INVESTIGATION OF THE EFFECTIVE NEUTRON ENERGY AT THE MASSIVE SPALLATION URANIUM TARGET QUINTA

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Uranium samples have been irradiated in the secondary neutron field generated at the massive natural uranium spallation target *QUINTA* [1]. The target assembly is composed of five hexagonal sections filled with uranium cylinders of the total mass of about 500 kg. The target was irradiated with the deuteron beams of energies 2 *A* GeV and 4 *A* GeV, of the total beam intensities $2.25(3)\times10^{13}$ and $6.13(6)\times10^{12}$ deuterons, respectively, at the JINR Nuclotron in December 2013. The samples of natural and enriched uranium ($m \approx 1$ g, diam. = 8 mm) were situated in different positions along the target axis (z = 254; 385; 516; 647 mm) and target radius (r = 0; 40; 80; 120 mm).

After the irradiation, the samples were measured with the well-calibrated HPGe detectors of 20% and 30% relative efficiency. Each sample has been measured at least six times in order to reach the results for isotopes of different half-lives $T_{1/2}$. The reaction rates (R, number of produced residual nuclei per one deuteron and one atom of the sample) for ^{238}U isotope were deduced from reaction rates of both natural and enriched uranium samples of different ^{235}U abundance. The reaction rates were calculated for the following fission products: ^{91}Sr, ^{97}Zr, ^{112}Ag, ^{115}Cd, ^{131}I, ^{133}I, ^{135}I, and ^{143}Ce.

Since the ^{112}Ag and ^{115}Cd isotopes lie in the valley of the typical double-hump fission fragment mass distribution and the other mentioned isotopes in the peak region, it was possible to calculate the inverse peak-to-valley (iPV) ratios. In general, the iPV should grow with an increase in the incident neutron energy. Indeed, a decrease in neutron energy as a function of target radius was confirmed, since the experimental ^{112}Ag / ^{97}Zr iPV^r (here r is the target radius at z = 254 mm; 2 *A* GeV run) are the following: $iPV^0 = 0.49(3)$, $iPV^{40} = 0.36(2)$, $iPV^{80} = 0.24(1)$, $iPV^{120} = 0.21(2)$. Other iPVs have similar trend.

Moreover, the ^{238}U fission fragment mass distributions for different incident neutron energies have been calculated with the nuclear reaction program TALYS-1.6 [2] using the optical model. An effective energy of the neutron field in some positions of the samples was estimated as a result of a comparison between the calculated values and experimental data.

1. W.Furman *et al*. // PoS (Baldin ISHEP XXI) 086. 2012.
2. A.Koning *et al*. // TALYS-1.6, NRG Petten. 2013.