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Creation of transuraniums in experimental prompt r-process and inverse task of the neutron fluence

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Creation of transuranic nuclides in experimental pulsed neutron fluxes of high intensity (up to 10E+30 – 10E+31 n/cm2) is investigated in the kinetic model of the astrophysical r-process. The dynamics of the rapid nucleosynthesis (in the interval ˜10E-6 s) is introduced when the process temperature decreases and is taken into account by correction of the cross sections at radiation capture of neutrons. In spite of the more lower fluxes and temperature compare to possible cosmological sites of superheavy isotope production (up tp 10E+40 n/cm2 and ˜10E+9 K in case of binary star mergers, stripping matter in massive binary systems) an application of heavy (actinides) targets allows to ensure production of identifiable quantities of transuraniums up to 257Fm by multiple neutron capture (up to 19 neutrons for 238U targets). Subsequent correction of transuranium outputs after pulse termination is taken into account in beta-decays of neutron-excess nuclei.

The produced analytical analysis strongly indicated on the roughly linear dependence of the relation of isotope yields on the pulse neutron fluence. Agreement of calculated isotope relations with experiments is a criterion of possible fluence. Evaluation of the realized neutron fluence is the inverse problem. The task of yields modeling of neutron-rich isotopes (and inverse problem of the achieved fluence) during multiple neutron captures is solved in the developed ABM model, which takes into account the drop of the temperature during the expansion of matter with a linear velocity ˜190 km/s. The model allowed to obtain good or satisfactory agreement with published US-experiment for pulse production of transuranic elements. In the simulation it was applied the 238U, 238Pa and 243Am targets according to declared results of the tests. It was proposed an algorithm for calculating dependence of isotope relations on fluence for complex targets. It was evaluated achieved fluences and obtained good agreement in isotope relation of seven large scale experiments.

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Primary author(s) : Dr. LYASHUK, Vladimir (The Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, 117312 Russia)

Presenter(s) : Dr. LYASHUK, Vladimir (The Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, 117312 Russia)

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