^{140}Ce(^{17}O,^{17}O$'\gamma$)   2016Kr04

			History	
Type	Author		Citation	Literature Cutoff Date
Full Evaluation	N. Nica		NDS 154, 1 (2018)	20-Nov-2018

Dataset based on unevaluated XUNDL files compiled from 2016Kr04 by G. Gürdal (Millsaps College).

2016Kr04, 2016Kr03, 2014Kr05 (same group): ^{17}O beam of E=340 MeV at the PIAVE-ALPI accelerator system of the Legnaro National Laboratories on 2.5 mg/cm^2 target. Used for ^{17}O two ΔE-E Si telescopes consisting of two segmented Si-pad detectors, each made of 60 pixels of the TRACE array. γ-rays detected by five triple clusters of HPGe detectors of the AGATA-Demonstrator array. Measured: Eγ, Iγ, E(recoil), γ-recoil coin, recoil-γ(θ). Deduced: Multipolarities, differential cross sections. Identification of pygmy states. Comparison of data to (α,α'γ) (2009En03) and (γ,γ') (2006Vo11). Comparison of experimental differential cross sections with the DWBA calculations using microscopically calculated transition densities and optical potentials. Isoscalar energy-weighted sum rule (ISEWSR) and Pygmy Dipole Resonance (PDR) strength (S$_{IS}$).

Unless noted otherwise data are from 2016Kr04.

^{140}Ce Levels

Isoscalar energy-weighted sum rule (ISEWSR (%)) was deduced by scaling the form factor for the different ISEWR value that was exhausted by the transition and using the known theoretical value from RQRPA calculations. The summed strength in the discrete peaks (%) = 0.44 12, the summed strength for the whole energy region (%) = 2.03 26 including the unresolved strength.

E(level)[†]	J$^{\pi}$[‡]	S$_{is}$ (10^2e^{2}fm^6)[b]	dσ/dΩ (mb/sr)[@]	Comments
0.0	0$^+$			
1596	2$^+$[#]			
1903	0$^+$[#]			
2464	3$^-$[#]			E(level): From the Adopted Levels.
				J$^{\pi}$: Comparison of dσ/dΩ measured as function of center of mass angle with the DWBA predictions (figure 5b in 2016Kr04) confirms the J$^{\pi}$ assignment.
3119	2$^+$[#]			J$^{\pi}$: Comparison of dσ/dΩ measured as function of center of mass angle with the DWBA predictions (figure 5c in 2016Kr04) confirms the J$^{\pi}$ assignment.
3643	1$^-$		0.335	J$^{\pi}$: Comparison of dσ/dΩ measured as function of center of mass angle with the DWBA predictions (figure 5d in 2016Kr04) confirms the J$^{\pi}$ assignment.
4174	1$^-$	0.83 112	0.05	E(level): 4147 keV in table 1 of 2014Kr04 (probably a typographical error). ISEWSR = 0.014 % 19.
4355	1$^-$	2.21 181	0.175	ISEWSR = 0.039 % 32.
4514	1$^-$	1.58 120	0.13	ISEWSR = 0.029 % 22.
4787	1$^-$	2.57 206	0.19	ISEWSR = 0.050 % 40.
4979	2$^+$,3$^-$[#]			
5170	1$^-$	1.43 163	0.105[&]	E(level): from figure 4a in 2016Kr04. 5157γ and 5190γ transitions depopulating 5157 keV and 5190 keV levels observed in (α,α'γ) data (2009En03) could not be distinguished due to low statistics in 2016Kr04. S$_{IS}$ given for only 5157 keV state in table 1 in 2016Kr04. ISEWSR = 0.030 % 34 measured for only 5157 keV state.
5211	1$^-$	1.56 133	0.135	S$_{IS}$ measured for 5190 keV and 5211 keV states since these states could not be distinguished in 2016Kr04. ISEWSR = 0.033 % 28 measured for 5190 keV and 5211 keV states.
5337	1$^-$	2.45 194	0.18	ISEWSR = 0.053 % 42.
5560	1$^-$	1.68 160	0.145[a]	E(level): from figure 6b in 2016Kr04. 5548γ and 5574γ transitions

^{140}Ce(^{17}O,^{17}O$'\gamma$)   **2016Kr04 (continued)**

^{140}Ce Levels (continued)

E(level)[†]	J$^\pi$[‡]	S$_{is}$ (10^2e^{2}fm^6)[b]	dσ/dΩ (mb/sr)[@]	Comments
				depopulating 5548 keV and 5574 keV levels observed in ($\alpha,\alpha'\gamma$) data (2009En03) could not be distinguished due to low statistics in 2016Kr04.
				S$_{IS}$ measured for 5548 keV and 5574 keV states since these states could not be distinguished in 2016Kr04.
				ISEWSR = 0.038 % *36* measured for 5548 keV and 5574 keV states.
5660	1$^-$	3.27 *192*	0.30	ISEWSR = 0.075 % *44*.
				J$^\pi$: Comparison of dσ/dΩ measured as function of center of mass angle with the DWBA predictions (figure 6b in 2016Kr04) confirms the J$^\pi$ assignment.
6160	1$^-$	3.04 *272*	0.25	ISEWSR = 0.076 % *68*.

[†] From Eγ, unless otherwise stated.
[‡] From 2016Kr04, unless otherwise stated (may differ from the adopted values).
[#] From the Adopted Levels unless otherwise stated.
[@] From scattering angle of 12° in c.m. frame of reference from Figure 4a in 2016Kr04.
[&] dσ/dΩ is the sum of the cross sections of 5157 keV and 5190 keV states.
[a] dσ/dΩ is the sum of the cross sections of 5548 keV and 5574 keV states.
[b] Pygmy dipole resonance strength educed by scaling the form factor and knowing the theoretical value of 1.2×10^4 e^{2}fm^6 for the state at 8.39 MeV. The total strength for the whole energy region was measured as 0.88×10^4 e^{2}fm^6 *11*.

$\gamma(^{140}$Ce)

The expected values for pure dipole and for pure quadrupole transitions are given in terms of Counts(65°−115°)/Counts(15°−65°) in 2016Kr04. For a pure dipole transition (ΔI=1) the ratio is 1.55 *17* and for a pure quadrupole transition (ΔI=2) the ratio is 0.68 *8* (from Figure 3c). 2016Kr04 assigned pure dipoles as E1 and pure quadrupoles as E2.

Measured Counts(65°−115°)/Counts(15°−65°) from Figure 3 are: 1.15 *7* for 3500γ-4000γ range, 1.40 *6* for 4000γ-5000γ range, 1.45 *7* for 5000γ-6000γ range, 1.43 *8* for 6000γ-7000γ range and 1.68 *17* for 7000γ-8000γ range.

E$_\gamma$[†]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[&]	Comments
868	2464	3$^-$	1596	2$^+$	D	Mult.: Counts(65°−115°)/Counts(15°−65°) $\approx$ (from Figure 3c).
1179[@a]	3643	1$^-$	2464	3$^-$		
1596	1596	2$^+$	0.0	0$^+$	Q	Mult.: Counts(65°−115°)/Counts(15°−65°) $\approx$ 0.72 (from Figure 3c).
1740[@a]	3643	1$^-$	1903	0$^+$		
3119	3119	2$^+$	0.0	0$^+$		
3643	3643	1$^-$	0.0	0$^+$		
4174[‡]	4174	1$^-$	0.0	0$^+$		
4355[#]	4355	1$^-$	0.0	0$^+$		
4514[‡]	4514	1$^-$	0.0	0$^+$		
4787[‡]	4787	1$^-$	0.0	0$^+$		
5211[‡]	5211	1$^-$	0.0	0$^+$		
5337[‡]	5337	1$^-$	0.0	0$^+$		
5660	5660	1$^-$	0.0	0$^+$		
6160[‡]	6160	1$^-$	0.0	0$^+$		

[†] From the Adopted Gammas unless otherwise stated. Eγ values were rounded to the nearest integer.

<u>$^{140}\text{Ce}(^{17}\text{O},^{17}\text{O}'\gamma)$ **2016Kr04** (continued)</u>

<u>$\gamma(^{140}\text{Ce})$ (continued)</u>

‡ From $(\alpha,\alpha'\gamma)$ dataset (2009En03).
# From (γ,γ') dataset (2006Vo11).
@ Transition expected by 2016Kr03 but not observed.
& From $\gamma(\theta)$ in 2016Kr04.
[a] Placement of transition in the level scheme is uncertain.

^{140}Ce(^{17}O,^{17}O'γ)   **2016Kr04**

Legend

Level Scheme

$- - - - - \blacktriangleright$ γ Decay (Uncertain)

1⁻	6160	3.04 *272*
1⁻	5660	3.27 *192*
1⁻	5337	2.45 *194*
1⁻	5211	1.56 *133*
1⁻	4787	2.57 *206*
1⁻	4514	1.58 *120*
1⁻	4355	2.21 *181*
1⁻	4174	0.83 *112*
1⁻	3643	
2⁺	3119	
3⁻	2464	
0⁺	1903	
2⁺	1596	
0⁺	0.0	

$^{140}_{58}$Ce$_{82}$