An international group of physicists from Asia and Europe performed three beam test experiments T572, T573 and T582 to develop MPGD-TPC for the International Linear Collider (ILC). The TPC for the ILC will have to measure 200 track points with a resolution of 100μm in the magnetic field of 3 - 4T, achieving a momentum resolution of 1 x 10^{-4} or better. The MPGD TPC is expected to be superior to the MWPC TPC. The group tested an aggressive MWPC TPC in 2004. A small prototype TPC (MP TPC), built at MPI, Munich, was set at the center of a persistent-current superconducting solenoid magnet JACEE (or PCMAG) in the Pi2 beam-line. The magnetic field at the center of JACEE was varied up to 1T. The pion beam up to 4GeV/c could penetrate the thin coil (20%rl) of the magnet and the TPC. In the beam tests the MP TPC was mounted with different types of MPGD; a triple GEN read out by pads of 1.1 (1.3) mm wide (pitch) in T573, a MicroMEGAS readout by pads of 2.1 (2.3) mm wide (pitch) in T572, and the MicroMEGAS with the resistive anode readout in T582. The GEM, the MicroMEGAS, and the resistive anode pads were prepared by Asian physicists (the CDC group), French physicists (Saclay and Orsay), and Canadian physicists (Carleton University), respectively. In the T582, a Canadian TPC prototype mounted with another MicroMEGAS readout by the resistive anode was also tested.

Pad response as a function of the drift distance measure by the MicroMEGAS readout by the normal pads is shown in Fig. 1, measuring the diffusion constant of Ar-Isobutane (5%) at 0.5T. Position resolution obtained at 1T with the same set up is shown in Fig. 2. A new analytic calculation of the pad response and the spatial resolution (Fig.3) was made by taking the gas gain fluctuation as well as the diffusion, the pad response function of MPGD, and the finite readout pad width (pitch) into account. The resolution calculation shown by the solid curve in Fig.2 reproduces the data nicely by assuming the effective number of electrons N_{eff} which is the only free parameter to be determined by other measurements. Note that N_{eff} can be different for different MPGD. Position resolutions measured for the triple GEM are shown in Fig. 4 for the P5 gas. Fig. 5 shows a result from the MicroMEGAS with the resistive anode readout measured in the Carleton TPC. By electrically broadening the anode signal on pads by using a resistive film, the position resolution is free from the effect of the finite width of readout pads, providing better resolutions in the short drift distances. The results of these beam tests may be extrapolated to the ILC TPC using the analytic formula. The diffusion constants of different gas mixtures at higher magnetic fields are estimated reliably by the Magboltz simulation. Final results of the tests will be published soon.

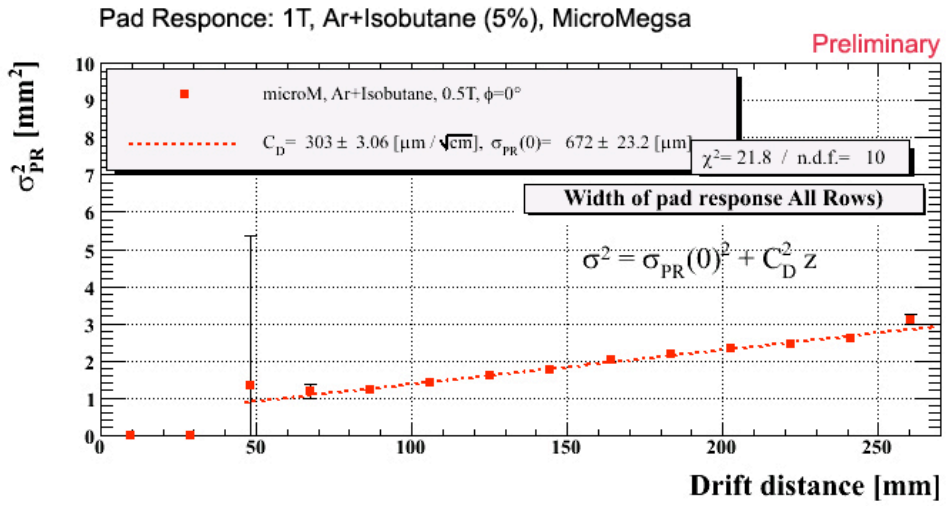

Fig. 1 Measurement of the diffusion constant of Ar-Isobutane (5%) at 0.5T in T572. The pad response is plotted as a function of the drift distance. The MicroMEGAS mounted on the MP TPC was readout by normal pads of 2.1 (2.3) mm wide (pitch).

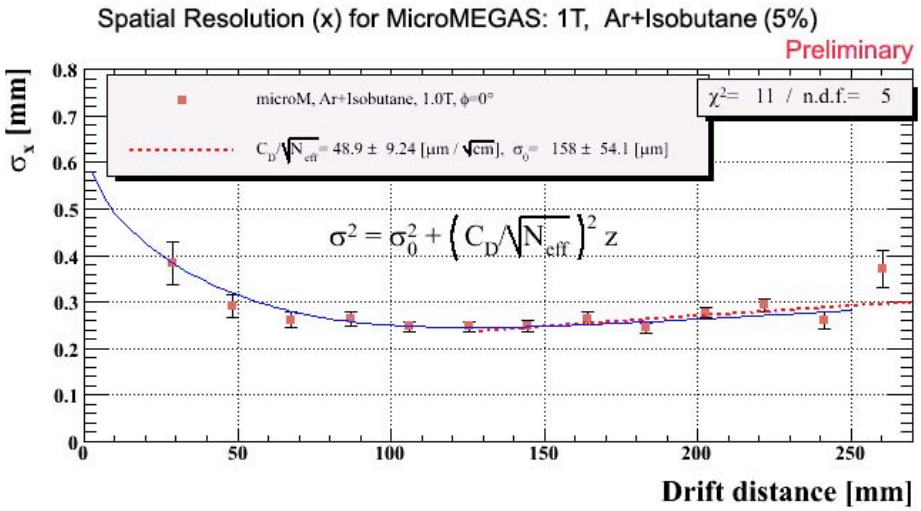

Fig. 2 Spatial resolutions measured for the MicroMEGAS in T572. The MicroMEGAS was readout by normal pads of 2.1 (2.3) mm wide (pitch) and the gas mixture was Ar-Isobutane (5%). The blue curb is the prediction from the analytic calculation with N_{eff}=17.

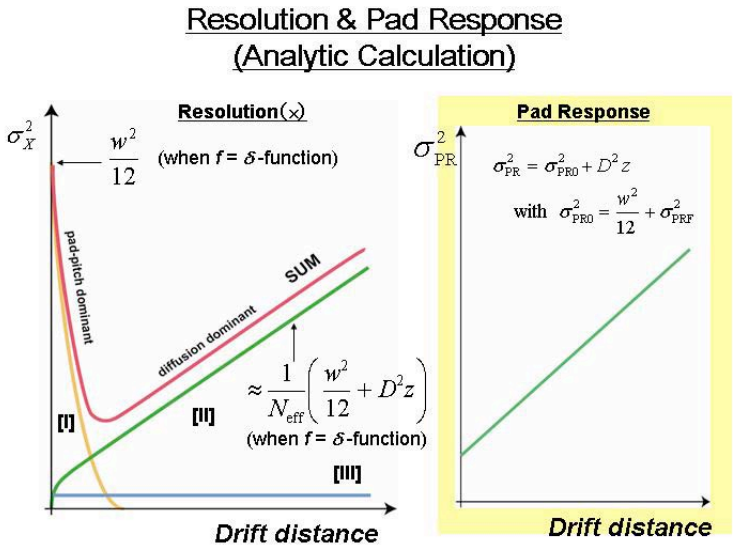

Fig. 3 In the left, the spatial resolution given by the analytic calculation is shown together with its components of different origins: (I) the effect of the finite pad width (pitch) w, (II) the combined effect from the diffusion, the gas gain fluctuation and the finite pad pitch, and (III) the contribution from random electrical noise. Here the pad response function f of MPGD is assumed to be the δ function, which is the case of MicroMEGAS. In the right, the pad response as function of the drift distance is given.

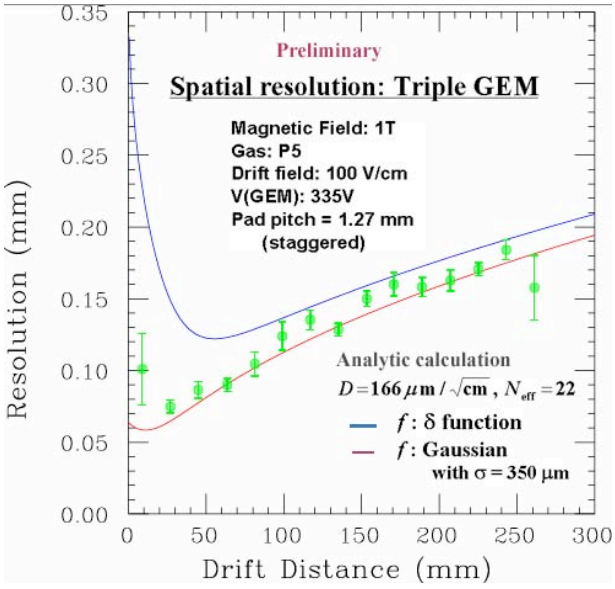

Fig 4 Spatial resolutions measured for the triple GEM at 1T in T783. The gas mixture was P5 and the pad width (pitch) 1.1 (1.3) mm. The curbs are the predictions from the analytic calculation, where N_{eff} is assumed to be 22. The width σ_{PRF} of the pad response function f for the triple GEM is assumed to be 350 μm based on a simulation.

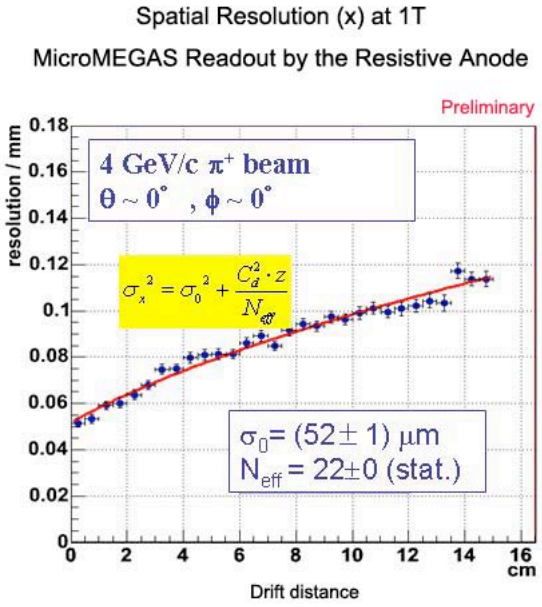

Fig. 5 Spatial resolutions measured for the MicroMEGAS readout by the resistive anode at 1T. The gas mixture was Ar-Isobutene (5%). The width of readout pads was 2 mm. The fitted curb with N_{eff} = 22 is also shown. The Carleton TPC was used for this measurement.