Experimental setup for hypernuclear study at the Super-FRS

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The first experiment of the HypHI collaboration aimed to demonstrate the feasibility of the hypernuclear spectroscopy by means of heavy ion beam induced reactions. The final results show that the experimental method is viable for the study of hypernuclei [1, 2]. For this first experiment a ^{6}Li beam at 2AGeV on a Carbon target was used. A second experiment with a ^{20}Ne beam with the similar condition was also performed, preliminary results show that again Λ hyperon and $^3_\Lambda$H were identifiable.

A new set of experiments at FRS fragment separator is under study [3, 4]. The design study for a first experiment at FRS is on-going, which the experiment would focus on demonstrate this time that a hypernuclear spectroscopy can be performed within the FRS. A new dedicated apparatus for exclusive measurement can be set up within the fragment separator FRS, in contrast to the experimental apparatus devoted to inclusive measurement of the first experiments of the HypHI project. In this report, the first design of the experimental apparatus that could be placed into S2 area of FRS will be presented. The aim of the first experiment would the use a ^{6}Li beam on the carbon target in order to produce the $^4_\Lambda$H hypernucleus as a reference species since it has been already identified in the phase 0 experiment. It will be considered as a benchmark to show the feasibility of the hypernuclear spectroscopy within FRS. Secondly, $nn\Lambda$ bound state can be also search again for confirming its existence.

At S2 area, a detection apparatus consisting of a couple of dipole magnets could be install in order to separate the π^- meson of the mesonic weak decay of produced hypernuclei, while the positively charged fragments would enter the second part of FRS for precise determination of their momentum. The second dipole magnet is placed in such a way that it will correct the deflection of the fragments induced by the first dipole magnet in order to allow them to enter on beam axis the second part of the FRS. Detectors that have been already developed for the first experiment of the HypHI project can used in a similar way to track charged particles around the decay volume. Thus, the fiber detectors and drift chamber could be place in the upstream of the first magnets. The π^- mesons are then detected with a set of hodoscope walls and drift chambers in order to complete the information needed for the track reconstruction. Complete design of the detection apparatus is still on-going, which aims to minimize the pion multiscattering within the detection layers to improve as much as possible the momentum resolution of the pions.

The transport optics calculated and simulated by MOCADI, is also used in order to determine the momentum and geometrical acceptance of the fragment within the second part of the FRS. Currently, the simulation code for the Monte Carlo simulation of the apparatus at S2 is coupled with the MOCADI code: at first the full set of events is produced and propagated up to the entrance of the second part of the FRS, then those events are set as input for the MOCADI simulation code. At the end, event per event, and fragment per fragment within the event, the fragment transport through S2 to S4 is performed and registered. The final acceptance is then estimated. Coupling the two code will allow us to determine the trigger rate and hypernuclear yield that could be expected during such experiment. Those estimations are still on-going. The optics of the couple of dipole magnets with the first magnet stage of the second part of the FRS (S2-S4) is also under investigation.

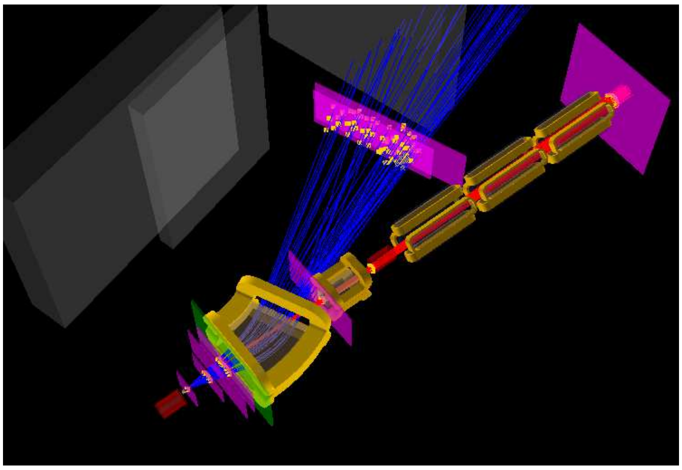

Figure 1: 3D view of the experimental apparatus at S2 area of the FRS. The couple of dipole magnets is shown with the simulated events of deuteron and π^- meson from the $nn\Lambda$ decay.

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References

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