J-PARC E19 experiment: Pentaquark Θ^+ search in hadronic reaction at J-PARC

T. N. Tkahashi[1#] for the J-PARC E19 Collaboration

[1]*Research Center for Nuclear Physics (RCNP), Ibaraki, Osaka, 567-0047, Japan*
 # a corresponding author: E-mail tomonori@rcnp.osaka-u.ac.jp

Exotic hadron study is key role to investigate the hadron structure and dynamics of the low energy QCD. In 2003, the evidence of the pentaquark Θ^+, a light baryon with strangeness S=+1, was reported as the first candidate for the multi-quark system by LEPS group [1]. After the first report, there have been many both theoretical and experimental works. However, since the existence of Θ^+ is not yet established, an experiment with higher sensitivity is required.

The J-PARC E19 experiment was performed to search for pentaquark Θ^+ in the $\pi^-p\rightarrow K^-X$ reaction at the K1.8 beam line as the first experiment in the J-PARC Hadron Experimental Facility. The unique features of E19 are as follows;

- Less ambiguity: A meson induced reaction is desirable to understand the production mechanism of Θ^+. In addition, a liquid hydrogen target was used in E19 to reduce the background contribution.
- High statistics and high resolution: High intensity π^- beam is available at J-PARC K1.8 beam line. The spectrometer for the beam and the scattered particle provided a mass resolution better than 2 MeV/c^2 (FWHM), which is useful to determine the narrow width.

Physics runs were carried out in 2010 and 2012. In the first (second) run, 7.8×10^{10} (8.7×10^{10}) π^- beam with the momentum of 1.92 (2.0) GeV/c was irradiated on the liquid hydrogen target. No peak structure was observed in the missing mass spectra of both data. The 90% confidence level upper limit of the production cross section was estimated to be 0.26 μb/sr [2] for the first run, which are averaged over 2-15 deg. in the laboratory frame. With a theoretical calculation using the effective Lagrangian approarch [3], the upper limit of the Θ^+ decay width was estimated to be 0.72 and 3.1 MeV/c^2 for $J^P=1/2^+$ and $1/2^-$ for the first run. The analysis on the second run is ongoing.

The contribution will review the result of E19 experiment including analysis update.

References

[1] T. Nakano *et al.*, Phys. Rev. Lett. **91**, 12002 (2003)
[2] K. Shirotori *et al.*, Phys. Rev. Lett. **109**, 132002 (2012)
[3] T. Hyodo, A. Hosaka and M. Oka, Prog. Thor. Phys. **128**, 523 (2012)