

Coulomb excitation [2013Ga23,2012GaZV](#)

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	J. Chen, M. S. Basunia P. Dimitriou, et al. ,		NDS 212,18 (2026)	31-Mar-2026

Adapted from the XUNDL dataset for [2013Ga23](#), compiled by B. Singh (McMaster University) on September 5, 2013.

[2013Ga23,2012GaZV](#): $E(^{220}\text{Rn})=620.40$ MeV produced by bombardment of thick Uranium carbide target by 1.4 GeV protons from CERN PS booster facility. ^{220}Rn was accelerated in REX-ISOLDE and incident on targets of 2.1 mg/cm^2 ^{60}Ni , 2.0 mg/cm^2 ^{114}Cd , 2.3 mg/cm^2 thick ^{120}Sn . Measured $E\gamma$, $I\gamma$, (particle) γ coin using MINIBALL array of 24 HPGe detectors. Scattered particles (beam and target recoils) were detected in a highly segmented Si detector. Measured yields of γ rays for 22.05° – 37.75° and 37.86° – 51.80° . Data analyzed using GOSIA computer code using as input parameters the known lifetimes and branching ratios for low-lying levels. A total of 22 free parameters (16 matrix elements and one normalization constant for each combination of target and recoil angle range) were determined from 34 independent data points. Deduced E1, E2, E3 matrix elements, and intrinsic quadrupole and octupole moments.

 ^{220}Rn Levels

Magnitude of matrix elements from [2013Ga23](#) are listed, signs are unknown.

Q_1 , Q_2 and Q_3 are intrinsic (or transition) dipole, quadrupole and octupole moments, respectively, and are from [2012GaZV](#) with some additionally listed in [2013Ga23](#).

E(level) [†]	J^π	$T_{1/2}$	Comments
0.0 [#]	0 ⁺		
241.1 [#]	2 ⁺		$Q_2=4.34$ 14 (2013Ga23). $\beta_2=0.119$ (2012GaZV). $\langle 0_1^+ E2 2_1^+ \rangle = 1.37$ 4. $T_{1/2}$: lifetime from literature was used to constrain GOSIA calculations thus, evaluators do not derive a $T_{1/2}$ from the deduced matrix element.
533.7 [#]	4 ⁺	46.1 [‡] ps 18	$Q_2=4.19$ 9. $\langle 2_1^+ E2 4_1^+ \rangle = 2.12$ 4.
645.3 [@]	1 ⁻		Dipole moment $Q_1 < 0.002$, < 0.019 in $\text{eb}^{1/2}$ units. Octupole moment $Q_3 < 6.0$ in $\text{eb}^{3/2}$ units. $\langle 0_1^+ E1 1_1^- \rangle < 0.010$. $\langle 2_1^+ E1 1_1^- \rangle < 0.013$. $\langle 2_1^+ E3 1_1^- \rangle < 2.60$.
663.1 [@]	3 ⁻		Octupole moment $Q_3=2.18$ 13. Octupole moment $Q_3 < 12.0$. $Q_2=4.2$ 15. Dipole moment $Q_1 < 0.002$. $\beta_3=0.095$ (2012GaZV). $\langle 2_1^+ E1 3_1^- \rangle < 0.018$. $\langle 1_1^- E2 3_1^- \rangle = 1.80$ 60. $\langle 0_1^+ E3 3_1^- \rangle = 0.810$ 50. $\langle 2_1^+ E3 3_1^- \rangle < 5.30$.
852.0 [@]	5 ⁻		$Q_2=4.0$ 30. Octupole moment $Q_3=3.0$ 7. Dipole moment $Q_1=0.00026$ 8. $\langle 4_1^+ E1 5_1^- \rangle = 0.0028$ 9. $\langle 3_1^- E2 5_1^- \rangle = 2.2$ 15. $\langle 2_1^+ E3 5_1^- \rangle = 1.70$ 40.
873.9 [#]	6 ⁺	19.7 [‡] ps 20	$Q_2=4.29$ 20. $\langle 4_1^+ E2 6_1^+ \rangle = 2.74$ 14.
937.9 ^{&}	2 ⁺		$Q_2=1.00$ 20. $\langle 0_1^+ E2 2_2^+ \rangle = 0.32$ 7.

Continued on next page (footnotes at end of table)

Coulomb excitation [2013Ga23,2012GaZV](#) (continued) ^{220}Rn Levels (continued)

$E(\text{level})^\dagger$	J^π	Comments
1128.2 [@]	7 ⁻	Dipole moment $Q_1 < 0.010$. $<6_1^+ E1 7_1^- > < 0.13$.
1244.3 [#] 6	8 ⁺	

[†] From a least-squares fit (by evaluators) to E_γ values, assuming $\Delta E_\gamma = 0.5$ keV.

[‡] Deduced from matrix element and Adopted Gamma ray properties.

[#] Band(A): The g.s. band.

[@] Band(B): Octupole band.

[&] Band(C): $K^\pi = 2^+$ γ band.

 $\gamma(^{220}\text{Rn})$

$E_\gamma^\dagger$	$I_\gamma^\ddagger$	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult. [#]	Comments
(17.9)		663.1	3 ⁻	645.3	1 ⁻	[E2]	B(E2)(W.u.)=60 +50-30 (2013Ga23)
188.8		852.0	5 ⁻	663.1	3 ⁻	E2	B(E2)(W.u.)=60 +100-50 (2013Ga23)
241.0	589 19	241.1	2 ⁺	0.0	0 ⁺	E2	B(E2)(W.u.)=48 3 (2013Ga23)
254.3		1128.2	7 ⁻	873.9	6 ⁺	E1	B(E1)(W.u.)< 0.5 (2013Ga23)
276.2		1128.2	7 ⁻	852.0	5 ⁻		
292.7	45.8 15	533.7	4 ⁺	241.1	2 ⁺	E2	B(E2)(W.u.)=63 3 (2013Ga23)
318.3	0.80 7	852.0	5 ⁻	533.7	4 ⁺	E1	B(E1)(W.u.)=3.0×10 ⁻⁵ +20-16 (2013Ga23)
340.2	2.33 11	873.9	6 ⁺	533.7	4 ⁺	E2	B(E2)(W.u.)=73 8 (2013Ga23)
370.4		1244.3	8 ⁺	873.9	6 ⁺		
404.2	0.14 6	645.3	1 ⁻	241.1	2 ⁺	E1	B(E1)(W.u.)< 0.003 (2013Ga23); B(E3)(W.u.)< 760 (2013Ga23)
422.0	1.90 10	663.1	3 ⁻	241.1	2 ⁺	E1	B(E1)(W.u.)< 0.002 (2013Ga23); B(E3)(W.u.)< 1400 (2013Ga23)
(611.1)		852.0	5 ⁻	241.1	2 ⁺	[E3]	B(E3)(W.u.)=90 50 (2013Ga23)
645.4	0.54 6	645.3	1 ⁻	0.0	0 ⁺	E1	B(E1)(W.u.)< 0.0015 (2013Ga23)
(663.3)		663.1	3 ⁻	0.0	0 ⁺	[E3]	B(E3)(W.u.)=33 4 (2013Ga23)
696.9 10	1.94 11	937.9	2 ⁺	241.1	2 ⁺		$I_\gamma(696.9)/I_\gamma(937.8) = 2.10$ 50.
^x 836 2	0.30 6						E_γ : unplaced γ ray from 2012GaZV .
937.8 12	0.92 8	937.9	2 ⁺	0.0	0 ⁺	E2	B(E2)(W.u.)=2.6 11 (2013Ga23)

[†] From [2013Ga23](#).

[‡] From [2012GaZV](#) for “total statistics”, (particle)- γ data. Listed intensities are divided by a factor of 1000 by the evaluators.

Values are also given in [2012GaZV](#) for individual six experiments.

[#] From measured matrix elements compared with theoretical predictions ([2013Ga23](#)).

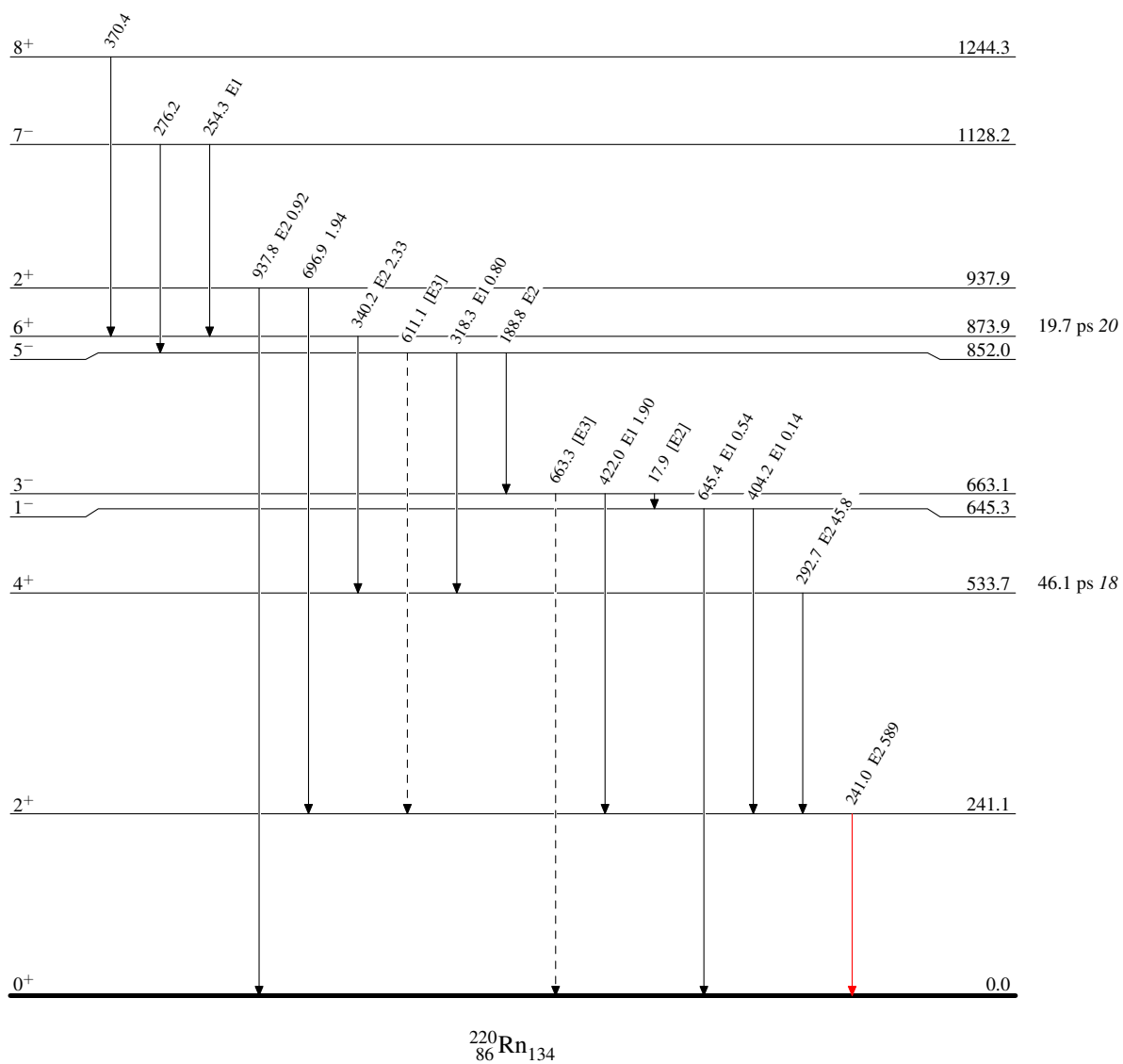
^x γ ray not placed in level scheme.

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Legend

Level SchemeIntensities: Relative I_γ

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



Coulomb excitation 2013Ga23,2012GaZV

Band(A): The g.s. band

 8^+ 1244.3

Band(B): Octupole band

 7^- 1128.2Band(C): $K^\pi=2^+ \gamma$ band 2^+ 937.9 6^+ 873.9 5^- 852.0 4^+ 533.7 3^- 663.1 1^- 18 645.3 2^+ 241.1 0^+ 0.0 $^{220}_{86}\text{Rn}_{134}$