## $^{51}$V(p,$\gamma$) E=res:IAR 1978Pr04,1974Ro44,1973Fa12

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Yang Dong, Huo Junde | NDS 128, 185 (2015) | 10-Jul-2015 |

Target $J^{\pi}$=7/2$^{-}$.
1966Te01: E≈0.7-2.5 MeV, $\gamma(\theta)$, 11*10 cm NaI detector.
1967Ar19: E≈0.7-2.5 MeV, $\sigma(\theta)$.
1971De25: E≈1.2-2.4 MeV, $\gamma(\theta)$, a Ge(Li) detector.
1971Ah02, 1972Ah08: E<3.2 MeV, $\gamma(\theta)$, 5 in * 6 in NaI(Tl) detector.
1972Pr15: E=1.567, 1.629 MeV, $\gamma(\theta)$, 30 cm$^3$ Ge(Li) detectors.
1973Fa12: E=0.74-0.82 MeV, $\gamma(\theta)$, 60 cm$^3$ coaxial Ge(Li) detector.
1974Ro44: E=0.72-1.30 MeV, $\gamma(\theta)$, two NaI(Tl) detector, 10.2*10.2 cm 10.2*12.7 cm, respectively.
1978Pr04: E=0.7-2.0 MeV, $\gamma(\theta)$, 94 cm$^3$ Ge(Li) detector with resolution 5.5 keV at 1.33 MeV.
A number of weak resonances reported by 1974Ro44 are not included here. See this reference for details.
Assignment of resonances as analogs of states in $^{52}$V were made by all authors. Cases of disagreement are noted.
Others: 1977AwZY, 1976AwZZ, 1977RaZK, 1975RaYK.

### $^{52}$Cr Levels

| E(level)† | J$^{\pi}$‡ | S# | Comments |
|---|---|---|---|
| 0 | 0$^+$ | | |
| 1434 | 2$^+$ | | |
| 2369 | 4$^+$ | | |
| 2768 | 4$^+$ | | |
| 2965 | 2$^+$ | | |
| 3114 | 6$^+$ | | |
| 3162 | 2$^+$ | | |
| 3414 | 4$^+$ | | |
| 3472 | 3$^+$ | | |
| 3616 | 5$^+$ | | |
| 3947 | ($^+$) | | |
| 4015 | 5$^+$ | | |
| 4039 | 4$^+$ | | |
| 4611 | 3,4$^+$ | | |
| 4630? | | | |
| 4742 | | | |
| 4808 | | | |
| 4837 | | | |
| 5054 | ($^+$) | | |
| 5097 | | | |
| 5446 | | | |
| 5563 | | | |
| 5664 | | | |
| 5724 | | | |
| 5737 | | | |
| 5860 | | | |
| 6034 | | | |
| 6204 | | | |
| 6374 | | | |
| 6389 | | | |
| 6794 | | | |
| S(p)+739 *2* | | 0.03 *1* | E(p)=739 *2* (1974Ro44). |
| S(p)+766 *2* | | 0.05 *2* | E(p)=766 *2* (1974Ro44). Other: 763 *6* (1966Te01). |
| S(p)+773 *2* | $^+$ | 0.06 *1* | E(p)=773 *2* (1974Ro44).<br>IAS ($^{52}$V g.s.). Some authors identify resonance at 766 keV as g.s. IAS. However, from a comparison of relative M1 transition rates from S(p)+773 state with Gamow-Teller $\beta$ decay matrix |

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## $^{51}$V(p,$\gamma$) E=res:IAR 1978Pr04,1974Ro44,1973Fa12 (continued)

### $^{52}$Cr Levels (continued)

| E(level)[†] | J$^{\pi}$[‡] | S[#] | Comments |
|---|---|---|---|
| | | | elements for $^{52}$V g.s. 1973Fa12 concluded that most of the IAS strength lies in the E(p)=773 keV resonance. The 766 keV resonance might still be a fragment of the g.s. IAS. J$^{\pi}$: from $\gamma(\theta)$ (1973Fa12). |
| S(p)+784 *2* | (5$^{+}$) | 0.13 *3* | E(p)=784 *2* (1974Ro44). Others: 781 *10* (1967Ar19), 781 *6* (1966Te01). Identified as fragment of IAS ($^{52}$V 23 keV). J$^{\pi}$: from $\gamma(\theta)$ (1973Fa12). |
| S(p)+800 *2* | | 0.06 *2* | E(p)=800 *2* (1974Ro44). Other: 795 *10* (1967Ar19). |
| S(p)+912 *2* | 4$^{+}$ | 0.58 *10* | E(p)=912 *2* (1974Ro44). Others: 915 (1972Ah08), 915 *10* (1967Ar19), 910 *6* (1966Te01). Identified by 1974Ro44 as IAS ($^{52}$V 148 keV). J$^{\pi}$: from $\gamma(\theta)$ (1978Pr04). |
| S(p)+1174 *2* | | 0.84 *24* | E(p)=1174 *2* (1974Ro44). |
| S(p)+1210 *2* | | 3.0 *8* | E(p)=1210 *2* (1974Ro44). Others: 1210 (1972Ah08), 1217 (1971De25), 1202 *10* (1967Ar19), 1210 *6* (1966Te01). IAS ($^{52}$V 437 keV). |
| S(p)+1232 *2* | | 0.56 *16* | E(p)=1232 *2* (1974Ro44). |
| S(p)+1244 *2* | | 1.2 *3* | E(p)=1244 *2* (1974Ro44). |
| S(p)+1265 *2* | | 1.5 *4* | E(p)=1265 *2* (1974Ro44). |
| S(p)+1558 *6* | | | E(p)=1558 *6* (1966Te01). Others: 1559 (1972Ah08), 1559 (1971De25). There is some confusion in the literature concerning the existence of a resonance at this energy and the correspondence of resonances observed by various authors. 1972Ah08 associated the resonance which they reported at E(p)=1559 keV with the resonances of 1966Te01 and 1967Ar19 (1565 and 1562 keV, respectively) which we associate with the S(p)+1564 keV level. See 1971De25 for information on $\gamma$ decay. |
| S(p)+1564 *5* | 3$^{+}$ | 0.65[@] *15* | E(p)=1564 *5*. E(p) is from weighted average of 1562 *10* (1967Ar19) and 1565 *6* (1966Te01). Others: 1567 (1972Pr15), 1568 (1971De25). J$^{\pi}$: IAS ($^{52}$V 793 keV (3$^{+}$)) and this resonance state has a total branch of about 35% to the first two 4$^{+}$ states, 1978Pr04 assigned 3$^{+}$ to the level. |
| S(p)+1628 *5* | 4$^{+}$ | 5.4[@] *11* | E(p)=1628 *5*. E(p) is from weighted average of 1626 *10* (1967Ar19) and 1629 *6* (1966Te01). Others: 1620 (1972Ah08), 1629 (1971De25), 1629 (1972Pr15). IAS ($^{52}$V 846 keV). J$^{\pi}$: this resonant state does not decay to any level whose spin is known to be less than 3. It has 23% branch to the first 4$^{+}$ level and 6% branch to the 5$^{+}$ state at 3.616 MeV, see 1978Pr04 for details. |
| S(p)+2203 *6* | | | E(p)=2203 *6* (1966Te01). Other: 2205 (1972Ah08). IAS ($^{52}$V 1418 keV)? |
| S(p)+2273 *6* | | | E(p)=2273 *6* (1966Te01). IAS ($^{52}$V 1492 keV)? |
| S(p)+2333 *6* | 4$^{+}$ | | E(p)=2333 *6* (1966Te01). Others: 2329 (1977AwZY,1972Ah08), 2333 (1971De25). IAS ($^{52}$V 1559 keV)? J$^{\pi}$: from $\gamma(\theta)$ (1971De25). |
| S(p)+2521 *6* | | | E(p)=2521 *6* (1966Te01). Other: 2514 (1972Ah08). IAS ($^{52}$V 1733 keV)? |
| S(p)+2538 *6* | | | E(p)=2538 *6* (1966Te01). Other: 2537 (1972Ah08). IAS ($^{52}$V 1759 keV)? |
| S(p)+2583 *6* | | | E(p)=2583 *6* (1966Te01). Other: 2576 (1972Ah08). IAS ($^{52}$V 1842 keV)? |
| S(p)+2870 | | | E(p)=2870 (1972Ah08). |
| S(p)+2945 | | | E(p)=2945 (1972Ah08). |
| S(p)+2972 | | | E(p)=2972 (1972Ah08). |

† For resonance states, E(level) is given as S(p)+E(p), where E(p) is the lab energy and S(p)=10503.4 *9* (2012Wa38).
‡ Spins shown for levels were assumed in $\gamma(\theta)$ analyses, see 1978Pr04, except as noted.

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## $^{51}V(p,\gamma)$ E=res:IAR 1978Pr04,1974Ro44,1973Fa12 (continued)

### $^{52}Cr$ Levels (continued)

[#] Resonance strength S=(2J+1)Γ(γ)Γ(p)/Γ(eV). From 1974Ro44, except as noted.
[@] From 1972Pr15.

### $\gamma(^{52}Cr)$

| $E_\gamma$ [†] | $I_\gamma$ [‡] | $E_i$(level) | $J^\pi_i$ | $E_f$ | $J^\pi_f$ | Mult. [f] | $\delta$ [f] |
|---|---|---|---|---|---|---|---|
| 4479 | 18 *3* | S(p)+784 | (5+) | 6794 | | | |
| 4899 | 6 *2* | S(p)+784 | (5+) | 6389 | | | |
| 5069 | 9 *3* | S(p)+784 | (5+) | 6204 | | | |
| 5239 | 5 *2* | S(p)+784 | (5+) | 6034 | | | |
| 5302 | 10 *1* | S(p)+1210 | | 6389 | | | |
| 5549 | 25 *3* | S(p)+784 | (5+) | 5737 | | | |
| 5836 | 23 *2* | S(p)+912 | 4+ | 5563 | | | |
| 5953 | 11 *2* | S(p)+912 | 4+ | 5446 | | | |
| 6027 | 7 *1* | S(p)+1210 | | 5664 | | | |
| 6239 | 9 *2* | S(p)+1628 | 4+ | 5860 | | | |
| 6245 | 16 *1* | S(p)+1210 | | 5446 | | | |
| 6362 | 9 *2* | S(p)+1628 | 4+ | 5737 | | | |
| 6471 | 5 *1* | S(p)+1558 | | 5563 | | | |
| 6588 | 5 *1* | S(p)+1558 | | 5446 | | | |
| 6595 | 11 *1* | S(p)+1564 | 3+ | 5446 | | | |
| 6637 [@] | 4 [&] *2* | S(p)+1210 | | 5097 | | | |
| 6653 | 7 *2* | S(p)+1628 | 4+ | 5446 | | | |
| 6854 | [a] | S(p)+1210 | | 4837 | | | |
| 6883 | [a] | S(p)+1210 | | 4808 | | | |
| 6949 | 11 *1* | S(p)+1210 | | 4742 | | | |
| 7002 | 3 *1* | S(p)+1628 | 4+ | 5097 | | | |
| 7233 | 5 *1* | S(p)+1564 | 3+ | 4837 | | | |
| 7258 | 15 *3* | S(p)+784 | (5+) | 4039 | 4+ | | |
| 7326 | 6 *2* | S(p)+784 | (5+) | 3947 | (+) | | |
| 7360 | [b] | S(p)+912 | 4+ | 4039 | 4+ | | |
| 7384 | [b] | S(p)+912 | 4+ | 4015 | 5+ | | |
| 7404 | 11 *1* | S(p)+1558 | | 4630? | | | |
| 7469 | 7 *1* | S(p)+1628 | 4+ | 4630? | | | |
| 7648 | <4 | S(p)+773 | + | 3616 | 5+ | | |
| 7652 | [c] | S(p)+1210 | | 4039 | 4+ | | |
| 7676 | [c] | S(p)+1210 | | 4015 | 5+ | | |
| 7783 | 10 *1* | S(p)+912 | 4+ | 3616 | 5+ | | |
| 7792 | <2 | S(p)+773 | + | 3472 | 3+ | | |
| 7850 | 17 *3* | S(p)+773 | + | 3414 | 4+ | M1+E2 | +0.06 *9* |
| 7859 | 2 *1* | S(p)+784 | (5+) | 3414 | 4+ | M1+E2 | +0.47 *10* |
| 7985 | 8 *1* | S(p)+912 | 4+ | 3414 | 4+ | | |
| 8060 [e] | 7 [ed] *1* | S(p)+1628 | 4+ | | | | |
| 8084 [e] | 3.0 [ed] *5* | S(p)+1628 | 4+ | 4039 | 4+ | | |
| 8150 | 11 *4* | S(p)+773 | + | 3114 | 6+ | | |
| 8152 | 5 *1* | S(p)+1628 | 4+ | 3947 | (+) | | |
| 8219 [@] | 9 [&] *2* | S(p)+1210 | | 3472 | 3+ | | |
| 8277 | 2 *1* | S(p)+1210 | | 3414 | 4+ | | |
| 8285 | 2 *1* | S(p)+912 | 4+ | 3114 | 6+ | | |
| 8291 | 54 | S(p)+766 | | 2965 | 2+ | | |
| 8299 | <2 | S(p)+773 | + | 2965 | 2+ | | |
| 8483 | 6 *1* | S(p)+1628 | 4+ | 3616 | 5+ | | |
| 8488 | 46 | S(p)+766 | | 2768 | 4+ | | |
| 8496 | 5 *3* | S(p)+773 | + | 2768 | 4+ | | |

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## $^{51}V(p,\gamma)$ E=res:IAR 1978Pr04,1974Ro44,1973Fa12 (continued)

### $\gamma(^{52}Cr)$ (continued)

| $E_\gamma$ [†] | $I_\gamma$ [‡] | $E_i$(level) | $J^\pi_i$ | $E_f$ | $J^\pi_f$ | Mult. [f] | $\delta$ [f] |
|---|---|---|---|---|---|---|---|
| 8529 | 4 *1* | S(p)+1210 | | 3162 | $2^+$ | | |
| 8562 | 4 *2* | S(p)+1558 | | 3472 | $3^+$ | | |
| 8569 | 12 *1* | S(p)+1564 | $3^+$ | 3472 | $3^+$ | | |
| 8620 | 23 *2* | S(p)+1558 | | 3414 | $4^+$ | | |
| 8627 | 5 *1* | S(p)+1564 | $3^+$ | 3414 | $4^+$ | | |
| 8627[e] | 4.0[e] *6* | S(p)+1628 | $4^+$ | | | | |
| 8685 | 12 *2* | S(p)+1628 | $4^+$ | 3472 | $3^+$ | | |
| 8726[@] | 8[&] *2* | S(p)+1210 | | 2965 | $2^+$ | | |
| 8879 | 16 *1* | S(p)+1564 | $3^+$ | 3162 | $2^+$ | | |
| 8895 | 44 *7* | S(p)+773 | + | 2369 | $4^+$ | M1+E2 | +0.9 *+10−5* |
| 8904 | 14 *2* | S(p)+784 | $(5^+)$ | 2369 | $4^+$ | M1+E2 | +0.19 *10* |
| 8923 | 3 *1* | S(p)+1210 | | 2768 | $4^+$ | | |
| 9030 | 38 *2* | S(p)+912 | $4^+$ | 2369 | $4^+$ | M1+E2 | 0.5[g] *2* |
| 9069 | 4 *2* | S(p)+1558 | | 2965 | $2^+$ | | |
| 9076 | 2 *1* | S(p)+1564 | $3^+$ | 2965 | $2^+$ | | |
| 9178 | 25[#] | S(p)+2333 | $4^+$ | 3616 | $5^+$ | | |
| 9266 | 17 *1* | S(p)+1558 | | 2768 | $4^+$ | | |
| 9273 | 8 *1* | S(p)+1564 | $3^+$ | 2768 | $4^+$ | | |
| 9322 | 8 *1* | S(p)+1210 | | 2369 | $4^+$ | | |
| 9331 | 8 *1* | S(p)+1628 | $4^+$ | 2768 | $4^+$ | | |
| 9665 | 18 *1* | S(p)+1558 | | 2369 | $4^+$ | | |
| 9672 | 26 *1* | S(p)+1564 | $3^+$ | 2369 | $4^+$ | | |
| 9730 | 23 *2* | S(p)+1628 | $4^+$ | 2369 | $4^+$ | | |
| 9830 | 15 *2* | S(p)+773 | + | 1434 | $2^+$ | M1+E2 | −0.30 *6* |
| 9856 | 100 | S(p)+800 | | 1434 | $2^+$ | | |
| 10257 | 30 *2* | S(p)+1210 | | 1434 | $2^+$ | | |
| 10424 | 31[#] | S(p)+2333 | $4^+$ | 2369 | $4^+$ | | |
| 10600 | 11 *1* | S(p)+1558 | | 1434 | $2^+$ | | |
| 10607 | 14 *1* | S(p)+1564 | $3^+$ | 1434 | $2^+$ | | |

[†] Only primary $\gamma$'s are given.
[‡] Photon branching ratio (%). Values are from 1973Fa12 (E(p)<900 keV) and 1978Pr04 (E(p)>900 keV), except as noted.
[#] Branching ratio from 1977AwZY.
[@] From 1974Ro44.
[&] From 1974Ro44. Not reported by 1978Pr04. If branch exists, the % branches of 1978Pr04 should be lowered.
[a] Iγ=3 *1* for the 6854, 6883 doublet.
[b] Iγ=8 *1* for the 7360, 7384 doublet.
[c] Iγ=5 *1* for the 7652, 7676 doublet.
[d] 1978Pr04 reported a branching of 12% *1* for the 8060, 8084 doublet.
[e] From 1972Pr15.
[f] From $\gamma(\theta)$ in 1973Fa12, except as noted. D+Q transitions assigned (M1+E2) from level scheme.
[g] From 1974Ro44.

## $^{51}$V(p,$\gamma$) E=res:IAR 1978Pr04,1974Ro44,1973Fa12

Level Scheme

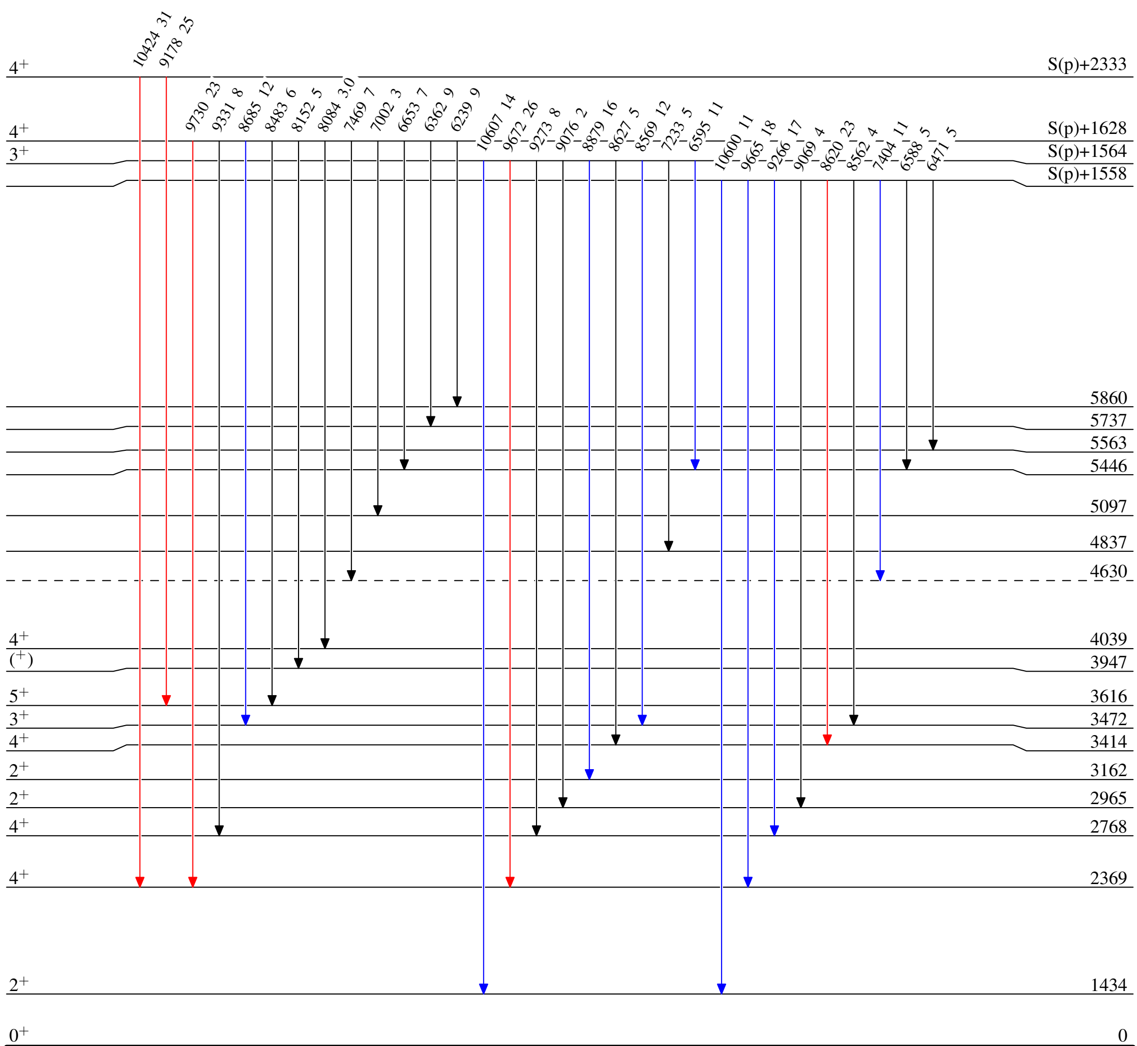
Intensities: Relative $I_\gamma$

Legend

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

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

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




$^{52}_{24}Cr_{28}$

**$^{51}V(p,\gamma)$ E=res:IAR 1978Pr04,1974Ro44,1973Fa12**

Level Scheme (continued)

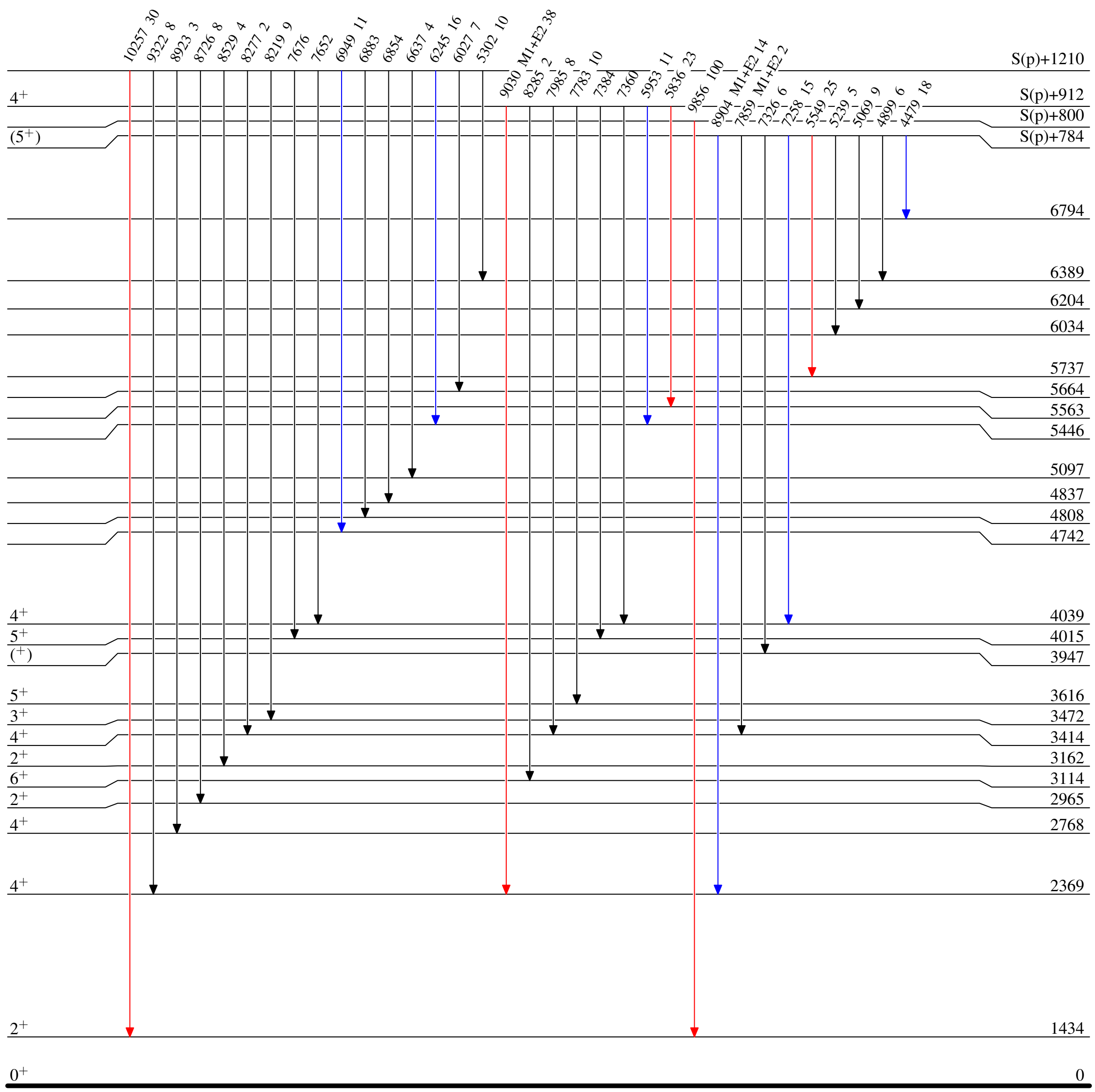
Intensities: Relative $I_\gamma$

Legend

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

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

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

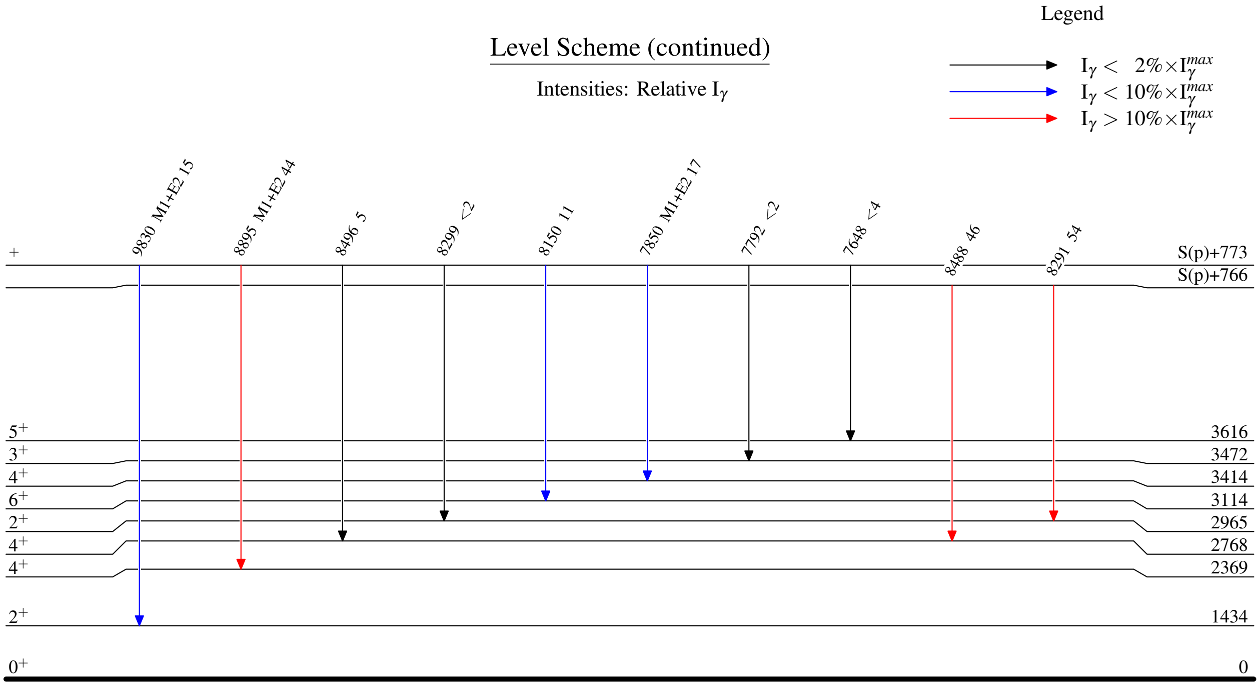



$^{52}_{24}Cr_{28}$

## $^{51}V(p,\gamma)$ E=res:IAR 1978Pr04,1974Ro44,1973Fa12

### Level Scheme (continued)

Intensities: Relative $I_\gamma$




$^{52}_{24}Cr_{28}$