Alternative experimental setup for hypernuclear spectroscopy at FRS/SuperFRS

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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 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 alternative design of the experimental apparatus that could be placed into S2 area of FRS will be presented.

The alternative setup would consist of a solenoid magnet in order to analyze the momentum of the π^- meson with an high acceptance while the fragments would enter the second part of the FRS for their momentum measurement. Within the solenoid magnet several stage of detection is under consideration. The size of the simulated solenoid magnet are 70 cm long with a radius of 50 cm, the magnetic field considered in the simulation vary from 0.3 T to 0.7 T. From the inner radius to the outer radius an inner cylindrical hodoscope, a TPC chamber and outer cylindrical hodoscope were considered respectively. Because of the Lorentz boost of the projectile spectator, the daughter particles and fragments of the produced hypernuclei are boost forward and does not stay within the solenoid apparatus. Therefore, a endcap of trackers and time-of-flight walls is considered to increase the detection acceptance of the light particles like the π^- of the mesonic weak decay. Figure 1 shows a 3D view of the S2 area, with it walls in grey box. The conceptual solenoid magnet system is shown with its endcap. It can be seen that the apparatus is quiet contact considering the dimension of the S2 area.

The angular deviation of the fragments through the magnetic field of the solenoid was estimated in order to determine if the optics of the FRS after S2 would not be too much affected. In left panel of Figure 2, the estimated deviation is shown given a mean value of 1.5 degree for magnetic field of 0.3 T. Additionally a first estimation of the momentum resolution of the π^- was also performed. In the right panel of Figure 2, the distribution of the momentum resolution as a function of the π^- momentum is shown. A reasonable momentum resolution could be achieved with such a apparatus, while the geometrical acceptance of the pi^- would much larger that in the case of the double dipole magnets described in [4].

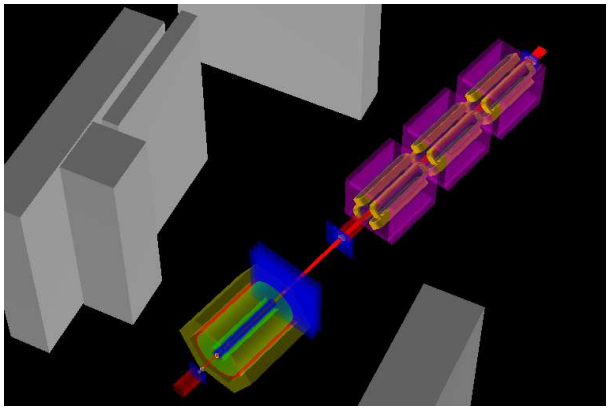

Figure 1: 3D view of the experimental apparatus in the S2 area of the FRS with the solenoid magnet.

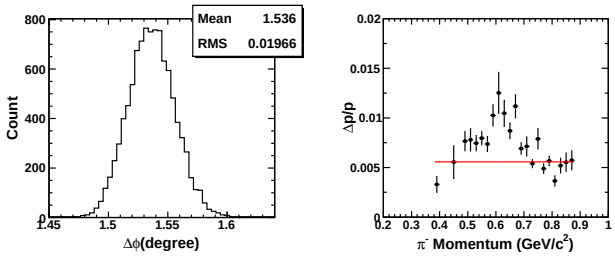

Figure 2: In the left panel, the fragment transversal angle $\Delta\Phi$ after going through the solenoid magnet. In the right panel, the π^- momentum resolution as a function of its momentum.

References

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