Annual Report of T467

The ATLAS experiment for the Large Hadron Collider (LHC) will start at CERN in 2006. The mass production of Thin Gap Chamber (TGC) which is used for the ATLAS End-Cap Muon Trigger has started in Japan since autumn in 2000. The main subject of T467 was to check the performance of TGCs which were made in the Japanese mass-production line.

The effective area of TGC is 1.4m×1.2m and the gap between anode wires and cathode plane is 1.4mm. Because of the short interval between the bunch crossing of 25nsec in LHC, the fast response of the trigger detector is essential to provide a bunch-crossing identification number to the triggered event. The characteristic structure of the thin gap is adopted to keep the time jitter less than 25nsec.

In December 2000, we performed the beam test of TGCs at KEK-π2 beam line with negative particles whose momenta were 4GeV/c. Here we present some results taken in the beam test.

- High voltage (HV) dependence of the efficiency
  First, we checked the efficiency with changing HV from 2.5kV to 3.3kV. Both of the signal from anode wires and from cathode strips reached the efficiency of 99.9% at HV of 3.1kV with our normal operation threshold as shown in Figure 1. After this, all the measurements were done at this point.

- The incident angle dependence of the time jitter
  Next, we checked the time jitter of TGCs. The definition of the time jitter is the minimum time gate for getting 99% of the efficiency. It is essential for the trigger counter whose time jitter is less than the period of bunch-crossing. We checked it with changing the incident angle of the particles. In ATLAS experiment, particles coming from the interaction point have an incident angle from 10 degrees to 45 degrees and the time jitter is a function of that angle as shown in Figure 2. The time jitter decreased with increasing the angle of the incident particles. There is a small region where the electric field is weak in the middle space between anode wires. In the case of the incident angle was 0 degree, some particles passed only that region and it appeared as a long tail of the time distribution. When the incident angle was larger than 15 degrees, delayed tail was disappeared and time jitter became less than 25nsec.

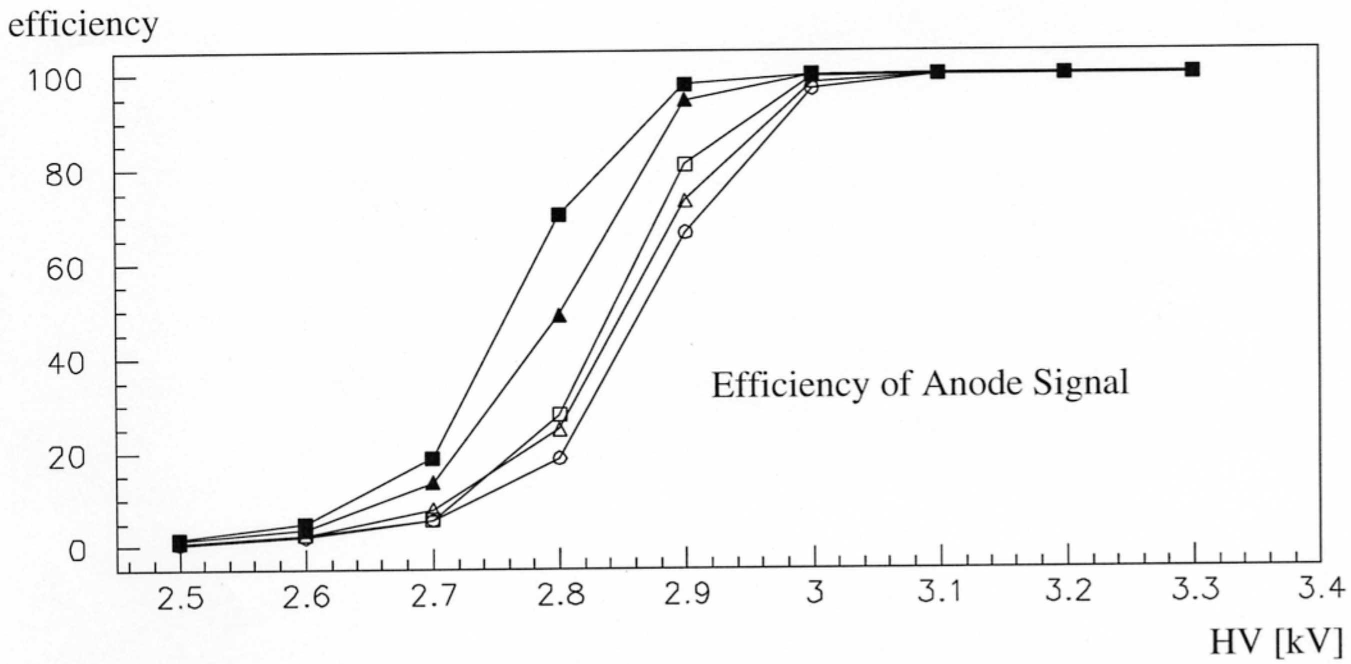
- Position dependence of the efficiency and the gain
  The position dependence of the efficiency and the gain is shown in Figure 3. Some dips of the efficiency were corresponding to the support structure inside TGC. In other place, we got the efficiency lager than 99.9% everywhere. The uniformity of the gain has a correlation with the distance of the gap. The most important parameter for the uniformity of the gain is the gap between anode and cathode plane. The variation of the gain was measured to be ±10%, which ensures that the flatness of the chamber is kept within ±100 microns as expected from the production tolerance.

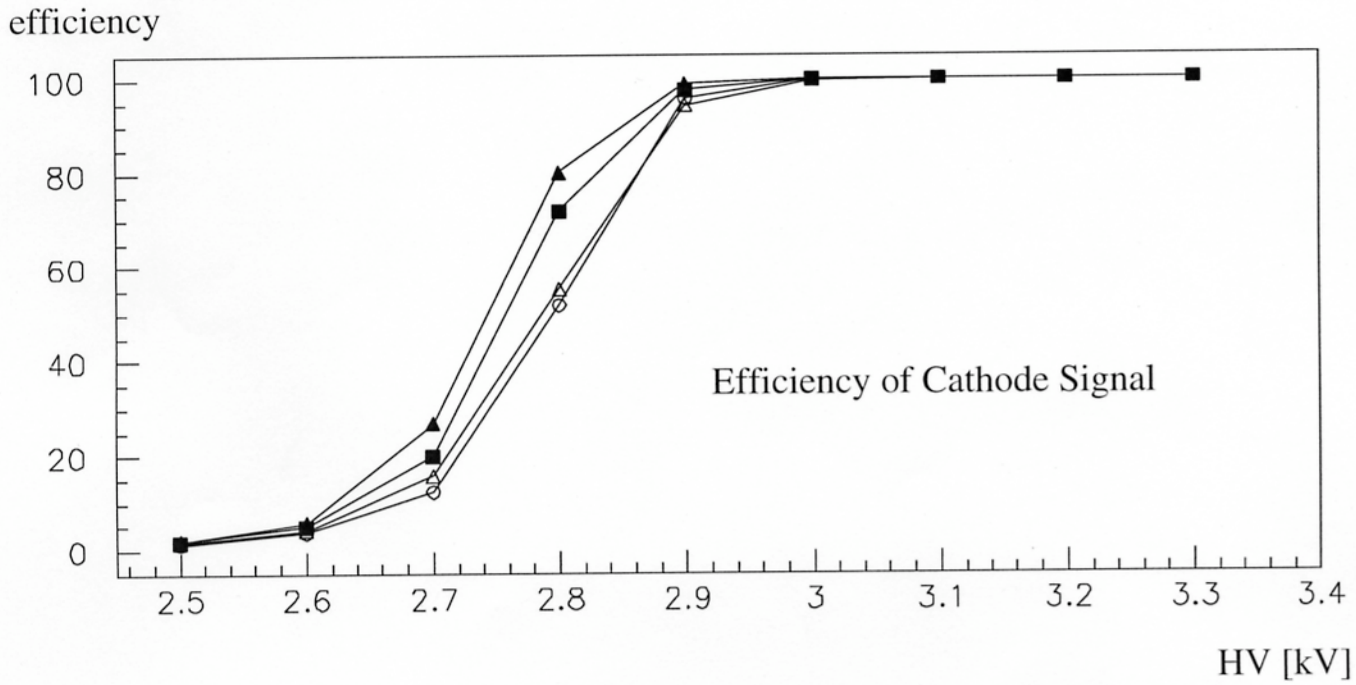
In conclusion, we confirmed the high quality of the thin gap chambers which were made in the Japanese mass production line from the result of the beam test T467.

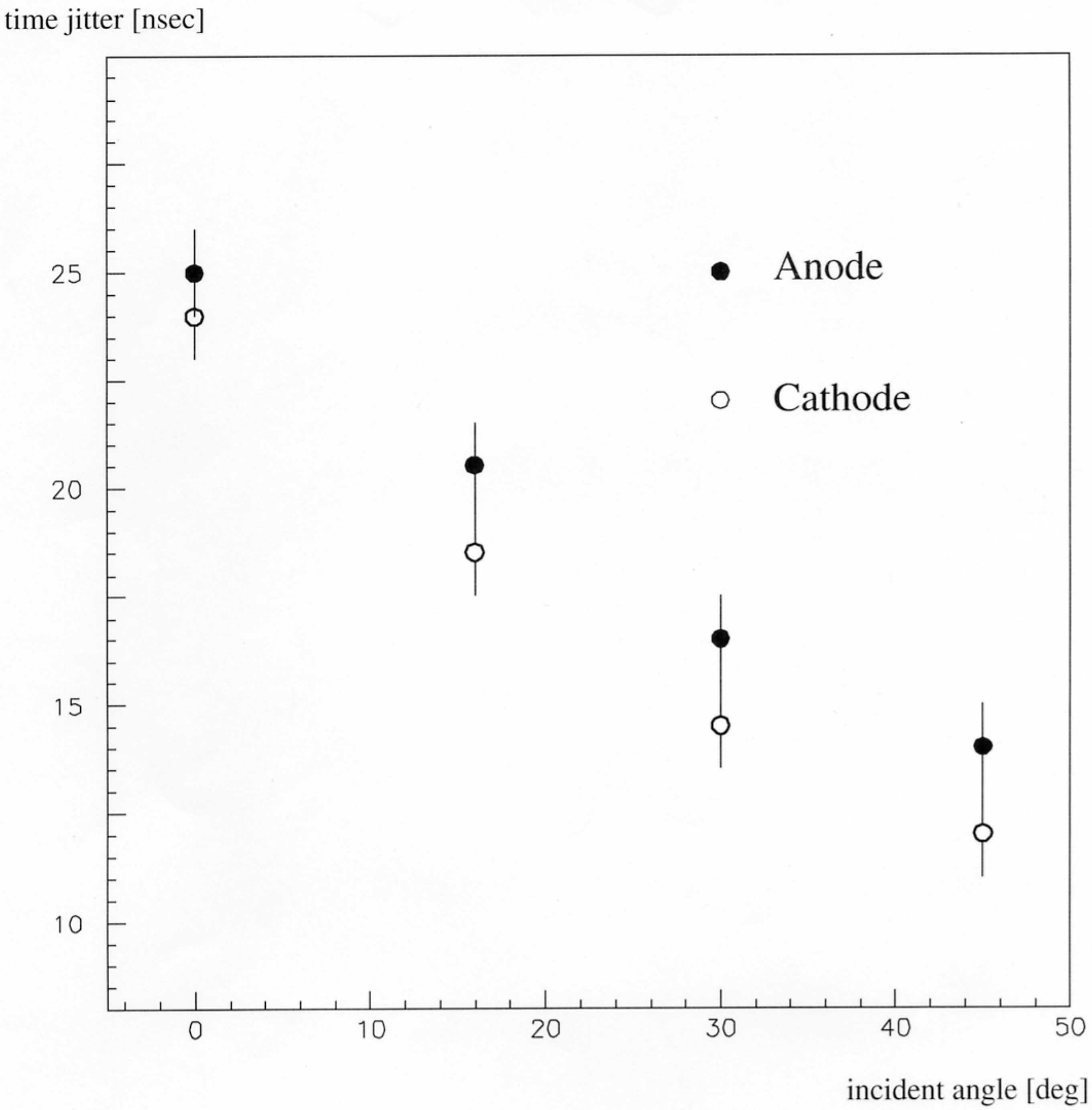
Figure 1: HV dependence of the efficiency for anode and cathode.

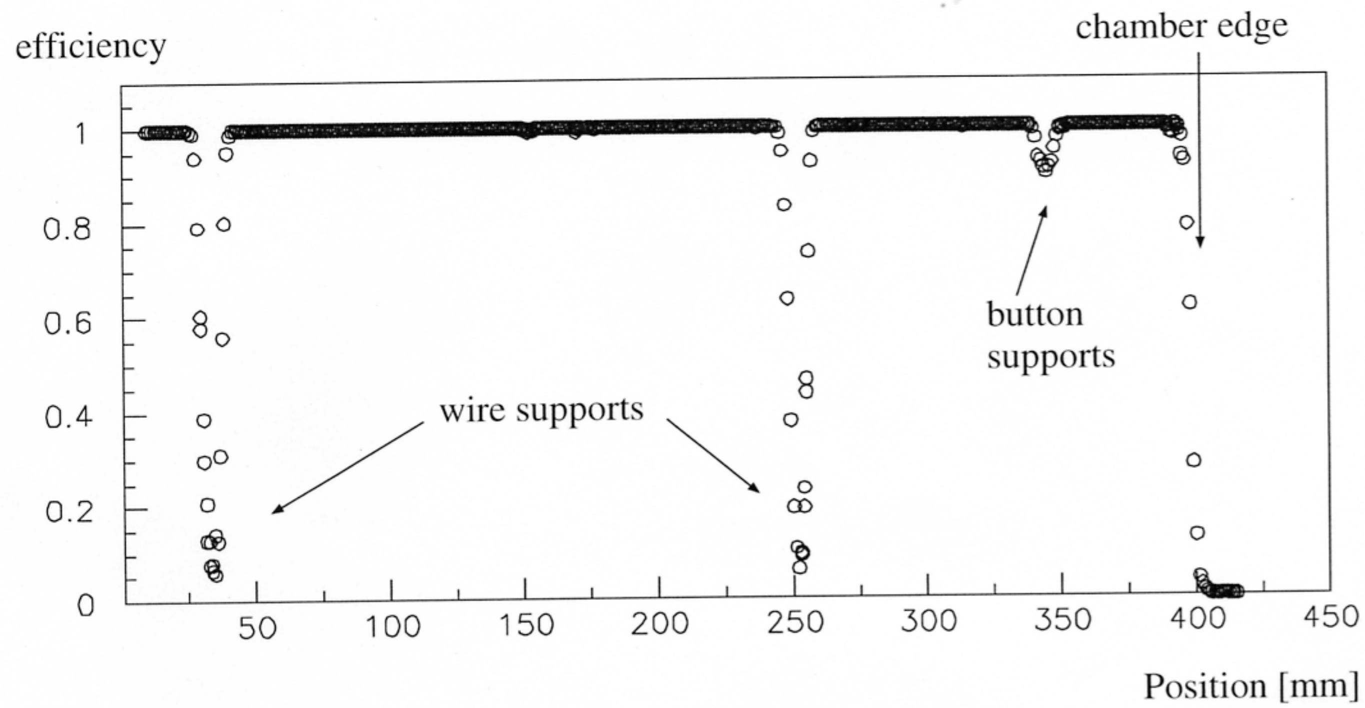
Figure 2: Incident angle dependence of the time jitter.

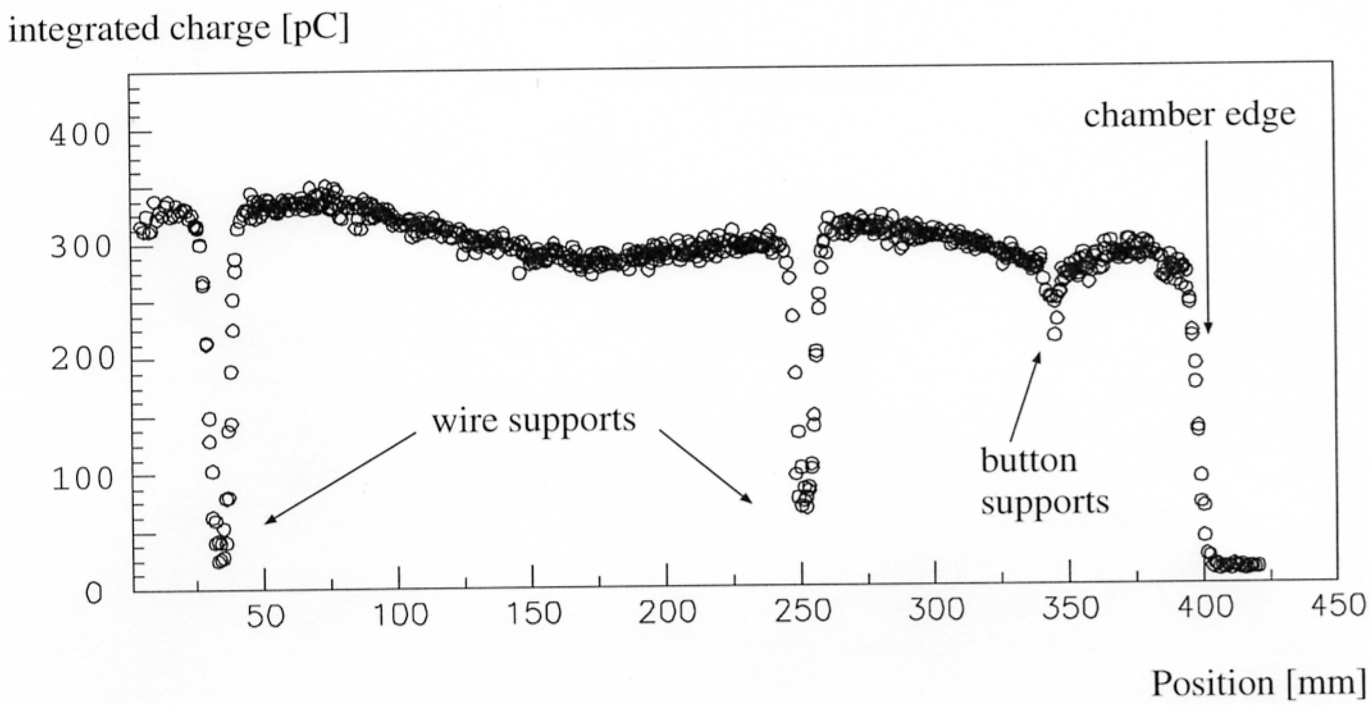
Figure 3: Position dependence of the efficiency and gain. We got 99.9% efficiency everywhere, and some dips of the efficiency were corresponding to the support structure inside TGC.


efficiency
100
80
60
40
20
0
2.5
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
3.4
HV [kV]
Efficiency of Anode Signal


efficiency
100
80
60
40
20
0
2.5
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
3.4
HV [kV]
Efficiency of Cathode Signal


time jitter [nsec]
25
20
15
10
Anode
Cathode
0
10
20
30
40
50
incident angle [deg]


efficiency
chamber edge
1
0.8
0.6
0.4
0.2
0
button supports
wire supports
50
100
150
200
250
300
350
400
450
Position [mm]


integrated charge [pC]
400
300
200
100
0
chamber edge
wire supports
button supports
50
100
150
200
250
300
350
400
450
Position [mm]