The primary and secondary target for the hypernuclear experiment at $\overline{\text{P}}$ANDA*

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Gamma spectroscopy of double Λ hypernuclei will be one of the main topics addressed by the $\bar{\text{P}}$ANDA experiment at the FAIR facility at Darmstadt. For this project a dedicated hypernuclear detector setup will be installed. In addition to the general purpose of the $\bar{\text{P}}$ANDA detector it consists of a primary nuclear target for the production of $\Xi^- + \bar{\Xi}$ pairs, a secondary active target for the formation of hypernuclei and the identification of associated weak decay pions as well as a germanium detector array to perform high precision γ spectroscopy.

The primary reactions $\overline{p}$ on a ^{12}C nucleus were simulated in several runs of GiBUU calculations to get a realistic momentum distribution of the Ξ^-. In the experiment a thin diamond filament will be used to produce those low momentum Ξ^-. For the positioning of the primary filament target in the beam halo a stage with piezo motors for a two-dimensional motion was designed and is currently under construction, fig. 1. The mounting of five linear piezo motors equipped with targets guarantees an easy replacement in the case that a filament breaks. The specifications of the linear motors could be confirmed in experimental tests and their functionality in vacuum and after irradiation during a beam time at COSY in Jülich was validated.

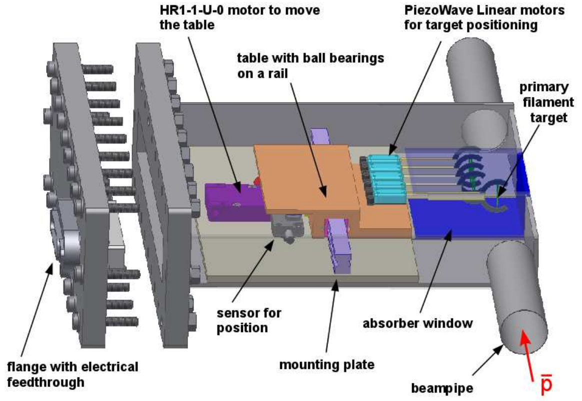

Figure 1: Vacuum chamber with target mechanics.

In order to stop the Ξ^- hyperons and track pions from the decay of the produced double hypernuclei, the secondary target is composed as a compact structure of silicon microstrip detectors and absorber material. In the area of the sensor layers an absorber window is inserted to the target chamber which also serves as first volume to decelerate and stop the Ξ^-, fig. 2. Stability and material tests were carried out for sheets of B_4C and CFC placed to a target chamber frame.

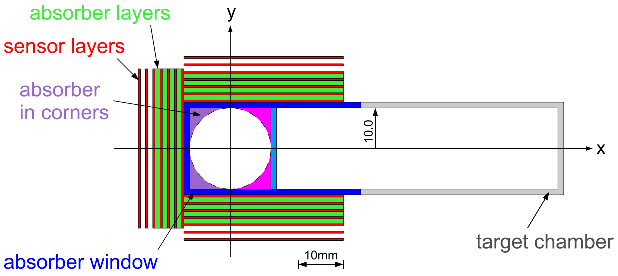

Figure 2: Arrangement of the secondary target layers in the x-y plane which is orthogonal to the beam direction.

In order to optimize the geometry of the secondary target, the stopping probability of Ξ^- hyperons and the reconstruction accuracy of weak decay pions were studied in detailed simulations. The $\Lambda\Lambda$ hypernuclei are created where the Ξ^- are stopped in the absorber volumes, fig. 3 (left). The momenta of the weak decay pions are reconstructed in the sensor layers. As one example the summed pion spectrum from the decay

$$^{11}_{\Lambda\Lambda}B \longrightarrow {}^{11}_{\Lambda}B + \pi_1^- \longrightarrow {}^{11}C + \pi_2^- + \pi_1^- \qquad (1)$$

is shown in fig. 3 (right).

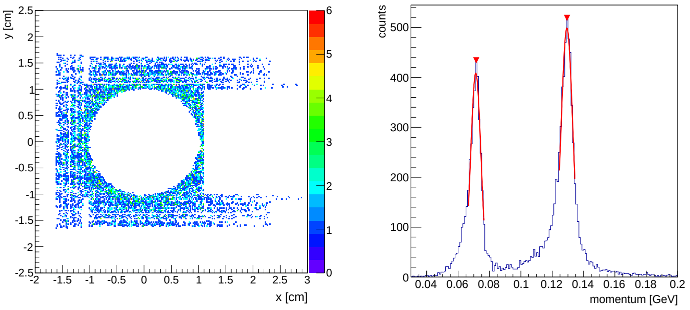

Figure 3: Simulation results of Ξ stopping and π tracking.

The resolution for the higher and lower momentum is 6.7% and 10.7%, rspectively. For a single pion a reconstruction efficiency of 58.6% was achieved.

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