

# Final result of the CALLISTO-experiment: Formation of sodium hassate(VIII)

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In October/November 2002 the CALLISTO-project led to a hassium chemistry experiment at the UNILAC, for which preliminary results have been previously reported [1,2].

For the data evaluation, a time window of five times the literature half-lives and an energy window of  $\pm 150$  keV around

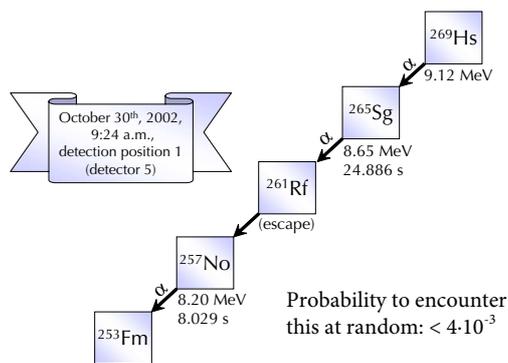


Fig. 1

the known  $\alpha$ -decay energies were used. The recently published results, that <sup>261</sup>Rf decays with an  $\alpha$ -decay energy of 8.52 MeV and a half-life of about 4.2 s, which is considered its ground state, were taken into account [3,4,5].

One correlated  $\alpha$ - $\alpha$ - $\alpha$  decay chain and five  $\alpha$ -SF decay chains were observed (Fig. 1 and 2).

Statistical considerations show, that these six events cannot be explained as background signals. The probability to encounter a random  $\alpha$ - $\alpha$ - $\alpha$ -decay chain within the described time-energy-

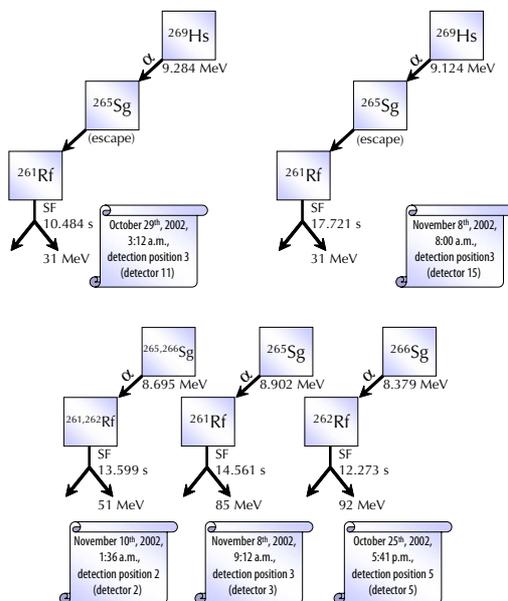


Fig. 2

window is below  $4 \cdot 10^{-3}$ . The probability to observe a SF-event after an  $\alpha$  decay has occurred was calculated to one  $\alpha$ -SF-correlation, based on the observed  $\alpha$ -decay rate and the measured fission background.

The spatial distribution of Os and Hs in the described deposition and detection system [1,2] should depend on the interac-

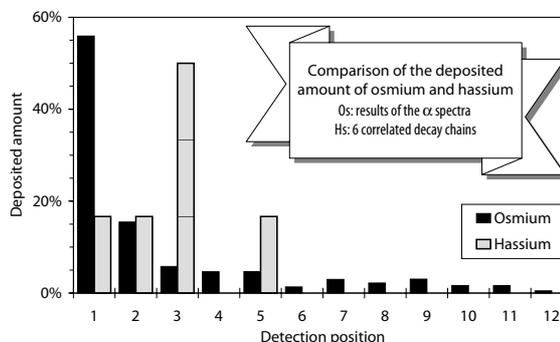


Fig. 3

tion of their tetroxides with the sodium hydroxide layer. In order to be able to investigate where the chemical reaction occurred, the data of all individual detectors had to be transformed. This is possible by defining a DETECTION POSITION, which is the position of detection relative to the gas inlet.

In this experiment, Os-isotopes and Hs-isotopes were produced simultaneously, the volatile  $\text{OsO}_4$  as well as the volatile  $\text{HsO}_4$  were synthesized in-situ and their deposition on NaOH in the presence of water was investigated. In the case of osmium, the formation of the osmate (VIII) is associated with a maximum at the first detection position (Fig. 3). The decay chains attributed to hassium decays were recorded in detection positions 1, 2, 3 and 5 (see Fig. 1 and 2 for the assignment of the individual decay chains). Since very similar properties of  $\text{OsO}_4$  and  $\text{HsO}_4$  can be expected, the deposition of hassium can be assumed to be the result of the formation of an analogous hassate (VIII) according to



The present experiment confirmed the formation and stability of the volatile  $\text{HsO}_4$  [3]. In addition, from our results we conclude, that for the first time, an acid-base reaction was performed with the tetroxide of hassium leading to the formation of a hassate (VIII). Whether there is some evidence for a lower reactivity of hassium with respect to moisturized NaOH as compared to  $\text{OsO}_4$ , remains an open question. Since only a few decay events were observed, further studies of the reactivity of  $\text{HsO}_4$  would help to better characterize its chemical properties.

## References

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