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Temperature effects on alpha radioactivity of ^{223}Ra.

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The chemical environment and the atomic charge state have well known influences on the radioactive decay. These effects may modify the decay half- life by small amounts. In some special cases of fully stripped ions dramatic changes have been reported. Stable nuclides in an atomic configuration may decay by bound state beta decay. (Bosch et al.)

Very recently (Rolfs et al.) have reported on special temperature effects of the radioactive decay induced by electronic shielding variations by conduction electrons in metals. These variations were observed as small effects induced by mild temperature changes around room temperatures. These authors could explain these effects by a "classical" electron gas model (Druwe) and they have predicted a strong increase of the decay rate by an extrapolation to low temperatures.

In the case of the alpha decay of ^{226}Ra a change by two orders of magnitude have been mentioned for temperatures of He_{liq} T=4K. According to the authors a special attention should be given to the metallic environment of the radioactive atoms.

The aim of the present letter of intent is to perform a test of the temperature variation of the alpha- decay of ^{223}Ra with a natural half- life of $T_{1/2}$ =11,43d.

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The samples should be implanted in pure gold foils in order to avoid oxidation at the surface. After transportation to the Institut für Kernchemie Mainz, the samples will be measured at room temperature and at “low” temperature down to T = 1,8 K. This can be achieved in a special set- up used for solid ^{3}H sources of the Mainz neutrino mass experiment.

Instead of measuring the α- lines with surface barrier detectors the coincident γ- lines at 269; 154; 144 keV in ^{223}Ra will be counted with a pair of high efficiency Ge- detectors, avoiding any temperature effect in the source- detector geometry. The γ- line detection is possible as well in the case of ^{226}Ra.

On the basis of the SC-ISOLDE Yields samples of

^{223}Ra of 3.6×10^5 Bq may be collected within 1h at 1×10^8 Atoms/s. Samples of

^{226}Ra of 10 Bq may be produced within 2h at 1×10^8 Atoms/s.

In total 4 samples are planned to be collected in order to allow different thermal treatments before measurements at room and cryogenic temperature. The collections should be possible within one shift, even when the yields given for SC-ISOLDE will not be reached at the actual production.