Adopted Levels

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. Gupta	ENSDF	1-Aug-2015

Q(β^-)=−3559 *SY*; S(n)=6058 *SY*; S(p)=3854 *SY*; Q(α)=9051 *SY* 2012Wa38

ΔQ(β^-)=264 syst, ΔS(n)=308 syst, ΔS(p)=266 syst, ΔQ(α)=112 syst (2012Wa38).

Q(α): 2003Au03 noted that 8976 keV *30* (1998Tu01) to ^{261m}Rf is the strongest group and May Be unhindered. Evaluators note that the combined Q(α) of the two energy groups In 2008Du09 is 8.952 MeV *58*. Other: adjusted value of 9077 keV *30* (1998Tu01); 9.07 MeV *+4−2* from Eα=8.93 MeV *+4−2* [weighted average of 8.94 MeV *3* (1998Tu01) and 8.90 MeV *+7−3* (2003Tu05)] assuming g.s. to g.s. transition; 9.08 MeV *5* (2003Au03).

1994Lo27, 1994La22: produced In the reaction ^{248}Cm(^{22}Ne,5n) E=116, 121 MeV using the U400 cyclotron At Dubna and the H-gas filled separator DGFRS. Separated EVR′s passed through a tof counter and impinged on a position sensitive surface barrier detector. Four α-α-(α) correlations At 121 MeV were attributed to this nucleus with Eα=8.71-8.91 MeV At a production cross-section of 260 pb accurate to within an approximate factor of three. Average Eα=8.82 MeV for the four events (evaluators), with a detector resolution of$\approx$100 keV (1998Tu01). since the lifetimes of the seaborgium isotopes could not Be measured due to the lack of the initial implantation signal In the silicon detectors, the experimenters used the Viola-Seaborg relation to estimate an α-half life of 2 to 30 s with a HF of 1-3. α-branching was estimated to Be$\geq$50%. The assignment was based on properties of rutherfordium known At the time. 2006Dv01 reassign 6 α-SF events to ^{265}Sg decaying to the second state In ^{261}Rf which was unknown At the time of this experiment. The average Eα=8.63 MeV for these 6 events (evaluators).

1996Ho13: descendent of ^{277}112 produced by ^{208}Pb(^{70}Zn,N), E=343.8 MeV (E×=10.1 MeV; σ=1.0 pb *+18−4*) At GSI/SHIP. Two EVR-α1−α2−α3−α4−α5−α6 events observed. First event retracted by 2002Ho11; σ revised to 0.4 pb *+9−3*. See ^{277}112 Adopted Levels In 2005Gu33 for details. One energy-time correlation recorded with one escaped particle for this nucleus with a time interval of 7.4 s.

1996La12: descendant of ^{273}Ds using the hot fusion reaction ^{244}Pu(^{34}S,5n) E=190 MeV At Dubna using DGFRS In collaboration with LLNL. The cross-section was about 0.4 pb for ^{273}Ds. 14 candidate events for ^{273}Ds were measured In beam-off conditions, of which one EVR-α1−α3−α4 event was considered to Be the most likely. See ^{273}Ds Adopted Levels In 2005Gu33 for details. The energy window was set At 8.5 to 9.0 MeV for ^{265}Sg with a time window of 360 s following the emission of the first α. Suggested properties from the most likely single event are Eα=8.63 MeV *6* with α lifetime of 158 s corresponding to $T_{1/2}$=110 s. For this event, the small non-zero value of 6×10^{-3} for random fourfold correlations over the entire time of measurement (1375 h) for the whole PSD array does not rule out the possibility of a random sequence. Additionally, the 8.63 MeV α was accompanied by a low amplitude ΔE signal about 60% of the time within 5 μS. Preliminary results suggest that the likely source for the signal could Be the conversion electron associated with the decay of ^{261}Rf and ^{257}No since odd-A ^{265}Sg decays preferentially to an excited state In ^{261}Rf.

1997Sc48, 1997Sc49: produced In the hot fusion reaction ^{248}Cm(^{22}Ne,5n) E=121 MeV At GSI using the UNILAC. two chemical separation techniques were used In these studies intended to study the chemical properties of Sg. 1997Sc48 reports results of the first aqueous chemistry for Sg using the ARCA setup (1989Sc42). IT was not possible to determine a half-life for Sg. The decay of ^{265}Sg was not seen although the presence of ^{261}Rf and and ^{257}No As daughter products indicate the production of the parent. 1997Sc49 report results from gas chromatography using the OLGA III (1996Tu05) setup. Three decay chains attributable to to ^{265}Sg were unambigiously measured with the following properties: Eα=8.81, 8.82 and 8.86 MeV ± 6 (FWHM) with average Eα=8.83 MeV ± 6. τ=2.8, 27.3 and 0.6 s, respectively corresponding to an average $T_{1/2}$=7.1 s *+97−26* for the three events (evaluators). Both studies indicate that Sg is chemically similar to the lighter homologues Mo and W and its behaviour is typical of group 6 elements. 1997Sc48 rule out pseudo-group ^{6,}U-like behavior for Sg. See also 1998Sc50 and 1999Tu04 for chemistry. 2006Dv01 believe that the event attributed to ^{266}Sg In 1997Sc49 should Be reassigned to ^{265}Sg decaying to the ‘second’ level In ^{261}Rf which was unknown At the time.

1998Tu01: produced by the hot fusion reaction ^{248}Cm(^{22}Ne,5n) E=121, 123 MeV At the GSI UNILAC; see also ^{266}Sg Adopted Levels In 2005Gu33. The reaction cross-section deduced for the α-decay branch was about 250 pb. Chemical separation of volatile Sg oxychlorides was achieved with OLGA (1996Tu05) using isothermal chromatography. Group 6 elements which passed through the column were transported to a 64-position rotating wheel system ROMA (1984SuZW). PIPS detectors were used to measure the nuclides of interest. The daughter mode (DM) mode was used to measure time and position of correlated parent-daughter α-decay events.

Correlated decay chains with Eα(mother)=8.57-9.07 MeV (^{265}Sg) and Eα(daughter(s))=8.05-8.45 MeV (^{261}Rf, ^{257}No), and Eα(mother)=8.41-8.85 MeV (^{266}Sg) and E_{SF}(daughter) $\geq$ 20 MeV (^{262}Rf) within 6.3 s are shown below:

A detailed random analysis specific to this method of detection was carried out on the basis of which the most representative

Adopted Levels (continued)

properties for this nucleus were suggested. From four decay chains measured In DM mode, the expected number of random events was deduced to Be 0.83. For 11 decay chains not In DM mode, the same number was 4.79. Highest confidence was placed on triple coincidences measured In chain 5 which had a randomness probability of 0.04. A total of 13 α-decay chains were attributed to ^{265}Sg. 4 α-energy groups were proposed with Eα=8.69 MeV *3* (8%), 8.76 MeV 3 (23%), 8.84 MeV *3* (46%) and 8.94 MeV *3* (23%). From a two component maximum likelyhood decay curve analysis the half-life was deduced to Be 7.4 s *+33−27* for ^{265}Sg. A sub-group of runs was undertaken to determine the SF branch. Five SF decays were seen possibly from ^{265}Sg although other decaying products were not excluded. From the analysis of three events with 24.3, 27.2 and 43.6 secs, the upper limit of the fission branch was estimated≤35% 16. The lower limit on the SF half-life was≥13 s. The corresponding partial α-decay $T_{1/2}$ was 4.7 to 16.5 s (68% c.i.).

The three events originally assigned to ^{266}Sg were reassigned to ^{265}Sg via 2006Dv01 and taken into account (As events 17 to 19) by 2008Du09. Note that Events 14-16 (in parentheses above) have a high degree of randomness and were not included in the re-evaluation by 2008Du09.

2001Hu22: In a chemical study of seaborgium oxide hydroxide with the reaction ^{248}Cm(^{22}Ne,4*n*)^{266}Sg At a beam energy of 119 MeV provided by UNILAC, GSI. The results of this experiment were reassigned to ^{265}Sg In the analysis by 2008Du09 and are therefore discussed here. Reaction products were transported to the **HI**GH **T**EMPERATURE on-line **G**AS chromatography **A**PPARATU**S** (HITGAS).

@B@0@0@@@@ @B@0@1@@@@@1 with the expected cross-section of 60 pb (1998Tu01) for the 4*n* channel, the production rate was about 0.8 h^{-1}. reaction products of interest leaving the chromatography column were deposited on ROMA with a step interval of 10 s. 15 PIPS detectors were used to measure α-SF correlations within a time period of 150 s after collection. a high level of contamination from polonium isotopes was present. two α-SF events were measured In the energy window of 8.61 to 8.75 MeV attributed to ^{266}Sg and ^{262}Rf: Eα_1=8.66 MeV, τ_1=84.9 s and τ(SF)=7.0 s; Eα_2=8.70 MeV, τ_2=4.8 s, τ(SF)=3.7 s. The energy resolution achieved was 28 keV (FWHM). From both events, probabilities of randomness were 0.82 (No random), 0.16 (one random) and 2% (both random). Production cross-sections were 60 pb +106-17 for both events and 27 pb +110-17 for one event. Evaluators note that average Eα=8.680 MeV ± 28 corresponding to $T_{1/2}$=31 s *+57−12* (Sg). the two-event SF $T_{1/2}$(SF)=4 s *+7−2* (Rf). experimenters conclude that Sg shows properties typical to group 6 elements As well As an uranium(VI) like behavior which is also known to form a volatile oxide hydroxide.

2002Ho11: descendant of ^{277}112. The experiment of 1996Ho13 was redone At GSI/SHIP. The ^{208}Pb(^{70}Zn,N) reaction was again used At projectile energies of 346.1 MeV (E×=12.0 MeV; σ=0.5 pb *+11−4*; 1 event) and 343.8 MeV (E×=10.1 MeV; σ<2.6 pb; 0 events). Retracted one event observed by 1996Ho13. see ^{277}112 Adopted Levels In 2005Gu33 for details. From the two remaining chains recorded the α particles from the decay of ^{265}Sg escaped. The half-life computed was 9 s *+17−4*. From the individual lifetimes, the α particle energies were estimated to Be 8.75 MeV (τ=4.6 s) and 8.62 MeV (τ=18.8 s).

2003Tu05, 2003Du27, 2002Du21: daughter of ^{269}Hs In a chemical study. ^{269,270}Hs produced by ^{248}Cm(^{26}Mg,xn) At E=143.7-146.8 MeV (σ(^{269}Hs)≈6 pb, σ(^{270}Hs)≈4 pb) At GSI using UNILAC with *In situ* Volatilization and Online detection (IVO) As part of a large international collaboration. Three decay chains were attributed to ^{269}Hs and daughter ^{265}Sg are listed below. Chemically separated Hs atoms were identified by observing genetically linked decay chains. See ^{270}Hs Adopted Levels In 2005Gu33 for details.

The above properties are from 2003Tu05. Note that the life-times of the parent could not Be estimated with the applied thermochromatography technique since deposition times are not measured. Two more possible candidates for ^{269}Hs are shown In 2002Du21 but not listed here since the parent (In the first event) and daughter (In the second event) were not seen. 2003Du27 suggest a probability of≤7×10^{-5} for the decay sequences originating with ^{269}Hs. Tentative assignments of two decay chains initially made to ^{270}Hs In 2003Tu05 and 2002Du21 are reassigned to ^{269}Hs via 2006Dv01. All six events (three chains above, two tentative decays and one candidate for either ^{269}Hs or ^{270}Hs from 2002Du21) are taken into account by 2008Du09 In their reanalysis of ^{265}Sg data. 2002Du21 also explains the chemical implications of these experiments. See also 2004Ga18.

2004Vo24: As daughter of ^{269}Hs In a chemical study. ^{269,270}Hs produced by ^{248}Cm(^{26}Mg,xn), E=142-150 MeV At GSI using the UNILAC with Continuously Working Arrangement for Clusterless Transport of *In-Situ* Produced Volatile Oxides (CALLISTO). See ^{269}Hs Adopted Levels In 2005Gu33 for details. One correlated α-α-α chain and five α-SF chains observed; the last α-SF chain is a likely candidate for a random correlation.

α-α-α chain:

α-SF events:

Events 3 and 4 were included In the reevaluation by 2008Du09 As originating from ^{269}Hs (undetected) and decaying to ^{265}Sg ($E_{\alpha2}$) ending by SF from the $^{261}Rf^b$ state (see ^{261}Rf Adopted Levels for details of the two levels).

2006Dv01: daughter of ^{269}Hs produced by ^{248}Cm(^{26}Mg,5n) At GSI/UNILAC. This was the first campaign, with beam energies of 193 MeV and 185 MeV corresponding to E=145, 136 MeV At the center of target for the expected 5n and 4n channels

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respectively. Three arc-shaped segmented targets (95.8% ^{248}Cm, 4.2% ^{246}Cm); one segment contained 2% by weight of ^{152}Gd (30% enrichment) for simultaneous production of α-decaying Os isotopes, a chemical analog to Hs. See 2002Ki25, 2002Du21, and 2002Du22 for description of rapid chemical separation and on-line detection method used. Detection system consisted of a linear array of 2×32 PIPS detectors In two Invar profiles forming a vacuum tight gas channel. Energy resolution=50 keV (FWHM). The energy region of interest At Eα=8.0-9.5 MeV contained 145 events In the first 25 detectors. α decay chain was defined As an 8.0-9.5 MeV α-decay followed within 300S In the same or neighboring detector pair by an α-decay In the same energy window or by an SF. The search was repeated within the chain until No α-decay was registered. Data analysis revealed 15 correlated decay chains In the first 25 detector pairs; eight At E=145 MeV and seven At E=136 MeV. Based on the count rates, 3×10^{-5} random sequences can Be for α-α-α-α, 5×10^{-3} for α-α-SF, and 1 for α-SF. Cross sections of≈3 pb were measured for ^{270}Hs At 136 MeV and≈7 pb for ^{269}Hs At 145 MeV within an estimated accuracy of a factor of≈3.

2006Dv01 deduced the following decay properties: ^{269}Hs: α decay, Eα=9.07 MeV *3* and 8.92 MeV *3*; ^{270}Hs: α decay, $T_{1/2}$=22 s (calculated using 2005Pa72 and Q(α) deduced from their experimental data), Eα=8.89 MeV *3*; ^{265}Sg: α decay, $T_{1/2}$=14.9 s *+91−41*, Eα=8.68 MeV *4*; and ^{266}Sg: SF decay, $T_{1/2}$=444 ms *+444−148*. Uncertainties correspond to 68% confidence limits and do not include systematic errors.

Evaluators Note: While the results from this experiment are contradictory to earlier reports, they also differ from the properties of ^{266}Sg and ^{270}Hs adopted In 2005Gu33. 2006Dv01 suggest that data pertaining to these nuclides from earlier studies are more consistent with decays from ^{265}Sg and ^{269}Hs and were erroneously assigned to ^{266}Sg and ^{270}Hs whose properties stand revised via this work. The quantities adopted In 2005Gu33 were In consonance with claims made by the various experimental groups, some of which cited ‘unambigious’ results for these nuclides. it is worthwhile to note that many of the early studies were designed primarily to measure chemical properties such As the greatly increased volatility of chlorides of trans-actinides (*i.e.* elements above Z=103). hence, the experimental focus was mainly on the transmission of SF activity through a suitable detection system indicative of the nuclide and chemical species of interest being formed (or its absence), rather than on the accurate measurement of a half-life. Two other experimental deficiencies resulting In the non-recognition of a second state In daughter ^{261}Rf which would otherwise have provided a vital clue, May have aided earlier interpretations. chemistry experiments employed hot fusion reactions with actinide targets which are known to lead to a relatively large SF background when compared to Pb-target based cold fusion reactions. this non-negligible SF background through most of the chemical studies could have hampered the identification of the second state of ^{261}Rf (2008Du09). additionally, the presence of ^{212}Po (Eα=8.52 MeV, I_α=2.05%) from transfer reactions caused by the projectile on Pb impurites In the target, May have also hindered the detection of the ‘second’ daughter state with almost the same Eα, energy gate permitting. independent future studies providing collateral information and improved characterisation and assignment properties, through both physical and chemical means are required to make conclusive assignments and an accurate determination of physical properties.

2006Ni10: In a study of the reaction ^{238}U(^{30}Si,xn)^{268}Sg At GSI using the UNILAC and SHIP. The SHIP setup was similar to earlier work. In this experiment, higher energy SF fragments were measured with additional electronics which allowed the detection of energies up to 320 MeV. An additional Si PIPS detector was used to detect inelastic reaction products behind the stop detector. A clover detector with four crystals was also mounted behind the stop detector to measure coincident x-rays or γ's. The probability of randomness from ^{208}Pb impurities was estimated to Be 1×10^{-4} for the observation of one SF event In each of the three ^{30}Si+^{238}U irradiations. One event with an escaped α particle was attributed to ^{265}Sg. The event life-time was 15.2 s corresponding to $T_{1/2}$= 10.2 s. 2006Ni10 assigned the event to ^{265}Sg due to the agreement with an “AVERAGE” half-life of 7.9 s *+64−24* computed by 2006Ni10 from three events reported In 2003Tu05 and two events In 2002Ho11. The SF fragments were attributed to the known 100% fission branch from the 3.6 s *+23−11* state In daughter ^{261}Rf. A γ of energy 1172 keV was measured In coincidence with the SF decay In the clover detector. The production cross-section was 3.5 pb *+81−29* At E_c.m.=133.0 MeV.

2007Mo09, 2005MoZT, 2005MoZQ: descendent of ^{277}112. Confirmatory experiments performed by the Japanese group At RIKEN with ^{208}Pb(^{70}Zn,N) E=345.9 MeV (σ=0.44 pb *+59−29*). Two EVR-α1−α2−α3−α4-SF events observed. Confirmed results of 2002Ho11. See ^{277}112 Adopted Levels In 2005Gu33 for details. Randomness factors are provided In 2007Mo09. The improved half-life for ^{265}Sg is suggested As 22 s *+22−8*. 2007Mo09 note that while Eα of grand-parent ^{269}Hs from 2006Dv01 is somewhat low when compared to their results, the α energies for ^{265}Sg and decay properties of ^{261}Rf are consistent.

2008Dv02: daughter of ^{269}Hs produced by ^{248}Cm(^{26}Mg,5n) At GSI/UNILAC. This was the second campaign with beam energies of 197 MeV, 189 and 181 MeV corresponding to E=150, 140 and 130 MeV At the target center. The experimental set-up was the same As used In 2006Dv01. Five decay chains attributed to ^{269}Hs were observed:

Revised decay properties were deduced from all events including those from 2006Dv01:

^{269}Hs: α decay, Eα=9.13 MeV *5* with $T_{1/2}$=4 s ($T_{1/2}$ calculated using 2005Pa72) and 8.95 MeV *5*; ^{270}Hs: α decay, $T_{1/2}$=23 s (calculated using 2005Pa72 and Q(α) deduced from their experimental data), Eα=8.88 MeV *5*; ^{265}Sg: α decay, $T_{1/2}$=15 s *+7−4*,

Adopted Levels (continued)

Eα=8.69 MeV *5*; and ^{266}Sg: SF decay, $T_{1/2}$=360 ms *+250−100*.

2008Du09 (and erratum): a comprehensive re-evaluation of all data relevant to the production of ^{265}Sg In the reaction ^{248}Cm(^{22}Ne,xN)$^{270-x}$Sg was undertaken In an attempt to address existing ambiguities In deduced properties due to the varying quality of older data and taking into account re-assignments suggested In 2006Dv01. Decay properties previously assigned to ^{266}Sg In 1994La22, 1996La12, 1998Tu01, 2001Hu22, 2003Tu05 and 2004Vo24 are re-examined together with new data from 2006Dv01 and 2008Dv02. a total of 60 events are considered for ^{265}Sg and ^{261}Rf following re-assignments. strong indications for two states (a and b) In ^{265}Sg are suggested although it is not possible to conclusively deduce which is the ground state due to the poor quality of data. from available data on the production of ^{265}Sg As an EVR the isomeric population ratio $\sigma(^{265}Sg^{a})/\sigma(^{265}Sg^{b})$=23/17≈1.4 is deduced. Directly produced ^{265}Sg decays with a combined $T_{1/2}$ = 10.5 s *+26−17* (26 events where α decays were observed) are consistent with the mixing of levels observed from the α spectra. new decay properties attributed to this nucleus are $^{265}Sg^{a}$: Eα=8.80 − 8.90 MeV; $T_{1/2}$=8.9 s *+27−19*; $^{265}Sg^{b}$: Eα=8.70 MeV; $T_{1/2}$=16.2 s *+47−35*. 91% of the α-decays from the parent ^{269}Hs feed the $^{265}Sg^{b}$ state. deduced decay branchings to the two suggested states In the daughter nucleus were 80% for $^{265}Sg^{a}$ to $^{261}Rf^{a}$ and 88% for $^{265}Sg^{b}$ to $^{261}Rf^{b}$ As shown In the erratum. cross sections for Sg In the ^{248}Cm(^{22}Ne,5n) from 260 nb (121 MeV, 1994La22) and 240 nb (121/123 MeV, 1998Tu01) are revised to 320 nb and 206 nb respectively. Recalculated cross-sections for 1998Tu01 and 2001Hu22 are multiplied by a factor of 2.2 to correct for the fact that these studies were not sensitive to all known decay paths for ^{265}Sg. the correction is applied taking into account α-α(-α) chains neglected In the PSI and HITGAS experiments which were sensitive only to α-SF chains. The corrected values are shown In figure 5. other recalculated cross sections for the ^{248}Cm(^{22}Ne,5n) reaction include: 80 nb (116 MeV, 1994La22), 78 nb (119 MeV, 1998Tu01) and 92 nb (119 MeV, 1996Ka66). the peak reaction cross-section for ^{248}Cm(^{22}Ne,5n) is of the order of a few hundred pico barns and In agreement with experimental systematics of simlar reactions. Revised values lie about a factor of three to four higher than theoretical (HIVAP) predictions. decay modes other than α decay could not Be determined on the basis of the data currently available.

2012Ha05: direct synthesis using chemical techniques with the ^{248}Cm(^{22}Ne,5n)^{265}Sg reaction At RIKEN using the GARIS set up. The beam was provided by the RIKEN linear accelerator (RILAC) At an energy of 117.8 MeV At the middle of target. EVR's were separated In flight and transported to the focal plane of garis with an estimated efficiency of 13% for the collection of ^{265}Sg. The atoms were thermalised In a gas jet chamber and delivered to a rotating wheel setup MANON (Measurement system for Alpha-particle and spontaneous fissioN events ON-line) for α/SF spectrometry. The combined set-up allowed for extremely low background conditions to enable a detailed study of this nuclide. Two α decay energies As suggested by 2008Du09 were clearly visible. At E ≥ 8.76 MeV a total of 18 decay events were reported with an average Eα=8.84±0.05 MeV consistent with the assignment to $^{265}Sg^{a}$ by 2008Du09. For the lower energy group with E<8.76 MeV, 24 events with an average energy Eα=8.69±0.05 were reported consistent with the $^{265}Sg^{b}$ state assigned by 2008Du09. The respective half lives were 8.5 s *+26−16* and 14.4 s *+37−25* (68% c.i.) In agreement with the analysis of 2008Du09. Decay branchings to two states In the daughter nucleus were 91% for $^{265}Sg^{a}$ to $^{261}Rf^{a}$ and 80% for $^{265}Sg^{b}$ to $^{261}Rf^{b}$. Details of assignments for 79 observed events are provided In Table II. IT was not possible to directly measure SF decay from this nuclide. Derived upper limits for SF decay were ≤0.50 and ≤0.51 (68% c.i.) for $^{265}Sg^{a}$ and $^{265}Sg^{b}$ respectively. Production cross-sections were 180 pb +80-60 (10 events) and 200 pb +60-50 (19 events) for $^{265}Sg^{a}$ and $^{265}Sg^{b}$ At the beam energy and efficiency provided. The total cross-section was $\sigma(^{265}Sg^{a}+^{265}Sg^{b})$=380 pb +90-70. The authors state that the cross-section ratio $\sigma(^{265}Sg^{a})/\sigma(^{265}Sg^{b})$=1.3±0.5 from all observed events $^{265}Sg^{a}/^{265}Sg^{b}$=18/24 which the evaluators note to Be 0.8.

2013Su04: descendent of ^{277}Cn produced In the cold fusion reaction ^{208}Pb(^{70}Zn,N)^{277}Cn At RIKEN. The target was bombarded by ^{70}Zn projectiles At three beam energies: 347.5, 351.5 and 355.5 MeV. The reaction products were separated In-flight by GARIS. Experiments were performed from June 17, 2011 through November 30, 2011 with a total dose of 2.31 x 10^{19} ions impinging on the target. A single event was observed At a beam energy of 351.5 MeV. The fourth decay In the sequence was attributed to $^{265}Sg^{b}$ by comparison to known properties. The event had an Eα=8.66 ± 0.08 MeV and $T_{1/2}$=20 s *+15−6*.

Other: 1999Tu04 and 2006Sc02.

Theory: see Nuclear Science References.

Assignment: 2012Ha05 direct synthesis with ^{248}Cm(^{22}Ne,5n)^{265}Sg, 117.8 MeV; 2008Du09 reassessment of all data from ^{248}Cm+^{22}Ne reaction; ^{248}Cm(^{22}Ne,5n) E=116, 121 MeV, parent of ^{262}Rf, grandparent of ^{257}No (1994La22); E=121 MeV, chem, parent of ^{262}Rf, grandparent of ^{257}No (1997Sc49); E=121, 123 MeV, chem, parent of ^{262}Rf, grandparent of ^{257}No (1998Tu01) and ^{238}U(^{30}Si,3n), parent of 3.6-S ^{261}Rf (2006Ni10).

Event	E_1^a	t_1^b	E_2^c	Δt_2^d	E_3^e	Δt_3^f	Temp.	N_R^g	Assignment
	(MeV)	(s)	(MeV)	(s)	(MeV)	(s)	(°C)		
1	8.86	0.6	8.35	48.4		300	0.83[h]	^{265}Sg->^{261}Rf	or

^{257}No

2	8.76	1.4	8.39	151.8			350	[h,i]	
3	8.93	7.0	8.22	22.2			350	[h,i]	
4	8.82	27.3	8.15	53.3			300	[h]	
5	8.81	2.8	8.36	31.0	8.11	14.8	400	0.04	^{265}Sg->^{261}Rf->^{257}No
6	8.69	1.4	8.18	56.0			300	1.90	^{265}Sg->^{261}Rf or ^{257}No
7	8.85	5.6	8.41	40.2			350	[i]	
8	8.76	6.6	8.28	45.8			350		
9	8.77	6.8	8.22	25.5			350		
10	8.96	12.8	8.23	23.5			350		
11	8.85	19.1	8.35	0.5			400		
12	8.93	19.1	8.41	35.6			350	[i]	
13	8.86	21.7	8.37	31.6			300		
14	8.95	34.0	8.22	31.2			400	2.90	(^{265}Sg->^{261}Rf or ^{257}No)
15	8.97	43.8	8.20	1.5			400		
16	8.83	52.1	8.42	1.3			400		
17	8.52	48.9	SF[j]	2.8			400	0.03[h]	^{266}Sg->^{262}Rf
18	8.79	15.1	SF[j]	1.7			350	0.09[i]	
19	8.74	3.5	SF[j]	2.4			DC[k]	0.45	

[a] Energy of mother α particle (^{265}Sg or ^{266}Sg).
[b] decay time (since beginning of measurement).
[c] Energy of daughter α particle (^{261}Rf or ^{257}No).
[d] Time difference between decay of mother and daughter nuclei.
[e] Energy of granddaughter particle (^{257}No).
[f] Time difference between the decay of the daughter and the granddaughter (^{261}Rf and ^{257}No).
[g] Expected number of random correlations for decay chains 1, 4, 5, 6, 13, 14, 16, 17, 18, and 19.
[h] Event was registered in daughter mode (DM).
[i] Event observed in the second series of experiments.
[j] Spontaneous fission (SF) with E_{SF} >20 MeV.
[k] Decay chain was observed during a direct catch (DC) experiment with the tape detection system.

TVEvent #1: 12-May-2001 at 09:55:03 hrs
$E_{\alpha1}$=9180 MeV +7-3 - assigned to ^{269}Hs
$E_{\alpha2}$=8.69 MeV +7-3 t2=4.4 s - assigned to ^{265}Sg
$E_{\alpha3}$=8.50 MeV +7-3 t3=2.4 s - assigned to ^{261}Rf
$E_{\alpha4}$=8.21 MeV +7-3 t4=55.6 s - assigned to ^{257}No
TVEvent #2: 12-MAY-2001 at 22:00:28 hrs
$E_{\alpha1}$=9.10 MeV +7-3 - assigned to ^{269}Hs
$E_{\alpha2}$=8.68 MeV +7-3 t2=9.3 s - assigned to ^{265}Sg
E_{SF}=179 MeV 6 t3=7.9 s - assigned to ^{261}Rf
TVEvent #3: 13-May-2001 at 10:02:07 hrs
$E_{\alpha1}$=8.88 MeV +7-3 (partial Eα) - assigned to ^{269}Hs
$E_{\alpha2}$=8.90 MeV +7-3 t2=17.1 s - assigned to ^{265}Sg
$E_{\alpha3}$=8.50 MeV +7-3 t3=0.846 s - assigned to ^{261}Rf

TVEvent: ^{269}Hs. October 30, 2002 (Probability to encounter this as random: <4×10^{-3})
$E_{\alpha1}$=9.12 MeV - assigned to ^{269}Hs
$E_{\alpha2}$=8.65 MeV t2=24.886 s - assigned to ^{265}Sg
$E_{\alpha3}$=escape - assigned to ^{261}Rf
$E_{\alpha4}$=8.20 MeV t4=8.029 s - assigned to ^{257}No

TVEvent #1: ^{269,270}Hs. October 29, 2002
$E_{\alpha1}$=9.284 MeV - assigned to ^{269,270}Hs
$E_{\alpha2}$=escape - assigned to ^{265,266}Sg
E_{SF}=31 MeV t3=10.484 s - assigned to ^{261,262}Rf
TVEvent #2: ^{269,270}Hs. November 8, 2002; 8:00 a.m.
$E_{\alpha1}$=9.124 MeV - assigned to ^{269,270}Hs
$E_{\alpha2}$=escape - assigned to ^{265,266}Sg
E_{SF}=31 MeV t3=17.721 s - assigned to ^{261,262}Rf
TVEvent #3: ^{269,270}Hs. November 10, 2002
$E_{\alpha2}$=8.695 MeV - assigned to ^{265,266}Sg
E_{SF}=51 MeV t3=13.599 s - assigned to ^{261,262}Rf
TVEvent #4: ^{269,270}Hs. November 8, 2002; 9:12 a.m.

$E_{\alpha2}$=8.902 MeV - assigned to ^{265,266}Sg
E_{SF}=85 MeV t3=14.561 s - assigned to ^{261,262}Rf
TVEvent #5: Not assigned; possible random event.
$E_{\alpha2}$=8.379 MeV
E_{SF}=92 MeV t3=12.273 s

TVCorrelated chains observed:

E_{beam} (MeV)	E_1 (MeV)	E_2 (MeV)	(s)	Δt_2	(MeV)	E_3 (s)	Δt_3	(MeV)	E_4 (s)	Δt_4	Assigment	
145	8.93	8.69	32.5	8.29	32.1	8.29	2.50	^{269}Hs				
145	9.06	8.68	85.6	93	4.44			^{269}Hs				
145	9.11	8.68	2.48	67/13	7.09			^{269}Hs				
145	8.91	8.65	6.75	29	6.69			^{269}Hs				
145	9.03	8.60	7.70	111/26	6.42			^{269}Hs				
145	8.92	8.72	6.82	90/101	1.29			^{269}Hs				
145	8.35	38	0.116					None				
145	8.85	100/74	1.62					^{270}Hs				
136	9.08	8.71	8.70	100/74	0.580			^{269}Hs				
136	9.10	80/90	96.0									^{269}Hs^{a}
136	8.90	89/55	0.0496					^{270}Hs				
136	8.92	106/82	0.449					^{270}Hs				
136	8.88	96/110	0.444					^{270}Hs				
136	9.30	8.20	149	89/95	12.0						^{271}Hs^{a}	
136	8.67	117/102	306					None				

[a] TVTentative assignment

TVCorrelated chains observed:

E_{beam} (MeV)	E_1 (MeV)	E_2 (MeV)	(s)	Δt_2	(MeV)	E_3 (s)	Δt_3	(MeV)	E_4 (s)	Δt_4	Assigment	
150	9.18	8.62	10.9	8.51	4.89	8.24	20.8	^{269}Hs				
150	9.13	8.68	7.61	79/88	2.25			^{269}Hs				
140	8.61	83/84	3.35									^{265}Sg^{a}
140	9.11	8.63	52.0	75/-	3.04						^{269}Hs^{b}	
140	9.22	8.47	12.3	84/120	0.128			^{269}Hs				

[a] TVIncomplete (α)-α-SF chain from ^{269}Hs
[b] TVFirst particle not position correlated

^{265}Sg Levels

2012Au07 assign the longer lived state to the isomer.

1999Ar21 proposed two levels At 0+x and 60+x (x=330 *400*) based two ^{277}112 α chains reported by 1996Ho13. Note that one of these chains was subsequently retracted by 2002Ho11.

Cross Reference (XREF) Flags

A ^{269}Hs α decay (9.7 s)

E(level)	$T_{1/2}$	XREF	Comments
x	14.4 s *+37−25*	A	%$\alpha\geq$50; %SF$\leq$50 (2012Ha05) %SF$\leq$50 (68 % c.i.) derived from data by 2012Ha05. Other: %SF$\leq$35 *16* (1998Tu01)\$%$\alpha\leq$65 *16*\$ (2012Au07 for isomer from syst). E(level): 8690 keV *50* (Q(α)=8823 keV *50*) from 2012Ha05. this level was labelled ^{265}Sg^{a} by 2008Du09 and could Be the g.s. $T_{1/2}$: from 2012Ha05 (68% c.i.). \$other: 16.2 s *+47−35* from 2008Du09 (68% c.i.) derived from 24 events In the energy group with E$\alpha\leq$8.73 MeV. This corresponds to Eα = 8685 keV *190* (Q(α)=8818 keV *190*) As the weighted average (Normalised Residual Method) of 32 events, by evaluators. 2008Du09 point out that decays from ^{269}Hs preferentially (91%) populate this level In ^{265}Sg. Of the observed two levels, this May Be the g.s.; 19.4 s *+58−36* from arithmetic mean τ=27.9 s of one event each from 1996Ho13, 1996La12,

Continued on next page (footnotes at end of table)

Adopted Levels (continued)

^{265}Sg Levels (continued)

E(level)	$T_{1/2}$	XREF	Comments
			2002Ho11, 2004Vo24, and 2006Ni10 and three events from 1997Sc49, three events from 2003Tu05, six events from 2006Dv01, and two events from 2007Mo09 (evaluators); 7.4 s *+33−27* (1998Tu01, 1999Ar21) and 15 s *+7−4* (2008Dv02). $T_{1/2}$(SF) ≥ 13 s (2000Ho27, based on 1998Tu01). $T_{1/2\ 1/2}$(CALC)= 14 s from Viola-Seaborg systematics (for g.s) assuming Q(α)=8.820 MeV (2012Ha05). J$^{\pi}$: 1/2^{+} seems probable from systematics if this is the g.s. (evaluators). Also suggested are 9/2^{+} (1999Ar21, Nillson Model) and 3/2^{+} (2012Au07 for isomer from SYST.). J$^{\pi}$: Ω(N)=1/2^{+} from 1997Mo25. β_2(theory): 0.229 (1995Mo29); 0.247 (2003Mu26); 0.273 (2005GaZY).
152+x *71*	8.5 s *+26−16*	A	%α≥49; %SF≤51 (2012Ha05) %SF≤51 (68 % c.i.) derived from data by 2012Ha05. $T_{1/2}$: from 2012Ha05 (68% c.i.). $other:8.9 s *+27−19* (2008Du09, 68% c.i.). $T_{1/2\ 1/2}$(CALC)=4.34 s from Viola-Seaborg systematics (for g.s.) assuming Q(α)=8.980 MeV from 2012Ha05. E(level): 8840 keV *50* (Q(α)=8976 keV *50*) from 2012Ha05. this level was labelled ^{265}Sg^{b} by 2008Du09 derived from 20 events In the energy group Eα > 8.73 MeV. Evaluators suggest Eα=8830 keV *60* (Q(α)=8965 keV *60*) As the weighted average (Normalised Residual Method) of events 8 and 33 from 2008Du09; 9.2 s 1.6 (2012Au07 for ground state). J$^{\pi}$: evaluators suggest J$^{\pi}$=9/2^{+} for an isomeric state based on decay systematics.