#### Adopted Levels, Gammas

Туре	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	08-Sept-2023

 $Q(\beta^{-})=13950 \text{ syst}; S(n)=3040 \text{ syst}; S(p)=22950 \text{ syst}; Q(\alpha)=-16520 \text{ syst}$  2021Wa16 Estimated  $\Delta Q(\beta^{-})=540, \Delta S(n)=640, \Delta S(p)=780, \Delta Q(\alpha)=940$  (2021Wa16).

 $S(2n)=4160\ 560,\ Q(\beta^-n)=11780\ 530\ (syst,\ 2021Wa16).\ S(2p)=41770\ (2019Mo01,\ theory).\ Q(\beta^-2n)=7850\ 560,\ Q(\beta^-3n)=5100\ 500,\ Q(\beta^-4n)=625\ 500\ (deduced by evaluator from relevant mass excesses in 2021Wa16).$ 

2009Ta24, 2009Ta05: <sup>58</sup>Ca identified by fragmentation of <sup>76</sup>Ge beam at 132 MeV/nucleon at NSCL facility using A1900 fragment separator combined with S800 analysis beam line to form a two stage separator system. The transmitted fragments were analyzed event-by-event in momentum and particle identification. The nuclei of interest were stopped in eight Si diodes which provided measurement of energy loss, nuclear charge and total kinetic energy. The time-of-flight of each particle that reached the detector stack was measured in four different ways using plastic scintillators, Si detectors, and parallel-plate avalanche counters. The simultaneous measurement of  $\Delta$ E signals, the magnetic rigidity, total kinetic energy and the time-of-flight (tof) provided unambiguous identification of the atomic number, charge state and mass number.

Theoretical structure calculations:

2023Kr01: calculated the nuclear ground state using relativistic Hartree-Bogoliubov model, and the M2 excitations using the relativistic QRPA with residual interaction.

2022Co05: calculated binding energies, isotope shifts, charge radii using independent particle model based on Hartree-Fock plus Bardeen–Cooper–Schrieffer (HF+BCS) approach.

2022Ko04: calculated ground state energies, charge rms radii using coupled cluster (CC) and ab-initio density functional theory.

2022Ku16: calculated potential energy surfaces, binding energy, S(2n), charge radius, neutron and proton rms radii, neutron skin thickness using covariant density functional theory with several Skyrme parametrizations.

2021Ful1: calculated energy levels,  $J^{\pi}$ , S(2n) using realistic shell model with chiral interaction.

2021Ma73: calculated levels,  $J^{\pi}$ , S(2n), two-body matrix elements (TBME) using state-of-the-art in-medium similarity

renormalization group (IMSRG) interaction, with universal fp shell interaction.

2020Bh06: calculated energy levels,  $J^{\pi}$ , occupancy, B(E2), nuclear magnetic moments, spectroscopic factors, wave functions using shell model in several model spaces.

2020Co10: calculated energy of the first  $2^+$  state, S(2n) using shell model.

2020Li35: calculated binding energy, S(n), S(2n), neutron effective single-particle energies (ESPE), levels,  $J^{\pi}$  using realistic Gamow shell model.

1998Br30: calculated binding energy, levels,  $J^{\pi}$  using shell model plus Hartree-Fock approach.

Other theoretical structure calculations: 87 primary reference extracted from the NSR database are listed under 'document' records in this dataset.

Additional information 1.

### <sup>58</sup>Ca Levels

#### Cross Reference (XREF) Flags

# <sup>1</sup>H(<sup>59</sup>Sc,2p $\gamma$ )

EF	Comments
	$\%\beta^{-}=100; \ \%\beta^{-}n=?; \ \%\beta^{-}2n=?; \ \%\beta^{-}3n=?; \ \%\beta^{-}4n=?$
	While no decay mode has been experimentally observed, evaluator assigns $\%\beta^-=100$ by inference, as $\beta^-$
	is the only decay mode energetically possible, followed by $\beta$ -delayed neutron emission decay that are
	possible for respective positive Q values listed above.

Theoretical  $T_{1/2}(\beta) = 7.9$  ms,  $\%\beta^{-}n = 15$ ,  $\%\beta^{-}2n = 1$ ,  $\%\beta^{-}3n = 0$ ,  $\%\beta^{-}4n = 0$  (2019Mo01).

Theoretical  $T_{1/2}(\beta)=8.27$  ms,  $\%\beta^{-}n=5.4$ , 6.1;  $\%\beta^{-}2n=0.98$ ;  $\%\beta^{-}3n=0.023$ , 0.016;  $\%\beta^{-}4n=0.0$  (2021Mi17), two values for different fission barriers.

 $T_{1/2}$ : no experimental value has been reported. A lower limit of 620 ns is implied from time of flight through the A1900 separator. Assuming a systematic decreasing trend of half-lives in neutron-rich

Continued on next page (footnotes at end of table)

 $E(level) = \frac{J^{*}}{2}$ 

 $^{58}_{20}{\rm Ca}_{38}\text{-}2$ 

# Adopted Levels, Gammas (continued)

# <sup>58</sup>Ca Levels (continued)

E(level)	$J^{\pi}$	XREF	Comments		
	_		nuclei, as neutron number increases, estimated $T_{1/2} < 10$ ms from the known half-lives of 90 ms for ${}^{54}$ Ca, 22 ms for ${}^{55}$ Ca, and 11 ms for ${}^{56}$ Ca. 2021Ko07 suggested 4 ms from systematic trend. Production cross section=10 fb + $12-54$ (from e-mail reply of Nov 11, 2009 from the first author of 2009Ta24, see also Fig. 8 for cross sections in 2009Ta24).		
1115 34	(2+)	A	$J^{\pi}$ : systematics of first $2^{+}$ energies in even-even Ca nuclei, and shell-model predictions (2023Ch26). Measured partial cross section for the 1115,(2 <sup>+</sup> ) level=0.47 mb <i>19</i> .		

# $\gamma$ (<sup>58</sup>Ca)

E <sub>i</sub> (level)	$\mathbf{J}_i^{\pi}$	Eγ	$I_{\gamma}$	$\mathbf{E}_f \mathbf{J}_f^{\pi}$	Comments	
1115	(2 <sup>+</sup> )	1115 34	100	0 0+	$E_{\gamma}$ : from <sup>1</sup> H( <sup>59</sup> Sc,2p $\gamma$ ).	

### Adopted Levels, Gammas

## Level Scheme

Intensities: Relative photon branching from each level



<sup>58</sup><sub>20</sub>Ca<sub>38</sub>