Q029

TITLE:

Beam test of GEM tracker for J-PARC E16 experiment

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1. Purpose

The purpose of the beam test is to evaluate the position resolution and the efficiency of GEM tracker for J-PARC E16 experiment. The items of the beam test are followings.

① Test of three types of readout configurations

We have three types of readout-electrode board, which have x- and y-strips on each side. The ratio of charge shared between x-strips and y-strips is studied. First has 12.5 μm insulator, which is thinner than that of others, 25 μm. Second is "through-hole" type, in which y-strips are conducted to the x-strips side by through-holes. Third has insulator only below x-strips. Charge is expected to be detected by y-strips directly due to reducing the insulator.

② Drift gap length and electric field dependence of position resolution and efficiency

Shorter drift gap (Figure 1) and stronger electric field in the drift gap shorten the rise time and arrival time spread of the signals, so the rate capability of the tracker is improved. But shorter drift gap decreases the number of ionized electrons and worsen the signal to noise ratio. Thus the optimum point for rate capability and efficiency should be studied by changing the drift gap length and the electric field strength.

③ Evaluation of position resolution with readout electronics board

The ASIC board GEMFE2007, developed by KEK for the strip readout of GEM detectors, gives hit maps of the strips and the hit timings at 100 MHz. The position resolution for angled tracks is evaluated with the data, instead of the FADC which is used in previous beam tests.

④ Study of the bias field in the "drift gap" for the HBD

Hadron Blind Detector (HBD) , which is a new type of Cherenkov detector, is used for J-PARC E16 experiment. CsI-evaporated GEM

serves as photocathode and the photoelectrons are amplified by the stack GEMs as the GEM Tracker. Over the CsI-evaporated GEM, a mesh electrode is also placed as the tracker shown in Figure. 1. However, unlike the tracker, the electric field (so called "bias field") in the "drift gap" is applied to absorb the ionized electrons with the mesh, in order to amplify only the photoelectrons.

In the beam test, we measure dependence of charge distributions on the gap length and the bias field strength, in the CF_4 gas and LCP-GEMs which are used in the HBD, in order to understand the detector response.

We use GEMs without CsI so that to measure distributions without Cherenkov radiation.

⑤ Operation check for lead-glass calorimeter

We will check a few lead-glass calorimeters (recycled from KEK-TRISTAN) with the test beam.

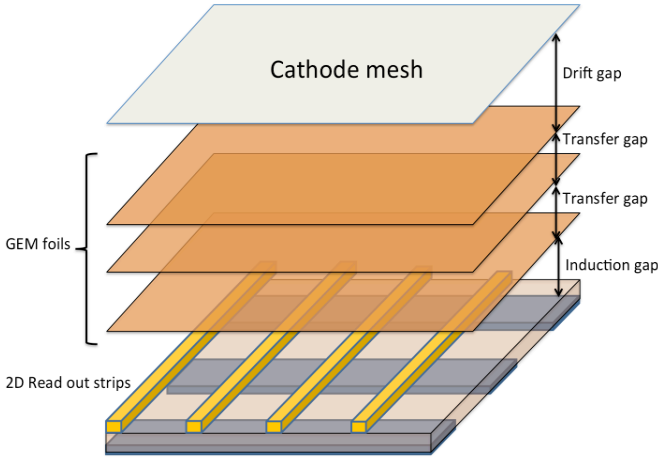

Figure 1. Structure of GEM chamber. The gap is called “drift gap”, “transfer gap” and “induction gap” from the top side.

2. Setup

Schematic view of the setup is shown in Figure 2. Event trigger is made by the coincidence of the scintillators. Three Silicon Strip Detectors (SSDs) are located up- and downstream of the GEM tracker. The reference position for GEM tracker is measured by the SSDs.

The signal waveforms from GEM tracker are sampled by FADC modules.

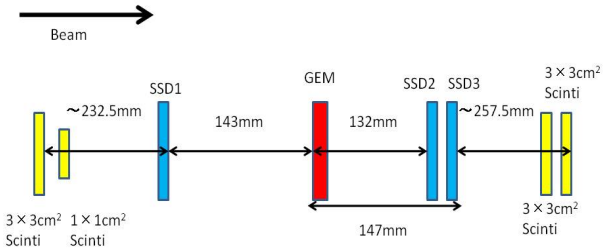

Figure 2. Schematic view of the setup. Trigger is made by the coincidence of the scintillators and GEM signals are sampled by FADC modules.

3. Beam requirement

Max 2.4 GeV photon beam on Pb converter 0.5 mm in thickness is required. Pb converter is set upstream of the LH_2 target. The ee blocker is removed to channel converted e^+ and e^- downstream.

4. Running time

Running time schedule is shown in Table 1. Setup and cleanup of the apparatus take 2 days of the beam time.

	schedule	beam	test item
10/20	apparatus set up	off	
10/21	DAQ set up, data taking	on	read out
10/22	data taking	on	read out
10/23	data taking	on	read out, drift gap
10/24	data taking	on	drift gap
10/25	data taking	on	drift field
10/26	data taking	on	asic
10/27	data taking, clean up	on/off	asic
10/28	clean up	off	

Table 1. Running time schedule.