SEARCH FOR LIGHT RADIATION IN THE DECAY OF THE $^{229}$Th ISOMER WITH ANOMALOUSLY LOW EXCITATION ENERGY

Yu.P. Gangrsky, F.F. Karpeshin$^1$, G.V. Mishinsky, S.G. Zemlyanoi, V.I. Zhemenik$^2$

$^1$ Institute of Physic, St.-Petersburg University, Russia
$^2$ INR NAS of Ukraine, Kyiv, Ukraine

The $^{229}$Th nuclide possesses a unique isomeric level positioned at 3.5±1 eV above the ground nuclear state [1] and may possibly emit gamma rays in the ultraviolet [2,3]. Thorium-229 is typically generated by the alpha decay of $^{233}$U, wherein 2% of the thorium daughter decays via the metastable isomeric level.

In some experiments, the spontaneous emission of ultraviolet light radiation was observed after alpha decay of $^{238}$U, but this was not confirmed later.

We have performed the experiments on the search for light radiation in the decay of the anomalously low energy isomer in $^{229}$Th.

This experiment was performed at the microtron MT-25 in FLNR JINR. The isomeric state was excited in the inelastic $\gamma$-rays scattering using bremsstrahlung with the cutoff energy of 8.2 MeV. A PEU-100 photomultiplier having maximal sensitivity of the photocathode at the wavelength 350 nm (3.6 eV) was used for the detection of ultraviolet radiation.

The photofission fragments of $^{229}$Th were detected simultaneously using solid state track detectors - mylar films.

Delayed light radiation above the background in the energy range of 2.3 – 6.3 eV and in the time interval 2 min – 10 hours was not observed in the experiment. The ratio of photon events to fission-fragment tracks is less than 5. A correction for the different thresholds for the fission and gamma inelastic scattering increases this limit up to 200. This means that either the half-life of the isomeric state has a very small value (<1 min) or that its energy falls outside the proposed limits.

REFERENCES