Detector system for LEPS2 project

Yoshikazu Maeda for the LEPS Collaboration[1]

[1]Research Center for Nuclear Physics, Osaka University, Ibaraki, Osaka 567-0047, Japan

A new beam line project, LEPS2 project, is planed to perform the hadron physics using a high energy polarized photon beam produced via laser-induced backward Compton scattering off electrons circulating in the storage ring at SPring-8. The aim of the project is to improve both the intensity and maximum energy of the photon beam and expand the detector acceptance from the current LEPS facility.

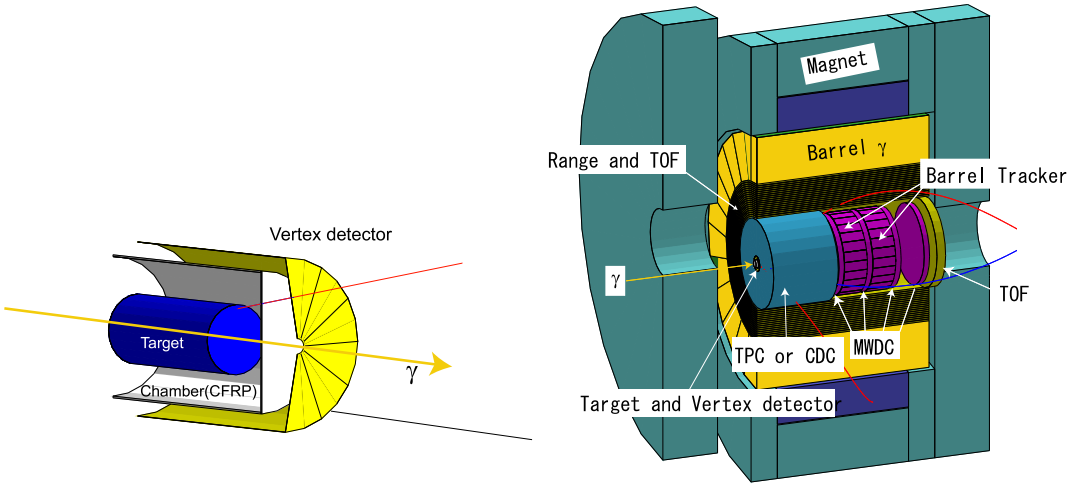

Figure 1: Left: Schematic view of vertex detector and liquid target system, placed inside the detector. Right: LEPS2 spectrometer with E949 solenoid magnet.

One of the most important requirement for the new detector system is to measure both the photoproduction process and the decay process simultaneously. In addition since the photoproduction cross section is small and the photon-beam experiment needs much longer beam time than that using the hadron-beam, a general purpose detector with a large solid angle to detect not only charged particles but also neutral particles like photons are desirable. One possible candidate is the BNL-E949 detector, which was used for the measurement of $K^+ \to \pi^+ \bar{\nu}\nu$ decay from kaons at rest. Measurement of charged decay products were made in a 1-T magnetic field using an active target, a low-mass central drift chamber and a cylindrical range stuck of scintillating detectors (RS). Photons were detected in 4π-sr calorimeter consisting of a lead/scitillator sandwich barrel detector surrounding the RS, and end caps of CsI crystals. For the photon-beam experiment, although the central part should be modified or removed, the inner bore size (2.96-m diameter and 2.2-m length) of 1-T solenoid magnet is sufficiently large for the further optimization of the detector

system with some modifications of the central part. A basic agreement to move the E949 detector to Japan and to use it at LEPS2 has been made.

A schematic view of the current setup is shown in Fig.1 with all the detector components installed in the E949 solenoid magnet. The inner part of the detector is devoted to triggering and tracking charged particles. The scattering angle as well as the particle trajectory for the momentum determination are measured by vertex detectors consisting of double-sided silicon strip detector (SSD), forward tracking detectors made up of four sets of drift chambers surrounded by a barrel tracker, and sideway tracking detector, a TPC. To identify charged particles, we use the energy loss information from the range stack counters combined with TOF information.

The requirements for the tracking system are that it must be possible to determine the momentum of charged particles down to 100 MeV/c and a similar momentum resolution must be realized as that of the LEPS spectrometer in the forward region, typically $\Delta P/P = 1\%$ for a 1-GeV/c kaon at around 10 degree laboratory angle. Calculated total momentum resolutions for use of different gases are shown in Fig.2, where the target is placed at the most upstream of the inner volume of the magnet. In case of solenoid magnetic field, the minimization of the multiple scattering effects is essential to obtain a reasonable momentum resolution for the forward emitted particles. Using a helium gas installed in bag between target and the forward detector and employing the low-mass gases for the chamber are very effective to improve the momentum resolution. Further studies for the detector design are in progress.

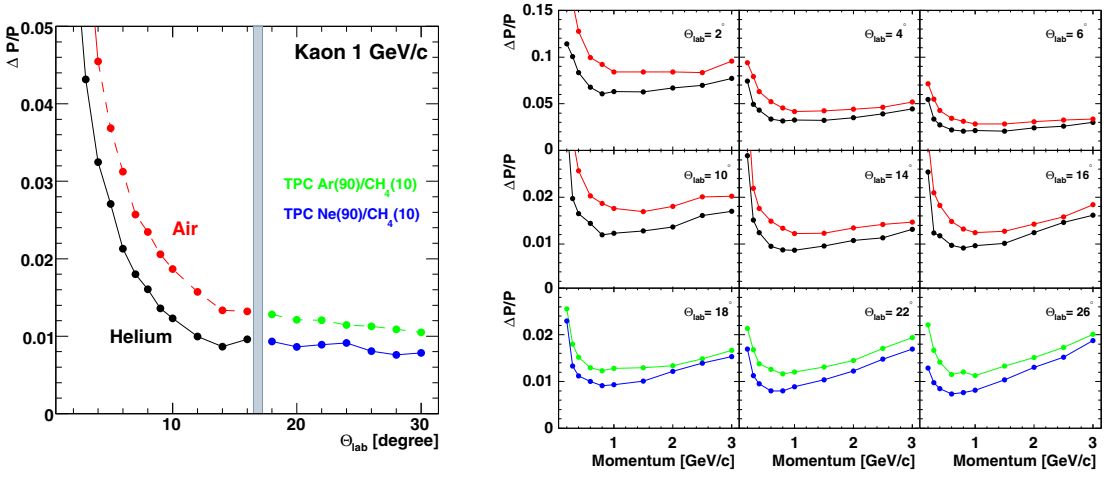

Figure 2: Calculated total momentum resolution $\Delta P/P$ for a kaon.