

CONFIRMATION OF A NEW ISOMERIC STATE IN THE ^{186}Re NUCLEUS

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In laser plasma, stimulated de-excitation of the ^{186m}Re isomer ($T_{1/2}$, $m = 2.0 \cdot 10^5$ y) was observed from the time dependence of the intensity I_{137} of 137 keV gammas from the decay of the ground state of the ^{186}Re nucleus after laser irradiation of the ^{186m}Re target [1]. The nonmonotonicity of this time dependence made it possible to assume the existence in the ^{186}Re nucleus of a new low-lying isomeric level with a half-life of 10 d order, which is populated upon de-excitation of ^{186m}Re in the laser plasma.

In ref. [2], we tried to observe this new isomer by obtaining the ^{186}Re nuclei in the (p, n) reaction irradiating ^{186}W target with 15 MeV protons. Population in this reaction of a new isomer for γ -quanta from an irradiated source would lead to the dependence of the intensity $I_{137}(t)$ on the time t after the formation of ^{186}Re nuclei, which differs from the simple exponential dependence associated with the decay of the ground state of ^{186}Re with a period of $T_{1/2}$, $g = 89.239 \pm 0.026$ h [3] (error is at the level of one standard deviation). In ref. [2], the measurement of $I_{137}(t)$ was started at small t and at the beginning there was no noticeable deviation of the decay curve from a simple exponential with $T_{1/2}$, g . However, at $t > 30$ d at a low intensity of I_{137} , a hint of a deviation of the decay curve from a net exponent appeared. This deviation could be associated with the formation of a new isomer. The known isomer with $T_{1/2}$, $m = 2.0 \cdot 10^5$ y cannot be observed in such experiments due to its very low radioactivity.

In this work, the source with ^{186}Re was prepared according to the method [2], to reduce the relative activity of the ground state of the ^{186}Re nucleus, we waited 30 d and only then began to measure $I_{137}(t)$ of the irradiated source in the well of the HPGe

γ -detector at the initial intensity $I_{137} \approx 50 \text{ s}^{-1}$. Due to the later start of measurements, it was possible to measure the $I_{137}(t)$ dependence at much longer times t than in ref. [2]. This dependence unambiguously indicates the presence of a new long-lived isomeric level in the ^{186}Re nucleus. At $t = 60$ d, the $I_{137}(t)$ dependence corresponds to a half-life of 24 ± 0.4 d.

References:

1. V.V. Vatulin, N.V. Zhidkov, A.A. Rimskii-Korsakov, V.V. Karasev, V.V. Koltsov, A.I. Kostylev, G.V. Tachaev, Bull. Russ. Acad. Sci.: Phys. 81, 1159 (2017).
2. V. V. Karasev, V. V. Koltsov, A. A. Rimskii-Korsakov, Bull. Russ. Acad. Sci: Phys. 82, 1237 (2018).
3. C.L. Baglin, NDS 99, 1 (2003).

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