Coulomb excitation **1969He07,1970Br12,1973Kr02**

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. Chen # and F. G. Kondev	NDS 126, 373 (2015)	30-Sep-2013

1969He07: $(\alpha,\alpha'\gamma)$ E=18 MeV, $(^{16}O,^{16}O'\gamma)$ E=70 MeV. Target was a thick piece of zone-purified ^{209}Bi. γ-rays were detected by a 32 cm^3 Ge(Li) detector, FWHM=4.5 KeV. Measured Eγ, Iγ, Doppler-shift, $\gamma(\theta)$. Deduced levels, $T_{1/2}$, γ-branching ratios, transition probabilities, μ.

1970Br12: $(\alpha,\alpha'\gamma)$ E=19 MeV. Targets were thick chemically pure bismuth with a thickness of 0.010 inch. γ-rays were detected by a 25 cm^3 lithium-drifted Ge detector. Measured Eγ, Iγ, $\gamma(\theta)$, Doppler-shift. Deduced levels, $T_{1/2}$, γ-branchings ratios, transition probabilities, configurations. Comparisons with model calculations.

1973Kr02: $(\alpha,\alpha'\gamma)$ E=15 MeV α beam was produced from the Heidelberg EN tandem accelerator. Natural Bi target. γ-rays were detected by two Ge(Li) detectors. Measured Eγ, Iγ, $\gamma(\theta)$. Deduced levels, mixing ratios, transition probabilities.

1972Ha59: $(\alpha,\alpha'\gamma)$ E=15-18 MeV α beam was produced from the Chalk River MP tandem accelerator. Natural Bi target. γ-rays were detected by two Ge(Li) detectors. Measured Eγ, Iγ. Deduced levels, transition probabilities.

Others: 1998Wo15, 1985Ze05, 1983Ru03, 1980Sh12, 1965An13, 1963Hr01, 1962Na06.

^{209}Bi Levels

B(E3) values are primarily from 1969He07 and are based on the assumption that unobserved but possible low-energy transitions between multiplet states do not have significant branching. Others: 1970Br12, 1972Ha59, 1973Kr02. Note that the B(E3) value for the combined seven states of the assumed multiplet configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ is 0.55 *7*, a weighted average of values of 1969He07 (0.45 *15*) and 1970Br12 (0.57 *7*).

E(level)‡	J$^\pi$#	$T_{1/2}$&	L@	Comments
0.0	$9/2^-$			configuration=$\pi(1h_{9/2})^{+1}$.
896.5 *3*	$7/2^-$	8.2[a] ps *12*	2	B(E2)↑=0.00261 *16* B(E2)↑: weighted average of 0.0018 *6* (1969He07), 0.0024 *2* (1972Ha59), and 0.00275 *14* (1973Kr02). Other: 0.00139 *+16−23* (1970Br12), but the bombarding energy was such that the assumption of pure Coulomb excitation may not be valid (1973Kr02). configuration=$\pi(2f_{7/2})^{+1}$.
1608.3 *4*	$13/2^+$	0.23[a] ns *13*	3	B(E3)↑=0.022 *8* (1969He07) B(E3)↑: other: 0.0124 *32* in 1970Br12, but see also the comment to the 896-keV level. configuration=$\pi(1i_{13/2})^{+1}$.
2492.0 *10*	$3/2^+$	≈31[a] ps		B(E3)↑=0.021 *3* (1969He07) configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$.
2563.0 *10*	$9/2^+$	0.015 ps *3*		B(E3)↑=0.074 *11* (1969He07) configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$.
2582.5 *9*	$7/2^+$	0.31 ps *10*		B(E3)↑=0.052 *8* (1969He07) configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$.
2600.3† *6*	$11/2^+$	0.036 ps *10*		B(E3)↑=0.094 *14* (1969He07) configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$.
2600.5† *7*	$13/2^+$	0.26 ps *11*		B(E3)↑=0.108 *15* (1969He07) configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$.
2615.8 *8*	$5/2^+$	7.2 ps *11*		B(E3)↑=0.034 *5* (1969He07) configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$.
2741.2 *4*	$15/2^+$	9.1[a] ps *12*		B(E3)↑=0.077 *10* (1969He07) configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$.
2821.8 *8*	$5/2^-$	6.9[a] fs *9*		B(E2)↑=0.029 *10* (1970Br12) E(level): from 1970Br12 only. This value is 4 keV lower than the adopted one. configuration=$\pi(2f_{5/2})^{+1}$.

Continued on next page (footnotes at end of table)

Coulomb excitation 1969He07,1970Br12,1973Kr02 (continued)

^{209}Bi Levels (continued)

† From the ^{16}O-induced spectrum, 1969He07 resolved the 992γ into two components based on the appreciable Doppler-broadening in one member of the doublet. The energy separation was determined to be 2±1 keV and the intensity of the Doppler-broadened component of the doublet relative to the 2600γ (also Doppler broadened) was found to be ≈0.2. 1969He07 and 1970Br12 suggest that the two Doppler-broadened transitions de-excite the $11/2^+$ member of the 11/2,13/2 doublet at 2600, while the non-Doppler-broadened component of the 992 doublet de-excites the $13/2^+$ member.

‡ From a least-squares fit to γ-ray energies.

From 1969He07 and 1970Br12.

@ Values for the 896 and 1608 levels are from 1970Br12 based on σ(E). Excitation of levels with E(level)=2493 to 2741 is assumed to be E3. The E1 contribution is estimated to be <1% (1970Br12).

& From Adopted Levels.

a From Adopted Levels.

$\gamma(^{209}Bi)$

E_i(level)	J_i^π	E_γ †	I_γ #	E_f	J_f^π	Mult.	δ	Comments
896.5	$7/2^-$	896.5 *3*	100	0.0	$9/2^-$	M1+E2	−0.95 *25*	E_γ: weighted average of 896.5 *5* in 1969He07, 897.0 *5* in 1970Br12, 896.5 *3* in 1972Ha59, 896.3 *3* in 1973Kr02. δ: from $\gamma(\theta)$ (1973Kr02).
1608.3	$13/2^+$	1608.4 *5*	100	0.0	$9/2^-$			Additional information 1.
2492.0	$3/2^+$	2492 *1*	100	0.0	$9/2^-$			Additional information 2.
2563.0	$9/2^+$	2563 *1*	100	0.0	$9/2^-$			Additional information 3.
2582.5	$7/2^+$	1686 *1*	67	896.5	$7/2^-$			Additional information 4.
		2582.5 *15*	33	0.0	$9/2^-$			Additional information 5.
2600.3	$11/2^+$	992.0 *5*	15@	1608.3	$13/2^+$			Additional information 6.
		2600 *1*	85	0.0	$9/2^-$			Additional information 7.
2600.5	$13/2^+$	992 *1*	99	1608.3	$13/2^+$			Additional information 8.
		2600 *1*	1	0.0	$9/2^-$			Additional information 9.
2615.8	$5/2^+$	1719 *1*	59	896.5	$7/2^-$			Additional information 10.
		2616 *1*	41	0.0	$9/2^-$			Additional information 11.
2741.2	$15/2^+$	140		2600.5	$13/2^+$			E_γ: from level energies. Transition not reported in Coulomb excitation. I(γ+ce)=29.1% *6* from Adopted Gammas.
		1133.0 *5*	33&	1608.3	$13/2^+$			Additional information 12.
		2741.3 *5*	38&	0.0	$9/2^-$			Additional information 13.
2821.8	$5/2^-$	1925‡ *1*		896.5	$7/2^-$			
		2822‡ *1*		0.0	$9/2^-$			

† From weighted average of 1969He07 and 1970Br12, unless otherwise noted.

‡ These values differ by 4-5 keV from adopted values.

From 1969He07 based on the α-induced spectrum, uncertainties=15%. The authors state that the ^{16}O-induced yield at θ=90° gives essentially the same values. Other: 1970Br12. Values of these authors for the 2582 and 2741 levels are inconsistent with those of 1969He07. Data of 1968Wi24 from (n,n′γ) and of 1972Ha59 from (^{7}Li,α2nγ) support the values of 1969He07.

@ Based on Doppler-broadening in the ^{16}O-induced spectrum, 1969He07 conclude that the 992γ is a doublet with energy separation 2±1 keV. The 15% branching shown is tentative since there is an impurity line present at the same energy. See comment on 2599, 2601 levels for a discussion of the level doublet at 2600.

& 1969He07 report 53% and 47% for the 2741γ and 1133γ, respectively. The evaluator has renormalized these values using I(γ+ce)(140γ)=29.1% *9* from Adopted Gammas.

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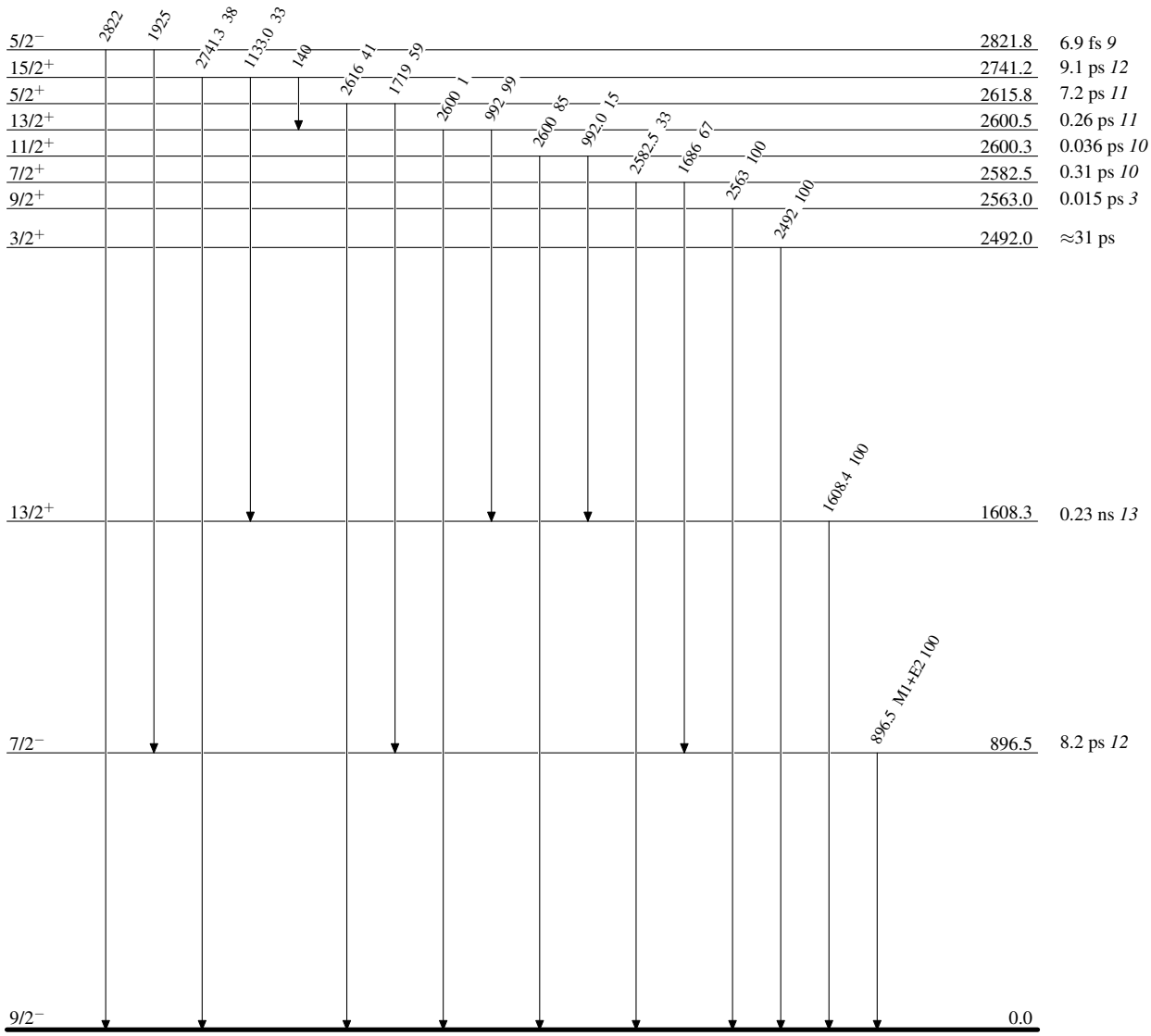
Level Scheme

Intensities: % photon branching from each level



$^{209}_{83}Bi_{126}$