Laser Electron Photon Experiment at SPring-8

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A GeV photon beamline has been constructed at BL33LEP of SPring-8. 8 GeV electrons are circulating in the synchrotron radiation ring with the maximum current 100 mA. Laser photons are injected into the ring and hit against the electron beam. By the Compton scattering, high energy photons are emitted in narrow cone in the electron beam direction (laser electron photon, LEP). An ultraviolet Ar laser ($\lambda \sim 350$ nm) is used for producing the LEP beam with 2.4 GeV maximum energy. At present, this is the highest energy and the only beam which can produce ϕ meson on free nucleon among the LEP facilities in the world. The first LEPS beam was produced in 1999 and the beam intensity has reached 2.5×10^6 photons/sec after the beam commissioning. We started the first test experiment of quark nuclear physics in May 2000.

Reactions of GeV photons are characterized by the process that γ fluctuates into a vector meson which is known as the vector meson dominance. The vector meson is scattered diffractively by Pomeron exchange [1]. Pomeron exchange can be understood as multi-gluon exchange process, which describes various hadronic cross sections at high energy [2]. In the low energy region, photoproduction of ϕ is a unique reaction for studying the gluon exchange process because of the strong OZI suppression of meson exchange processes. We expect that precise measurement of unpolarized cross section will clarify 0^+ glueball contribution [3]. Measuring the parity asymmetry of K^+K^- decay of ϕ with linearly polarized photon, we can study the strength of natural parity (including 0^+ glueball) and unnatural parity exchange processes [4].

A detector system has been optimized for the forward ϕ photoproduction measurement [5]. It consists of a dipole magnet spectrometer in the beam direction, Si microstrip detectors

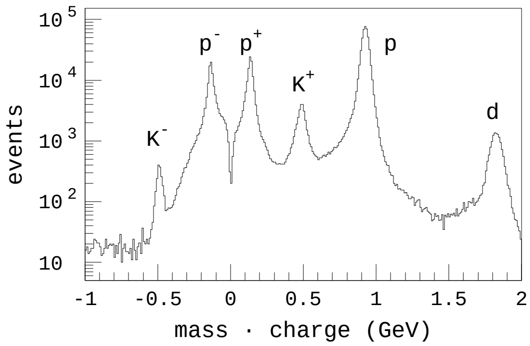

Figure 1: A mass distribution reconstructed from measured momentum and TOF.

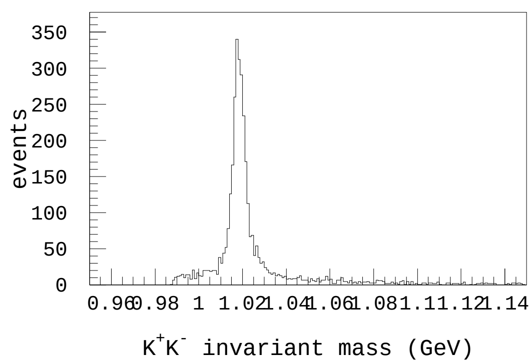

Figure 2: An invariant mass distribution for K^+K^- events.

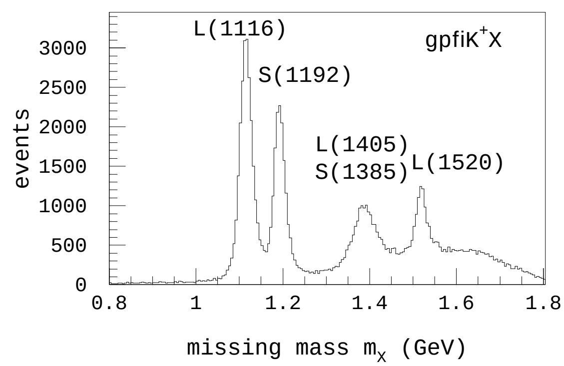

Figure 3: A missing mass distribution for K^+ production events.

and multi-wire drift chambers for particle tracking, and time of flight (TOF) counters. The energy of the incident beam is determined with about 15 MeV resolution by measuring recoil electron with a tagging counter.

In the test experiment, we have used a liquid hydrogen target [6] and some nuclear targets. Masses of charged particles emitted from the target have been reconstructed from the measured momenta and TOFs. As shown in Fig. 1, the detector system shows good performance on the particle identification. For the event with the K^+K^- pair, a clear peak has been observed in the invariant mass spectrum at ϕ mass (Fig. 2). For the single K^+ production events, we have seen a hyperon mass spectrum as shown in Fig. 3. The further data analysis is now in progress.

References

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