

α - decay studies of ^{217g}Pa and ^{217m}Pa

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More than twenty years ago an isomeric state at $E^* \approx 1854$ keV decaying by α - emission of $E_\alpha = 10.16$ MeV was identified in ^{217}Pa by Schmidt et al. [1]. Recently Ikuta et al. [2] observed an α -line with an energy of 9.54 MeV which they attributed to a second isomeric state. This line was reproduced in an experiment at SHIP, but it was rather interpreted as fine structure in the decay of the known isomeric state especially since an additional weak line at 9694 keV was observed [3]. To settle the decay of ^{217m}Pa we performed a new experiment also aiming to measure α - γ - and α - γ - γ - coincidences using a four-fold segmented clover detector. The isotope was produced by the reaction $^{181}\text{Ta}(^{40}\text{Ar},4n)^{217}\text{Pa}$ using beam currents of up to 2.2 μA . The results of our measurement are shown in Fig. 1 and Tab. 1.

Isotope	E_α / keV	i_α	$T_{1/2}$ / ms	E_γ / keV
^{217m}Pa	10157 ± 5	0.72 ± 0.04	1.08 ± 0.02	
	9697 ± 5	0.02 ± 0.01	0.95 ± 0.05	466.5 ± 0.2
	9552 ± 5	0.09 ± 0.01	0.94 ± 0.09	613.0 ± 0.2
	9533 ± 5	0.06 ± 0.01	1.11 ± 0.20	634.3 ± 0.1
	8306 ± 5	0.11 ± 0.02	0.68 ± 0.05	450.4 ± 0.1 612.7 ± 0.1 820.8 ± 0.2
^{217g}Pa	8337 ± 5	0.99 ± 0.01	3.8 ± 0.2	
	7873 ± 10	0.004 ± 0.002		466.1 ± 2.0
	7728 ± 10	0.003 ± 0.002		612.5 ± 0.8
	7710 ± 10	0.003 ± 0.002		634.3 ± 1.1

Table 1: Summary of α - γ decay data for ^{217}Pa

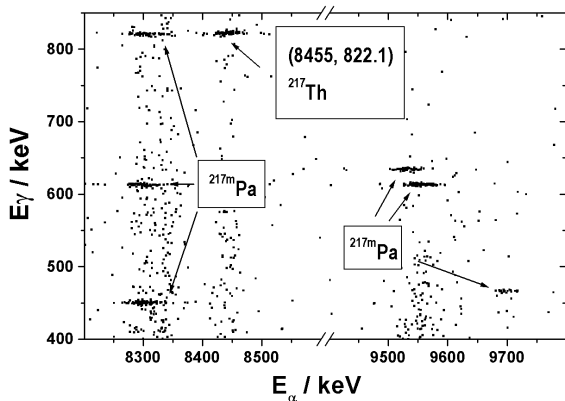


Figure 1: α - γ coincidence spectrum observed in a bombardment of ^{181}Ta with ^{40}Ar using a detector setup behind SHIP.

The new results fully confirm our previous interpretation of fine structure in the α - decay of ^{217}Pa . The sum $E_\alpha + E_\gamma$ amounts to the energy of the previously known decay, which further indicates that the 10157 keV - α transition represents the decay into the groundstate of ^{213}Ac . The α - γ - coincidence measurements identified the line at 9.55 MeV as a doublet not

resolved in the single α - spectra. In addition we observed a line of low energy at $E_\alpha = 8306$ keV, populating a level at $E^* = 1884$ keV, which decays by emission of a series of three γ - events. The latter was verified by measuring γ - γ - coincidences. It is seen in Fig. 2 that each two lines occur in coincidence to the third one.

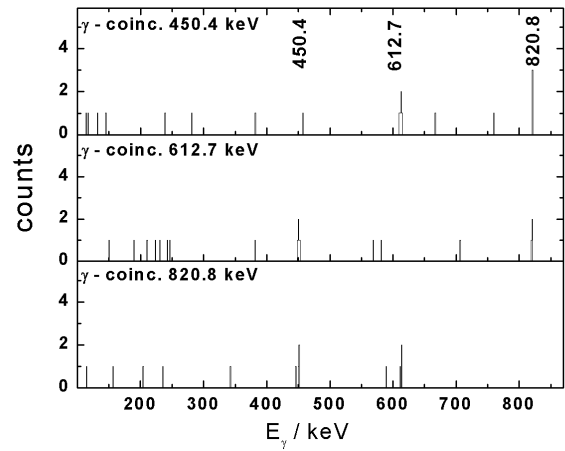


Figure 2: γ -spectra coincident to α - particles of (8250-8350) keV and to γ -transitions of 450, 613 and 821 keV, respectively.

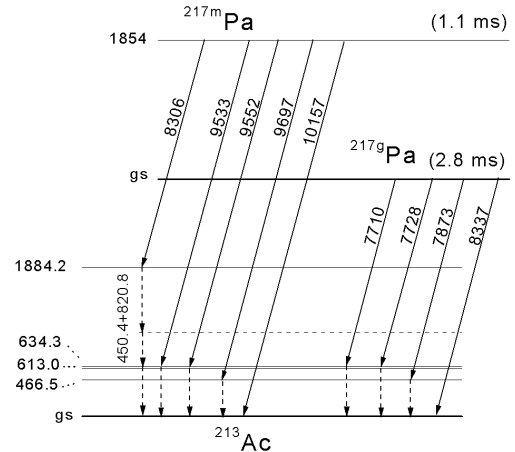


Figure 3: Decay scheme of $^{217m,217g}\text{Pa}$. All energies are in keV

Knowing the decay- pattern of ^{217m}Pa we searched for fine structure in the α -decay of ^{217g}Pa . Three weak lines attributed to the decay into the levels at 466.5, 613.0, and 634.3 keV were identified by α - α - correlation to the daughter ^{213}Ac (see Fig. 3); also a few α - γ - coincidences were observed (Tab.1). No α - lines were observed that could be attributed to decays into other levels of ^{213}Ac .

References

- [1] K.-H. Schmidt et al. Nucl. Phys. A318, 243 (1979)
- [2] Ikuta et al. Phys. Rev. C R2804 (1998)
- [3] F.P.Heßberger et al. EPJ A8, 521 (2000)