Test on veto detectors for $K_L \rightarrow \pi^0 \nu\nu$ experiment

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This test experiment aims to evaluate the basic performance of veto detectors, which are currently under development for future $K_L \rightarrow \pi^0 \nu\nu$ experiment. Since the event signature of the process is an existence of π^0 without any missing particle, hermetic veto counter is the key component in the experiment to identify the signal among many backgrounds. We evaluated various basic performances of test counters, using charged beams at the T1 line, and try to feed them back to the design of real detectors in future experiments.

The most important subject among the various counters tested in this experiment is a neutron-insensitive photon detector, which will be installed inside the neutral beam in $K_L \rightarrow \pi^0 \nu\nu$ experiment. In order to operate in the intense beam, it is designed to be a series of aerogel counters with lead converters. We constructed a full-size prototype module, as shown in the right picture. It consists of an aerogel array, a flat mirror, Winston cone, and a 5-inch photomultiplier. By stacking 5 layers of 3 by 3 aerogel tiles, its sensitive area of 30cm-square is achieved.

The structure of the prototype of aerogel-based photon counter

The role of the prototype is to find out unexpected problems specific to large size. We mainly used 1GeV/c π^+ beam and measured incident angle and position dependence of the light yield. We found it happens to have a deficit when the emitted Cherenkov lights pass through edges of aerogel tiles, which were relatively rough due to cutting process by water-jet. Also, we found that the incident angle dependence is sensitive to a deformation of the Winston cone. These findings will be feedbacks to production processes of the real detector in future.

After this beam test, the module was installed in the E391 experiment and operated in the real neutral beam environment. These are parts of R&D efforts toward future experiment at J-PARC.