## Adopted Levels

| History | | | |
|---|---|---|---|
| Type | Author | Citation | Literature Cutoff Date |
| Full Evaluation | Balraj Singh | ENSDF | 30-Nov-2021 |

Q($\beta^-$)=9282 *5*; S(n)=3180 *5*; S(p)=15830 *SY*; Q($\alpha$)=−8294 *6* 2021Wa16

Estimated uncertainty=200 for S(p) (2021Wa16).

Q($\beta^-$n)=3652 *5*, S(2n)=8709 *4*, S(2p)=29980 *300* (syst) (2021Wa16).

$^{89}$Se identified by 1971To13 from delayed neutron emission in thermal fission of $^{235}$U. Others: 1980Al17, 1982Re08, 2008Ha23, 2008Su19. $^{89}$Se produced by 2008Ha23 through U(p,F) and U(d,F) reactions at 25 MeV. In 2008Su19, $^{89}$Se was produced in $^{9}$Be($^{238}$U,X) at E($^{238}$U)=411 MeV/nucleon.

2012Qu01: $^{136}$Xe primary beam, E=120 MeV/nucleon, impinged on a 235 mg/cm$^2$ $^{9}$Be target. Experiment performed at the NSCL Coupled Cyclotron Facility. Fragments were separated by the A1900 fragment separator using the B$\rho$-$\Delta$E-B$\rho$ technique. Beta decays measured in the NSCL Beta Counting System (BCS) consisting of four silicon PIN detectors, a double sided silicon strip detector (DSSD), and a single sided silicon strip detector (SSSD). Measured energy loss, total kinetic energy (TKE), time of flight, and half-life of $^{89}$Se g.s.

2019Pe09: $^{208}$Pb($^{238}$U,F),E=950 MeV/nucleon: measured production cross sections and yield.

Mass measurements: 2008Ha23 (JYFLTRAP, Penning-trap method at IGISOL facility in Jyvaskyla), 2008Su19 (large-scale Isochronous Mass spectrometry at FRS-ESR facility in GSI, also 2009Su04, 2010Li02).

Theoretical calculations: consult NSR database at www.nndc.bnl.gov/nsr/ or additional document records in this dataset for four primary references, two each for structure and for half-life and $\beta^-$n decay mode of $^{89}$Se.

Additional information 1.

### $^{89}$Se Levels

| E(level) | J$^\pi$ | T$_{1/2}$ | Comments |
|---|---|---|---|
| 0 | (5/2$^+$) | 0.43 s *5* | %$\beta^-$=100; %$\beta^-$n=7.8 *25* (1971To13,1993Ru01)<br>%$\beta^-$n: original value of 5.0 *15* from 1971To13 (based on %$\beta^-$n($^{89}$Br)=8.8 *9*) revised by 1993Ru01 to 7.8 *25* using %$\beta^-$n($^{89}$Br)=13.8 *4*. The same value is obtained using %$\beta^-$n($^{89}$Br)=13.7 *6* in $^{89}$Br Adopted Levels.<br>J$^\pi$: from shell-model predictions; also systematics (2021Ko07). Other: 3/2$^+$ in theoretical calculations (2019Mo01).<br>T$_{1/2}$: weighted average of 0.41 s *4* (1971To13,($\beta$)(fission neutrons)(t)); 0.56 s *8* (1982Re08), 0.345 s *20*(syst) *+95−75*(stat) (2012Qu01; maximum-likelihood method for 90 correlated events). Reduced $\chi^2$=1.9.<br>Additional information 2. |