

Adopted Levels

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 156, 70 (2019)	31-Jan-2019

$S(n)=6790$ SY; $S(p)=230$ SY; $Q(\alpha)=10996$ 25 [2017Wa10](#)

Estimated uncertainties ([2017Wa10](#)): $\Delta S(n)=550$, $\Delta S(p)=310$.

$S(2p)=2670$ 350, $Q(\epsilon p)=4260$ 390 (syst,[2017Wa10](#)). $S(2n)=15510$ (theory, [1997Mo25](#)).

[2018It04](#) deduced mass excess of ^{266}Mt as 127803 keV 152 using $Q(\alpha)$ from [2017Wa10](#), where mass excess is given as 127962 keV 306 from systematic trend.

[1982Mu15](#), [1984Mu07](#), [1988Mu15](#), [1989Mu16](#): ^{266}Mt produced in $^{209}\text{Bi}(^{58}\text{Fe},n),E=5.15, 5.17$ MeV/nucleon using SHIP separator at GSI. One decay chain reported by [1982Mu15](#) and [1984Mu07](#). Two additional decay chains were reported by [1988Mu15](#). Results also summarized in [1989Mu16](#) review article.

Event #1: [1982Mu15](#), [1984Mu07](#):

$E_{\alpha 1}=11.10$ MeV 4, $\Delta t_1=5.0$ ms, assigned to ^{266}Mt .

$E_{\alpha 2}=1.14$ MeV (escaped), $\Delta t_2=22.3$ ms, assigned to ^{262}Bh .

ϵ , $\Delta t_3=12.9$ s, assigned to ^{258}Db , decays to ^{258}Rf by ϵ .

$E_{\text{SF}}=232$ MeV for dominant SF decay of ^{258}Rf .

Event #2: [1988Mu15](#), [1989Mu16](#):

$E_{\alpha 1}=5.8$ MeV (escaped), $\Delta t_1=4.8$ ms, assigned to ^{266}Mt .

$E_{\alpha 2}=10.21$ MeV, $\Delta t_2=13.2$ ms, assigned to ^{262}Bh .

$E_{\alpha 3}=1.4$ MeV (escaped), $\Delta t_3=9.3$ s, assigned to ^{258}Db .

ϵ decay of ^{254}Lr to ^{254}No .

$E_{\alpha 4}=8.10$ MeV, $\Delta t_4=96$ s, assigned to ^{254}No , which α decays to ^{250}Fm .

Event #3: [1988Mu15](#), [1989Mu16](#):

Missed detection of α particles from the decay of ^{266}Mt .

$E_{\alpha 2}=10.34$ MeV, $\Delta t_2=4.0$ ms, assigned to ^{262}Bh .

$E_{\alpha 3}=9.01$ MeV, $\Delta t_3=2.9$ s, assigned to ^{258}Db , which α decays to ^{254}Lr .

[1984Og03](#): $^{209}\text{Bi}(^{58}\text{Fe},n),E=5.5$ MeV/nucleon using U400 cyclotron at JINR-Dubna, followed by off-line detection of long-lived daughters by radiochemical separation of Cm, Cf, Es, and Fm. Detected one track of ^{258}Db (possibly originating from the α - α decay chain of ^{266}Mt), and seven α decays from ^{246}Cf ($T_{1/2}=35$ h +39-14).

[1997Ho14](#) (also [1999He11](#) review article): ^{266}Mt produced in $^{209}\text{Bi}(^{58}\text{Fe},n),E=287.6, 289.8, \text{ and } 292.0$ MeV using the UNILAC and SHIP at GSI. Measured excitation functions and production cross sections.

History of 12 α - α - α decay chains observed by [1997Ho14](#):

Event #1:

$E_{\alpha 1}=10814$ keV, $\Delta t_1=1.8$ ms, assigned to ^{266}Mt .

$E_{\alpha 2}=10213$ keV, $\Delta t_2=11.5$ ms, assigned to ^{262}Bh .

ϵ , $\Delta t_3=1.18$ s – assigned to ^{258}Db .

Event #2:

$E_{\alpha 1}=10661$ keV, $\Delta t_1=1.1$ ms, assigned to ^{266}Mt .

$E_{\alpha 2}=9834$ keV, $\Delta t_2=14.1$ ms, assigned to ^{262}Bh .

$E_{\alpha 3}=9387$ keV, $\Delta t_3=9.6$ s, assigned to ^{258}Db .

Event #3:

$E_{\alpha 1}=10576$ keV, $\Delta t_1=0.4$ ms, assigned to ^{266}Mt .

$E_{\alpha 2}=10379$ keV, $\Delta t_2=16.7$ ms, assigned to ^{262}Bh .

$E_{\alpha 3}=9189$ keV, $\Delta t_3=2.2$ s, assigned to ^{258}Db .

Event #4:

$E_{\alpha 1}=10561$ keV, $\Delta t_1=1.9$ ms, assigned to ^{266}Mt .

$E_{\alpha 2}=10443$ keV, $\Delta t_2=18.4$ ms, assigned to ^{262}Bh .

$E_{\alpha 3}=9380$ keV, $\Delta t_3=0.60$ s, assigned to ^{258}Db .

Adopted Levels (continued)

Event #5:

 $E_{\alpha 1}=10809$ keV, $\Delta t_1=1.3$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=9763$ keV, $\Delta t_2=255$ ms, assigned to ^{262}Bh . ε decay, $\Delta t_3=11.2$ s, assigned to ^{258}Db .

Event #6:

 $E_{\alpha 1}=11739$ keV, $\Delta t_1=7.8$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=6.4$ MeV (escaped), $\Delta t_2=6.9$ ms, assigned to ^{262}Bh . $E_{\alpha 3}=9179$ keV, $\Delta t_3=1.85$ s, assigned to ^{258}Db .

Event #7:

 $E_{\alpha 1}=10456$ keV, $\Delta t_1=4.5$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=10372$ keV, $\Delta t_2=17.3$ ms, assigned to ^{262}Bh . $E_{\alpha 3}=1.0$ MeV (escaped), $\Delta t_3=11.2$ s, assigned to ^{258}Db .

Event #8:

 $E_{\alpha 1}=11306$ keV, $\Delta t_1=2.0$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=10001$ keV, $\Delta t_2=45$ ms, assigned to ^{262}Bh . $E_{\alpha 3}=0.6$ MeV (escaped), $\Delta t_3=1.38$ s, assigned to ^{258}Db .

Event #9:

 $E_{\alpha 1}=10484$ keV, $\Delta t_1=0.2$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=9902$ keV, $\Delta t_2=7.5$ ms, assigned to ^{262}Bh . ε decay, $\Delta t_3=7.0$ s, assigned to ^{258}Db .

Event #10:

 $E_{\alpha 1}=11682$ keV, $\Delta t_1=0.2$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=9831$ keV, $\Delta t_2=278$ ms, assigned to ^{262}Bh . $E_{\alpha 3}=1.1$ MeV (escaped), $\Delta t_3=0.11$ s, assigned to ^{258}Db .

Event #11:

 $E_{\alpha 1}=10859$ keV, $\Delta t_1=0.7$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=9803$ keV, $\Delta t_2=21.1$ ms, assigned to ^{262}Bh .

Event #12:

 $E_{\alpha 1}=10848$ keV, $\Delta t_1=2.5$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=10143$ keV, $\Delta t_2=225$ ms, assigned to ^{262}Bh . $E_{\alpha 3}=9064$ keV, $\Delta t_3=4.19$ s, assigned to ^{258}Db . $^{1997}\text{Ho}14$ obtain $T_{1/2}=1.7$ ms $+6-4$ from the arithmetic mean of 14 decay times. $^{2009}\text{Ne}02$: $^{208}\text{Pb}(^{59}\text{Co},n)$, $E=291.5$ MeV from the 88-Inch Cyclotron at LBNL, using the Berkeley Gas Separator to separate the evaporation residues. Measured α decays and spontaneous fission events using a multiwire proportional counter (MWPC).History of five correlated decay chains observed in $^{2009}\text{Ne}02$:

Event #1: Energy of the evaporation residue=21.6 MeV.

 $E_{\alpha 1}=11260$ keV, $\Delta t_{\alpha 1}=15$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=3090$ keV (escaped), $\Delta t_{\alpha 2}=2$ ms, assigned to ^{262}Bh . $E_{\alpha 3}=6880$ keV (partial), $\Delta t_{\alpha 3}=15.035$ s, assigned to ^{258}Db . ^{254}Lr decays by ε to ^{254}No . $E_{\alpha 4}=8060$ keV, $\Delta t_{\alpha 4}=26.990$ s, assigned to ^{254}No . $E_{\alpha 5}=7400$ keV, $\Delta t_{\alpha 5}=25.812$ min, assigned to ^{250}Fm .

Event #2: Energy of the evaporation residue=24.1 MeV.

 $E_{\alpha 1}=2180$ keV (escaped), $\Delta t_{\alpha 1}=7$ ms, assigned to ^{266}Mt . $E_{\alpha 2}=10380$ keV, $\Delta t_{\alpha 2}=38$ ms, assigned to ^{262}Bh . $E_{\alpha 3}=1153$ keV (escaped), $\Delta t_{\alpha 3}=5.577$ s, assigned to ^{258}Db . $E_{\alpha 4}=8450$ keV, $\Delta t_{\alpha 4}=17.908$ s, assigned to ^{254}Lr .

Event #3: Energy of the evaporation residue=23.1 MeV.

Adopted Levels (continued)

$E_{\alpha 1}$ =4340 keV (escaped), $\Delta t_{\alpha 1}$ =0.6 ms, assigned to ^{266}Mt .
 $E_{\alpha 2}$ =10060 keV, $\Delta t_{\alpha 2}$ =1 ms, assigned to ^{262}Bh .
 $E_{\alpha 3}$ =9250 keV, $\Delta t_{\alpha 3}$ =1.364 s, assigned to ^{258}Db .
 $E_{\alpha 4}$ =8490 keV, $\Delta t_{\alpha 4}$ =9.013 s, assigned to ^{254}Lr .
 $E_{\alpha 5}$ =7780 keV, $\Delta t_{\alpha 5}$ =16.610 s, assigned to ^{250}Md .

Event #4: Energy of the evaporation residue=23.1 MeV.

$E_{\alpha 1}$ =10670 keV, $\Delta t_{\alpha 1}$ =0.2 ms, assigned to ^{266}Mt .
 $E_{\alpha 2}$ =8150 keV (partial), $\Delta t_{\alpha 2}$ =185 ms, assigned to ^{262}Bh .
 $E_{\alpha 3}$ =1450 keV (escaped), $\Delta t_{\alpha 3}$ =7.804 s, assigned to ^{258}Db .
 ^{254}Lr decays by ε to ^{254}No .
 $E_{\alpha 4}$ =8050 keV, $\Delta t_{\alpha 4}$ =9.412 s, assigned to ^{254}No .
 $E_{\alpha 5}$ =7570 keV, $\Delta t_{\alpha 5}$ =36.260 min, assigned to ^{250}Fm .

Event #5: Energy of evaporation residue=23.1 MeV.

$E_{\alpha 1}$ =1140 keV (escaped), $\Delta t_{\alpha 1}$ =0.5 ms, assigned to ^{266}Mt .
 $E_{\alpha 2}$ =10070 keV, $\Delta t_{\alpha 2}$ =39 ms, assigned to ^{262}Bh .
 $E_{\alpha 3}$ =1440 keV (escaped), $\Delta t_{\alpha 3}$ =8.786 s, assigned to ^{258}Db .
 $E_{\alpha 4}$ =8450 keV, $\Delta t_{\alpha 4}$ =13.759 s, assigned to ^{254}Lr .
 ^{250}Mo decays by ε to ^{250}Fm .
 $E_{\alpha 5}$ =7440 keV, $\Delta t_{\alpha 5}$ =7.495 min, assigned to ^{250}Fm .

Possible isomerism in ^{266}Mt : isomeric activity decaying by α is proposed by [1997Ho14](#) and [1999He11](#) in view of the large spread in measured E_{α} values (10.484 to 11.739 MeV) and mean lifetimes (ranging from 0.2 to 7.8 ms) for 14 events in [1997Ho14](#) (including two from [1988Mu15](#) and [1984Mu07](#)) and five from [2009Ne02](#), and also existence of two α -decaying activities of ^{262}Bh , α daughter of ^{266}Mt . Also note a comment by [1997Ho14](#) that events #5, #10 and #12 were correlated to three α decays of ^{266}Mt near 10.8 MeV, possibly decays from a level different from the other transitions. [2017Au03](#) (NUBASE-2016) adopted g.s. of ^{266}Mt with $T_{1/2}$ =1.2 ms 4, based on lifetime data from ten events in [1997Ho14](#); and isomer in ^{266}Mt at 1140 keV 80 with $T_{1/2}$ =6 ms 3, based on data from three events in [1997Ho14](#). [2017Au03](#) and [2017Wa10](#) did not refer to [2009Ne02](#) work where five additional events were reported. In the opinion of the evaluator, a definite evidence for an isomer in ^{266}Mt is lacking, and further experiments on this isotope are warranted.

For theoretical studies, consult Nuclear Science References (NSR) database at NNDC, BNL for 44 primary references dealing with the half-lives and other aspects of nuclear structure in this mass region.

 ^{266}Mt Levels

<u>E(level)</u>	<u>$T_{1/2}$</u>	<u>Comments</u>
0	2.1 ms 7	<p>$\% \alpha > 75$; $\% \text{SF} < 25$ (2009Ne02) No evidence was found for ε or SF decay modes (2009Ne02, 1997Ho14). The SF events detected in 1984Og03 were interpreted as being from ^{258}Rf decay, the ε decay daughter of ^{258}Sg, the α grand-daughter of ^{266}Mt. From the systematics of SF decay half-lives, 1984Og03 suggested that ^{266}Mt decays mostly by α. E(level): the observed SF or α activity is assumed to correspond to the ground state of ^{266}Mt, although, as stated in 1997Ho14 and 1999He11, isomeric activity is also possible. $T_{1/2}$: weighted average of 3.3 ms +25-10 (2009Ne02, from five decay chains) and 1.7 ms +6-4 (1997Ho14, from 14 decay chains, including one each from 1988Mu15 and 1984Mu07). The half-life is assigned to one activity, but as stated in 1997Ho14 and 1999He11, isomeric activity is also possible. J^{π}: $1^+, 10^+$ from $\Omega(\text{proton})=11/2^+$, $\Omega(\text{neutron})=9/2^+$ (1997Mo25, theory). E_{α}=11.26 and 10.67 MeV (2009Ne02), 10.484 to 11.739 MeV in 1997Ho14. From all the 15 decay chains, where full energy α decay from ^{266}Mt was recorded, unweighted average E_{α}=10.86 MeV 10. 2017Wa10 and 2017Hu03 adopt $Q(\alpha)(^{266}\text{Mt decay})=10996.25$ (implying $E_{\alpha}=10831.25$) by taking average of four measured E_{α} values 10859, 10848, 10809 and 10814 keV in 1997Ho14; and also adopt $Q(\alpha)=11920.50$</p>

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Adopted Levels (continued)

 ^{266}Mt Levels (continued)

<u>E(level)</u>	<u>T_{1/2}</u>	<u>Comments</u>
		for an isomer in ^{266}Mt from an event with measured $E\alpha=11739$ keV in 1997Ho14 . However, note that the procedure adopted in 2017Hu03 is at variance with a comment by 1997Ho14 that events #5, #10 and #12 were correlated to three α decays of ^{266}Mt near 10.8 MeV, possibly decays from a level different from the other transitions. Production $\sigma=7.5$ pb 27 (maximum); $\sigma(287.6$ MeV) $=7.4$ pb $+48-33$, $\sigma(289.8$ MeV) $=6.1$ pb $+49-29$, and $\sigma(292.0)=2.5$ pb $+25-14$ (1997Ho14). Measured $\sigma=7.7$ pb $+52-33$ at $E^*=14.9$ MeV (2009Ne02). Earlier value: $\sigma=10$ pb $+10-6$ (1988Mu15 , also includes 1984Mu07).