Recent results from LEPS

Takashi Nakano, for the LEPS and LEPS2 collaborations

Research Center for Nuclear Physics, Osaka University, 10-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

E-mail: nakano@rcnp.osaka-u.ac.jp

(Received November 29, 2016)

The linearly polarized photon beam in the GeV energy region at SPring-8 is produced by backward-Compton scattering of laser photons from 8 GeV electrons. The current LEPS facility studies photo-production of hadrons such as ϕ and K mesons in the forward angles, while the newly built LEPS2 facility currently concentrates on studies of neutral meson productios with a large solid-angle calorimeter BGOegg. In my talk, I report on the selected results including the Θ^+ study from LEPS and the status of the LEPS2 experiments.

KEYWORDS: hadron, photon beam, polarization

1. Introduction

The Laser-Electron Photon facility (LEPS) at SPring-8 has been under operation at SPring-8 since 2000. The photon beams are produced by laser-induced backward Compton scattering (BCS) from 8 GeV electrons. Because of the nature of BCS, the low energy component is much less than that of conventional Bremsstrahlung photon beams. The beam polarization is high and can be changed easily by changing the laser polarization. The LEPS covers photon energy region from 1.5 GeV to 2.9 GeV, which is suitable to study strange quark and anti-strange quark pair creations near the production thresholds such as photo-production of the ϕ meson, $\Lambda(1405)$ and $\Lambda(1520)$.

In 2011, we constructed a new beam-line (LEPS2). The intensity of the tagged photon beam was 1.4–1.8 MHz with the simultaneous injection of three or four ultraviolet lasers [1]. Although the main detector with a solenoidal magnet is still under construction, we have started a physics run with a large acceptance calorimeter that consists of 1320 BGO crystals (BGOegg).

2. Study of Θ^+

Since we, the LEPS collaboration, reported the observation of a narrow baryon resonance-like structure in the nK^+ invariant mass spectrum produced in $\gamma n \to K^+K^-n$ reactions in 2003 [2], a considerable number of experiments have been carried out to check the existence of the exotic baryon, now called the Θ^+. The Θ^+ is a genuine exotic baryon with the minimum quark configuration of $uudd\overline{s}$, for which a narrow decay width and a light mass were first predicted by Diakonov, Petrov, and Polyakov using a chiral quark soliton model. Although the LEPS result seemed to be supported by several experiments which reported positive evidence for the existence of the Θ^+ in various reactions, the experimental situation soon became controversial. Many experiments at the high energy, especially collider experiments, found no positive evidence in the pK_s invariant mass distributions with a good mass resolution and high statistics.

In 2009, the LEPS collaboration studied the $\gamma d \to K^+K^-pn$ reaction to search for the evidence of the Θ^+ by detecting K^+K^- pairs at forward angles [3]. The Fermi-motion corrected nK^+ invariant mass distribution shows a narrow peak at 1.53 GeV/c^2, which may be inconsistent with the other