

**$^{223}\text{Pa}$   $\alpha$  decay (4.9 ms) 1970Bo13,1995AnZY,1999Ho28**

| Type            | Author                | History<br>Citation | Literature Cutoff Date |
|-----------------|-----------------------|---------------------|------------------------|
| Full Evaluation | Balraj Singh et al. , | NDS 175, 1 (2021)   | 19-May-2021            |

Parent:  $^{223}\text{Pa}$ :  $E=0$ ;  $J^\pi=(9/2^-)$ ;  $T_{1/2}=4.9$  ms 4;  $Q(\alpha)=8327$  6;  $\% \alpha$  decay=100.0

$^{223}\text{Pa}$ - $T_{1/2}$ : From 1999Ho28 ( $\alpha$  decay curve). Others: 7 ms 1 (2019Mi08, 27 (ER)- $\alpha$  correlated decay chains); 5 ms 1 (1995AnZY, 7.5 ms 15 in an earlier report 1993AnZS); 6.5 ms 10 (1970Bo13,  $\alpha$ -decay). Value from 1999Ho28 is preferred as this has the highest statistics. Value from 2019Mi08 is based on only 27 events. In 1970Bo13, the  $\alpha$  peaks from the decay of  $^{223}\text{Pa}$  seem statistically weak in spectral Figs. 10 and 16. Weighted average of all the five values is 5.3 ms 4.

$^{223}\text{Pa}$ - $J^\pi$ : 2021Ko07 assign  $9/2^-$  based on favored  $\alpha$  decay to  $9/2^-$  g.s. in  $^{219}\text{Ac}$ . However, with  $\text{HF}=7.6$  21, favored nature of  $\alpha$  decay is not obvious, thus evaluators assign tentative ( $9/2^-$ ).

$^{223}\text{Pa}$ - $Q(\alpha)$ : Deduced by evaluators from  $E\alpha=8178$  6 to the g.s. 2021Wa16 give 8340 60, larger uncertainty assigned if 8178 $\alpha$  feeds a level in 60-keV vicinity of the g.s.

$^{223}\text{Pa}$ - $\% \alpha$  decay:  $\% \alpha=100$  for  $^{223}\text{Pa}$   $\alpha$  decay.

1970Bo13:  $^{223}\text{Pa}$  activity produced in  $^{205}\text{Tl}(^{22}\text{Ne},4n)$ ,  $^{208}\text{Pb}(^{19}\text{F},4n)$  and  $^{209}\text{Bi}(^{20}\text{Ne},\alpha 2n)$  reactions. Experiments were carried out using the heavy-ion beams from the Berkeley heavy-ion linear accelerator (HILAC). The reaction products were transported from the reaction cell by the helium-jet technique and their decay was measured with a semiconductor detector. Measured  $E\alpha$ ,  $I\alpha$ , excitation functions, half-lives.

1993AnZS, 1995AnZY: activity produced by fusion reactions and separated using the electrostatic mass separator VASSILISSA. Measured  $E\alpha$ ,  $I\alpha$ ,  $T_{1/2}$ . Semi conductor detector was used.

2019Mi08:  $^{223}\text{Pa}$  produced in  $^{181}\text{Ta}(^{48}\text{Ca},\alpha 2n)$ ,  $E=212,226$  MeV reaction followed by separation of products using SHIP separator at the UNILAC accelerator facility of GSI. The evaporation residues (ER) and  $\alpha$  correlations were measured using DSSD detectors at the COMPASS decay spectroscopy station. Measured  $E\alpha$  and half-life of  $^{223}\text{Pa}$  decay from (ER)- $\alpha_1$ - $\alpha_2$ - $\alpha_3$  correlations in 27 decay chains:  $^{223}\text{Pa} \rightarrow ^{219}\text{Ac} \rightarrow ^{215}\text{Fr}$ .

 $^{219}\text{Ac}$  Levels

| E(level) | $J^\pi$ | $T_{1/2}$             | Comments                                                                                 |
|----------|---------|-----------------------|------------------------------------------------------------------------------------------|
| 0        | $9/2^-$ | 11.8 $\mu\text{s}$ 15 | $J^\pi, T_{1/2}$ : from the Adopted Levels.                                              |
| 169 8    |         |                       | E(level): from difference of $E\alpha$ to the g.s. and this level, corrected for recoil. |

 $\alpha$  radiations

| $E\alpha^\dagger$ | E(level) | $I\alpha^\#$ | $\text{HF}^\ddagger$ | Comments                                                                                                                                                                                                                                                                                                                                 |
|-------------------|----------|--------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8012 5            | 169      | 33 2         | 3.8 5                | $E\alpha$ : weighted average of 8006 keV 10 (1970Bo13), 8000 keV 15 (1995AnZY,1993AnZS), 8014 keV 5 (1999Ho28), and 8030 40 (2019Mi08).<br>$I\alpha$ : from 1999Ho28. Others: 55% 5 (1970Bo13), 57% 3 (1995AnZY), are in disagreement. Value from 1999Ho28 is preferred due to high resolution of the $\alpha$ spectrum in their Fig. 2. |
| 8178 6            | 0        | 67 2         | 5.9 6                | $E\alpha$ : weighted average of 8196 keV 10 (1970Bo13), 8190 keV 15 (1995AnZY,1993AnZS), 8172 keV 5 (1999Ho28), and 8220 40 (2019Mi08).<br>$I\alpha$ : from 1999Ho28. Others: 43% 3 (1995AnZY), 45% 5 (1970Bo13) are in disagreement. Value from 1999Ho28 is preferred due to high resolution of the $\alpha$ spectrum in their Fig. 2.  |

$^\dagger$  Original values from 1970Bo13 have been increased by 1 keV because of a change in the calibration energies of the  $^{215}\text{Po}$  and  $^{212}\text{Po}$  standard sources (1971Gr17,1977Ma31).

$^\ddagger$  Using  $r_0(^{219}\text{Ac})=1.5543$  24, interpolation of  $r_0(^{218}\text{Ra})=1.5571$  17 and  $r_0(^{220}\text{Th})=1.5514$  30; values of  $r_0$  taken from 2020Si16.

$^\#$  Absolute intensity per 100 decays.