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HypHI project: Final results of the study of hypernuclei in the reaction ${}^6\text{Li}+{}^{12}\text{C}$ at 2 AGeV

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The HypHI collaboration aimed to demonstrate the feasibility of the spectroscopy of hypernuclei produced in heavy-ion and rare isotope induced reactions. A first experiment was performed on October 2009 with a ${}^6\text{Li}$ beam bombarded on a ${}^{12}\text{C}$ carbon fixed target at 2 AGeV. In a second experiment in March 2010, a different beam nucleus of ${}^{20}\text{Ne}$ at 2 AGeV was employed in a similar setup. The experimental approach was developed to measure and study hypernuclei produced in the projectile rapidity region. Such Λ -hypernuclei are assumed to be obtained by the coalescence between Λ hyperon produced in the mid rapidity region of the participant zone and projectile spectator fragments from the collision between the beam and target nuclei. Final results of the first experiment ${}^6\text{Li}+{}^{12}\text{C}$ at 2 AGeV will be presented, demonstrating that Λ hyperon, ${}^3_\Lambda\text{H}$ and ${}^4_\Lambda\text{H}$ hypernuclei were observed by performing the vertex reconstruction and the measurement of their invariant mass. Their lifetimes were extracted and were in good agreement with the world data. A review of the lifetime of these light hypernuclei was performed and showed that their measured lifetimes are significantly shorter than the Λ lifetime which bring new interrogation about their fundamental structures. As well, the evidence of a bound state of two neutrons and one Λ hyperon, ${}^3_\Lambda\text{n}$, will be presented. It corresponds to the first observation of a neutral bound state. Finally the estimation of the production cross section of the observed Λ hyperon and hypernuclei will be shown, corresponding the first experimental estimation of those observables. These estimations will be useful for constraining theoretical models of the hypernuclear production, and an insight on these implications will be given. Future plans to study exotic proton and neutron rich hypernuclei will conclude the presentation.

On behalf of collaboration:

[Other]

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