

$^{31}\text{P}(\text{p},\alpha),(\text{p},\text{p})$:resonances **1967Ri07,1960Cl02,1967Ve05**

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$J^\pi(^{31}\text{P g.s.})=1/2^+$.

Includes $^1\text{H}(^{31}\text{P},\alpha)$ from 2011Mo12.

- 1967Ri07:** (p, α) E=1-3 MeV protons were from the University of Texas KN 4MV accelerator and E=2.8 MeV protons from the University of Texas EN tandem accelerator, in steps of 1 keV. Targets were natural red phosphorus. α particles were detected with surface barrier detectors. Measured excitations, $\sigma(\theta)$, yields. Deduced resonance levels, J, π , widths.
- 1960Cl02:** (p, α) E=1-3 MeV protons were from Chalk River electrostatic accelerator. Targets were Zn_3P_2 . α particles were momentum-analyzed with a double-focusing magnetic spectrometer and detected with a scintillation counter (KI and CsI). Measured energy spectra, yields. Deduced resonance levels, strengths, widths.
- 1967Ve05:** (p, α) E=1.4-1.9 MeV protons were from the Van de Graaff accelerator at Laboratoire Joliot-Curie. Targets were Zn_3P_2 . α particles were detected with surface barrier detectors. Measured excitation functions, yields, $\sigma(\theta)$. Deduced resonance levels, J, π , strengths and widths.
- 1988Fa01:** (p,p),(p, α) E=1.00-4.01 MeV protons were produced from the KN Van de Graaff accelerator at TUNL, in steps of 0.1-0.4 keV. Targets were Zn_3P_2 on carbon backings. Reaction products were detected with surface-barrier detectors. Measured excitation functions. Deduced resonance levels, J, π , widths from R-matrix analysis. Authors claim a total of 143 resonances were observed, but only a few are presented with numerical data in 1988Fa01.
- 1968Gu01:** (p,p),(p, α) E=1.0-2.02 MeV protons (in steps of 1-2 keV) were from the Van de Graaff, Laboratoire de Physique, Ecole Polytechnique, Paris. Targets were PH_3 targets. α particles were detected with scintillator detectors. Measured excitation functions, $\sigma(\theta)$. Deduced resonance levels, J, π , widths.
- 1973Ve08,1976Ve03:** 1.24-1.60 MeV from 4MV Van de Graaff accelerator at Orsay Institute and a 2MV Van de Graaff at the Centre for Nuclear Research, Strasbourg-Cronenbourg. Natural Phosphorus targets. Measured $\sigma(E_p)$. Deduced widths.
- 2011Mo12:** $^1\text{H}(^{31}\text{P},\alpha)$ E=19.78, 19.80, 19.845 and 19.875 keV ^{31}P beams were produced from the Holifield Radioactive Ion Beam Facility (HRIBF). Target was hydrogen gas. Charged particles were detected with the SIDAR silicon detector array and a Micron Type S1 detector. Measured energy spectra, $\sigma(\theta)$. Deduced resonance strengths for 600- and 622-keV proton resonances.
- 1963Ku24:** (p, α) E=0.2-0.87 MeV protons were from the Utrecht Cockroft-Walton generator. Targets were Zn_3P_2 . α particles were detected with surface barrier Si detectors. Measured alpha spectra, yields, $\sigma(\theta)$. Deduced resonance levels, J, π , widths, strengths.
- 1973Sh07:** blocking technique used to investigate lifetime of one level (642 keV).
- 1995Ro22:** proton-unbound levels were populated using $^{31}\text{P}(\text{He},\text{d})$ with $E(^3\text{He})=25$ keV. Measured particle and γ spectra in coincidence with deuterons. Deduced proton-resonance levels, relative decay widths.
- Others: 1963Co03, 1966Ve10, 1968Da03, 1968Vo04, 1969Ka12, 1969An33, 1969He01.

 ^{32}S Levels

E(p) values given under comments are from 1967Ri07 in the lab frame, unless values from other references are given or noted otherwise.

Resonance strength $\omega\gamma=(2J+1)/[(2J_t+1)(2j+1)]\times\Gamma_\alpha\Gamma_p/\Gamma$, where J is the spin of resonance, J_t spin of target nucleus, and j the angular momentum of light beam nuclide.

E(level) [†]	J^π [‡]	$\omega\gamma$ (eV) [‡]	Comments
(9023 [@])	3 ^{-@}		E(p)(c.m.)=159, $\Gamma_\alpha/\Gamma=0.37$ 13, $\Gamma_\gamma/\Gamma=0.75$ 19 (1995Ro22), but the authors don't explain why the sum of α and γ decay branches is greater 100%. In Adopted Levels, the evaluator has adopted % α and % γ deduced from the ratio of Γ_α/Γ and Γ_γ/Γ here.
(9059 [@])	(1,2) ^{-@}		E(p)(c.m.)=194; $\Gamma_\alpha/\Gamma\leq 0.03$; $\Gamma_\gamma/\Gamma=1.0$ 2 (1995Ro22).
(9170 [@])	3 ^{+@}		E(p)(c.m.)=305; $\Gamma_\alpha/\Gamma\leq 0.08$; $\Gamma_\gamma/\Gamma=1.0$ 3 (1995Ro22).
9208?	1 ⁺	<0.0075 ^{&}	E(level): E(p)=355 (1963Ku24); E(p)(c.m.)=344 (1995Ro22). J^π : from 1995Ro22. $\Gamma_\alpha/\Gamma\leq 0.05$; $\Gamma_\gamma/\Gamma=1.2$ 3 (1995Ro22).
9236	1 ⁻	<0.075 ^{&}	E(level): E(p)=384 (1963Ku24); E(p)(c.m.)=371 (1995Ro22). J^π : from 1995Ro22.

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$^{31}\text{P}(\text{p},\alpha),(\text{p},\text{p})$:resonances 1967Ri07,1960Cl02,1967Ve05 (continued) ^{32}S Levels (continued)

E(level) [†]	J^π [‡]	Γ [‡]	L [#]	$\omega\gamma$ (eV) [‡]	Comments
(9255 [@])	2 ⁺ [@]				$\Gamma_\alpha/\Gamma=1.00$ 8; $\Gamma_\gamma/\Gamma<0.15$ (1995Ro22).
9289	1 ⁺			<0.01 ^{&}	E(p)(c.m.)=390; $\Gamma_\alpha/\Gamma\leq 0.08$; $\Gamma_\gamma/\Gamma=0.84$ 22 (1995Ro22). E(level): E(p)=439 (1963Ku24); E(p)(c.m.)=425 (1995Ro22). J^π : from 1995Ro22.
9388	2 ⁻			<0.01 ^{&}	$\Gamma_\alpha/\Gamma\leq 0.13$; $\Gamma_\gamma/\Gamma=1.03$ 26 (1995Ro22). E(level): E(p)=541 (1963Ku24); E(p)(c.m.)=524 (1995Ro22). J^π : from 1995Ro22.
9462.3 9	(2 ⁺ ,3 ⁻)	3.1 eV		0.025 ^{&}	$\Gamma_\alpha/\Gamma\leq 0.02$; $\Gamma_\gamma/\Gamma<0.05$ (1995Ro22). E(level): E(p)=618.7 9 (1963Ku24); E(p)(c.m.)=600 (1995Ro22). $\omega\gamma$ (eV): other: 0.022 eV 7 (2011Mo12). J^π, Γ : from 1963Ku24, spin from $\sigma(\theta)$. Additional information 1.
9485	1 ⁻	8.2 eV 25		0.99 8	E(level): E(p)=641 (1963Ku24), 642 (1973Sh07). J^π : spin from $\sigma(\theta)$ in 1963Ku24. Γ : from 1973Sh07. $\omega\gamma$ (eV): from 2011Mo12. Other: 1.35 (1963Ku24). Additional information 2.
9651				<0.03 ^{&}	E(level): E(p)=812 (1963Ku24).
9658		8.2 eV 25		<0.065 ^{&}	E(level): E(p)=820 (1963Ku24).
9856 10	1 ⁻	0.8 keV		5.0	E(level): E(p)=1024 10 (1960Cl02), 1014 10 (1967Ri07), 1020 (1968Gu01). J^π : 1 ⁻ also from $\sigma(\theta)$ of (p, α) in 1968Gu01. Γ : others: ≥ 3 keV (1960Cl02), 3 keV (1968Gu01). $\omega\gamma$ (eV): other: 26 eV (1960Cl02). $\Gamma_\alpha=35$ eV (1960Cl02).
9988 10	0 ⁺	≈ 4 keV		6.1	E(level): E(p)=1161 10 (1960Cl02), 1158 (1968Gu01). Γ : from 1960Cl02. Other: 2 keV (1968Gu01). J^π : from $\sigma(\theta)$ of (p, α) in 1968Gu01. $\omega\gamma$ (eV): from 1960Cl02.
10072.1 15	2 ⁻	1.60 keV 24	1+3		$\Gamma_\alpha=3.1$ eV (1960Cl02). E(level): E(p)=1247.4 15 (1973Ve08), 1250 3 (1988Fa01). J^π, Γ : from 1973Ve08.
10219.2 8	3 ⁺	≤ 10 eV	2		$\Gamma_p=1.50$ keV 15 (1988Fa01), 1.60 keV 24 (1973Ve08). E(level): E(p)=1399.3 8 (1973Ve08), 1403 3 (1988Fa01), 1403 6 (1967Ve05), 1404 10 (1960Cl02), 1400 10 (1967Ri07). J^π, Γ : from 1973Ve08.
10221.2 15	3 ⁻	0.065 keV 25	3	24 4	$\Gamma_p\leq 10$ eV (1973Ve08). E(level): E(p)=1401.9 15 (1973Ve08), 1403 3 (1988Fa01), 1403 6 (1967Ve05), 1404 10 (1960Cl02), 1400 10 (1967Ri07), 1404 (1968Gu01). Additional information 3. J^π, Γ : from 1973Ve08.
10225.0 16	1 ⁻	0.165 keV 25	1		Γ : from 1973Ve08. Others: ≤ 0.7 keV (1967Ve05), ≈ 6 keV (1960Cl02), 1.5 keV (1968Gu01), 1.8 keV (1967Ri07). $\omega\gamma$ (eV): others: 33 eV (1960Cl02), 11 (1967Ri07). $\Gamma_p=16$ eV 2 (1988Fa01), 16 eV 6 (1973Ve08). $\Gamma_\alpha=49$ eV 17 (1973Ve08).
10230.1 8	1 ⁺	25 eV 10	0+2		E(level): E(p)=1405.1 15 (1973Ve08). J^π, Γ : from 1973Ve08, with J^π from analysis of $\sigma(\theta)$ and L(p,p)=1 from 1/2 ⁺ of ^{31}P g.s.
10256.0 15	4 ⁻	45 eV 20	3		E(level): E(p)=1410.6 18 (1973Ve08). J^π : from 1973Ve08. $\Gamma_p=0.025$ eV 10 (1973Ve08). E(level): E(p)=1437.3 15 (1973Ve08), 1438 3 (1988Fa01).

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$^{31}\text{P}(\text{p},\alpha),(\text{p},\text{p})$:resonances [1967Ri07](#),[1960Cl02](#),[1967Ve05](#) (continued) ^{32}S Levels (continued)

<u>E(level)[†]</u>	<u>J^π[‡]</u>	<u>Γ[‡]</u>	<u>L[#]</u>	<u>ωγ (eV)[‡]</u>	<u>Comments</u>
10286.7 15	3 ⁻	0.18 keV 6	1+3	12 2	J ^π : from 1973Ve08 . Γ _p =35 eV 4 (1988Fa01), 45 eV 20 (1973Ve08). E(level): E(p)=1469.0 15 (1973Ve08), 1470 6 (1967Ve05), 1468 (1968Gu01), 1468 7 (1966Ve10). J ^π : spin from σ(θ) in 1967Ve05 ; 3 ⁻ also in 1968Gu01 . Γ: from 1973Ve08 . Others: ≤0.55 keV (1967Ve05), <=1 keV (1968Gu01). ωγ (eV): from 1967Ve05 . Γ _p =9 eV 4, Γ _α =170 eV 60 (1973Ve08).
10290.2 6	2 ⁻	0.125 keV 20	1		E(level): E(p)=1472.1 15 (1973Ve08). J ^π : from 1973Ve08 . Γ _p =0.125 keV 20 (1973Ve08).
10292.0 15	2 ⁺	1.3 keV	2	15 4	E(level): E(p)=1474.3 15 (1973Ve08), 1476 6 (1967Ve05), 1474 10 (1960Cl02), 1466 10 (1967Ri07), 1475 (1968Gu01). J ^π : from 1973Ve08 . Other: J=2 also from 1967Ve05 ; 2 ⁺ , 3 ⁻ from σ(θ) in 1968Gu01 . Γ: others: ≤0.45 keV (1967Ve05), ≤2.4 keV (1960Cl02), 1.5 keV (1968Gu01). ωγ (eV): from 1967Ve05 . Others: 16 eV (1967Ri07), 8.5 eV (1960Cl02). Γ _α =11.3 eV (1960Cl02).
10331.0 6	1 ⁻	7 eV 1	1	750 75	E(level): E(p)=1514.8 15 (1973Ve08), 1514 6 (1967Ve05), 1514 10 (1960Cl02), 1513 10 (1967Ri07), 1515 (1968Gu01), 1509 7 (1966Ve10). J ^π : spin=1 from σ(θ) in 1967Ve05 , L(p,p)=1 (1973Ve08). Γ: from 1967Ve05 . Others: 7 keV 2 (1960Cl02), 8 keV (1968Gu01), 8.3 keV (1967Ri07). ωγ (eV): from 1967Ve05 . Others: 770 eV (1960Cl02), 690 (1967Ri07). Γ _α =1.03 keV (1960Cl02), 3.8 keV 6 (1973Ve08). Γ _p =3.8 keV 6.
10370.3 3	2 ⁺	30 eV 10	2		E(level): E(p)=1555.4 15 (1973Ve08), 1557 3 (1988Fa01). J ^π ,Γ: from 1973Ve08 . Γ _p =25 eV 3 (1988Fa01), 30 eV 10 (1973Ve08).
10396.7 6	4 ⁻	25 eV +20-10	3		E(level): E(p)=1581.1 15 (1973Ve08), 1583 3 (1988Fa01). J ^π : from 1973Ve08 and 1988Fa01 . Γ _p =12 eV 2 (1988Fa01), 25 eV +20-10 (1973Ve08).
10399.2 6	0 ⁻	8.3 keV 13	1		E(level): E(p)=1585.2 15 (1973Ve08), J ^π : from 1973Ve08 . Γ _p =8.3 keV 13 (1973Ve08).
10456 6	0 ⁺ , 1 ⁻	2.9 keV		75 9	E(level): E(p)=1643 6 (1967Ve05), 1640 10 (1960Cl02), 1639 10 (1967Ri07), 1642 (1968Gu01), 1642 7 (1966Ve10). J ^π : spin=0,1 from σ(θ) in 1967Ve05 ; 1 ⁻ from 1968Gu01 . Γ: others: ≤2.3 keV (1967Ve05), ≈4.2 keV (1960Cl02), 6 keV (1968Gu01). ωγ (eV): from 1967Ve05 . Others: 40 (1967Ri07), 58 eV (1960Cl02). Γ _α =77 eV (1960Cl02).
10525 6	2 ⁺	1.8 keV		6.0 13	E(level): E(p)=1715 6 (1967Ve05), 1710 10 (1960Cl02), 1715 10 (1967Ri07), 1715 (1968Gu01), 1713 7 (1966Ve10). J ^π : spin from σ(θ) (1967Ve05). Γ: others: ≤1.2 keV (1967Ve05), ≤5.5 keV (1960Cl02), 2.5 keV (1968Gu01). ωγ (eV): from 1967Ve05 . Others: 9 eV (1960Cl02); 26.5 eV from 1967Ri07 seems discrepant. Γ _α =12 eV (1960Cl02).

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$^{31}\text{P}(\text{p},\alpha),(\text{p},\text{p})$:resonances [1967Ri07](#),[1960Cl02](#),[1967Ve05](#) (continued) ^{32}S Levels (continued)

<u>E(level)[†]</u>	<u>J^{π‡}</u>	<u>Γ[‡]</u>	<u>ωγ (eV)[‡]</u>	<u>Comments</u>
10539		8 keV		E(level): E(p)=1730 (1968Gu01). Γ: from 1968Gu01 .
10605	2 ⁺ ,3 ⁻	3 keV		E(level): E(p)=1798 (1968Gu01). J ^π ,Γ: from σ(θ) of (p,α) in 1968Gu01 .
10624 6	3 ⁻	3.1 keV	28 5	E(level): E(p)=1817 6 (1967Ve05), 1811 10 (1960Cl02), 1815 10 (1967Ri07), 1814 (1968Gu01), 1816 7 (1966Ve10). J ^π : spin from σ(θ) (1967Ve05); 3 ⁻ also from σ(θ) of (p,α) in 1968Gu01 . Γ: others: ≤1.6 keV (1967Ve05), ≈4.7 keV (1960Cl02), 3 keV (1968Gu01). ωγ (eV): from 1967Ve05 . Others: 26 eV (1960Cl02), 16 (1967Ri07). Γ _α =35 eV (1960Cl02).
10701 6	1 ⁻	26 keV 2	1100	E(level): E(p)=1896 6 (1967Ve05), 1892 10 (1960Cl02), 1891 10 (1967Ri07), 1892 (1968Gu01), 1893 7 (1966Ve10). J ^π : spin from σ(θ) in 1967Ve05 ; 1 ⁻ in 1968Gu01 ; 2 ⁺ ,1 ⁻ in 1967Ri07 . Γ: weighted average of 24 keV 3 (1967Ve05) and 27 keV 2 (1960Cl02). Others: 24 keV (1968Gu01), 20 keV (1967Ri07). ωγ (eV): others: 730 eV (1960Cl02); 1750 eV 250 (1967Ve05) seems discrepant. Γ _α =970 eV (1960Cl02).
10771	1 ⁻ ,2 ⁺	2.5 keV		E(level): E(p)=1970 (1968Gu01). J ^π ,Γ: from σ(θ) of (p,α) in 1968Gu01 .
10778 10	2 ⁺ ,(1 ⁻)	4.4 keV	65	E(level): E(p)=1976 10 (1960Cl02), 1971 10 (1967Ri07), 1976 (1968Gu01). Γ: other: ≤2.8 keV (1960Cl02). ωγ (eV): other: 17 eV (1960Cl02). Γ _α =23 eV (1960Cl02).
10790 3	1 ⁻	≤3 keV	38	E(level): E(p)=1989 3 (1988Fa01), 1990 10 (1960Cl02), 1985 10 (1967Ri07), 1983 (1968Gu01). Γ: others: ≤3.6 keV (1960Cl02), 5 keV (1968Gu01). J ^π : other: 2 ⁺ from 1988Fa01 is in disagreement. ωγ (eV): other: 30 eV (1960Cl02). Γ _p =80 eV 8 (1988Fa01), Γ _α =40 eV (1960Cl02).
10822 3	1 ⁻	≈6 keV	68	E(level): E(p)=2022 3 (1988Fa01), 2018 10 (1960Cl02), 2004 10 (1967Ri07), 2018 (1968Gu01). Γ: other: ≤3 keV (1960Cl02), 4 keV (1968Gu01). J ^π : 1 ⁻ also from σ(θ) of (p,α) in 1968Gu01 . ωγ (eV): other: 23 eV (1960Cl02). Γ _p =19 keV 4 (1988Fa01), Γ _α =31 eV (1960Cl02).
10823 3	1 ⁻	15 keV		E(level): E(p)=2023 3 (1988Fa01), 2020 (1968Gu01), 2011 10 (1967Ri07). J ^π ,Γ: from σ(θ) of (p,α) in 1968Gu01 , but 2 ⁺ from 1988Fa01 ; 1 ⁻ and Γ≈4 keV from 1967Ri07 . Γ _p =0.17 keV 2 (1988Fa01).
10829 10		18 keV 2	450	E(level): E(p)=2029 10 (1960Cl02), 2015 10 (1967Ri07). Γ: from 1960Cl02 . Other: ≈4 keV (1967Ri07), 18 keV 2 (1960Cl02). ωγ (eV): from 1960Cl02 . Γ _α =0.6 keV (1960Cl02).
10831 10	2 ⁺ ,(3 ⁻)	≈2.5 keV	54	E(level): E(p)=2031 10 (1960Cl02), 2019 10 (1967Ri07). Γ: other: ≈6 keV (1960Cl02). ωγ (eV): other: 120 eV (1960Cl02). Γ _α =160 eV (1960Cl02).
10841 10		≈0.4 keV	20	E(level): E(p)=2041 10 (1960Cl02), 2027 10 (1967Ri07). Γ: other: ≈6 keV (1960Cl02). ωγ (eV): from 1960Cl02 . Γ _α =27 eV (1960Cl02).
10907 10	1 ⁻	2.1 keV	21	E(level): E(p)=2109 10 (1960Cl02), 2115 10 (1967Ri07). Γ: other: ≤4 keV (1960Cl02). ωγ (eV): other: 1.3 eV (1960Cl02). Γ _α =1.7 eV (1960Cl02).

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$^{31}\text{P}(\text{p},\alpha),(\text{p},\text{p}):$ resonances **1967Ri07,1960Ci02,1967Ve05** (continued) ^{32}S Levels (continued)

E(level) [†]	J ^π [‡]	Γ [‡]	ωγ (eV) [‡]	Comments
10976 3	2 ⁻			E(level): E(p)=2181 3 (1988Fa01). J ^π : from 1988Fa01.
11091 3	3 ⁻			E(level): E(p)=2300 3 (1988Fa01). J ^π : from 1988Fa01.
11221 10	1 ⁻	17 keV 2	220	Γ _p =30 eV 3 (1988Fa01). E(level): E(p)=2434 10 (1960Ci02), 2448 10 (1967Ri07). Γ: from 1960Ci02. Other: 9 keV (1967Ri07). ωγ (eV): other: 407 eV (1960Ci02). Γ _α =540 eV (1960Ci02).
11425 10	1 ⁻	≈4 keV	29	E(level): E(p)=2644 10 (1960Ci02), 2662 10 (1967Ri07). Γ: other: ≈5 keV (1960Ci02). ωγ (eV): other: 23 eV (1960Ci02). Γ _α =31 eV (1960Ci02).
11556 10	(0 ⁺ ,1 ⁻)	8 keV 2	122	E(level): E(p)=2779 10 (1960Ci02), 2808 10 (1967Ri07). Γ: from 1960Ci02. Other: 6.1 keV (1967Ri07). ωγ (eV): other: 120 eV (1960Ci02). Γ _α =160 eV (1960Ci02).
11581 10	1 ⁻	17 keV 2	212	E(level): E(p)=2805 10 (1960Ci02), 2831 10 (1967Ri07). Γ: from 1960Ci02. Other: 10.7 keV (1967Ri07). ωγ (eV): other: 136 eV (1960Ci02). Γ _α =180 eV (1960Ci02).
11648 10	1 ⁻	6.6 keV	130	E(level): E(p)=2874 10 (1960Ci02), 2907 10 (1967Ri07). Γ: other: ≈5 keV (1960Ci02). ωγ (eV): other: 22 eV (1960Ci02). Γ _α =29 eV (1960Ci02).
11695 10	(2 ⁺)	10 keV 2	250	E(level): E(p)=2922 10 (1960Ci02), 2950 10 (1967Ri07). Γ: from 1960Ci02. Other: 8.0 keV (1967Ri07). ωγ (eV): other: 273 eV (1960Ci02). Γ _α =360 eV (1960Ci02).
11778 10	2 ⁺ , (1 ⁻)	75 keV 2	1000	E(level): E(p)=3008 10 (1960Ci02), 3040 10 (1967Ri07). Γ: from 1960Ci02. Other: 30 keV (1967Ri07). ωγ (eV): other: 1370 eV (1960Ci02). Γ _α =1830 eV (1960Ci02).
11886 10	1 ⁻	20 keV 2	250	E(level): E(p)=3119 10 (1960Ci02), 3119 (1967Ri07), 3148 10 (1967Ri07). Γ: from 1960Ci02. Other: 7.6 keV (1967Ri07). ωγ (eV): other: 156 eV (1960Ci02). Γ _α =208 eV (1960Ci02).
11937 10	3 ⁻ , 2 ⁺	7.3 keV	59	E(level): E(p)=3173 10.
12015 10	(2 ⁺)	11.8 keV	620	E(level): E(p)=3254 10.
12044 3	4 ⁻	0.47 keV 5		E(level): E(p)=3283 3 (1973Ve06). J ^π : 4 ⁻ with I _p =3 from analysis of yield (1973Ve06). Γ: from 1973Ve06.
12049 3	0 ⁺	<0.17 keV		E(level): E(p)=3289 3 (1973Ve06). J ^π : analog of 5073, 0 ⁺ level in ^{32}P (1973Ve06). Γ: from 1973Ve06.
12151 10	(3 ⁻ , 2 ⁺)	6.9 keV	550	E(level): E(p)=3394 10.
12190 10	0 ⁺	22 keV	300	E(level): E(p)=3434 10.
12297 10	(1 ⁻ , 2 ⁺)	21 keV	600	E(level): E(p)=3545 10.
12389 10	3 ⁻ , (2 ⁺)	4.8 keV	170	E(level): E(p)=3640 10.
12422 10	3 ⁻	7.7 keV	110	E(level): E(p)=3674 10.
12457 10	3 ⁻ , 2 ⁺	13.9 keV	200	E(level): E(p)=3710 10.
12513 10	2 ⁺	7.8 keV	86	E(level): E(p)=3768 10.
12540 10	(2 ⁺ , 1 ⁻)	18.6 keV	290	E(level): E(p)=3796 10.
12580 10	2 ⁺	8.4 keV	45	E(level): E(p)=3837 10.
12596 10	2 ⁺	3.0 keV	90	E(level): E(p)=3853 10.

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$^{31}\text{P}(\text{p},\alpha),(\text{p},\text{p})$:resonances [1967Ri07](#),[1960Cl02](#),[1967Ve05](#) (continued) ^{32}S Levels (continued)

<u>E(level)[†]</u>	<u>J^π[‡]</u>	<u>Γ[‡]</u>	<u>ωγ (eV)[‡]</u>	<u>Comments</u>
12628 10	3 ⁻ ,2 ⁺	7.9 keV	93	E(level): E(p)=3886 10.
13395 10	3 ⁻	10.5 keV	670	E(level): E(p)=4678 10.

[†] From E(level)=E(p)(c.m.)+S(p)(^{32}S), where S(p)=8863.9638 14 ([2021Wa16](#)) and E(p)(c.m.)=E(p)×m(^{31}P)/[m(^{31}P)+m(p)] with masses from [2021Wa16](#). The first E(p) given under comment is used to deduce E(level). E(p) values are primarily from [1967Ri07](#), but note that many of their E(p) values deviate from those in [1960Cl02](#) by up to 29 keV as compared by the authors and are also in disagreement with values from other groups.

[‡] From [1967Ri07](#), unless otherwise noted. Spins are from analysis of measured $\sigma(\theta)$; π=natural for levels populated $^{31}\text{P}(\text{p},\alpha)$:res.

From [1973Ve08](#) for L(p,p').

@ Proton-unbound level not seen in (p,p) or (p,α) but populated in $^{31}\text{P}(\text{}^3\text{He},\text{d})$ with observation of subsequent γ or α decay of the level in coincidence; spin-parities are as given in [1995Ro22](#). E(p)(c.m.) given under comments are deduced from E(level).

& From [1963Ku24](#).