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Study of multi-nucleon transfer reactions in 26Mg + 238U collisions at the SHELS separator

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Today, along with standard nuclear reaction approaches such as fragmentation, fission or fusion, the use of multi-nucleon transfer reactions (MNT, MultiNucleonTransfer) is a potential method to reach the field of unknown exotic heavy and superheavy nuclei enriched with protons/neutrons. In addition to studies of the kinematics and cross sections of the formation of products of MNT reactions, the development of suitable methods for separation and registration of heavy nuclei formed in MNT reactions continues. The use of the SHIP kinematic separator (GSI) for the study of MNT reactions has shown that this method is a new approach in the study of MNT reactions.

In May-June 2023, the experiment was conducted at the Laboratory of Nuclear Reactions (LAR) at the U-400 accelerator complex to study MNT reactions in collisions of 26Mg + 238U. The separation of the products of the desired nuclei from the products of side reactions was carried out by the kinematic separator SHELS (Separator for Heavy Element Spectroscopy). After separation, the recoil nuclei fly through a time-of-flight detector and are implanted into a focal two-sided multi-strip silicon detector (DSSD, 128x128 strips), around which 116 proportional neutron counters filled with 3He (SFiNx detection system) are placed. Here, the studied nuclei are registered, as well as the alpha particles emitted by them, fragments of spontaneous fission and neutrons. During the preprocessing, about 100 spontaneous fission events of various nuclei were recorded. The proposed products in the MNT 26Mg + 238U reactions, which can be seen in the online experiment, are americium isotopes. The statistics are small, but nevertheless, as confirmation that we obtained spontaneously dividing nuclei, we studied the average number of neutrons per fission act (according to preliminary estimates $\bar{\nu} = 2.68 \pm 0.36$) and the distribution of neutrons by multiplicity. In order to make concrete conclusions, it is proposed to continue studying this MNT reaction, and process the data more thoroughly.

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