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The study of the ${}^3\text{H}(\alpha, \gamma){}^7\text{Li}$ reaction through the inverse ${}^7\text{Li}(\gamma, \alpha){}^3\text{H}$ reaction

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In contrast with the other light elements, the Li-7 measured abundance is 3-4 times lower than expected from the Big Bang Nucleosynthesis predictions. This fact is known as the “cosmological Li problem” and a better understanding of the disagreement may be achieved by studying the reactions which are leading to the Li-7 production and destruction. The ${}^3\text{H}(\alpha, \gamma){}^7\text{Li}$ reaction contributes to the production of Li-7 in Universe and has been previously studied in a direct measurement in 1994 for center-of-mass energies below 1.2 MeV. According to the reciprocity theorem, the ${}^3\text{H}(\alpha, \gamma){}^7\text{Li}$ ground state cross-section can be determined by measuring the Li-7 photodisintegration cross section. Therefore, the ${}^7\text{Li}(\gamma, \alpha){}^3\text{H}$ reaction has been studied by our team in a series of experiments at the High Intensity γ -ray Source (HI γ S) Laboratory of Duke University (USA) in 2017 and 2023. Alpha particles and the triton coincidences were detected using a silicon detector array (SIDAR) from Oak Ridge National Laboratory. In 2017 the energies of the gamma beam have been between 4.4 and 10 MeV, but below 6 MeV the coincidences have been observed only in a thinner set of detectors. In 2023, the set-up has been improved and the reaction has been studied for energies of the gamma-ray beam between 3.7 and 6 MeV. The preliminary astrophysical S-factor has been extracted and an R-matrix fit has been performed over the data from 2023, together with the data from 2017.

The experimental details and the comparison of the results from the 2017 and 2023 campaign at HI γ S with the direct measurement obtained in 1994 will be presented.

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