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Recoil-α-fission and recoil-α-α-fission chains stemming from element 115


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Products of the 48Ca+243Am fusion-evaporation reaction were studied with the TASISpec set-up [1, 2] behind TASCA [3-5]. Thirty correlated α-decay chains originating from different isotopes of E115 were observed [6, 7], produced with an overall production cross section of ≈ 10 pb. There are 1+22=23 five-α-long chains linked to the production of 287,288115 [6], in agreement with 2+31=33 chains reported earlier [8]. The combined 22+31=53 chains associated with 285115 yield a statistically solid reference.

Besides these 'long chains', two recoil-α-fission and five recoil-α-α-fission chains are present in the TASISpec data [7]. Interestingly, the interpretation and thus the assignment of these 'short chains' to a certain isotope of E115 turns out to be non-trivial. The issue is discussed with the help of Fig. 1: Panel (a) shows the relevant beginning of the long 288115 reference chain. The average values of the 2+5=7 new short chains in panel (b) are consistent with the numbers in panel (a). This indicates at first sight ∼ 5-15% fission or electron-capture branches of 284113 and 288Rg. However, this view is at variance with the interpretation of 3+1=4 short chains previously observed at Dubna [8] [panel (c)]. There, one chain, denoted 'D3', is significantly different from all the other E115 chains. However, only including this particular chain in the 3+1=4 averaging procedure generated a seemingly consistent link between E115 and E117 [8, 9] [panel (d)]. Panel (e) provides a refined interpretation of all published E117 data [9, 10]. The rightmost sequence averaged over twelve E117 chains opens for a connection to E115 via 'D3', while the other ten E117 chains would be consistent with (a subset of) other E115 chains [11].

More high-quality spectroscopic data is obviously required. This is necessary to provide the foundation for a relevant nuclear-structure based interpretation of links between decay chains of these two odd-Z elements [7, 11].

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References


Figure 1: Average values from selections of decay chains of isotopes of E115 to E113 into Rg (Z = 111). (a) 53 288115 reference chains [6, 8]. (b) Seven recoil-α-(α) fission chains observed with TASISpec [7]. (c) Data from all four recoil-α-α-fission 'Dubna chains' listed in Table III of Ref. [8]. (d) Sixteen chains associated with the decay of 290117, i.e. interpreted to populate the isotope 289115 [9]. (e) Possible re-interpretation [11] of all existing E117 decay data [9, 10].