Study of baryon excited states in $(\pi, 2\pi)$ reactions at J-PARC

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Baryon excited states consisting of light quarks (N* and Δ*) have been studied for a long time. However, very little is known about their mass spectra and properties due to overlapping mass spectra from their large widths. An advanced Dynamical-Couple Channel (DCC) model [1] shows significant contributions of 2π reactions to higher mass baryon exited states. Surprisingly, there were only 240 thousand events of these reaction data which was mainly measured in 1970's. In this situation, we have proposed an experiment E45 to study baryon exited states in $(\pi, 2\pi)$ reaction utilizing 10^6Hz $\pi^{\pm}$ beams at J-PARC. We aim at clarifying baryon resonance properties and renew the world database by increasing the statistics of $(\pi, 2\pi)$ data by two orders of magnitude. We also search for exotic baryons such as hybrid baryons predicted by lattice QCD calculations [2]. The experimental setup is shown in Fig. 1. We measure reactions of $\pi^- p \to \pi^+\pi^- n, \pi^0\pi^- p$ and $\pi^+ p \to \pi^0\pi^+ p, \pi^+\pi^+ n$, as well as $\pi^- p \to K^0\Lambda$ and $\pi^+ p \to K^+\Sigma^+$ in a large acceptance Time Projection Chamber (TPC) inside a Helmholtz dipole magnet. We trigger the event with two charged particles in the hodoscope counters surrounding the TPC. We will measure these reactions in small momentum steps over a large beam momentum range and perform partial wave analysis based on the DCC model to extract properties of each resonance. In this presentation, we will show the experimental design, the R&D status of the detectors, and analysis methods and expected results.

[1] H. Kamano, *et al.*, Phys. Rev. C79 (2009) 025206.

[2] J. Dudek, *et al.*, Phys. Rev. D85 (2012) 054016.

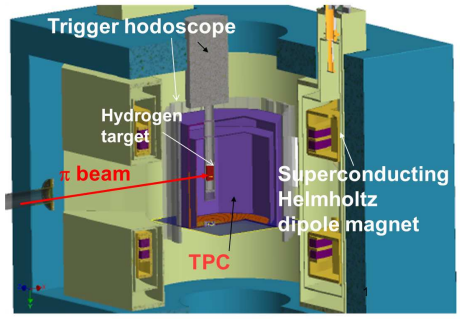

Figure 1: The experimental setup for E45.