

$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  1993LiZX

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia		NDS 199,271 (2025)	1-Sep-2024

1993LiZX: E=95 MeV; Tessa3 array (16 BGO suppressed Ge detectors with 50-element inner BGO ball for  $\gamma$  sum-energy and multiplicity measurements); measured  $E\gamma$ ,  $\gamma\gamma$  coin,  $\gamma\gamma\gamma$  coin.

It should be noted that 1993LiZX constitutes a preliminary report of data from this reaction.

 $^{81}\text{Sr}$  Levels

E(level) <sup>†</sup>	$J\pi^{\ddagger}$
0 <sup>i</sup>	1/2 <sup>-</sup>
79.0 <sup>g</sup>	5/2 <sup>-</sup>
88.7 <sup>e</sup>	7/2 <sup>+</sup>
119.5 <sup>b</sup>	1/2 <sup>+</sup>
132.0 <sup>d</sup>	9/2 <sup>+</sup>
154.9 <sup>h</sup>	3/2 <sup>-</sup>
220.5 <sup>c</sup>	3/2 <sup>+</sup>
335.8 <sup>b</sup>	5/2 <sup>+</sup>
365.8 <sup>f</sup>	7/2 <sup>-</sup>
378.9 <sup>i</sup>	5/2 <sup>-</sup>
557.5 <sup>c</sup>	7/2 <sup>+</sup>
632.1 <sup>h</sup>	7/2 <sup>-</sup>
706.1 <sup>g</sup>	9/2 <sup>-</sup>
795.6 <sup>b</sup>	9/2 <sup>+</sup>
809.4 <sup>e</sup>	11/2 <sup>+</sup>
903.7 <sup>d</sup>	13/2 <sup>+</sup>
998.7 <sup>i</sup>	9/2 <sup>-</sup>
1054.1 <sup>f</sup>	11/2 <sup>-</sup>
1107.9 <sup>c</sup>	11/2 <sup>+</sup>
1331.4 <sup>h</sup>	11/2 <sup>-</sup>
1468.7 <sup>b</sup>	13/2 <sup>+</sup>
1503.6 <sup>g</sup>	13/2 <sup>-</sup>
1737.8 <sup>e</sup>	15/2 <sup>+</sup>
1801.7 <sup>i</sup>	13/2 <sup>-</sup>
1859.8 <sup>c</sup>	15/2 <sup>+</sup>
1863.6 <sup>d</sup>	17/2 <sup>+</sup>
1908.4 <sup>f</sup>	15/2 <sup>-</sup>
2210.9 <sup>h</sup>	15/2 <sup>-</sup>
2322.7 <sup>b</sup>	17/2 <sup>+</sup>
2446.3 <sup>g</sup>	17/2 <sup>-</sup>
2736.8 <sup>i</sup>	17/2 <sup>-</sup>
2788.7 <sup>c</sup>	19/2 <sup>+</sup>
2901.6 <sup>f</sup>	19/2 <sup>-</sup>
2959.9 <sup>d</sup>	21/2 <sup>+</sup>
3142.9 <sup>h</sup>	19/2 <sup>-</sup>
3328.7 <sup>b</sup>	21/2 <sup>+</sup>
3403.6	21/2 <sup>+</sup>
3493.1 <sup>g</sup>	21/2 <sup>-</sup>
3710.4 <sup>a</sup>	23/2 <sup>+</sup>

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$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  1993LiZX (continued) $^{81}\text{Sr}$  Levels (continued)

E(level) <sup>†</sup>	J <sup>π</sup> <sup>‡</sup>	Comments
3752.8 <sup>#i</sup>	21/2 <sup>-</sup>	E(level): 3799.6 in Adopted Level.
3885.9 <sup>c</sup>	23/2 <sup>+</sup>	
3975.0 <sup>f</sup>	23/2 <sup>-</sup>	
4103.6 <sup>d</sup>	25/2 <sup>+</sup>	
4140.9 <sup>h</sup>	23/2 <sup>-</sup>	
4471.9 <sup>b</sup>	25/2 <sup>+</sup>	
4549.0 <sup>g</sup>	25/2 <sup>-</sup>	
4749.0 <sup>a</sup>	27/2 <sup>+</sup>	
4810.8 <sup>#i</sup>	25/2 <sup>-</sup>	E(level): 4934.4 in the adopted dataset.
5083.0 <sup>c</sup>	27/2 <sup>+</sup>	
5099.6 <sup>f</sup>	27/2 <sup>-</sup>	
5174.3	27/2 <sup>+</sup>	
5239 <sup>d</sup>	29/2 <sup>+</sup>	
5246.0 <sup>h</sup>	27/2 <sup>-</sup>	
5704.5 <sup>g</sup>	29/2 <sup>-</sup>	
5751.4 <sup>b</sup>	29/2 <sup>+</sup>	
5945.6 <sup>#i</sup>	29/2 <sup>-</sup>	
5998 <sup>a</sup>	31/2 <sup>+</sup>	
6353.9 <sup>f</sup>	31/2 <sup>-</sup>	
6464 <sup>@c</sup>	31/2 <sup>+</sup>	
6480 <sup>d</sup>	33/2 <sup>+</sup>	
6988 <sup>g</sup>	33/2 <sup>-</sup>	
7080 <sup>#i</sup>	33/2 <sup>-</sup>	
7184 <sup>b</sup>	33/2 <sup>+</sup>	
7444 <sup>a</sup>	35/2 <sup>+</sup>	
7755 <sup>f</sup>	35/2 <sup>-</sup>	
7857 <sup>d</sup>	37/2 <sup>+</sup>	
7934 <sup>@c</sup>	35/2 <sup>+</sup>	
8402 <sup>g</sup>	37/2 <sup>-</sup>	
8773 <sup>b</sup>	37/2 <sup>+</sup>	
9333 <sup>&amp;f</sup>	39/2 <sup>-</sup>	
9403 <sup>d</sup>	41/2 <sup>+</sup>	
9474 <sup>@c</sup>	39/2 <sup>+</sup>	
9928 <sup>g</sup>	41/2 <sup>-</sup>	

<sup>†</sup> From a least-squares fit to E $\gamma$ , allowing equal weight for all gammas.

<sup>‡</sup> Values proposed by authors in preliminary level scheme; basis for assignments not stated. Values are consistent with adopted values apart from the addition of parentheses in Adopted Levels for many levels.

<sup>#</sup> Adopted energy for this band member differs from that shown here because the 1016 $\gamma$ , placed by 1993LiZX as the 21/2 to 17/2 transition, was shown in a subsequent ( $^{30}\text{Si},\alpha 2\text{p}\text{n}\gamma$ ) reaction study to be absent from this band's  $\gamma$  cascade. With the omission of the 1016 $\gamma$ , the 25/2 to 21/2 transition of 1993LiZX becomes the 21/2 to 17/2 transition in Adopted Levels, Gammas, etc., leading to adopted energies of 3800, 4934, 6068 keV for the 21/2, 25/2, 29/2 band members, and eliminating the 33/2 member proposed by 1993LiZX. The 25/2 and 29/2 members have not been independently observed, so should be considered tentative, at best.

<sup>@</sup> The members of the 1540.0 $\gamma$ -1470.3 $\gamma$ -1380.6 $\gamma$  cascade, placed above the 27/2<sup>+</sup> 5083 level in 1993LiZX, have also been reported in a ( $^{30}\text{Si},\alpha 2\text{p}\text{n}\gamma$ ) study but, in that study, they could not be fitted into a self-consistent level scheme. The evaluator, therefore, considers the levels defined by those transitions in the present reaction to be uncertain.

<sup>&</sup> Not adopted; the 1578 $\gamma$  placed from this level by 1993LiZX actually deexcites the 43/2 member of the band (adopted E=10829

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$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  **1993LiZX** (continued) $^{81}\text{Sr}$  Levels (continued)

keV). The adopted 1489 keV, 39/2 to 35/2 transition is not reported by **1993LiZX**.

- <sup>a</sup> Band(A):  $\alpha=-1/2$   $g_{9/2}$  band, yrast following crossing of 1-quasiparticle band by this 3-quasiparticle configuration including two aligned  $g_{9/2}$  protons.  
<sup>b</sup> Band(B):  $K^\pi=1/2^{(+)}$ ,  $\alpha=+1/2$  band.  
<sup>c</sup> Band(b):  $K^\pi=1/2^{(+)}$ ,  $\alpha=-1/2$  band.  
<sup>d</sup> Band(C):  $\nu$  5/2[422],  $\alpha=+1/2$ , decoupled yrast band.  
<sup>e</sup> Band(c):  $\nu$  5/2[422],  $\alpha=-1/2$ , decoupled yrast band.  
<sup>f</sup> Band(d):  $\nu$  5/2[303],  $\alpha=-1/2$  band.  
<sup>g</sup> Band(D):  $\nu$  5/2[303],  $\alpha=+1/2$  band.  
<sup>h</sup> Band(e):  $\nu$  1/2[301],  $\alpha=-1/2$  band.  
<sup>i</sup> Band(E):  $\nu$  1/2[301],  $\alpha=+1/2$  band.

 $\gamma(^{81}\text{Sr})$ 

$E_\gamma$	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$
43	132.0	9/2 <sup>+</sup>	88.7	7/2 <sup>+</sup>
79	79.0	5/2 <sup>-</sup>	0	1/2 <sup>-</sup>
101.0	220.5	3/2 <sup>+</sup>	119.5	1/2 <sup>+</sup>
115.3	335.8	5/2 <sup>+</sup>	220.5	3/2 <sup>+</sup>
119.5	119.5	1/2 <sup>+</sup>	0	1/2 <sup>-</sup>
154.9	154.9	3/2 <sup>-</sup>	0	1/2 <sup>-</sup>
216.3	335.8	5/2 <sup>+</sup>	119.5	1/2 <sup>+</sup>
220.5	220.5	3/2 <sup>+</sup>	0	1/2 <sup>-</sup>
221.7	557.5	7/2 <sup>+</sup>	335.8	5/2 <sup>+</sup>
223.9	378.9	5/2 <sup>-</sup>	154.9	3/2 <sup>-</sup>
238.1	795.6	9/2 <sup>+</sup>	557.5	7/2 <sup>+</sup>
253.1	632.1	7/2 <sup>-</sup>	378.9	5/2 <sup>-</sup>
277.1	365.8	7/2 <sup>-</sup>	88.7	7/2 <sup>+</sup>
286.8	365.8	7/2 <sup>-</sup>	79.0	5/2 <sup>-</sup>
306.8	3710.4	23/2 <sup>+</sup>	3403.6	21/2 <sup>+</sup>
312.1	1107.9	11/2 <sup>+</sup>	795.6	9/2 <sup>+</sup>
332.5	1331.4	11/2 <sup>-</sup>	998.7	9/2 <sup>-</sup>
337.0	557.5	7/2 <sup>+</sup>	220.5	3/2 <sup>+</sup>
340.2	706.1	9/2 <sup>-</sup>	365.8	7/2 <sup>-</sup>
347.7	1054.1	11/2 <sup>-</sup>	706.1	9/2 <sup>-</sup>
360.7	1468.7	13/2 <sup>+</sup>	1107.9	11/2 <sup>+</sup>
366.4	998.7	9/2 <sup>-</sup>	632.1	7/2 <sup>-</sup>
378.9	378.9	5/2 <sup>-</sup>	0	1/2 <sup>-</sup>
393.2	4103.6	25/2 <sup>+</sup>	3710.4	23/2 <sup>+</sup>
405@	1908.4	15/2 <sup>-</sup>	1503.6	13/2 <sup>-</sup>
412.3	7857	37/2 <sup>+</sup>	7444	35/2 <sup>+</sup>
443.8	3403.6	21/2 <sup>+</sup>	2959.9	21/2 <sup>+</sup>
449.1@	1503.6	13/2 <sup>-</sup>	1054.1	11/2 <sup>-</sup>
455@	2901.6	19/2 <sup>-</sup>	2446.3	17/2 <sup>-</sup>
459.9	795.6	9/2 <sup>+</sup>	335.8	5/2 <sup>+</sup>
470@&	1801.7	13/2 <sup>-</sup>	1331.4	11/2 <sup>-</sup>
477.1	632.1	7/2 <sup>-</sup>	154.9	3/2 <sup>-</sup>
482.4	6480	33/2 <sup>+</sup>	5998	31/2 <sup>+</sup>
489.8	5239	29/2 <sup>+</sup>	4749.0	27/2 <sup>+</sup>
537.9@	2446.3	17/2 <sup>-</sup>	1908.4	15/2 <sup>-</sup>
550.3	1107.9	11/2 <sup>+</sup>	557.5	7/2 <sup>+</sup>
620.0	998.7	9/2 <sup>-</sup>	378.9	5/2 <sup>-</sup>
627.1	706.1	9/2 <sup>-</sup>	79.0	5/2 <sup>-</sup>

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$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  **1993LiZX** (continued)

$\gamma(^{81}\text{Sr})$  (continued)

$E_\gamma$	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	Comments
645.5	4749.0	27/2 <sup>+</sup>	4103.6	25/2 <sup>+</sup>	
673.2	1468.7	13/2 <sup>+</sup>	795.6	9/2 <sup>+</sup>	
677.2	809.4	11/2 <sup>+</sup>	132.0	9/2 <sup>+</sup>	
688.4	1054.1	11/2 <sup>-</sup>	365.8	7/2 <sup>-</sup>	
699.5	1331.4	11/2 <sup>-</sup>	632.1	7/2 <sup>-</sup>	
721.0 <sup>@</sup>	809.4	11/2 <sup>+</sup>	88.7	7/2 <sup>+</sup>	
750.5	3710.4	23/2 <sup>+</sup>	2959.9	21/2 <sup>+</sup>	
751.9	1859.8	15/2 <sup>+</sup>	1107.9	11/2 <sup>+</sup>	
759.2	5998	31/2 <sup>+</sup>	5239	29/2 <sup>+</sup>	
771.5	903.7	13/2 <sup>+</sup>	132.0	9/2 <sup>+</sup>	
797.7	1503.6	13/2 <sup>-</sup>	706.1	9/2 <sup>-</sup>	
803.0	1801.7	13/2 <sup>-</sup>	998.7	9/2 <sup>-</sup>	
833.9	1737.8	15/2 <sup>+</sup>	903.7	13/2 <sup>+</sup>	
854.0	2322.7	17/2 <sup>+</sup>	1468.7	13/2 <sup>+</sup>	
854.5	1908.4	15/2 <sup>-</sup>	1054.1	11/2 <sup>-</sup>	
879.5	2210.9	15/2 <sup>-</sup>	1331.4	11/2 <sup>-</sup>	
928.6	1737.8	15/2 <sup>+</sup>	809.4	11/2 <sup>+</sup>	
928.9	2788.7	19/2 <sup>+</sup>	1859.8	15/2 <sup>+</sup>	
932.0	3142.9	19/2 <sup>-</sup>	2210.9	15/2 <sup>-</sup>	
935.0	2736.8	17/2 <sup>-</sup>	1801.7	13/2 <sup>-</sup>	
942.4	2446.3	17/2 <sup>-</sup>	1503.6	13/2 <sup>-</sup>	
959.9	1863.6	17/2 <sup>+</sup>	903.7	13/2 <sup>+</sup>	
993.5	2901.6	19/2 <sup>-</sup>	1908.4	15/2 <sup>-</sup>	
998.0	4140.9	23/2 <sup>-</sup>	3142.9	19/2 <sup>-</sup>	
1006.0	3328.7	21/2 <sup>+</sup>	2322.7	17/2 <sup>+</sup>	
1016.0 <sup>‡</sup>	3752.8	21/2 <sup>-</sup>	2736.8	17/2 <sup>-</sup>	$E_\gamma$ : other: 1060 $\gamma$ in the adopted dataset instead of 1016.0 $\gamma$ .
1038.8	4749.0	27/2 <sup>+</sup>	3710.4	23/2 <sup>+</sup>	
1046.8	3493.1	21/2 <sup>-</sup>	2446.3	17/2 <sup>-</sup>	
1055.9	4549.0	25/2 <sup>-</sup>	3493.1	21/2 <sup>-</sup>	
1058.0 <sup>‡</sup>	4810.8	25/2 <sup>-</sup>	3752.8	21/2 <sup>-</sup>	$E_\gamma$ : a comparable 1060 $\gamma$ from (21/2 <sup>-</sup> ) and 1134.8 $\gamma$ from from (25/2 <sup>-</sup> ) in the adopted dataset. The latter $\gamma$ is from 29/2 <sup>-</sup> state in this dataset.
1073.4	3975.0	23/2 <sup>-</sup>	2901.6	19/2 <sup>-</sup>	
1096.3	2959.9	21/2 <sup>+</sup>	1863.6	17/2 <sup>+</sup>	
1097.2	3885.9	23/2 <sup>+</sup>	2788.7	19/2 <sup>+</sup>	
1105.1	5246.0	27/2 <sup>-</sup>	4140.9	23/2 <sup>-</sup>	
1124.5	5099.6	27/2 <sup>-</sup>	3975.0	23/2 <sup>-</sup>	
1134.0 <sup>‡</sup>	7080	33/2 <sup>-</sup>	5945.6	29/2 <sup>-</sup>	
1134.6	5239	29/2 <sup>+</sup>	4103.6	25/2 <sup>+</sup>	
1134.8 <sup>‡</sup>	5945.6	29/2 <sup>-</sup>	4810.8	25/2 <sup>-</sup>	
1143.2	4471.9	25/2 <sup>+</sup>	3328.7	21/2 <sup>+</sup>	
1143.6	4103.6	25/2 <sup>+</sup>	2959.9	21/2 <sup>+</sup>	
1155.4	5704.5	29/2 <sup>-</sup>	4549.0	25/2 <sup>-</sup>	
1197.1	5083.0	27/2 <sup>+</sup>	3885.9	23/2 <sup>+</sup>	
1241.4	6480	33/2 <sup>+</sup>	5239	29/2 <sup>+</sup>	
1248.7	5998	31/2 <sup>+</sup>	4749.0	27/2 <sup>+</sup>	
1254.3	6353.9	31/2 <sup>-</sup>	5099.6	27/2 <sup>-</sup>	
1279.5	5751.4	29/2 <sup>+</sup>	4471.9	25/2 <sup>+</sup>	
1283.9	6988	33/2 <sup>-</sup>	5704.5	29/2 <sup>-</sup>	
1288.4	5174.3	27/2 <sup>+</sup>	3885.9	23/2 <sup>+</sup>	
1377.1	7857	37/2 <sup>+</sup>	6480	33/2 <sup>+</sup>	
1380.6	6464	31/2 <sup>+</sup>	5083.0	27/2 <sup>+</sup>	
1401.4	7755	35/2 <sup>-</sup>	6353.9	31/2 <sup>-</sup>	
1413.5	8402	37/2 <sup>-</sup>	6988	33/2 <sup>-</sup>	
1432.1	7184	33/2 <sup>+</sup>	5751.4	29/2 <sup>+</sup>	

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$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  **1993LiZX (continued)**
 $\gamma(^{81}\text{Sr})$  (continued)

$E_\gamma$	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	$E_\gamma$	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$
1446.0	7444	35/2 <sup>+</sup>	5998	31/2 <sup>+</sup>	1546.1	9403	41/2 <sup>+</sup>	7857	37/2 <sup>+</sup>
1470.3	7934	35/2 <sup>+</sup>	6464	31/2 <sup>+</sup>	1578.0 <sup>#</sup>	9333	39/2 <sup>-</sup>	7755	35/2 <sup>-</sup>
1526.2	9928	41/2 <sup>-</sup>	8402	37/2 <sup>-</sup>	1589.0	8773	37/2 <sup>+</sup>	7184	33/2 <sup>+</sup>
1540	3403.6	21/2 <sup>+</sup>	1863.6	17/2 <sup>+</sup>	<sup>x</sup> 1665.0 <sup>†</sup>				
1540.0	9474	39/2 <sup>+</sup>	7934	35/2 <sup>+</sup>					

<sup>†</sup> Placed by **1993LiZX** from a 11068-keV level (nominated to be the 45/2<sup>+</sup> member of the 5/2[542] band); however, that placement is rejected in different reaction studies which extend the band to which **1993LiZX** assigned this level.

<sup>‡</sup> See comment on level deexcited by this  $\gamma$ .

<sup>#</sup> Placed elsewhere (viz., from 43/2 member of same band) in Adopted Levels, Gammas.

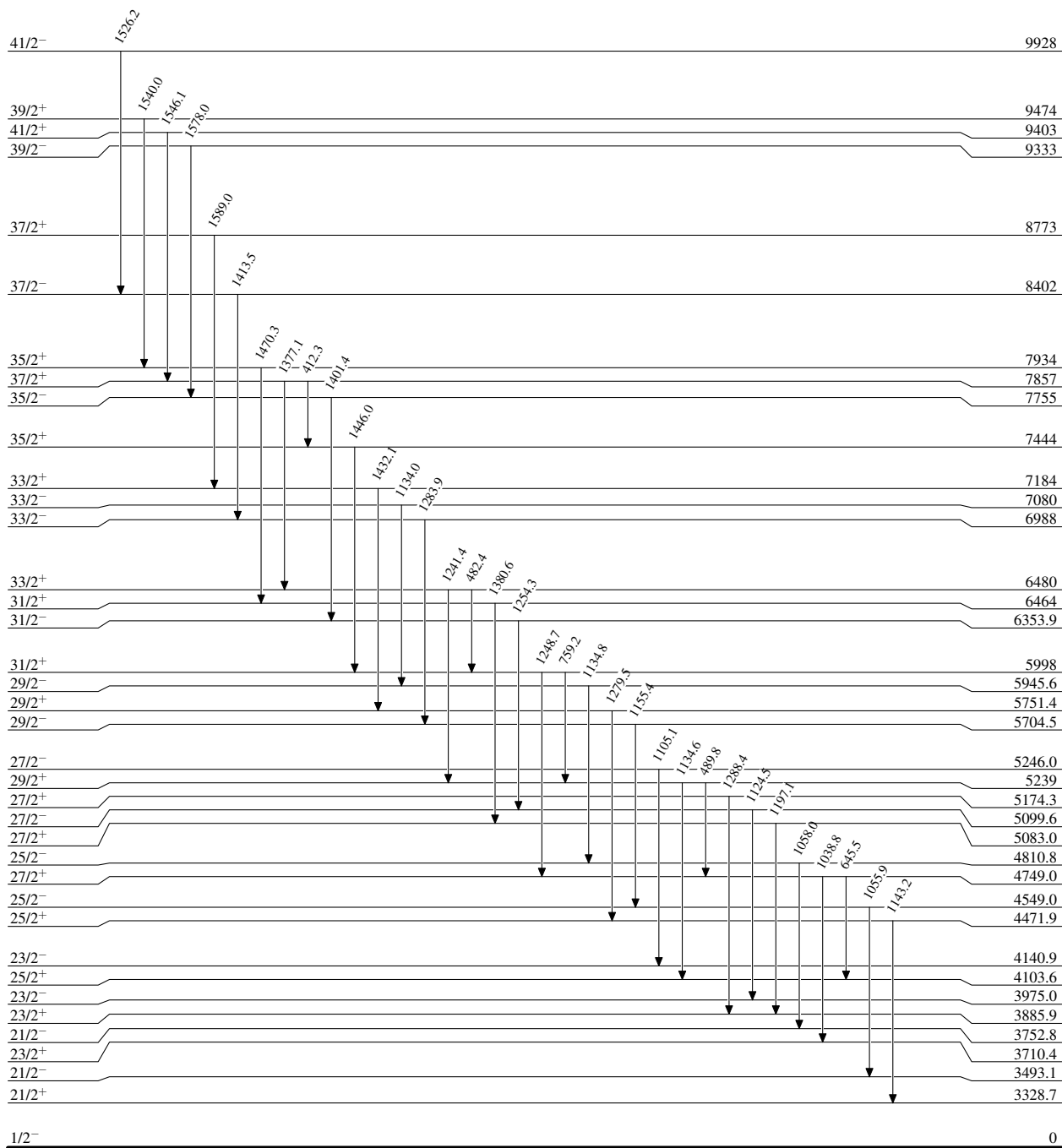
<sup>@</sup> This transition would be expected to appear in ( $\alpha,\text{xn}\gamma$ ) and/or other (HI, $\text{xn}\gamma$ ) studies, but it does not; this casts doubt on the present placement, especially so since the present level scheme is preliminary. Consequently, it is not included in Adopted Gammas.

<sup>&</sup> Placement of transition in the level scheme is uncertain.

<sup>x</sup>  $\gamma$  ray not placed in level scheme.

$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  1993LiZX

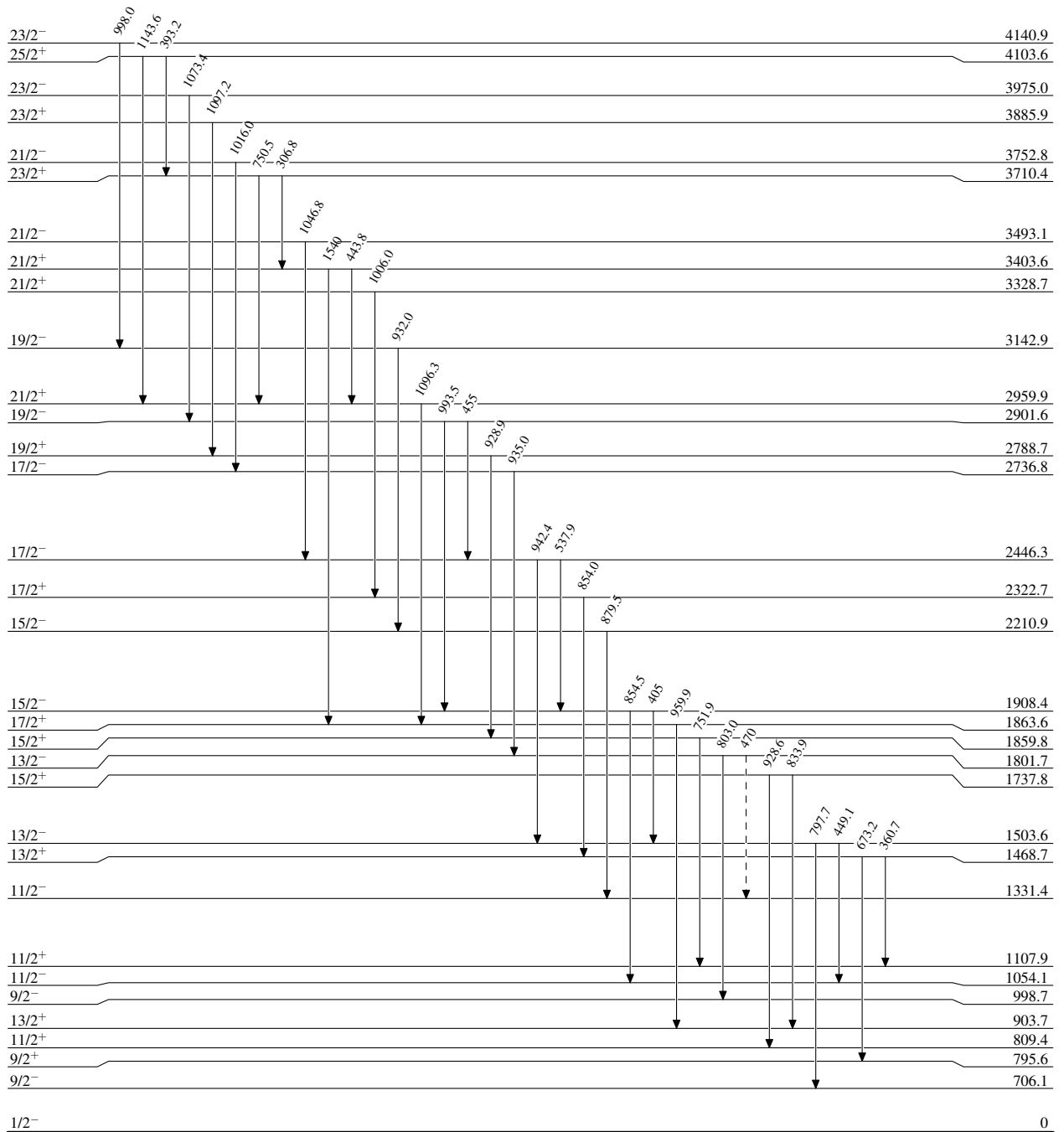
## Level Scheme



$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  1993LiZX

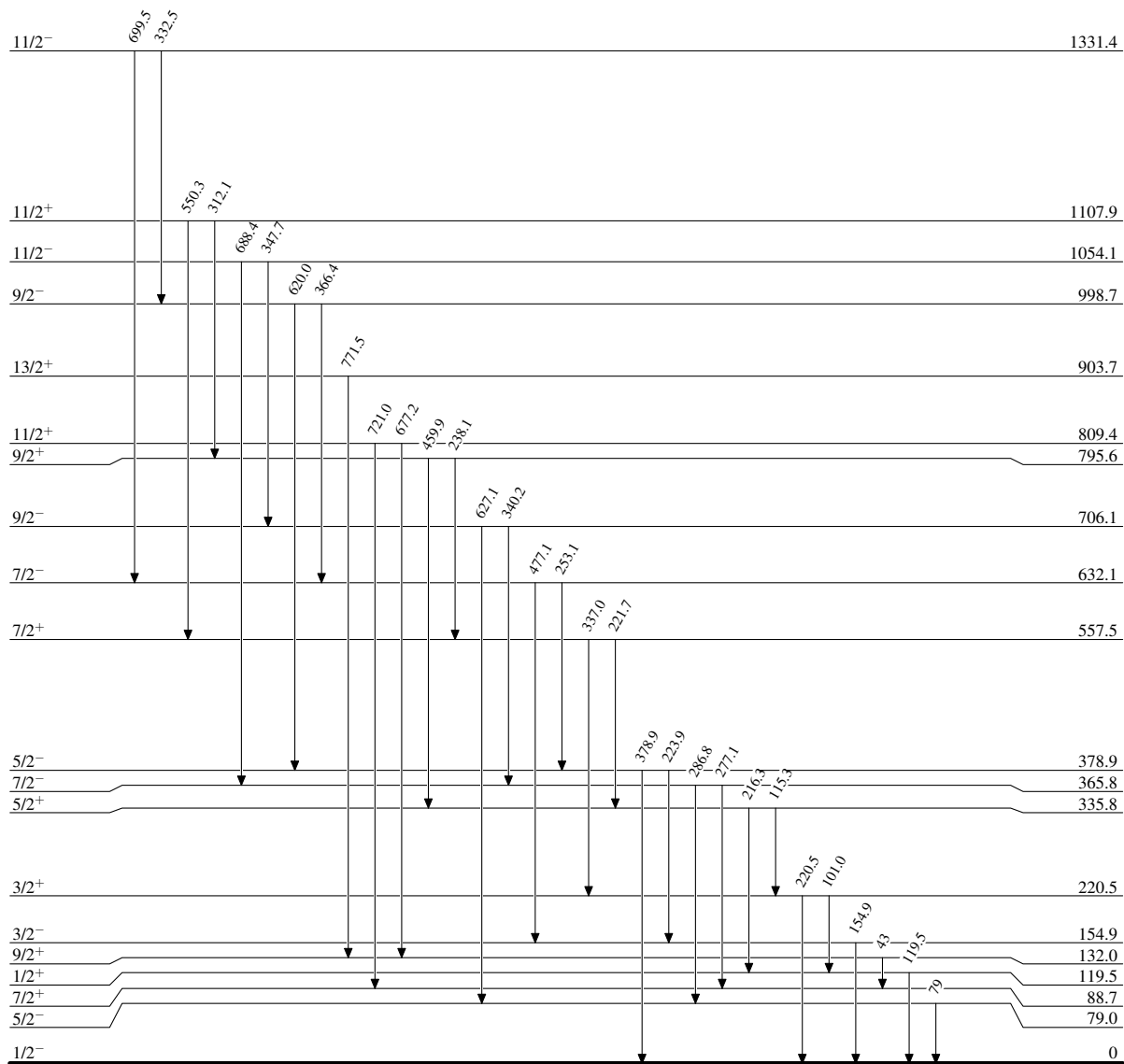
Legend

## Level Scheme (continued)

----->  $\gamma$  Decay (Uncertain)

$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  1993LiZX

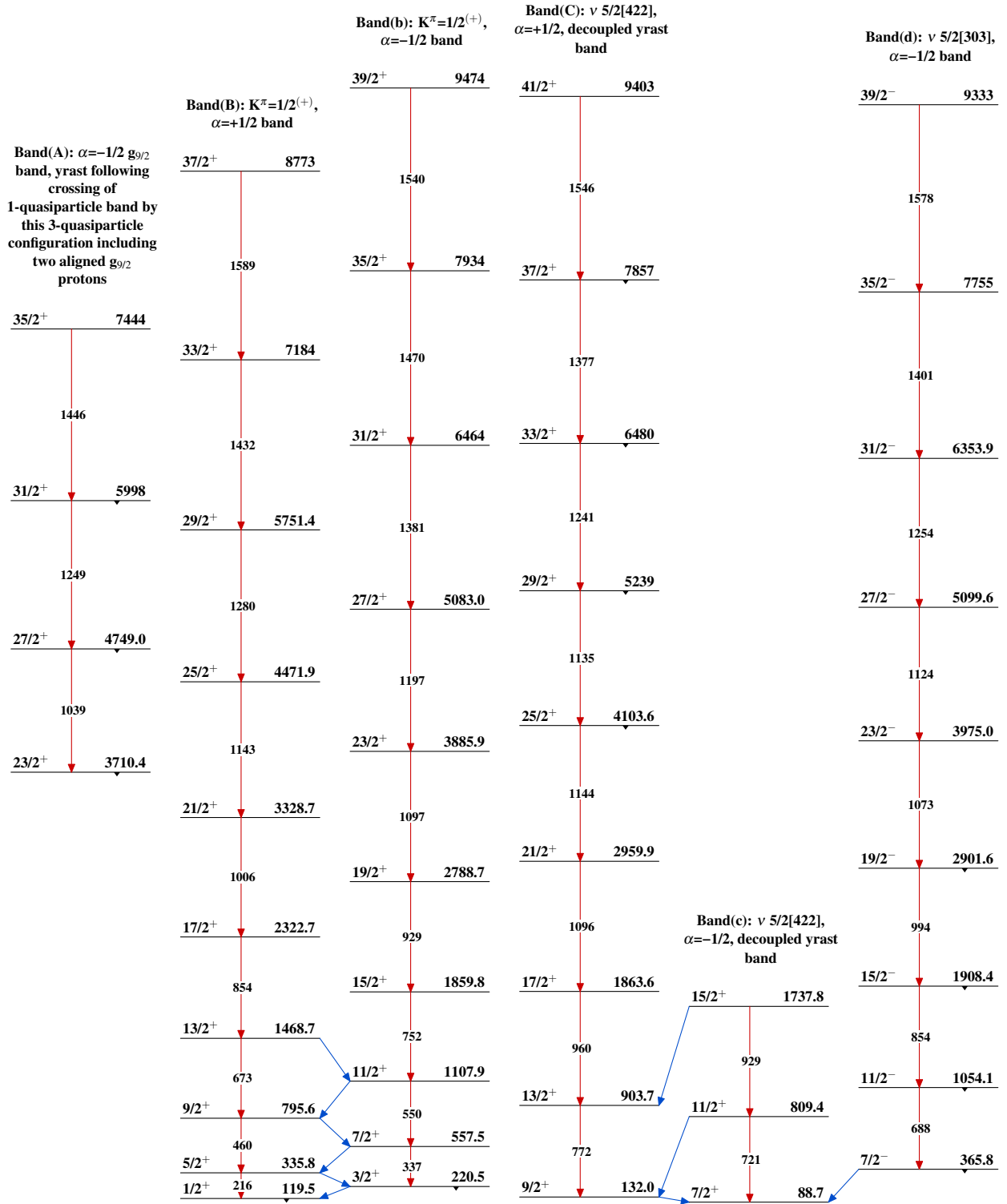
Level Scheme (continued)

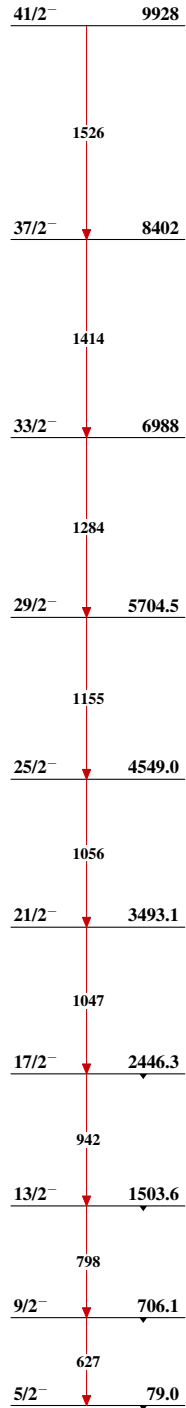
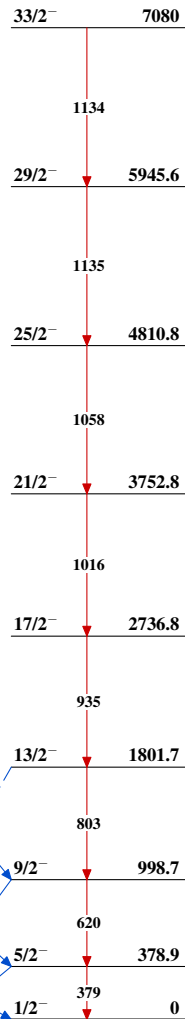
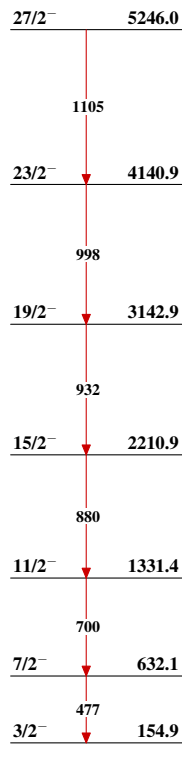


$^{81}_{38}\text{Sr}_{43}$



$^{53}\text{Cr}(^{31}\text{P}, p2n\gamma)$  1993LiZX



$^{53}\text{Cr}(^{31}\text{P},\text{p}2\text{n}\gamma)$  1993LiZX (continued)Band(D):  $\nu$  5/2[303],  
 $\alpha=+1/2$  bandBand(E):  $\nu$  1/2[301],  
 $\alpha=+1/2$  bandBand(e):  $\nu$  1/2[301],  
 $\alpha=-1/2$  band $^{81}_{38}\text{Sr}_{43}$