Development of New Acrylic Cherenkov counter and Performance of Particle Identification for Λ hypernuclear spectrosocpy with the (π^+, K^+) reaction (J-PARC E94 Experiment)

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Content

The J-PARC E94 experiment is set to employ the (π^+, K^+) reaction at the K1.8 beamline of the J-PARC Hadron Experimental Facility to generate single Λ hypernuclei, specifically $^{7}_{\Lambda}$Li, $^{10}_{\Lambda}$B, and $^{12}_{\Lambda}$C [1]. The experiment aims to measure the Λ binding energies using the missing mass method and compare these with those of the mirror nuclei to investigate the violation of charge symmetry in the ΛN interaction. The first doublet states of $^{7}_{\Lambda}$Li will serve as energy calibration sources, with the objective of achieving an accuracy of approximately 100 keV. A novel magnetic spectrometer, the Strangeness -2 Spectrometer (S-2S), is being utilized for this experiment at the K1.8 beamline. The inaugural experiment with the S-2S was concluded in May 2025 (J-PARC E70 Experiment), confirming its basic spectroscopic performance for J-PARC E94.

During the experiment, experimental targets with an areal density of 1 g/cm^2 are exposed to a beam of intensity 5M/spill where the spill cycle of 4.2 sec. Background particles, such as protons, pions, and muons, are anticipated in the S-2S. These background particles must be rejected at the trigger level for data acquisition (DAQ) due to the limited rate of the DAQ system. We plan to employ two types of Cherenkov counters with radiation media of aerogel (refractive index n = 1.05) and acrylic (n = 1.49) for background rejection at the trigger. We are developing a new acrylic Cherenkov counter, while the existing aerogel Cherenkov counter will be utilized.

I will be presenting on the development of the new acrylic Cherenkov counter, as well as the expected trigger rates and the particle identification capability of the S-2S detector system using exploratory data.

Reference

[1] T. Gogami et al., Proposal to J-PARC, E94 (2022)

Field of Research: Production, structure and decay of hypernuclei / Future experiments and facilities
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