Central Tracker R&D in Asia

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Collaboration

- KEK, NooKooDai University, University of Tsukuba, Kinki Univ., Osaka Univ. and Mindanao Univ.

Basic Design Parameters

- **For 2T option**

$$\begin{cases} \sigma_{xy} & = & 85\mu m \longrightarrow \text{(cool gas + mini-jet cell)} \\ l & = & R_{\text{out}} - R_{\text{in}} \\ & = & 230(\text{outer cylinder}) - 45(\text{support tube}) = 185cm \\ n & = & 80 \\ B & = & 2T \\ L & = & 460cm \quad \text{(full lever arm above } 45^\circ\text{)} \end{cases}$$

$$\sigma_z = \sigma_{xy} / \tan\alpha_{\text{stereo}} \simeq 1mm$$

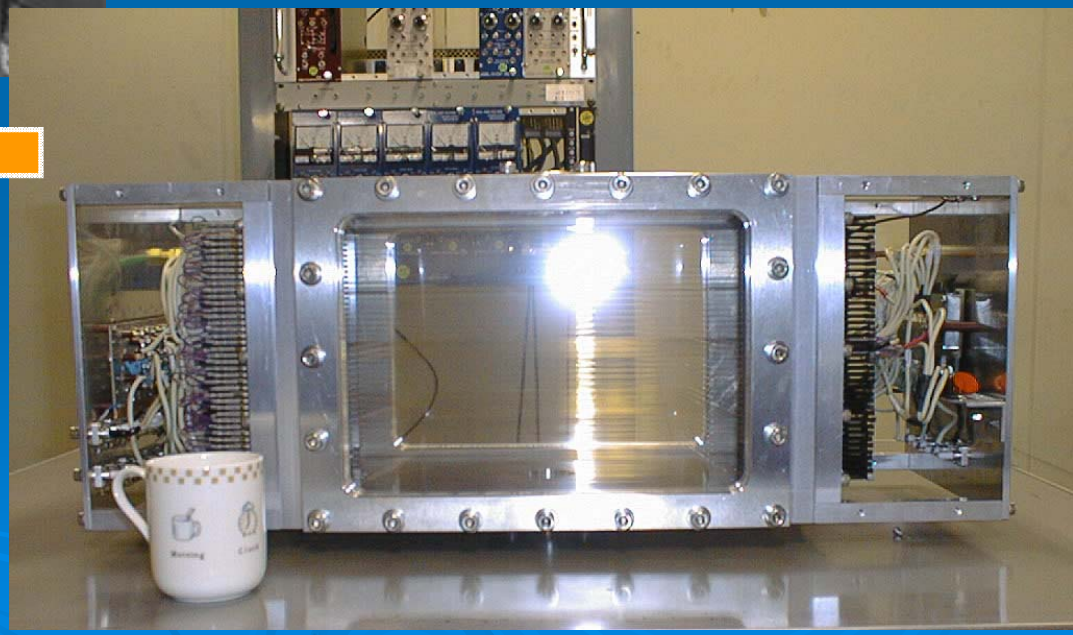
$$\tan\alpha_{\text{stereo}} \simeq 0.1 \longrightarrow \text{mini-jet cell}$$

$$\sigma_{T_0} \simeq \frac{\sigma_{xy}}{v_{\text{drift}}\sqrt{n}} \lesssim 1.4nsec$$

4.6m Test chamber (1993)

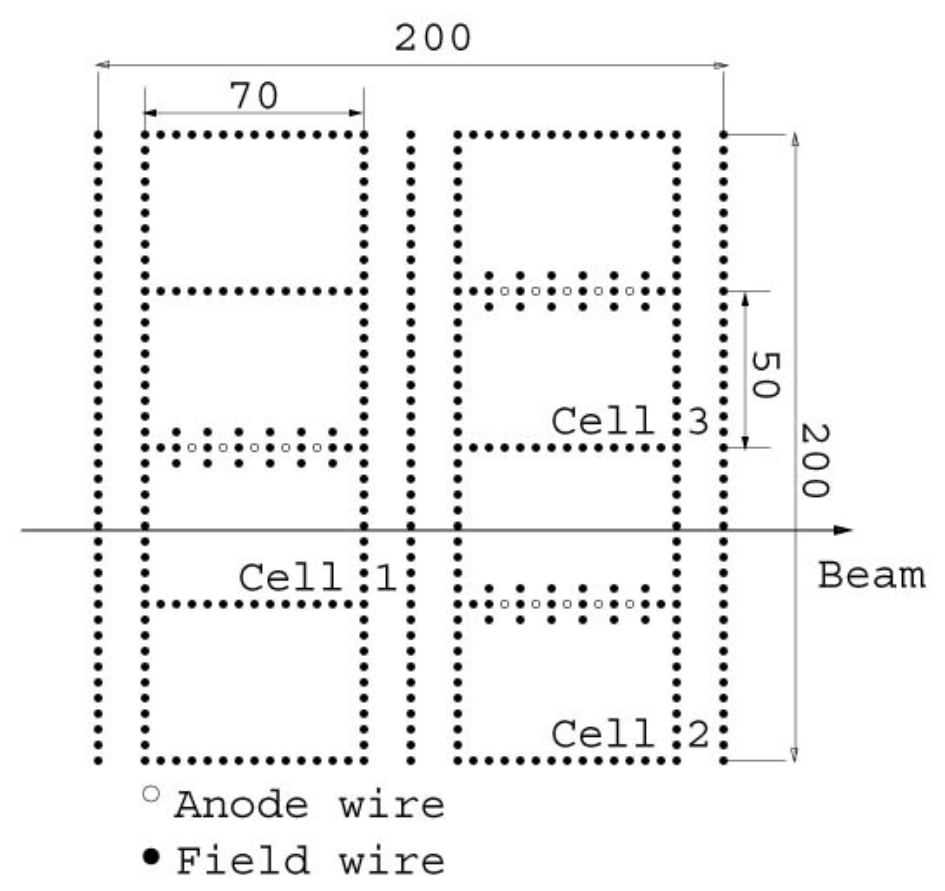
- Wire Sag measurement
- Cosmic Ray Test

Baby chamber (1996)

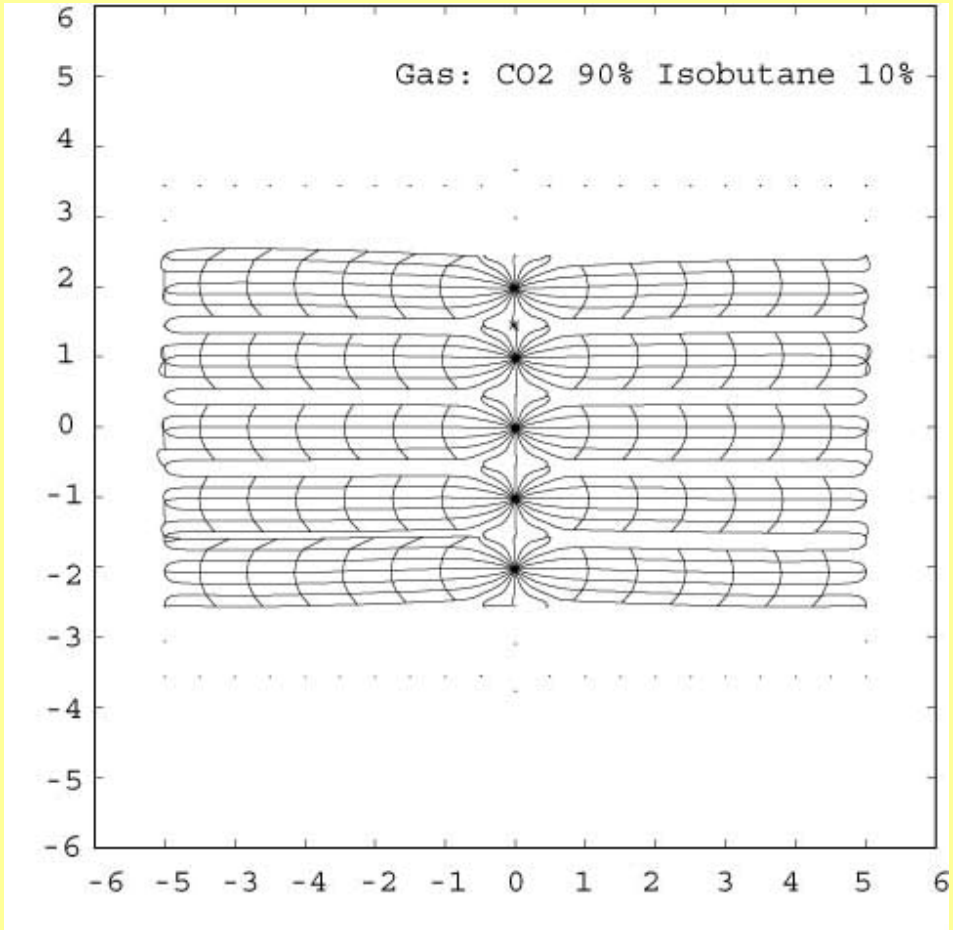


- Single track study
- Oxygen contamination study
- dE/dx measurement
- Two track separation study

The wire configuration of the Baby test chamber



Electron drift lines and isochronous lines



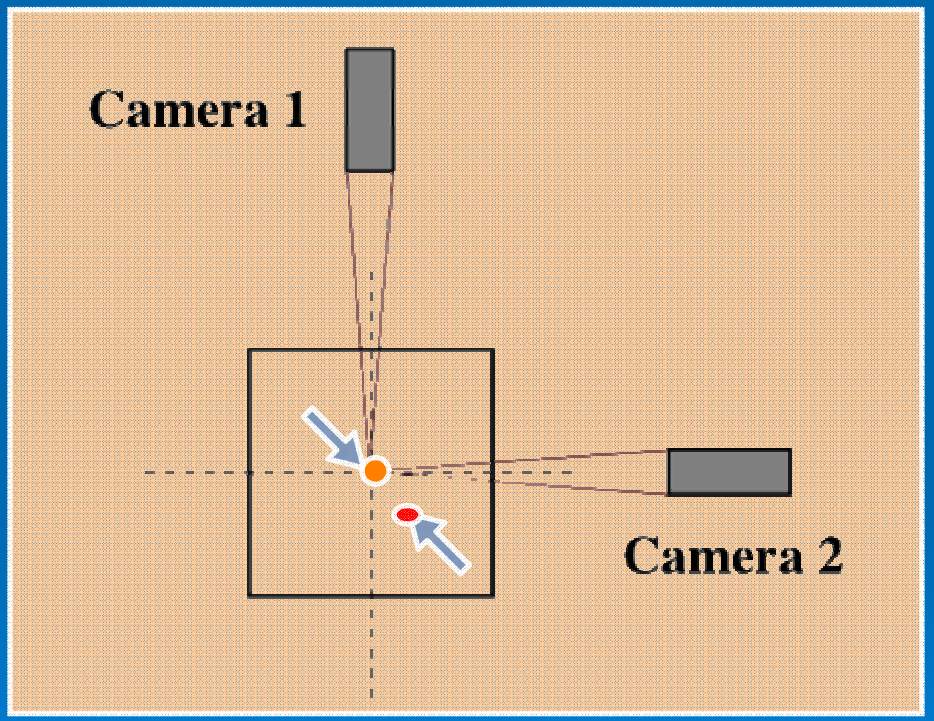
Wire sags

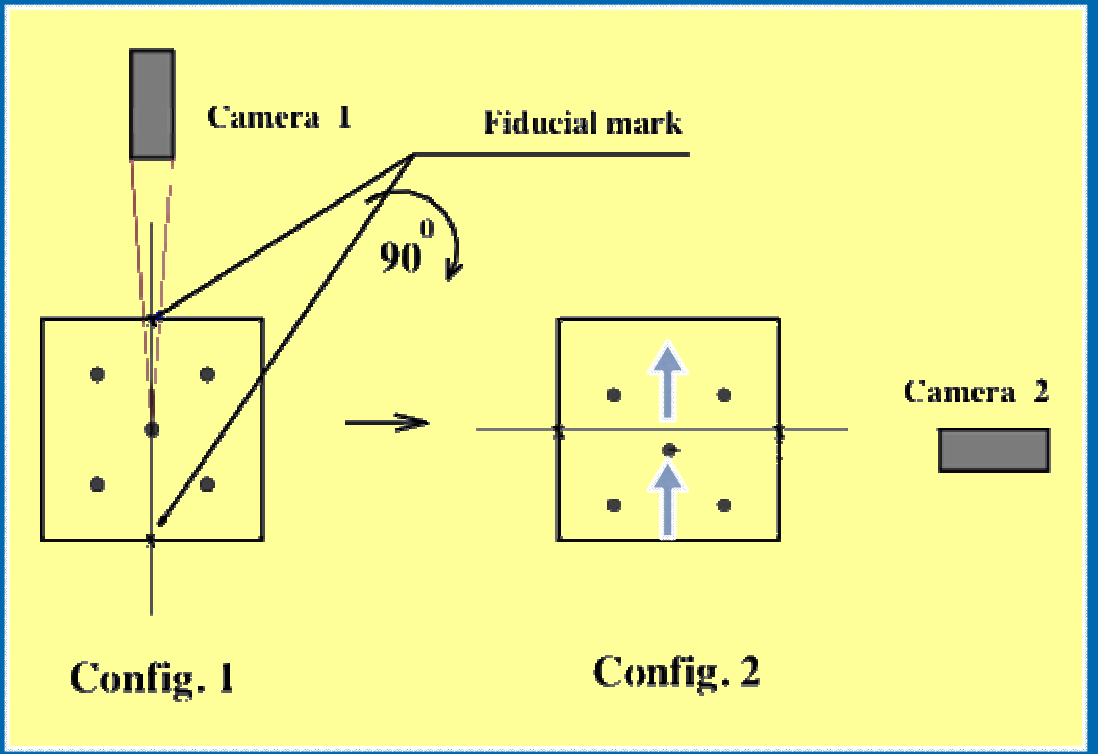
NIM A383 (96), 391.

Measurement Principle

Gravitational Sag

Rotate & measure





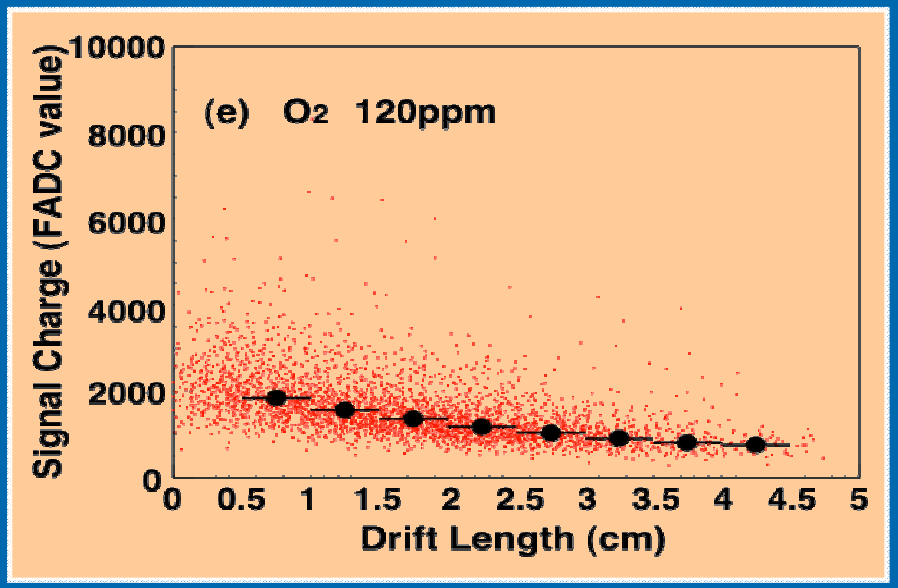
Electrostatic Sag

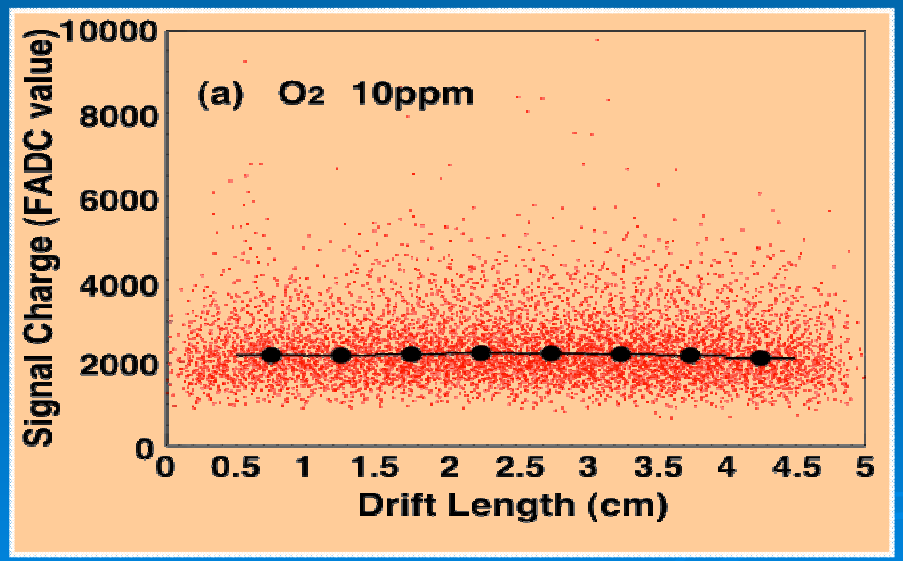
Compare

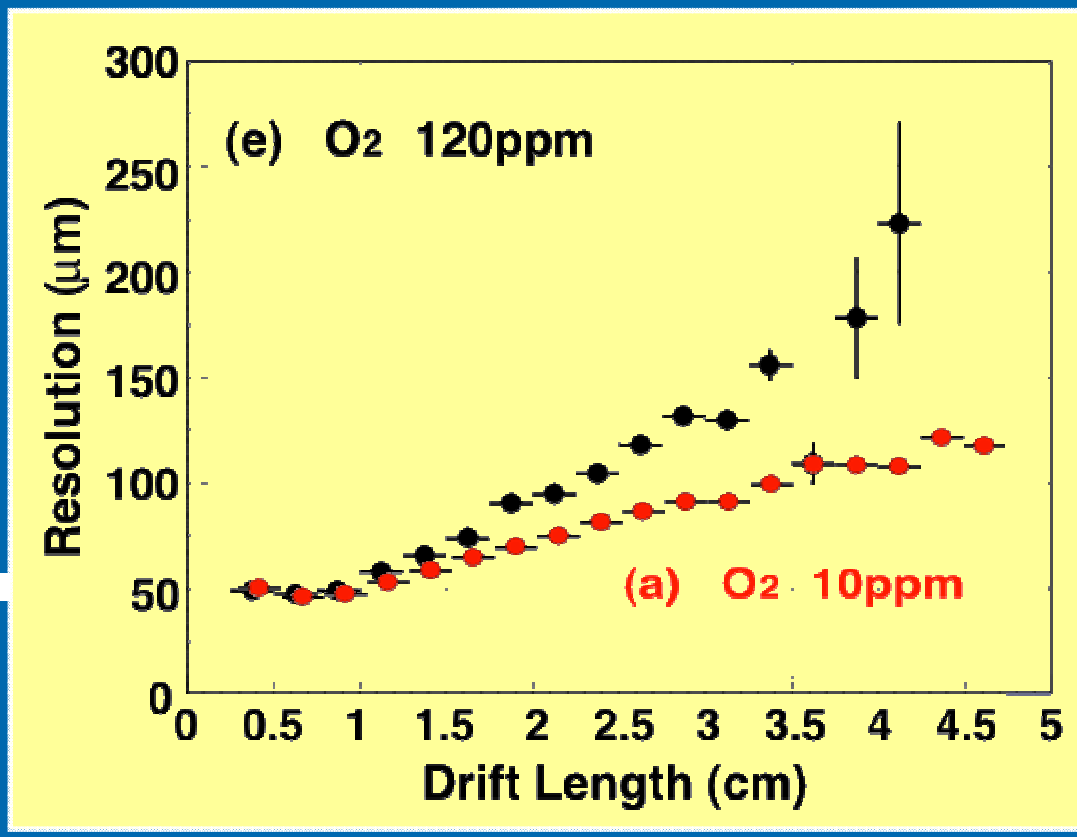
H.V. off & H.V. on

Measurements and calculation are in good agreement

Spatial Resolution

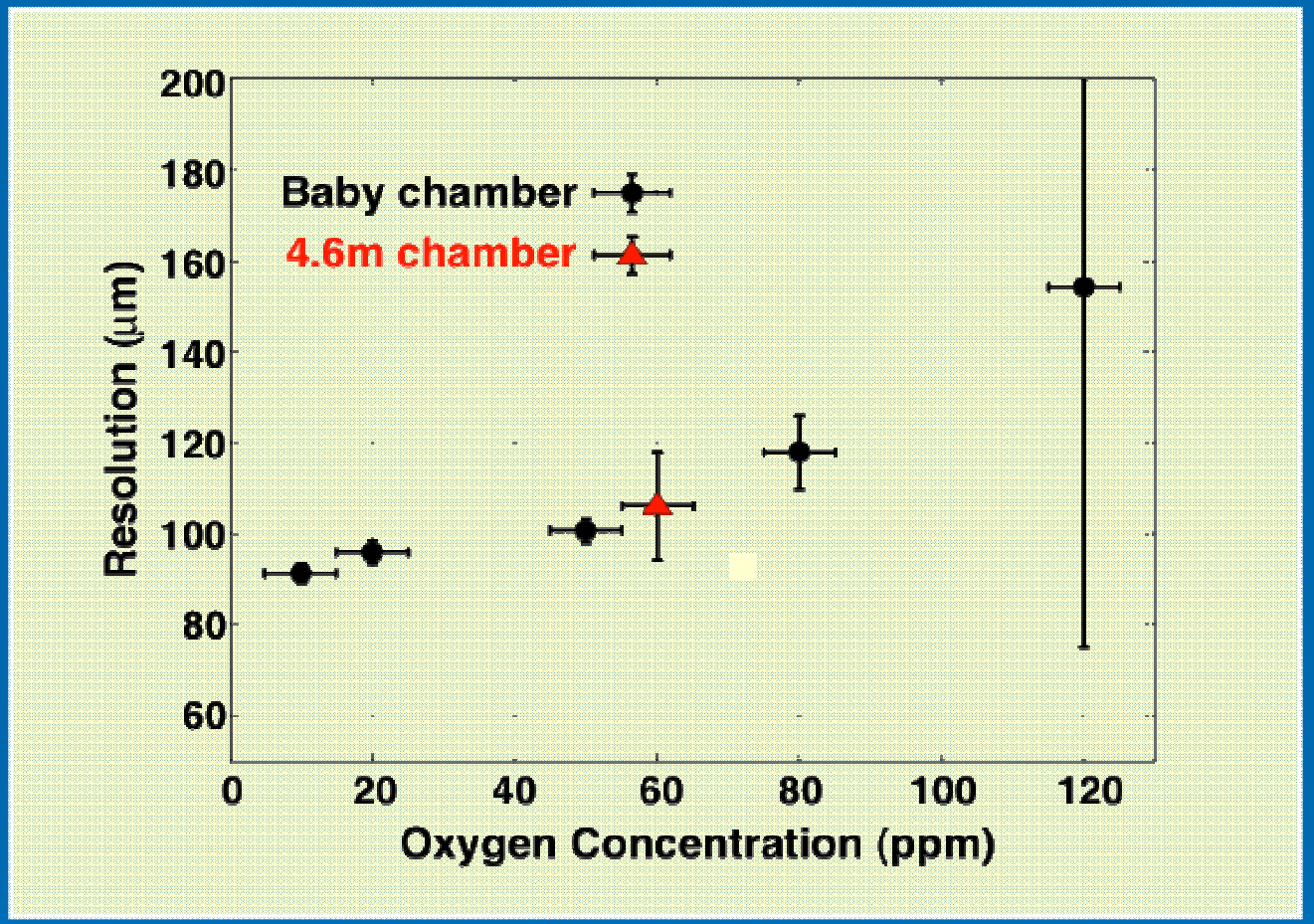






$$\langle \sigma_x \rangle \simeq 90 \mu m$$

Oxygen Concentration v.s. Resolution

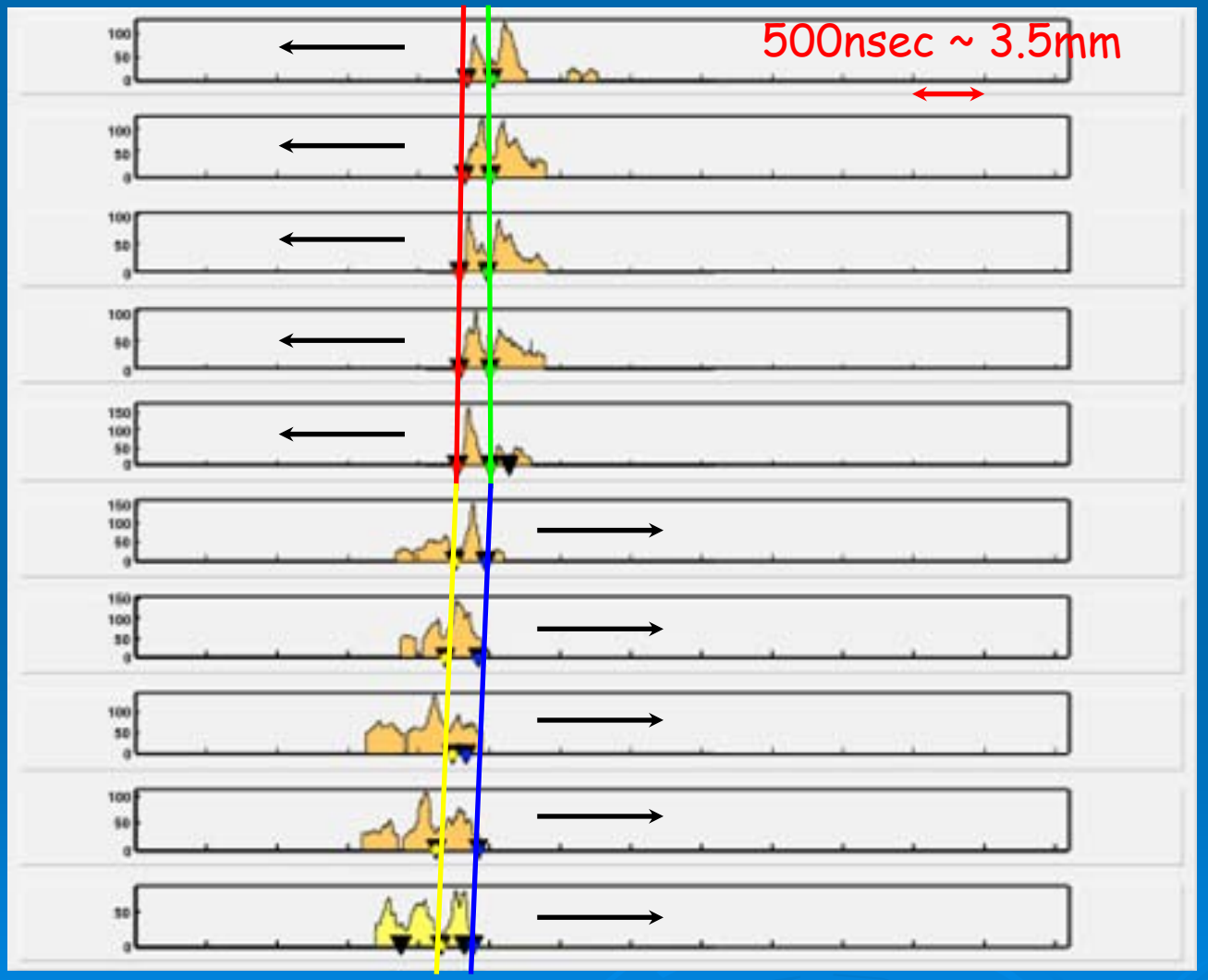


For sufficiently low Oxygen contamination the average spatial resolution of 90 microns is possible.

2-Track Separation Study

Typical 2-Track Event (Tanashi: Normal Incidence)

Up stream



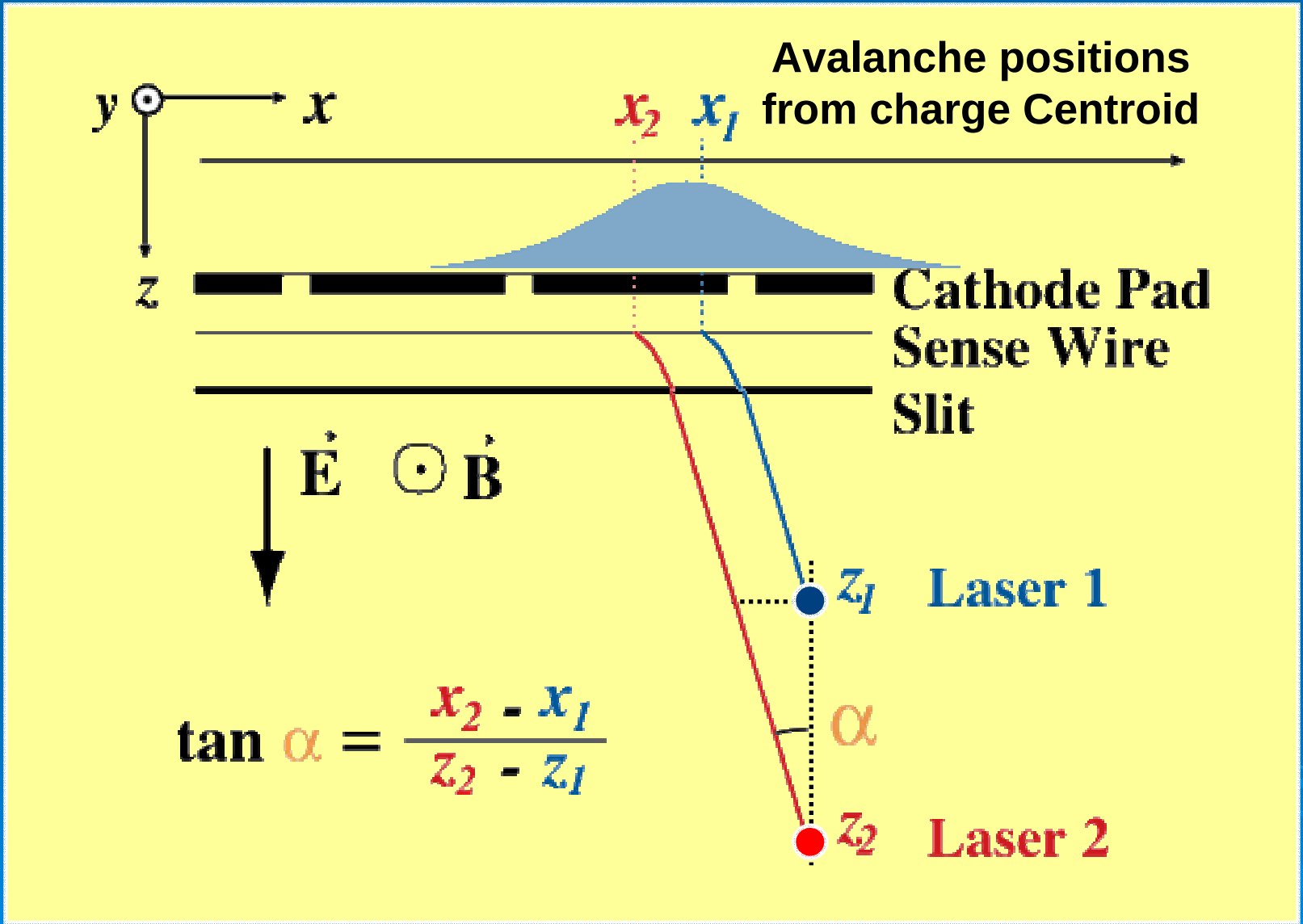
Down stream

Very successful case

It looks possible to separate 2 tracks as close as 1mm to each other!

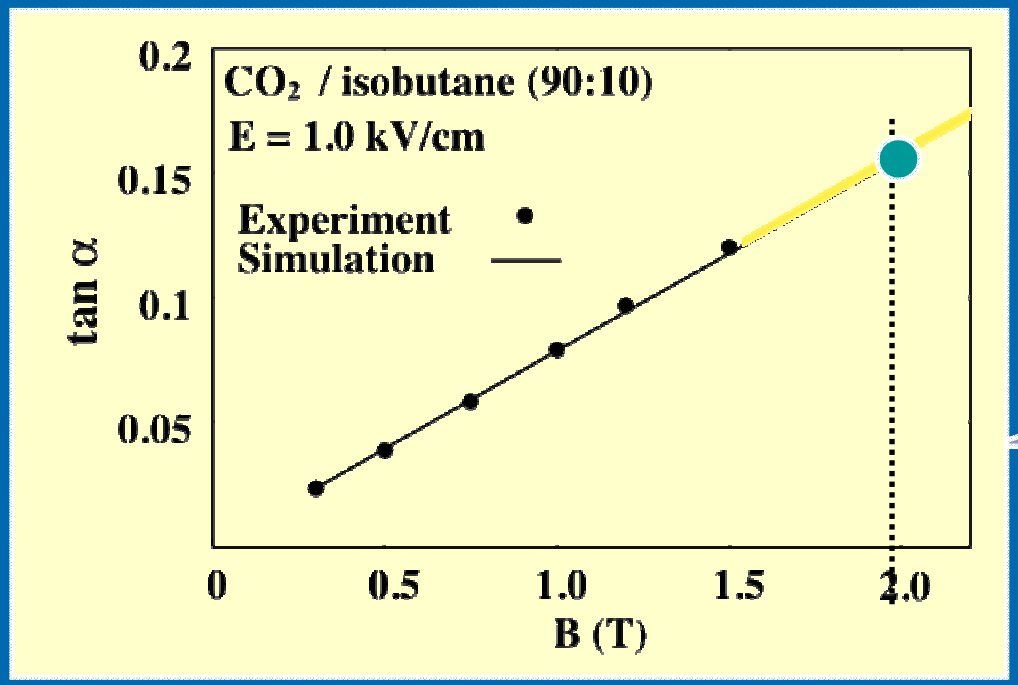
Lorentz Angle Measurement

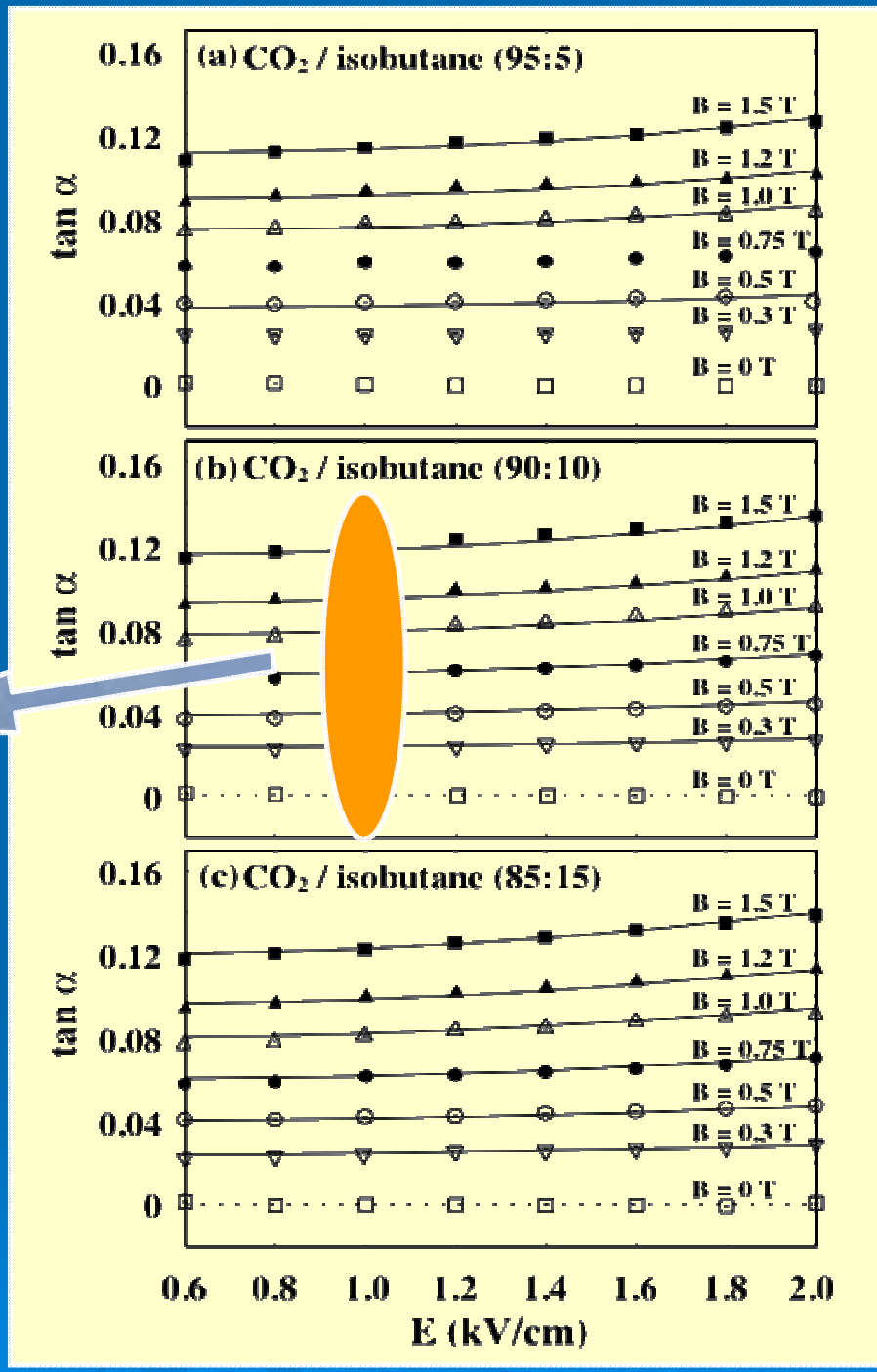
NIM A479 (02) 278



Lorentz angle measurement

Lorentz angles for various E, B, and Mixing Ratios



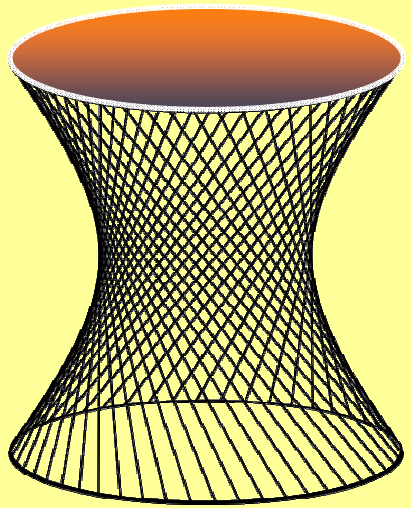


Measured Lorentz angles are well reproduced by Garfield/Magboltz calculations

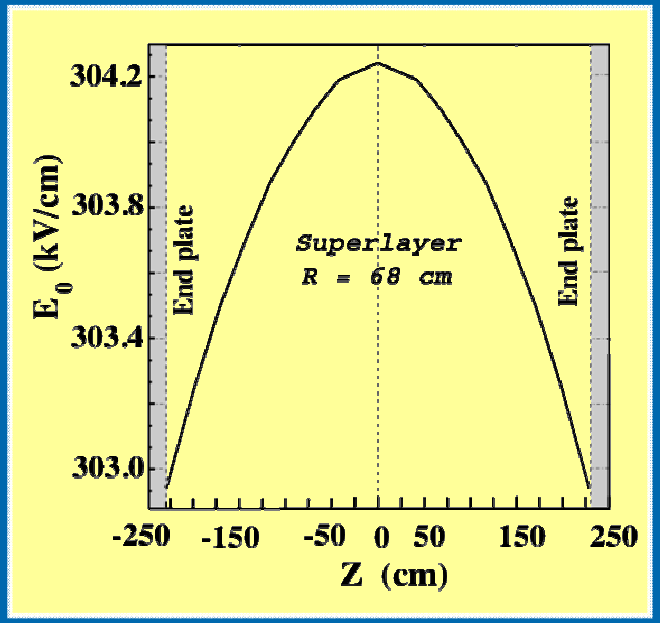
Stereo-Wire Study

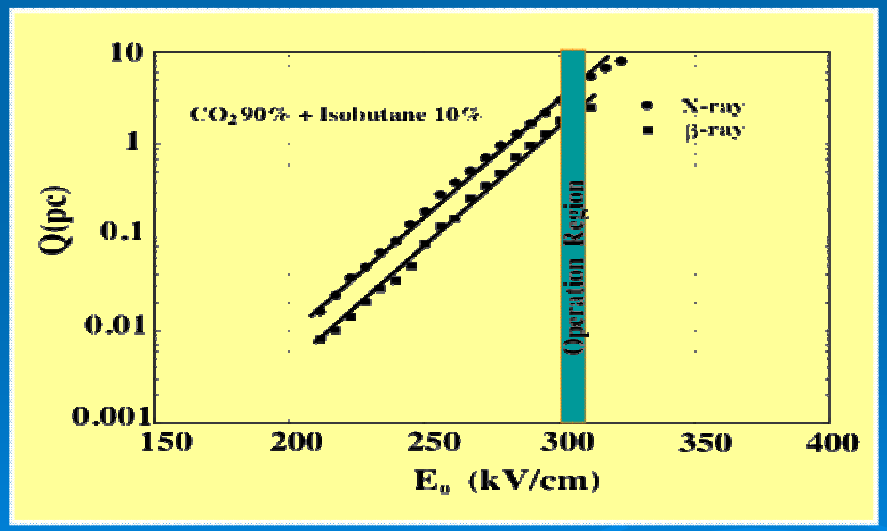
Shrink Factor

NIM A428 (99) 403



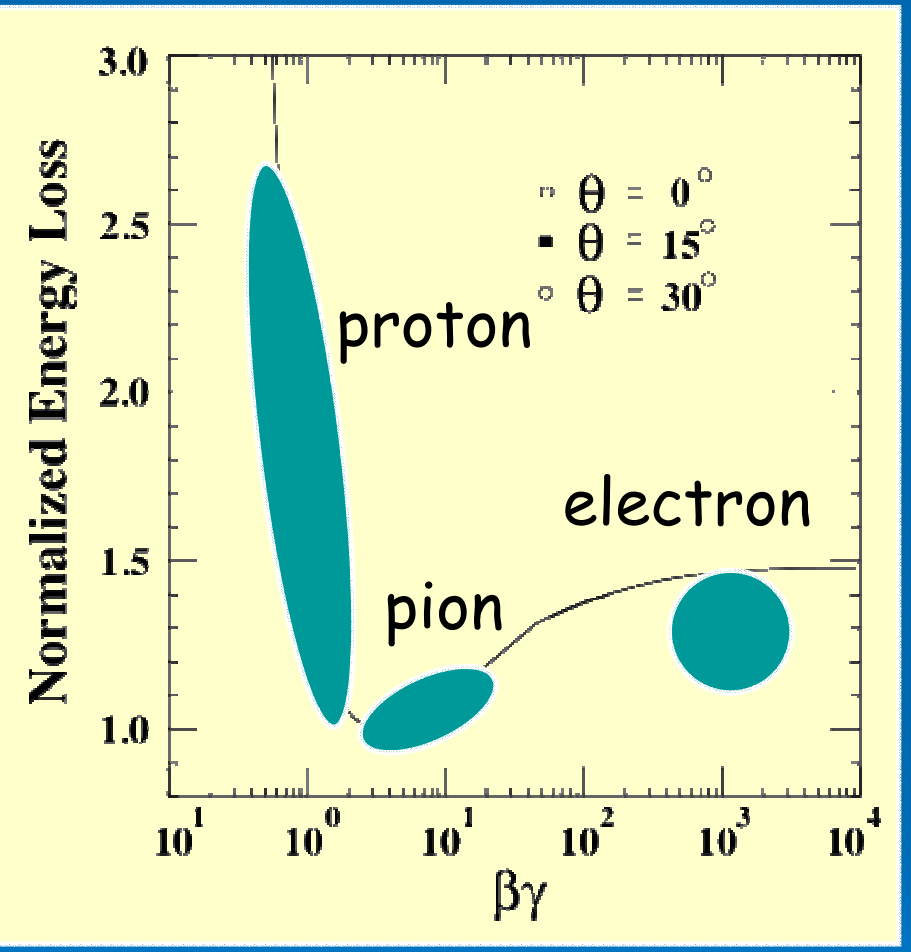
How does this affect gas gain and operational stability?



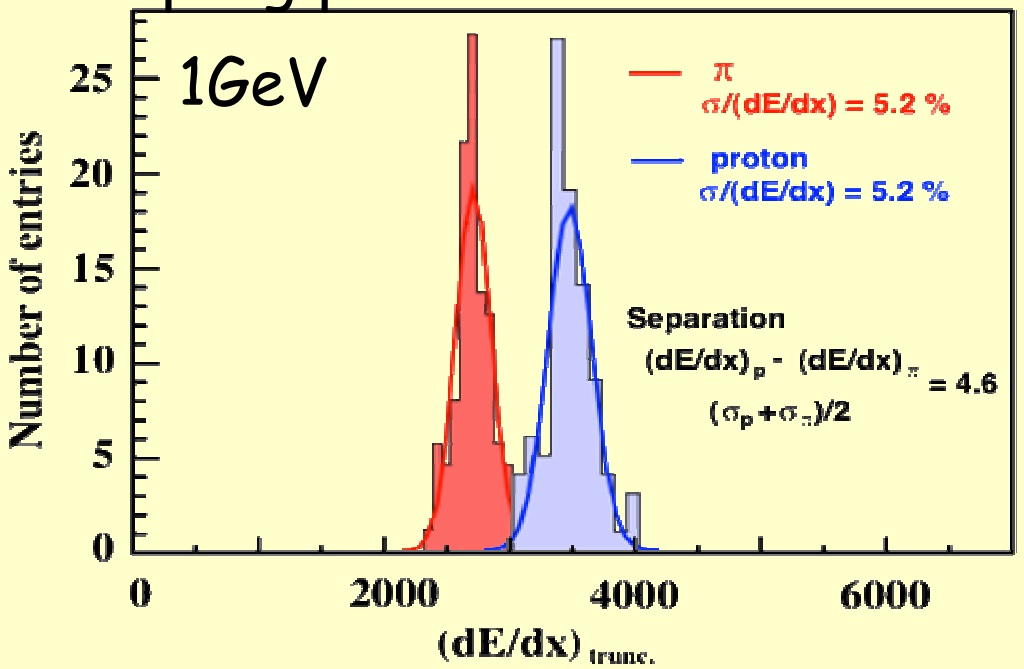


Gain variation < 25% (4.6m)

dE/dx measurements

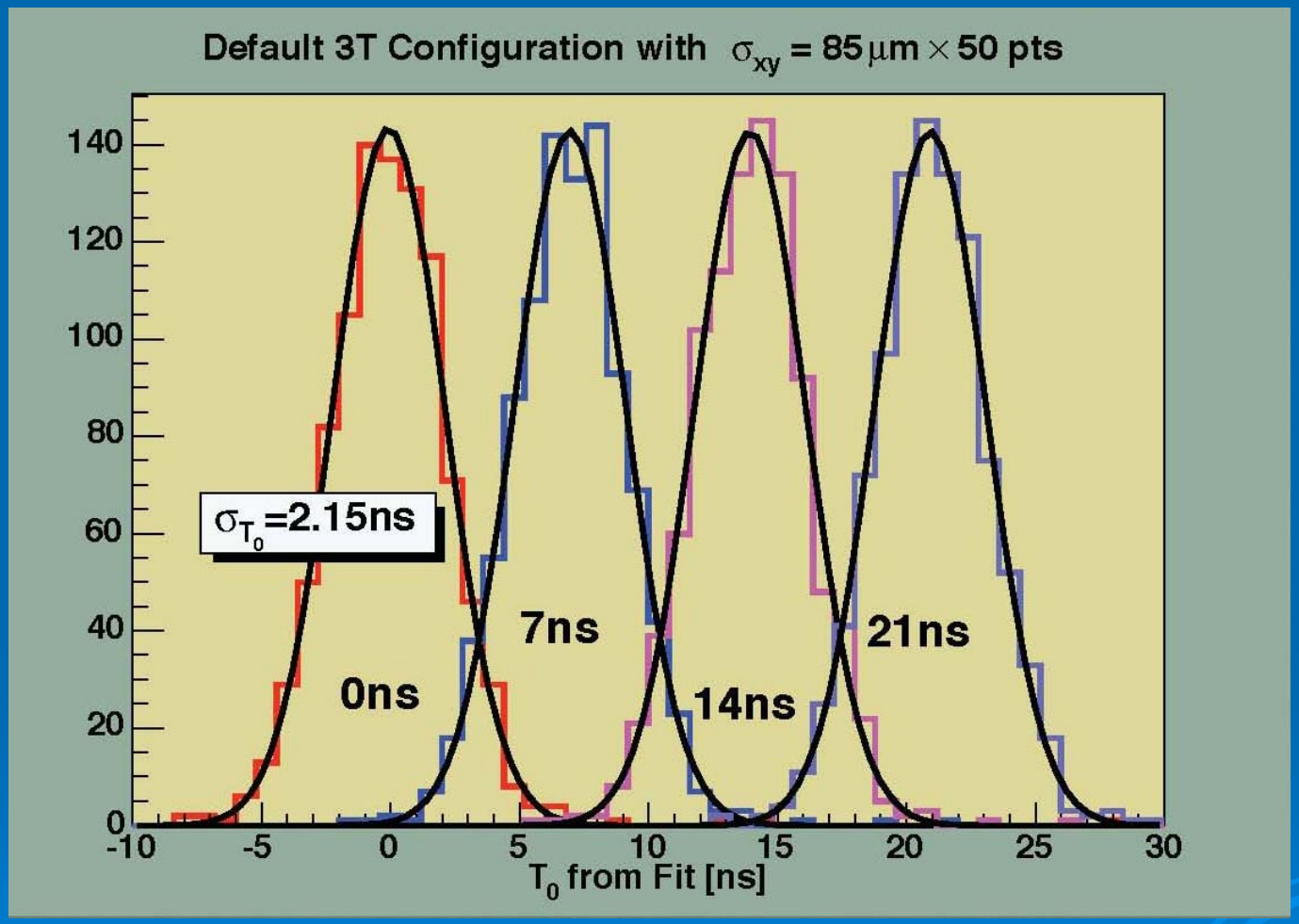


80 sampling points



Time Stamping for JLC CDC

- **T0 from Helix Fit (axial+stereo)**



We can determine T0 with ~2.2ns accuracy!

What We Have Achieved

- Gravitational and Electrostatic Sags (4.6m Test Chamber): NIM A383 (96) 391
- Cosmic Ray Tests (4.6m Test Chamber): NIM A441 (00) 393
- Designing of Stereo-Wire Geometry: NIM A428 (99) 403
- Gas Gain Measurement: NIM A447 (00) 459
- Lorentz Angle Measurement: NIM A479 (02) 278
- Effects of Oxygen Contamination: NIM A516 (04) 377
- dE/dx Measurement: Draft
- 2-Track Separation (Baby Chamber + Beam): Draft
- Time stamping for CDC: Draft

Conclusions

- ***The proof-of-principle phase of the Cylindrical Drift Chamber (CDC) R&D had essentially been completed.***

- ***CDC can be used for "Warm" machine as a main tracker.***