Decay properties of ^{251}No and its daughter products

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Identification of ^{251}No was reported more than thirty-five years ago by Ghiorso et al. [1]. They measured two α-lines of 8.68 MeV (i=0.2) and 8.60 MeV (i=0.8) and a half-life of 0.8±0.2 s. In our decay studies of ^{255}Rf, where ^{251}No was produced as daughter activity, the 8.68 MeV α-decay energy and the half-life were reproduced, but no indication of a line at 8.60 MeV was found [2]. To clarify if this α-line could be due to the decay of an isomeric state not populated by the decay of ^{255}Rf, we produced ^{251}No directly by the reaction ^{206}Pb(^{48}Ca,3n)^{251}No. The result of α-α-correlations is shown in fig. 1. Besides the correlations ^{251}No (E_α = 8608 keV) – ^{247}Fm (characterized by a broad distribution of α-decacy energies in the range 7800-8150 keV) we observed correlations of α1 (8678 keV) - α2 (8170 keV). Energy and half-life of α2 fit to that of an activity observed by Flerov et al. [3] in an irradiation of ^{239}Pu with ^{12}C and attributed to an isomeric state ^{247m}Fm. The energy of α1 obviously complies with that of the second line attributed to ^{251}No by Ghiorso et al. [1]. Thus it is assigned to the decay of an isomeric state ^{251m}No.

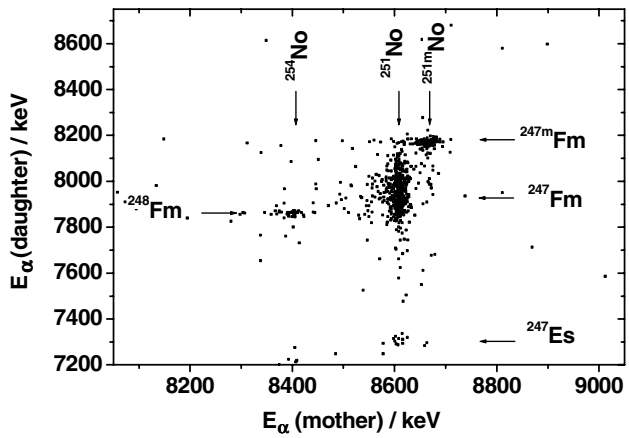

Fig.1: α-α-correlation plot for activities observed in the reaction ^{48}Ca + ^{206}Pb at E_p = 4.8 AMeV.

No coincidences with γ-rays were measured for α-decays of ^{251,251m}No and ^{247m}Fm.

The broad energy distribution of α-decays attributed to ^{247}Fm can be explained by energy summing with conversion electrons (CE). It indicates, however, population of at least one excited level in the daughter nucleus, that decays by at least two steps of internal conversion. Besides strong K-x-ray – lines three weak γ-lines of E = 121.5, 141.4 and 166.2 keV were observed in coincidence with α-particles.

Since a spin difference $\Delta I \geq 3$ is necessary to build up an isomeric state with a half-life of about a second or longer the isomeric states ^{251m}No, ^{247m}Fm are attributed to the Nilsson level 1/2$^+$[631], while the ground-state (gs) of ^{251}No was attributed to 7/2$^+$[624] on the basis of systematics of N=149 and N=151 isotones. The unhindered 8608-keV transition of ^{251}No is not influenced by energy summing with CE and not accompanied by γ-ray emission. It suggests a gs – gs transition and thus a tentative assignment of the gs of ^{247}Fm as 7/2$^+$[624], while from systematics for N=147 isotones rather 5/2$^+$[622] is expected as gs. The decay scheme for ^{247}Fm is complicated and the decay data are still of unsatisfying quality. Nevertheless, on the basis of a comparison with the known nuclear properties of ^{239}Pu we propose the tentative decay scheme shown in fig. 2, where also the decay data are presented. A confirmation experiment is in preparation.

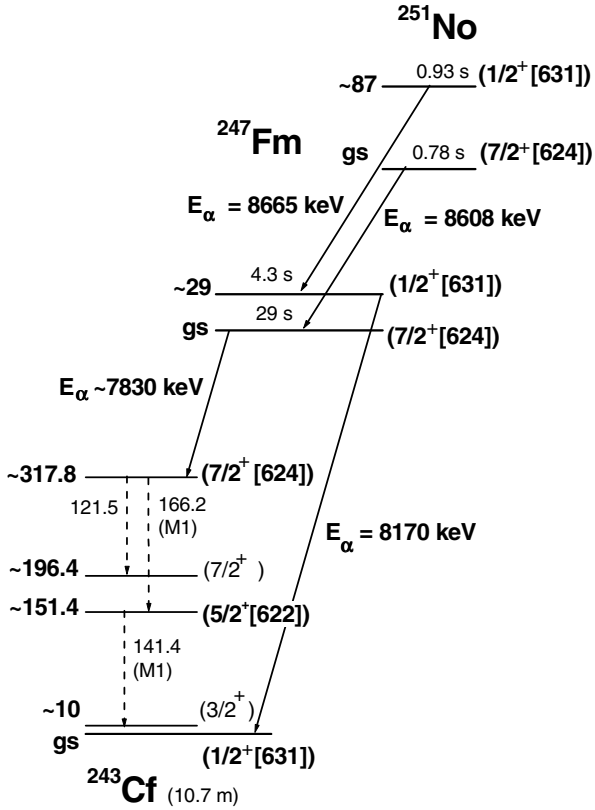

Fig. 2: Suggested decay schemes of ^{251}No and ^{247}Fm

References

[1] A. Ghiorso et al., Phys. Rev. Lett. 18, 401 (1967)

[2] F.P. Heßberger et al., EPJA 12, 57 (2001)

[3] G.N. Flerov et al. Atomnaya Energiya. 22, 342 (1967)