PSI Center for Neutron and Muon Sciences

6129 keV line in 16O

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29. November 2024

Levels in 16O

0.5 keV difference between Bergem and value in NNDC

XREFs ☑ J^π ☑ $T_{1/2}$/Decay ☑ E(γ) ☑ I(γ) ☑ M(γ) ☑ Final Levels ☑

E(level) (keV)	XREF	J^π(level)	$T_{1/2}$(level)	E(γ) (keV)	I(γ)	M(γ)	Final Levels	
0.0	ABCDEF HIJKLMNOPQ	0+	STABLE					
6049.4 *10*	ABC EF IJK M P	0+	67 ps *5*	6048.2 *10*		[E0]	0.0	0+
6129.89 *4*	ABC EF HIJKL NOPQ	3−	18.4 ps *5*	6128.63 *4*	100	[E3]	0.0	0+
6917.1 *6*	ABC EF HI KLMNOPQ	2+	4.70 fs *13*	787.2 *6* 867.7 *12* 6915.5 *6*	≤0.008 0.027 *3* 100	[E1] [E2] [E2]	6129.89 6049.4 0.0	3− 0+ 0+
7116.85 *14*	AB EF HIJKLM OPQ	1−	8.3 fs *5*	986.93 *15* 1067.5 *10* 7115.15 *14*	0.070 *14* <6E-4 100	[E2] [E1] [E1]	6129.89 6049.4 0.0	3− 0+ 0+

TABLE IV. Calibration sources and their γ-ray energies used for calibration and detector system nonlinearity.

Source	References	Energies (keV)	
^{56}Co	25	846.764(6)	1037.844(4)
		1175.099(8)	1238.287(6)
		1360.206(6)	1771.350(15)
		1963.714(12)	2015.179(11)
		2034.759(11)	2598.460(10)
		3009.596(17)	3201.954(14)
		3253.417(14)	3272.998(14)
		3451.154(13)	
^{110}Ag^m	25	446.811(3)	620.360(3)
		657.762(2)	677.623(2)
		687.015(3)	706.682(3)
		744.277(3)	763.944(3)
		818.031(4)	884.685(3)
		937.493(4)	1384.300(4)
		1475.788(6)	1505.040(5)
		1562.302(5)	
^{192}Ir	25	316.508 0(8)	416.471 9(12)
		468.071 5(12)	484.577 9(13)
		588.585 1(16)	604.414 6(16)
		612.465 7(16)	884.542 3(20)
^{207}Bi		569.702(2)	1063.662(4)
^{16}N	23	6129.142(32)	
	24	6129.119(40)	
		weighted mean	6129.133(25)

Where does the NNDC data come from?

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???

Level in overview table and source data do not match

The measurements are the same as quoted by Bergem

ADOPTED LEVELS, GAMMAS for ^{16}O

Authors: J.H. Kelley, D.R. Tilley, H.R. Weller and C.M. Cheves | Citation: Nucl. Physics 564 1 (1993) |
Cutoff date: 31-DEC-1992

D.R. Tilley et al. / Energy levels of light nuclei A=16–17 43

TABLE 16.13
Energy levels of ^{16}O [a])

E_x (MeV±keV)	J^π; T	K^π	$\Gamma_{c.m.}$ or τ_m (keV)	Decay	Reactions
0	0^+; 0		stable		5, 7, 11–19, 22–24, 30, 32–34, 37–68, 70–82
6.0494±1.0	0^+; 0	0^+	τ_m = 96±7 ps	π	5, 7, 11–13, 15, 17, 19, 21, 23, 30, 32–34, 38, 39, 43, 44, 47, 54, 55, 57, 66, 67, 70, 71, 73, 79, 81
6.129893±0.04	3^-; 0		τ_m = 26.6±0.7 ps; g = +0.556±0.004	γ	1, 5, 7, 11–13, 15, 17–19, 21, 30–34, 37–39, 43–46, 49–51, 53, 54, 66–68, 70, 71, 73, 79, 81
6.9171±0.6	2^+; 0	0^+	τ_m = 6.78±0.19 fs	γ	1, 5, 7, 11–13, 15, 17, 19, 30–34, 37, 38, 42–47, 49, 50, 53–55, 67, 68, 70, 71, 73, 78, 80
7.11685±0.14	1^-; 0		τ_m = 12.0±0.7 fs	γ	1, 5, 7, 11–13, 17, 30–34, 37–39, 42–44, 46, 47, 50, 66–68, 70, 71, 73, 81
8.8719±0.5	2^-; 0		τ_m = 180±16 fs	γ, α	5, 7, 11, 12, 16, 19, 30, 31, 33, 37–39, 43,

39. $^{16}N(\beta^-)^{16}O$ Q_m = 10.419

The ground state of ^{16}N decays to seven states of ^{16}O: reported branching ratios are listed in Table 16.25. The ground-state transition has the unique first-forbidden shape corresponding to ΔJ = 2, fixing J^π of ^{16}N as 2^-: see (59AJ76). The unique first-forbidden decay rates to the 0^+ ground state and 6.06 MeV level are well reproduced by a large-basis $(0+2+4)\hbar\omega$ shell-model calculation (92WA25). The decays to odd-parity states (see Table 16.25) are well reproduced by recent calculations of Gamow–Teller matrix elements (93CH1A). For the β-decay of $^{16}N^*$(0.12), see reaction 1 in ^{16}N.

The β-delayed α-decays of $^{16}O^*$(8.87, 9.59, 9.84) have been observed: see (71AJ02). The parity-forbidden α-decay from the 2^- state $^{16}O^*$(8.87) has been reported: Γ_α = $(1.03 \pm 0.28) \times 10^{-10}$ eV [E_α = 1282 ± 5 keV]: see (77AJ02).

Transition energies derived from γ-ray measurements are: E_x = 6130.40 ± 0.04 keV [E_γ = 6129.142 ± 0.032 keV (82SH23)], E_x = 6130.379 ± 0.04 [E_γ = 6129.119 ± 0.04 keV (86KE15)] and E_x = 7116.85 ± 0.14 keV [E_γ = 7115.15 ± 0.14 keV]. See (77AJ02). See also p. 16 in (82OL01).

Let's go back in time…

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Somehow couldn't download the publications anymore, but if I remember correctly the value for the level and transition energy changes between these two publications wit the measured gamma energy not really changing?

Typo? Wrong calculation of level from gamma energy?

ELSEVIER

Nuclear Physics A

Volume 375, Issue 1, 1 February 1982, Pages 1-168

Energy levels of light nuclei A = 16–17 ☆

F. Ajzenberg-Selove

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Nuclear Physics A

Volume 460, Issue 1, 24 November 1986, Pages 1-110

Energy levels of light nuclei A = 16–17 ☆

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So it looks like everything is fine with the 208Pb energies after all!

2020 JINST 15 C07005

Table 2. The energy of photons E_γ emitted by $(3^-; 0)$ excited level of ^{16}O.

N	Reaction	Reported energy [keV]	Year, reference	Corrected E_γ [keV]
1	$^{16}N(\beta^-)^{16}O$	$E_\gamma = 6129.170 \pm 0.043$	1975, [24]	$E_\gamma = 6129.03 \pm 0.04$
2	$^{13}C(\alpha,n)^{16}O$	$E_\gamma = 6129.266 \pm 0.053$	1981, [25]	$E_\gamma = 6129.24 \pm 0.05$
3	$^{19}F(n,\alpha)^{16}O$	$E_\gamma = 6129.119 \pm 0.040$	1986, [26]	$E_\gamma = 6129.12 \pm 0.04$
4	$(3^-; 0)$ ^{16}O level	$E_x = 6129.893 \pm 0.040$	1993, [27]	$E_\gamma = 6128.63 \pm 0.04$

in the present reference value of the energy of ^{198}Au γ-rays. Here we would like to mention that the energy E_γ in the last line of table 2 is definitely in contradiction with the values in the first three lines. It is not clear from [27] how this value was obtained and why it is so different.

Table 5.2

Commonly used calibration γ-rays, showing the changes in the last 20 years. The 1979 data are the compendium of Helmer et al. [431], plus the hydrogen line of Greenwood and Chrien [432]. The latest compendium is that of Helmer and van der Leun [429]. Other data are from [433,434]. We use $E_\lambda = 1239.84244$ (37) eV nm

Source	1979 (eV)	1999 (eV)
^{198}Au	411,804.4 (11)	411,802.05 (17)
^{60}Co	1,332,502 (5)	1,332,492 (4)
^{152}Eu	121,782.4 (4)	121,781.7 (3)
	244,698.9 (10)	244,697.4 (8)
	344,281.1 (19)	344,278.5 (12)
$^{16}N/^{13}C(\alpha,n)$	6,129,270 (50)	6,129,140 (30)[a]
m_e	511,003 (2)	510,998.902 (21)[b]
$np \to \gamma d$	2,223,247 (17)	2,223,258.3 (23)[c]

[a]The site www.nndc.bnl.gov and [435] seem to use an erroneous value of E_x= 6,129,893 (40) eV and E_γ= 6,128,630 (40) eV. We use the average of 3 determinations [436–438], as confirmed by Wapstra [434].
[b]Observed annihilation radiation is slightly less than $m_e c^2$.
[c]Value of [433], as corrected by Wapstra [434].

Nuclear Instruments and Methods in Physics Research A292 (1990) 671–676
North-Holland

ENERGY CALIBRATION FOR 2–13 MeV GAMMA RAYS

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Received 23 February 1990

4. The ^{16}O calibration gamma ray of 6129 keV

The consistency between the two scales was checked in the following comparison. Utrecht [18] determined the γ-ray energy of the lowest occurring γ-transition in ^{16}O in the ^{198}Au scale as 6129266(54) eV*, which corresponds to 6129228 eV′. This value should be compared with a Los Alamos value 6129121(22) eV′ derived from a difference [19] of 121174(21) eV* with the neutron-capture γ-ray to ^{3}T and a McMaster [20] value 6129095(40) eV′ measured through comparison with ^{14}N(n, γ) γ-rays (slightly corrected in view of the discussion of ^{15}N below). The Utrecht "diffraction" value is 18(10) ppm higher than the averaged "mass-spectrometry" result.

Proposed accepted value: 6129140(30) eV′.