# Observation of K isomers in $^{254}$No

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Super Heavy Elements (SHE) offer a unique possibility to study the effective nuclear interaction in highly charged, massive quantum systems. The understanding of the structure of SHE is essential for the development of mean field theories that are used to predict nuclear properties far from stability. A promising approach is to study bands built on multi-quasiparticle states in nuclei with Z ~ 100 where down-sloping SHE orbitals lie close to the Fermi surface in these highly deformed systems. Isomeric states are expected in these nuclei because many of the orbitals near the Fermi surface have high-Ω values, and high-K states can be readily formed in multi-particle excitations. Such isomers have been identified (with varying degrees of certainty) in Cm (Z=96) to No (Z=102) nuclei, although none have been fully characterized.

We report here the observation of two isomeric states (~300 ms and ~0.2 ms) and their gamma-ray decay pattern in $^{254}$No, populated by the reaction $^{208}$Pb ($^{48}$Ca, 2n) $^{254}$No at 219 MeV. The long-lived isomer was first observed by Ghiorso et al. [1], and subsequently observed by Butler et al. [2] and Mukherjee et al. [3]. In this experiment described here, carried out at the Jyväskylä University Accelerator Laboratory, we employed the gas filled recoil separator RITU and the focal plane spectrometer GREAT. Data was read out using the triggerless TDR system. The experimental technique [4] relies on the fact that high-spin isomers are likely to decay by γ-emission to rotational states that in turn decay by low-energy transitions that undergo internal conversion with high probability. The signal for the population of a K-isomer is therefore a triple position correlation in the silicon DSSD implantation detector of GREAT: (i) the recoil implantation; (ii) the (summed) conversion-electron emission that has the same apparent half-life as the isomer; (iii) the α-decay of the ground state of $^{254}$No that has a half-life of 55 s. At the same time γ-rays and X-rays accompanying the isomer decay were detected in the planar and clover germanium detectors of GREAT.

Precise values of the lifetimes of the isomeric states will be presented. The observed sequence of high-energy and low-energy γ-rays associated with both isomers, and the observed time correlation between the two isomers, have enabled a tentative decay-scheme to be established. Some of the high-energy transitions have been also observed in similar decay experiments recently carried out at ANL [5] and in in-beam measurements at Jyväskylä [6] and ANL [5]. The suggested spin, parity and excitation energy of the isomers will be compared with model calculations [7].

[1] A. Ghiorso et al., Phys. Rev. **C 7** (1973) 2032

[2] P.A. Butler et al. Acta Physica Polonica B34 (2003) 2107

[3] G. Mukherjee et al., proceedings of LIMITS04 conference (2004)

[4] G.D. Jones, Nucl. Instr. Meth. A**488** (2002) 471

[5] T.-L. Khoo, priv. comm.

[6] S. Eeckhaudt et al., to be published

[7] P. Stevenson, priv. comm.