Recent progress of the HypHI project at GSI and its perspective at FAIR

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The HypHI project at GSI aims to perform precise hypernuclear spectroscopy with induced reactions of stable heavy ion projectiles and rare-isotope beams on a fixed target. Two experiments have been already performed with stable heavy ion beams in order to prove the experimental principle, Phase 0 and Phase 0.5, respectively with the ^{6}Li+^{12}C and ^{20}Ne+^{12}C reactions at 2 A GeV.

The data analysis for the Phase 0 experiment has been already completed, and the results on the invariant mass reconstruction and lifetime values for the observed $^{3}_{\Lambda}$H and $^{3}_{\Lambda}$H hypernuclei as well as the Λ-hyperon have been published [1]. In addition to these known hypernuclei, we have also observed signals in the d+π^- + t+π^- invariant mass distributions, and the lifetime measurements of the state associated with these final states have revealed that it decays with a strangeness-changing weak interaction [2]. Analyses on the production cross section as well as on the kinematics variables have also been completed [3], and the results will be also discussed. The analysis for the Phase 0.5 experiment are to be completed [4], and preliminary results will be also discussed.

Since the experimental principle has been already proven by the Phase 0 experiment, we plan to extend the project with rare-isotope beams and stable heavy ion beams with FRS at GSI and super-FRS at FAIR. In the proposed experiments, FRS and super-FRS will be employed not only for the production of rare-isotope beams but also as a high resolution forward spectrometer. Details of proposed experiments will be discussed.

In addition, we would like to discuss on the observed lifetime values of $^{3}_{\Lambda}$H, the combined analysis of which has revealed that it is significantly shorter than that of the Λ-hyperon [5], and it should be noted that it has not been understood theoretically even though it is the simplest hypernucleus.

References

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