(11^-) isomeric state in ^{194}Po*

B. Andel[†1], *A.N. Andreyev*[2], *S. Antalic*[1], *F.P. Heßberger*[3,4], *D. Ackermann*[3], *S. Hofmann*[3,5], *M. Huyse*[6], *Z. Kalaninová*[‡1], *B. Kindler*[3], *B. Lommel*[3], *R. Mann*[3], *K. Nishio*[7], *R.D. Page*[8], *B. Sulignano*[3], *and P. Van Duppen*[6]

[1]Comenius University, Bratislava, Slovakia; [2]University of York, York, United Kingdom; [3]GSI, Darmstadt, Germany; [4]HIM, Mainz, Germany; [5]Goethe-Universität Frankfurt, Frankfurt, Germany; [6]KU Leuven, Leuven, Belgium; [7]JAEA, Tokai, Japan; [8]University of Liverpool, Liverpool, United Kingdom

Metastable nuclear excited states - nuclear isomers - are valuable probes for nuclear structure studies. In neutron deficient even-mass polonium isotopes, 11^- isomeric states are systematically present.

The most recent study of excited levels in ^{194}Po was performed at JYFL (Finland) [1]. In decay spectroscopy data, an (11^-) isomer was identified, feeding the 8^+ and 6^+ levels of the ground state band. However, the connection to the ground state band, spin and parity assignment were based only on energy balance and systematic trends in heavier Po isotopes. A ground state band up to the (16^+) and a side band up to the (10) level were established based on in-beam data.

In our experiment, ^{194}Po was produced in the fusion-evaporation reaction ^{56}Fe(^{141}Pr,p2n)^{194}Po at the velocity filter SHIP at GSI, Darmstadt (Germany). Evaporation residues (ERs) were separated from the primary beam and products of other reactions by the SHIP [2] and implanted into a 16-strip position sensitive silicon detector (PSSD). Upstream around the PSSD, six additional silicon strip detectors were placed, forming an opened box (BOX detector) to detect escaping particles. For detection of γ and X rays, germanium clover detector was installed in close geometry to the PSSD.

Our statistics of γ rays from the decay of the isomer was approximately 10 times higher than in the previous study [1], which allowed us to investigate γ - γ coincidences for this isomer for the first time. In order to distinguish γ rays originating in ^{194}Po, we applied correlation search between implantations of ERs and α decays of ^{194}Po within a position window $\leq$ 0.6 mm and a time window of 1.2 s ($T_{1/2}$(^{194}Po) = 392(4) ms [3]). Spectrum of γ rays in coincidence (within $\approx$ 5 μs) with ERs is shown in fig. 1 c).

In addition to all previously-known transitions, 5 new ones were found (209, 248, 362, 494 and 847 keV). Moreover, we registered also weak transitions from the side band up to the 9^- level, which were reported only from in-beam data so far [1]. Therefore, relevant levels from the side band are populated by an isomeric state, either the (11^-) or another isomer placed above the 9^- level.

For γ - γ coincidence analysis, we required a coincidence of at least two γ rays with ERs. We confirmed the decay scheme of the isomer from [1] except for the transition de-exciting the (11^-) level. We suggest to replace the previously assigned 459 keV transition by the new 248 keV transition.

To determine half-life of the isomer, we employed ER - γ - α(^{194}Po) correlations with time differences between ER - γ within (25 - 200) μs and between γ - α(^{194}Po) up to 1.2 s. We deduced the half-life to be 12.9(5) μs, which is consistent with the previously obtained value of 15(2) μs [1], but more precise.

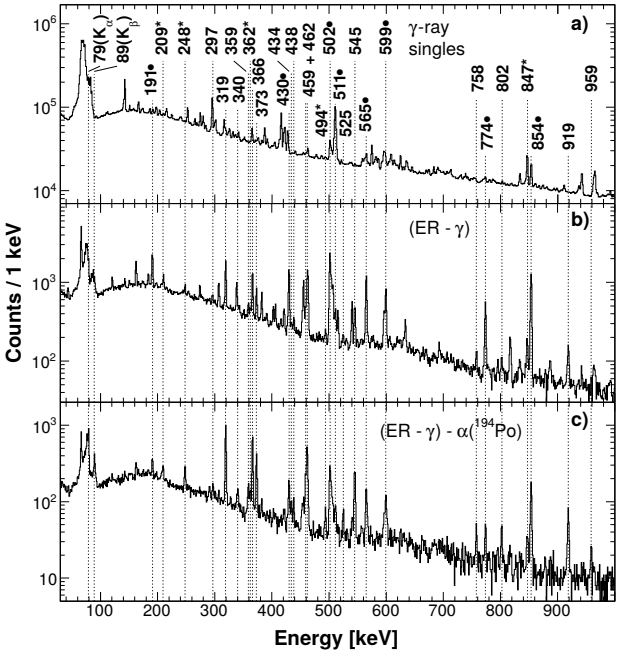

Figure 1: a) all γ rays registered during measurement; b) γ rays in coincidence with ERs; c) γ rays in coincidence with ERs correlated to α decays of ^{194}Po. Energies are in keV, asterisks denote new transitions, full circles denote background lines (mostly from ^{192}Pb).

References

[1] K. Helariutta *et al.*, Eur. Phys. J. A **6**, 289 (1999).

[2] G. Münzenberg *et al.*, Nucl. Instrum. Methods **161**, 65 (1979).

[3] J. Wauters *et al.*, Phys. Rev. C **47**, 1447 (1993).

* Work supported by GSI(UNILAC), HI Mainz, the Slovak Research and Development Agency (Contract No. APVV-0105-10) and the Slovak Grant Agency VEGA (Contract No. 1/0576/13).

† boris.andel@fmph.uniba.sk

‡ Present address: JINR, Dubna, Russia

DOI:10.15120/GR-2015-1-MU-NUSTAR-SHE-P-02