Cross sections of the ^{76}Se(p,γ)^{77m,g}Br, ^{77}Se(p,n)^{77m,g}Br and ^{80}Se(p,n)^{80m,g}Br reactions for the astrophysical γ-process

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Using the beams of the Van de Graaff accelerators of NSC KIPT (Kharkiv) and ATOMKI (Debrecen) and conventional activation technique applying high resolution γ-ray spectrometry, the production cross sections of isomeric pairs were measured for the ^{76}Se(p,γ)^{77m,g}Br $\left(T_{1/2}^{m} = 4.28\,\text{min},\ J_{m}^{\pi} = 9/2^{+},\ T_{1/2}^{g} = 57.04h,\ J_{g}^{\pi} = 3/2^{-}\right)$, ^{77}Se(p,n)^{77m,g}Br and ^{80}Se(p,n)^{80m,g}Br $(T_{1/2}^{m} = 4.42h,\ J_{m}^{\pi} = 5^{-},\ T_{1/2}^{g} = 17.68\,\text{min},\ J_{g}^{\pi} = 1^{+})$ reactions at the proton energy range up to 3.5 MeV. Determination of individual isomeric and ground state production cross sections of the ^{77m,g}Br pair in (p,γ) and (p,n)-reactions could be executed separately using thin highly enriched ^{76}Se and ^{77}Se targets. Experimental isomeric cross section ratios for the ^{77}Se(p,n)^{77m,g}Br and ^{80}Se(p,n)^{80m,g}Br reactions are compared to available literature data at slightly higher bombarding energies. The total cross sections ($\sigma_m+\sigma_g$) of the ^{77}Br residual nucleus production both in (p,γ) and (p,n)-reactions were determined from the ground state activities measured after the decay of the relatively short-lived isomeric state ^{77m}Br, while decay curve analysis was carried out for the ^{80m,g}Br coupled pair. Experimental astrophysical S-factors were derived from the total cross sections of the studied reactions. Theoretical S-factors calculated with the default settings of the NON-SMOKER statistical model code [1], which is widely used in astrophysical network calculations, overestimate experimental results by about 40%. Experimental isomeric cross section ratios for the ^{76}Se(p,γ)^{77m,g}Br reaction passing through highly excited states can be used for the parameterization of the nuclear level density, in particular for the value of the nuclear effective moment of inertia. Preliminary results will be presented while the further analysis is in progress.

[1] T. Rauscher, F.-K. Thielemann, At. Data Nucl. Data Tables. 75, 1 (2000).