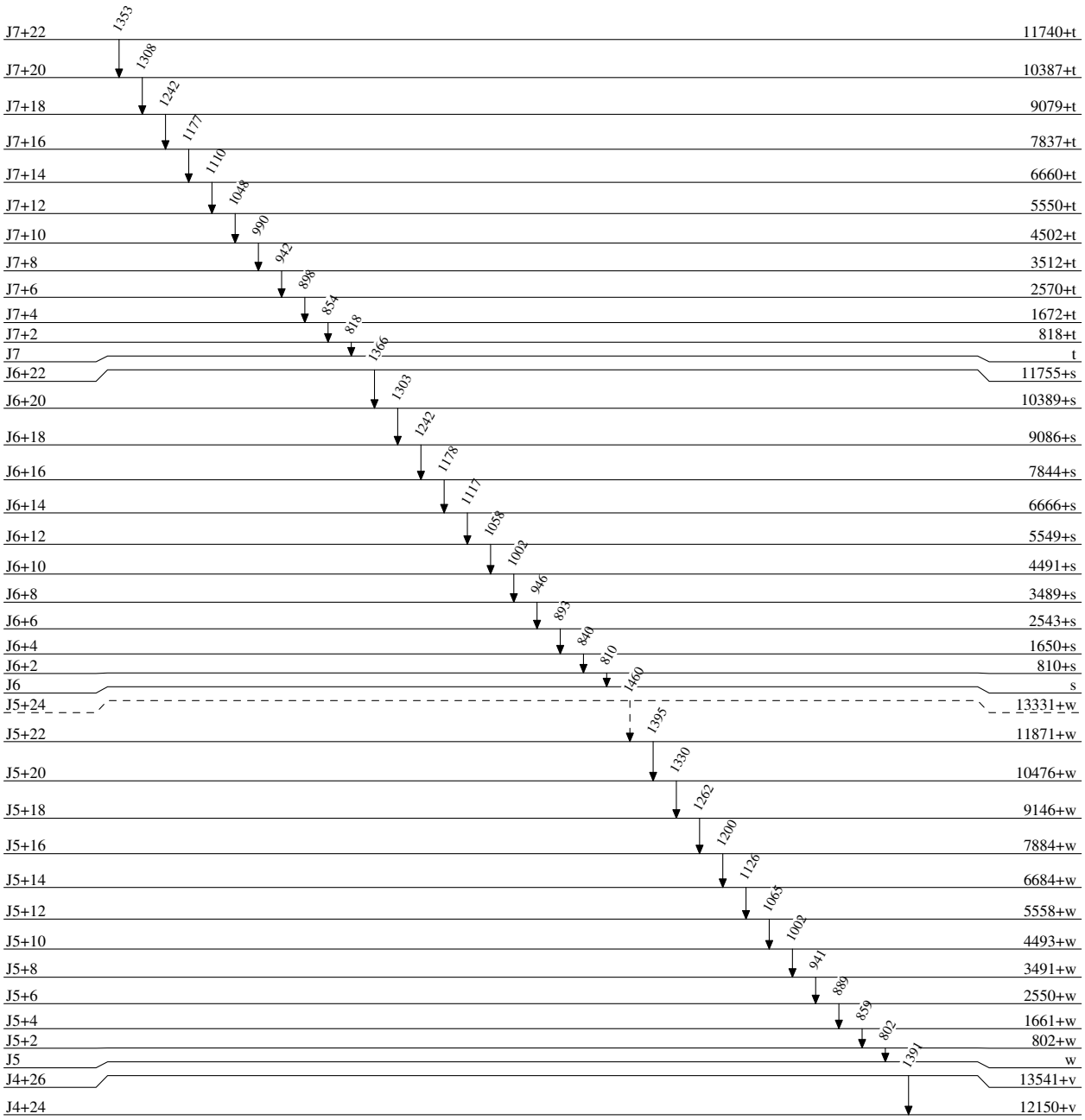
[x] γ ray not placed in level scheme.

^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01 Legend

Level Scheme

Intensities: Relative I_γ

γ Decay (Uncertain)



$^{174}_{72}Hf_{102}$

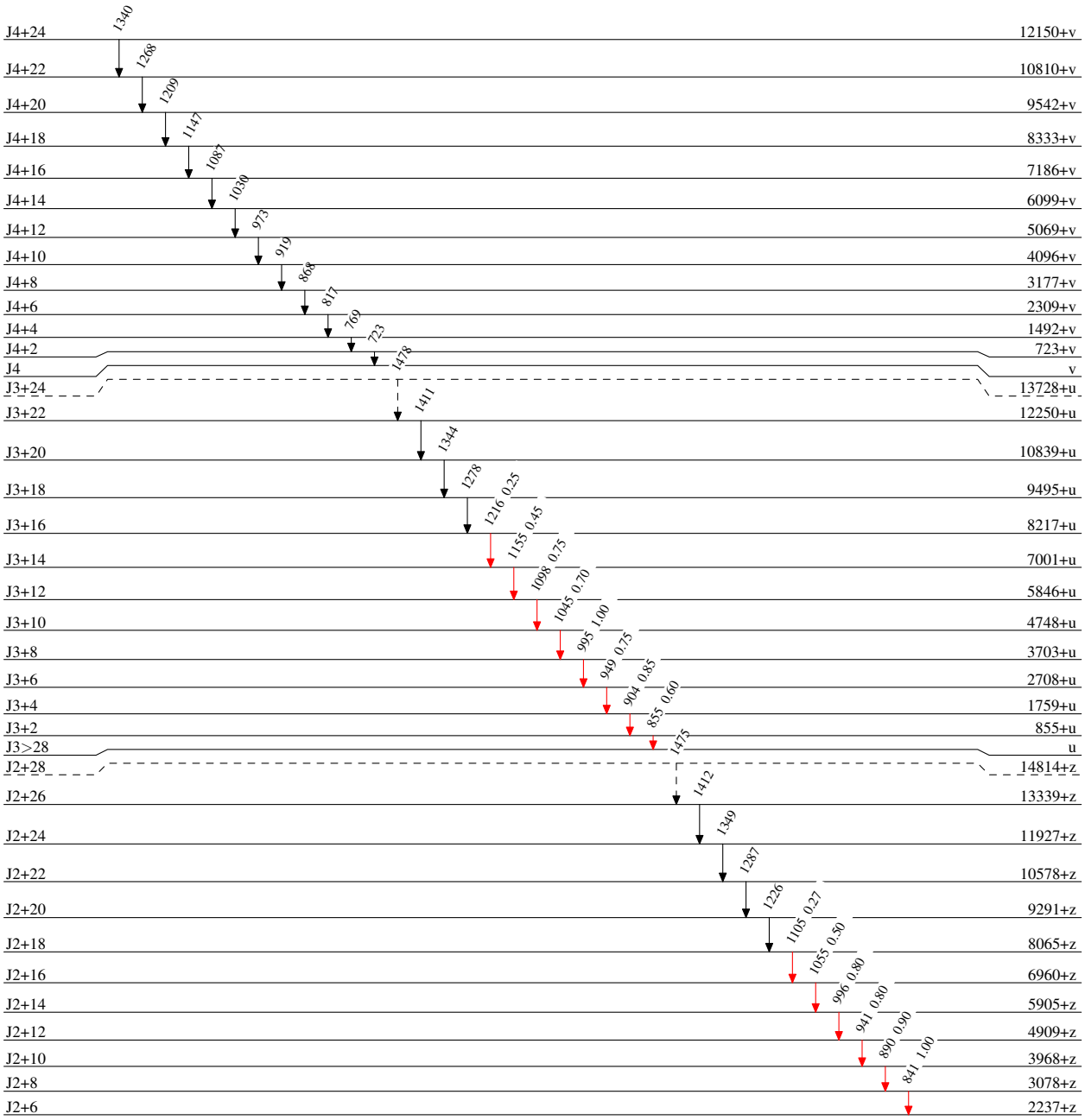
^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01

Level Scheme (continued)

Intensities: Relative I_γ

Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)



$^{174}_{72}Hf_{102}$

^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01

Level Scheme (continued)

Intensities: Relative I_γ

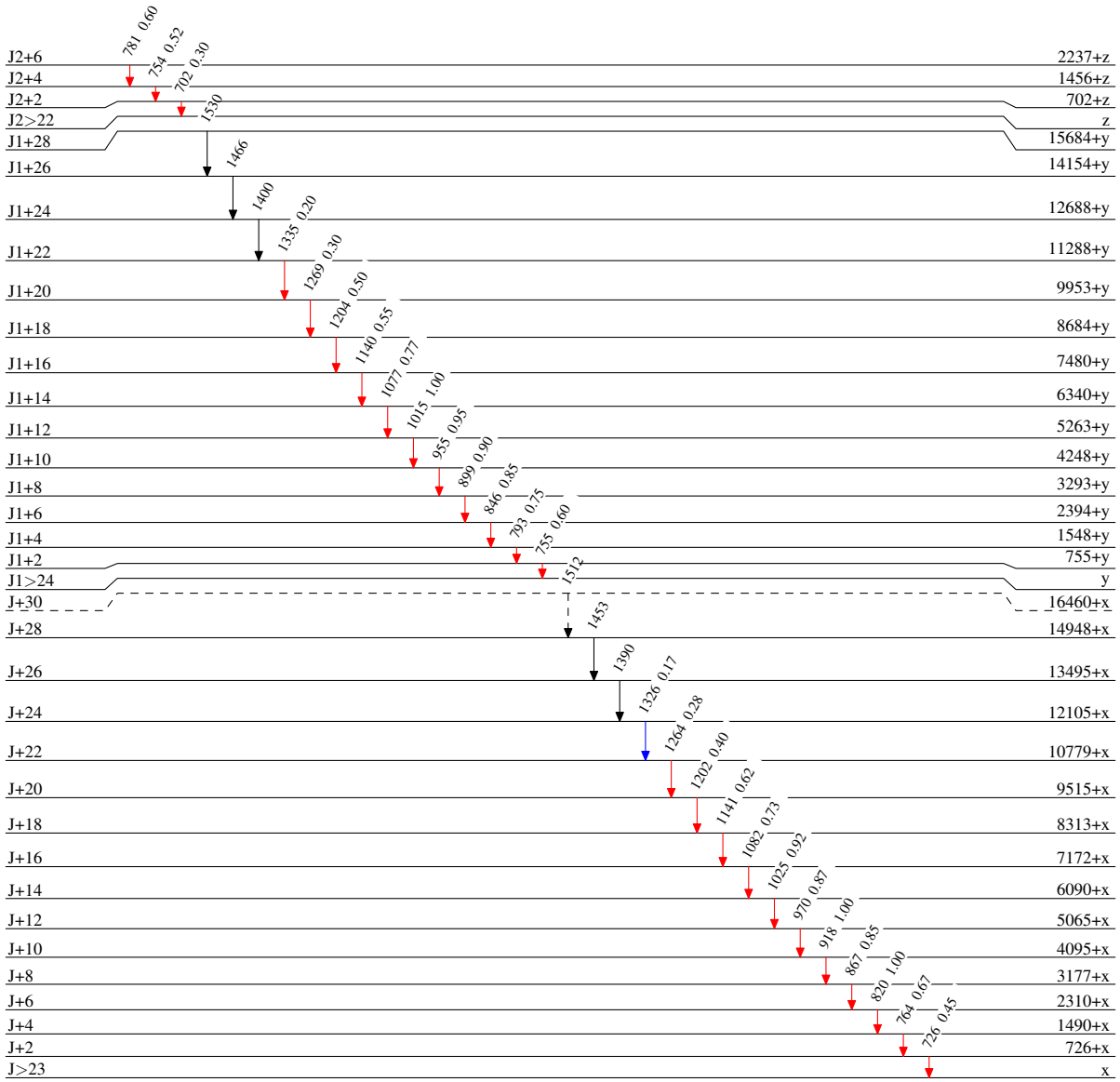
Legend

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

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

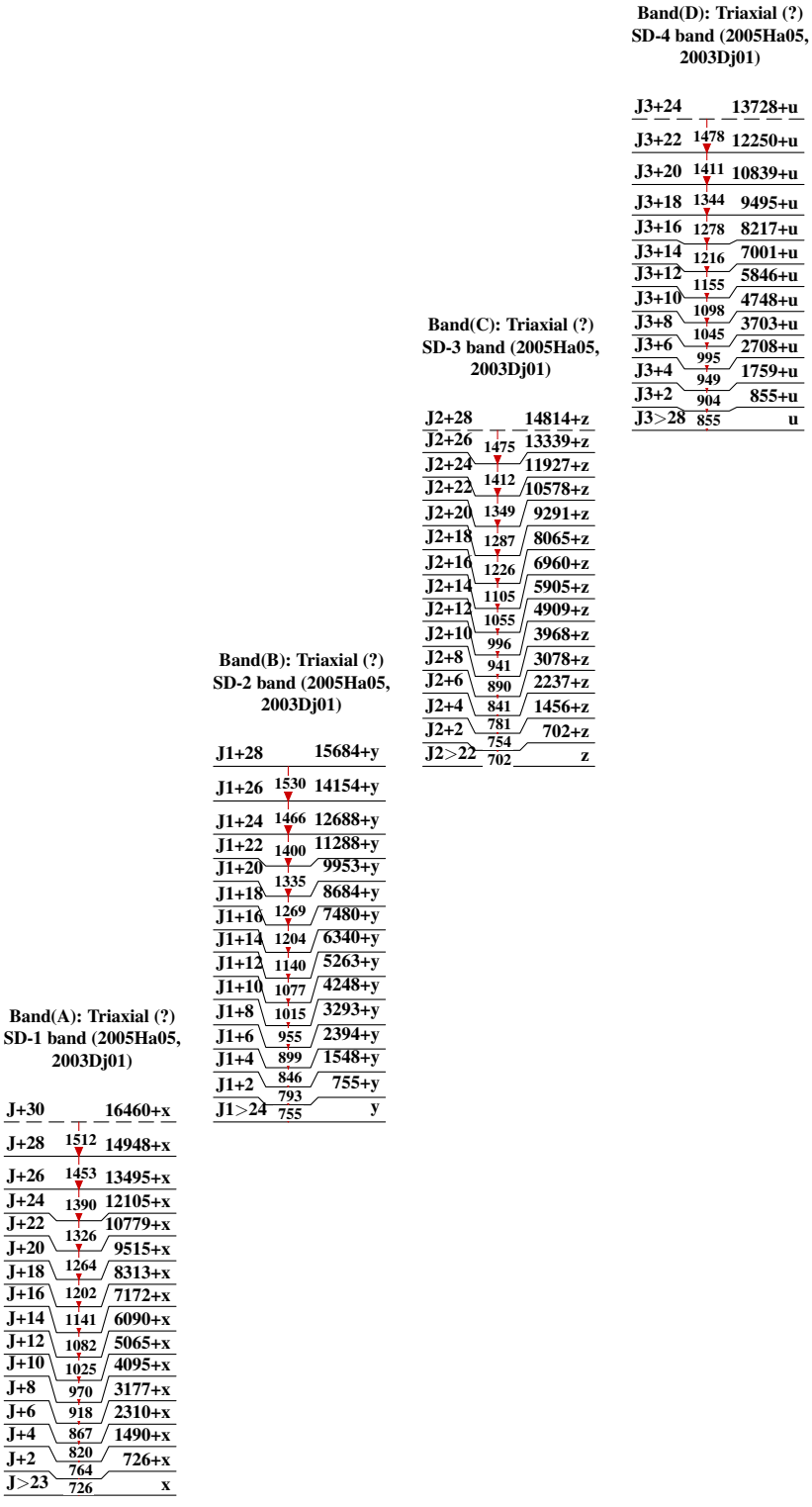
$I_\gamma > 10\% \times I_\gamma^{max}$

γ Decay (Uncertain)



$^{174}_{72}Hf_{102}$

^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01



$^{174}_{72}Hf_{102}$

^{130}Te(^{48}Ca,4nγ):SD 2005Ha05,2003Dj01 (continued)