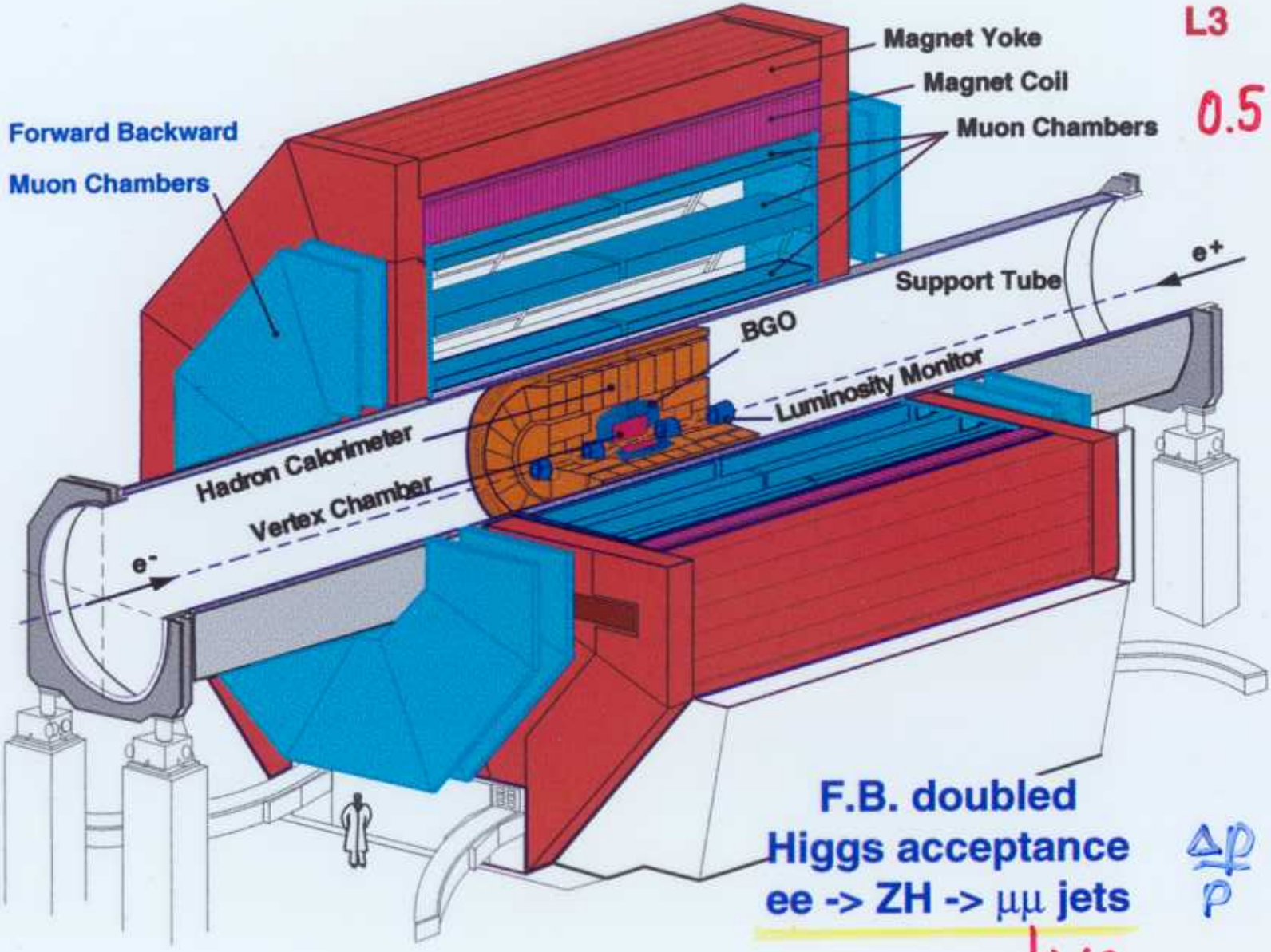
PAST



L3

0.5 T

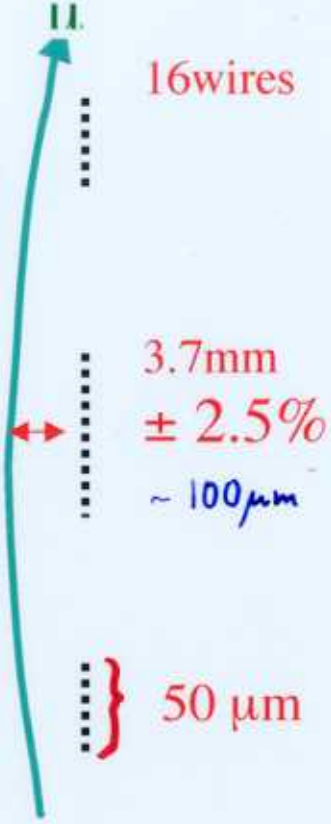
F.B. doubled Higgs acceptance

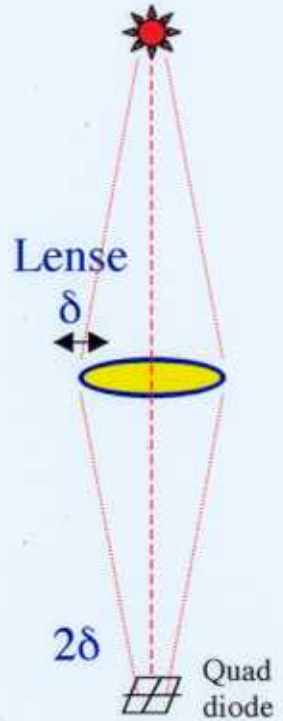
ee -> ZH -> μμ jets

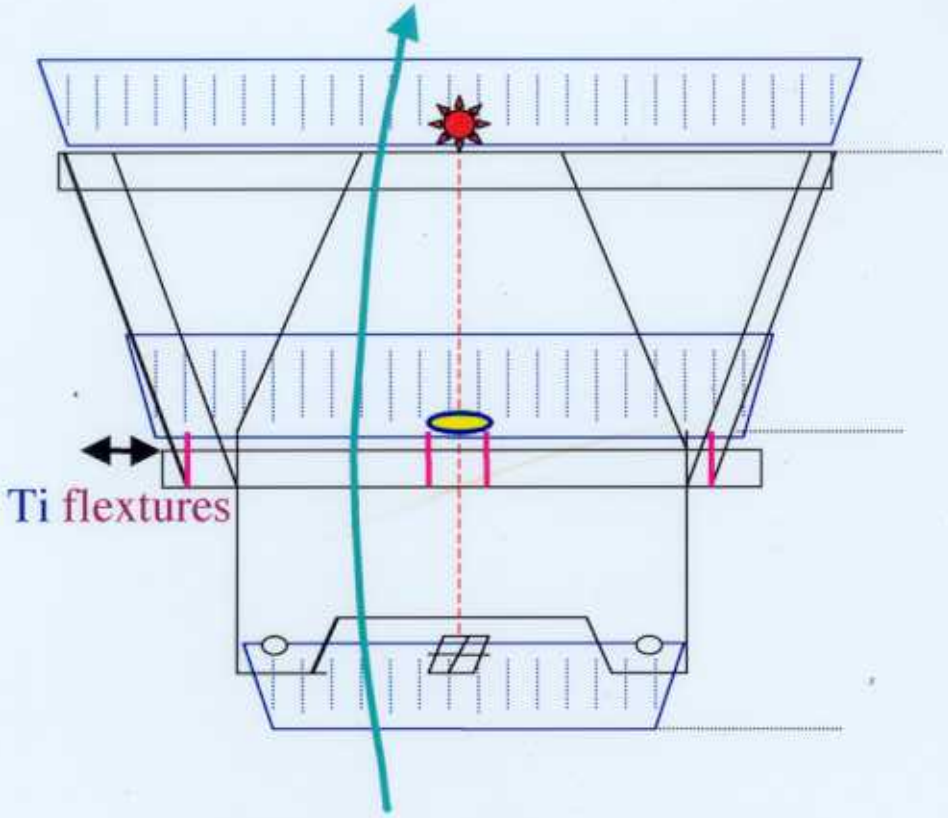
$\frac{\Delta p}{p} \propto B l^2$

↳ $\frac{\Delta p}{p} \approx 2.5\%$ @ 50 GeV

Accuracy- Muon Detector L3







200μm/√N

2 μm rel

10 μm abs

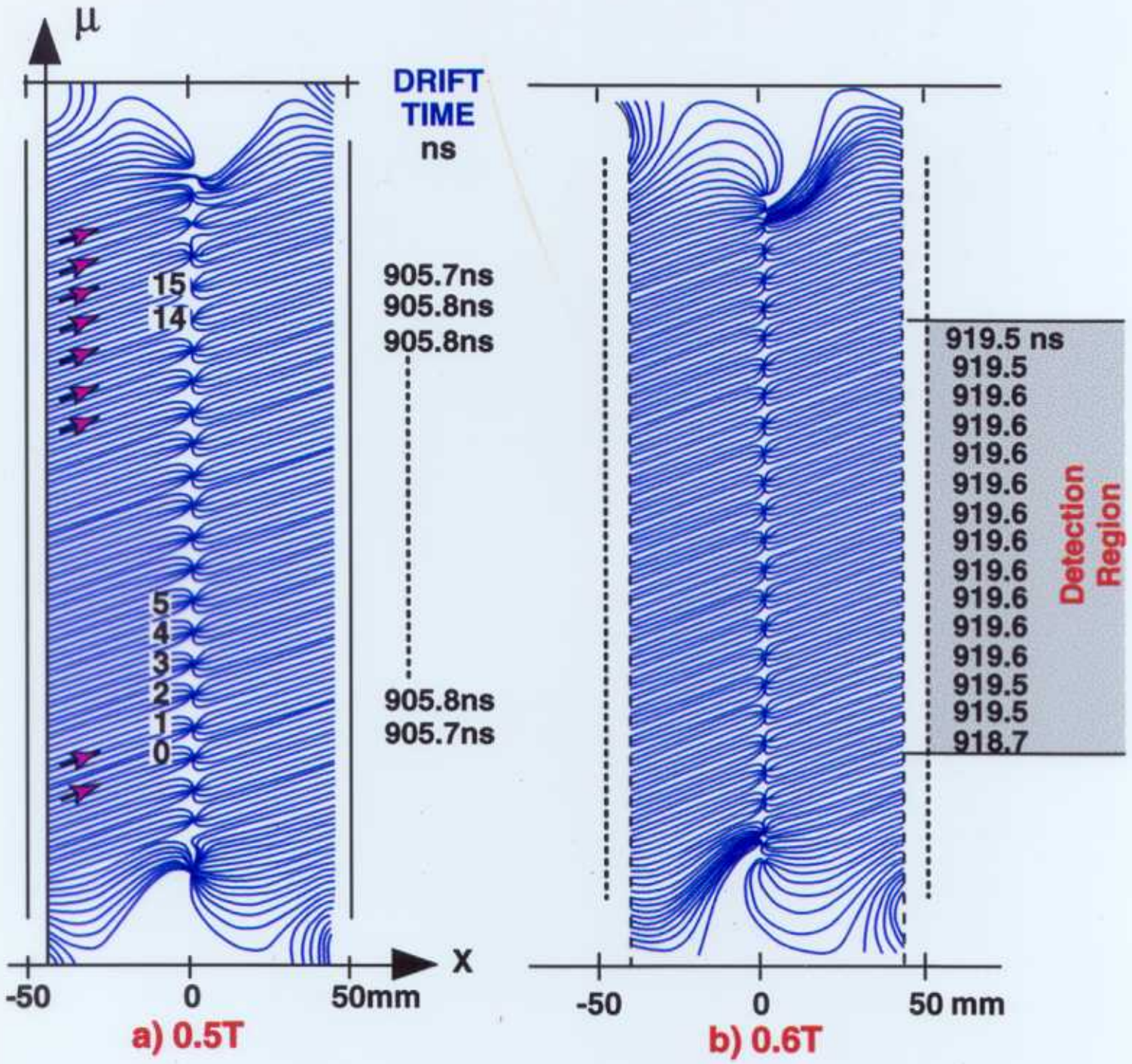
Align to <30μm

Parallelism < 10^{-7}

NIKHEF (100w)
MIT(B=0.51 T)

Draper-MIT
NIKHEF/RASNIK

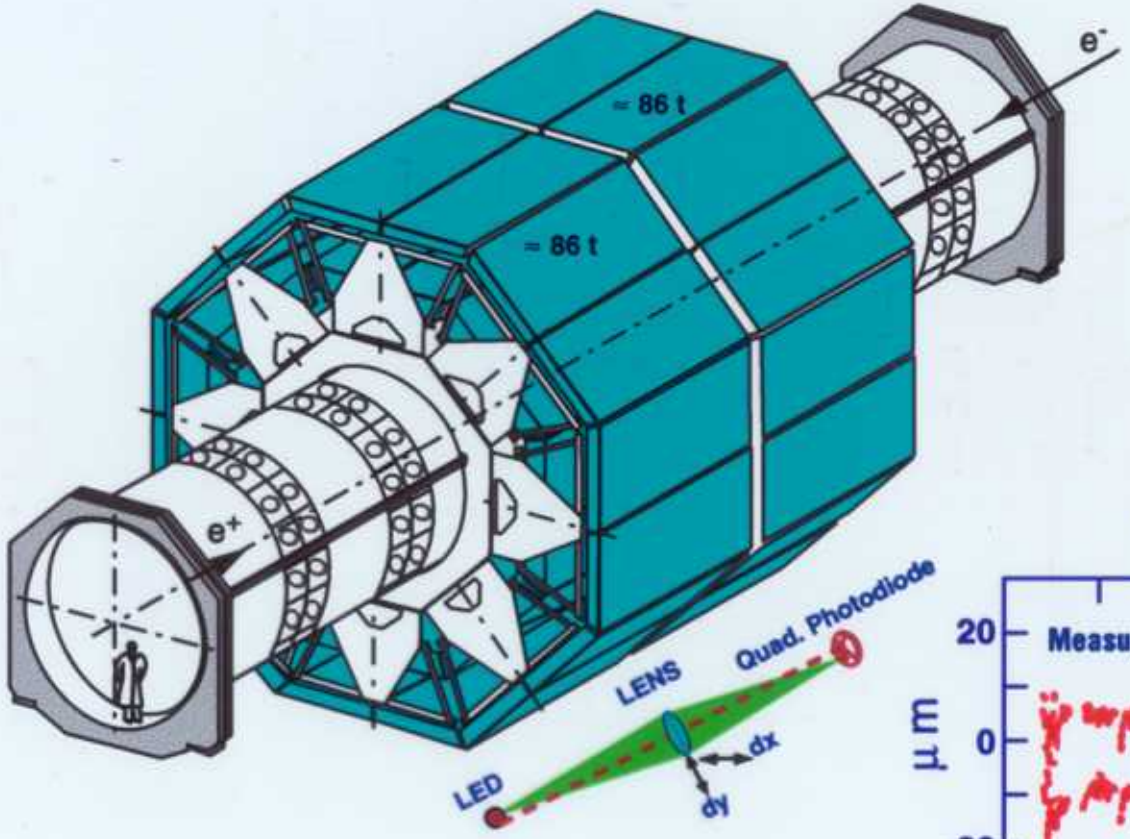
No Tensor-forces,
DRAPER design



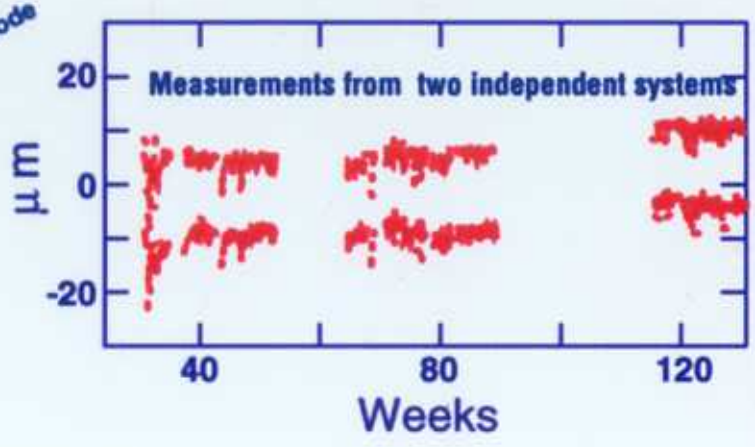
y1117a/1118aBeckercol

L3 Muon Detector - MIT

The 1000 m^3 precision muon detector (250 000 wires, 24000 TDC) which has an accuracy of 17 μm was first developed at MIT and in Holland. The construction was done in the US, Spain, Switzerland, Italy and Holland.

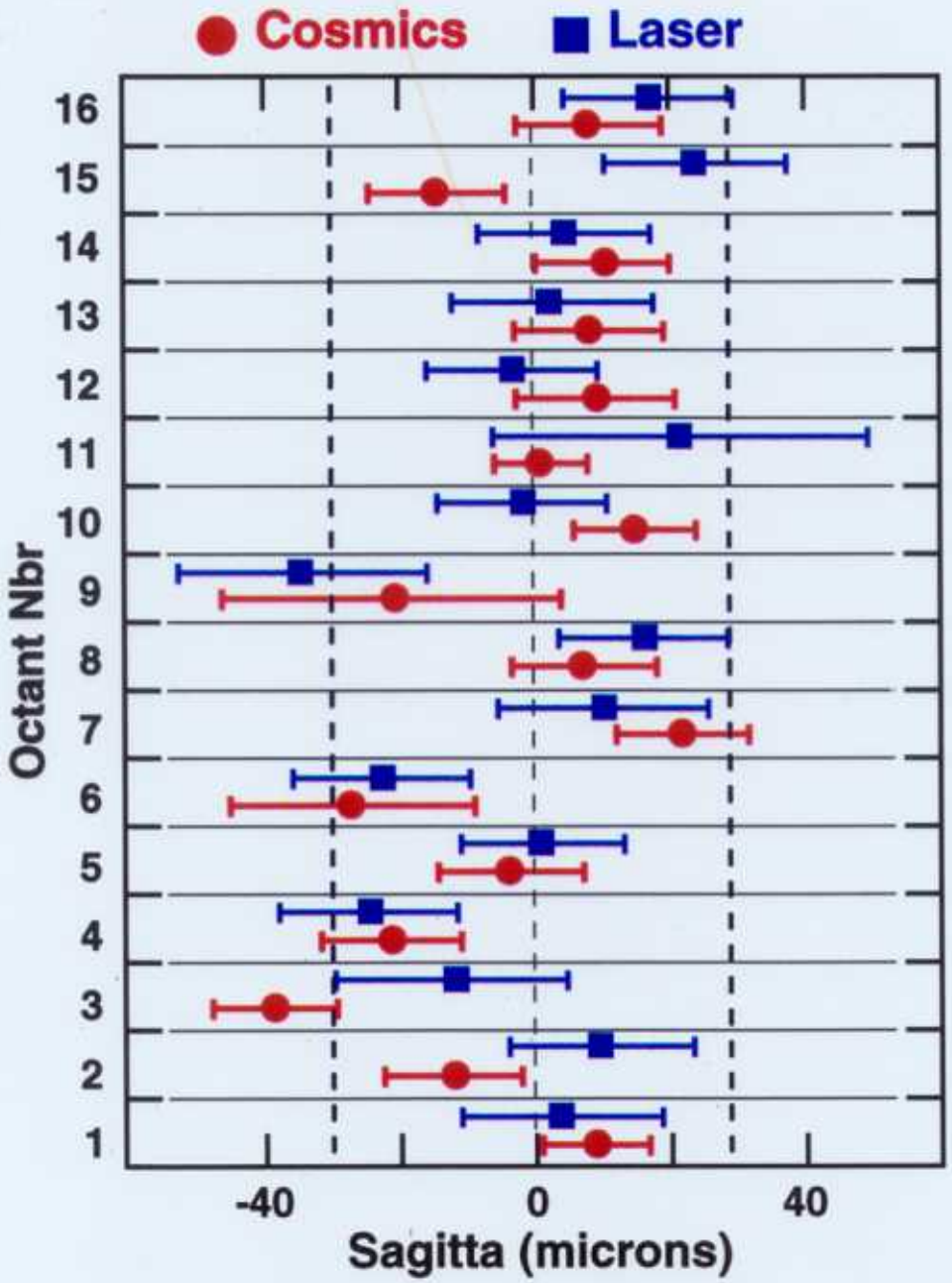


Alignment system



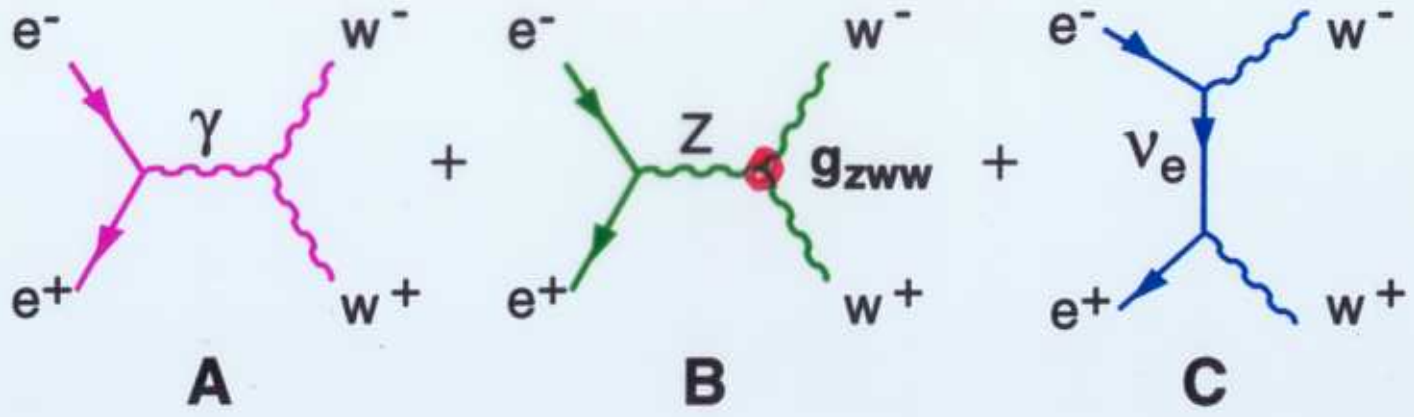
y94168ea DOE01

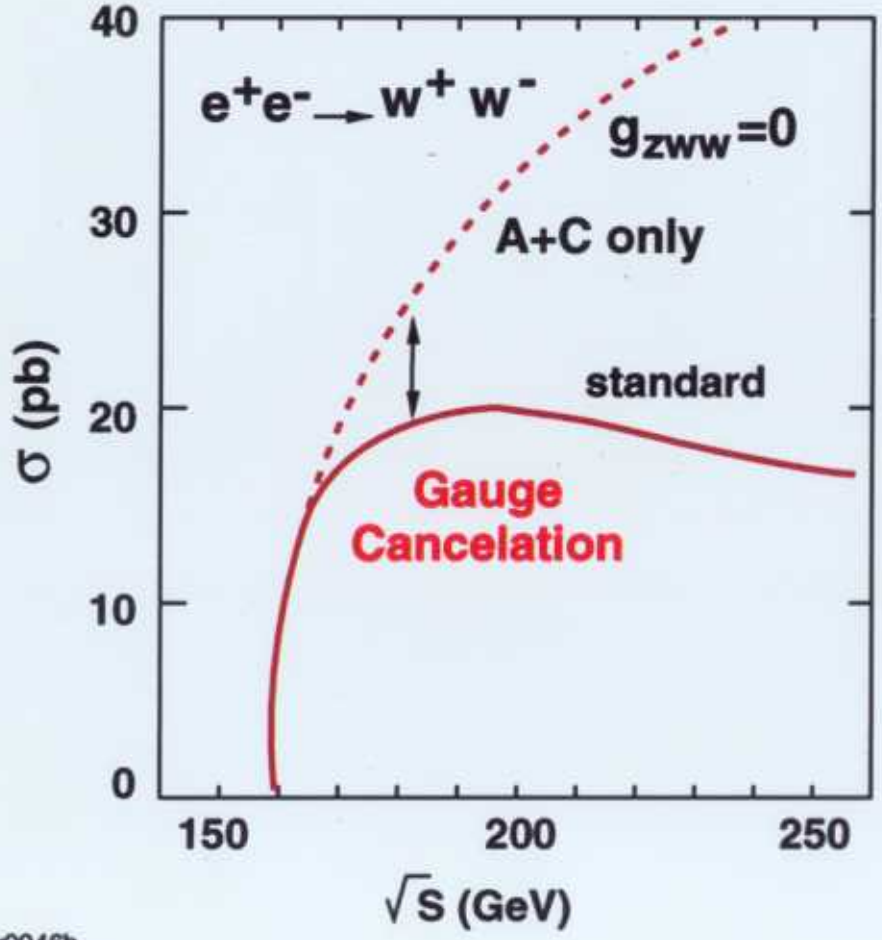
Alignment error < 30 μm

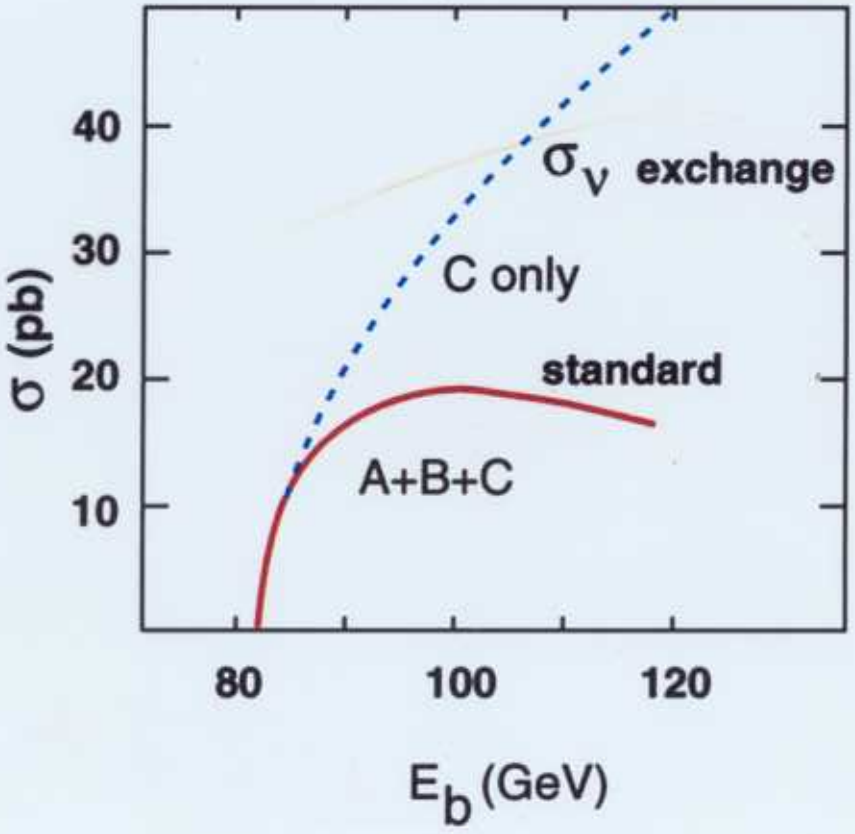


Alignment results for all 16 L3 octants

$\sigma = 17\ \mu$


e-
w-
γ
e+
w+
A
+
e-
w-
Z
gzww
e+
w+
B
+
e-
w-
νe
e+
w+
C


e+e- → w+ w-
gzww=0
A+C only
standard
Gauge
Cancelation
σ (pb)
40
30
20
10
0
150
200
250
√S (GeV)

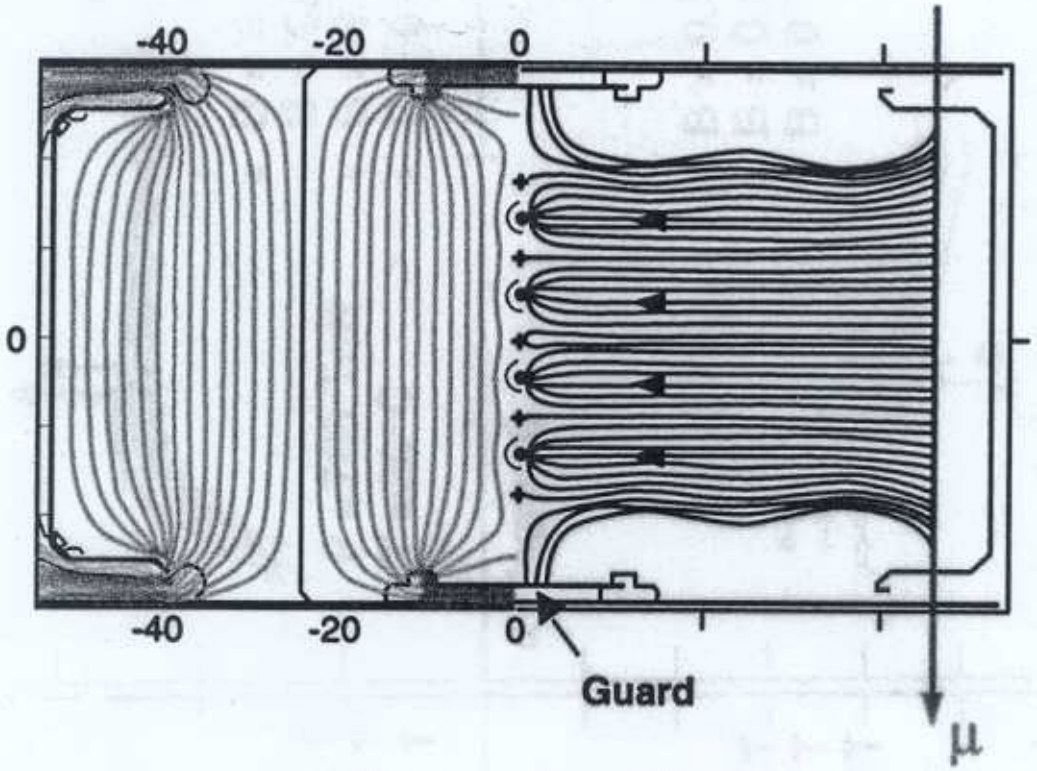

σν exchange
C only
standard
A+B+C
σ (pb)
40
30
20
10
80
100
120
Eb (GeV)

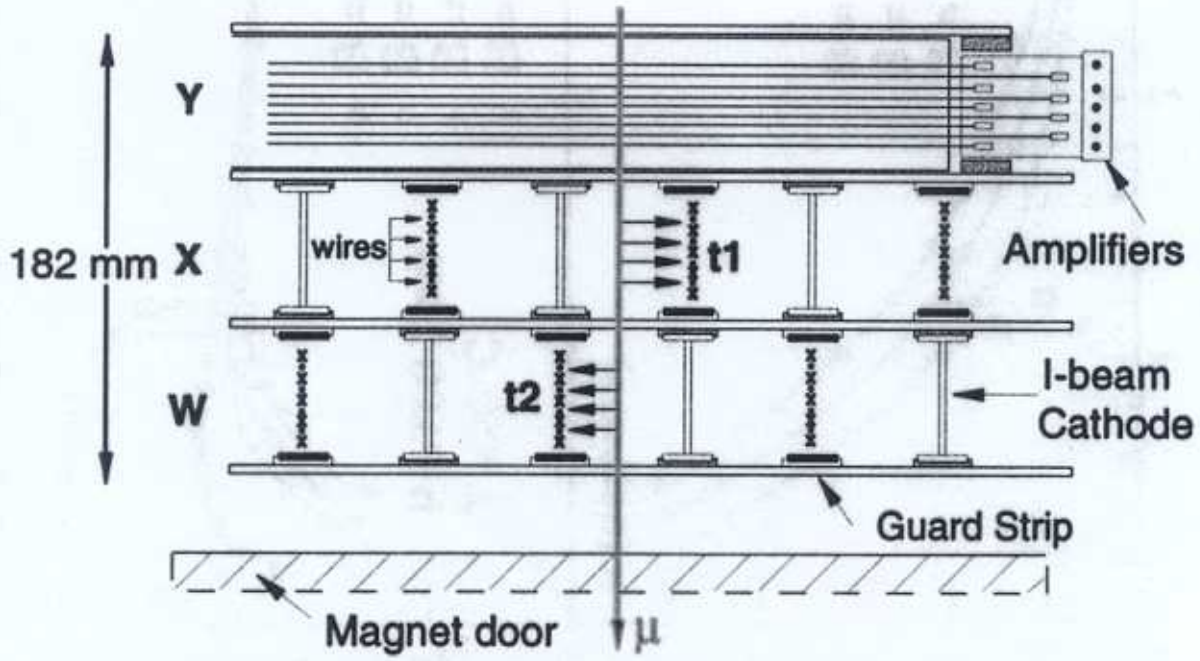
y0046b

2 DOF

L3 F/B Chambers

Equipot. Drift field



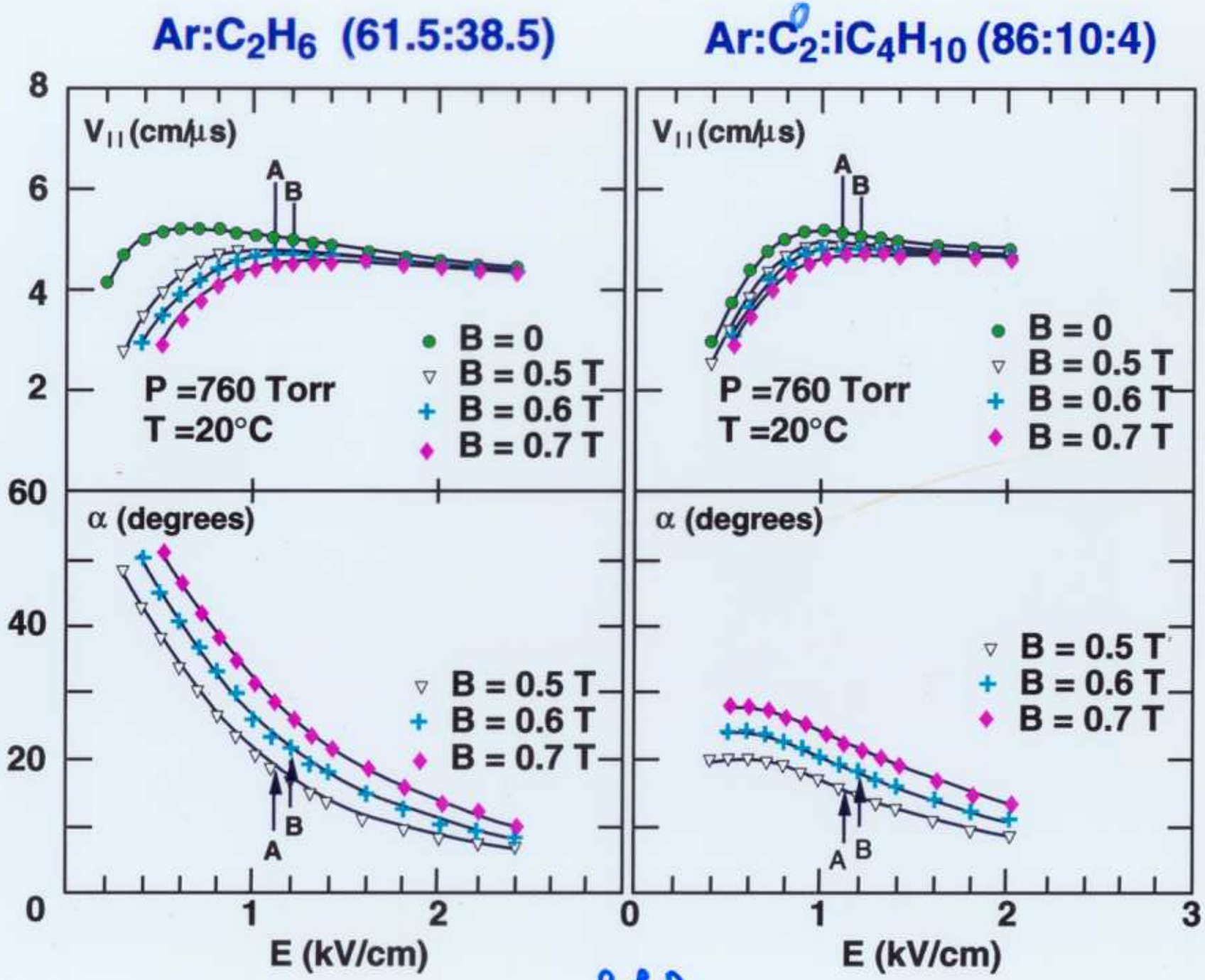


Calibration : t1 + t2 = constant

$-2\Delta t_{bunch}$

y96002
y96026aBecker

I)



Used 1988-94

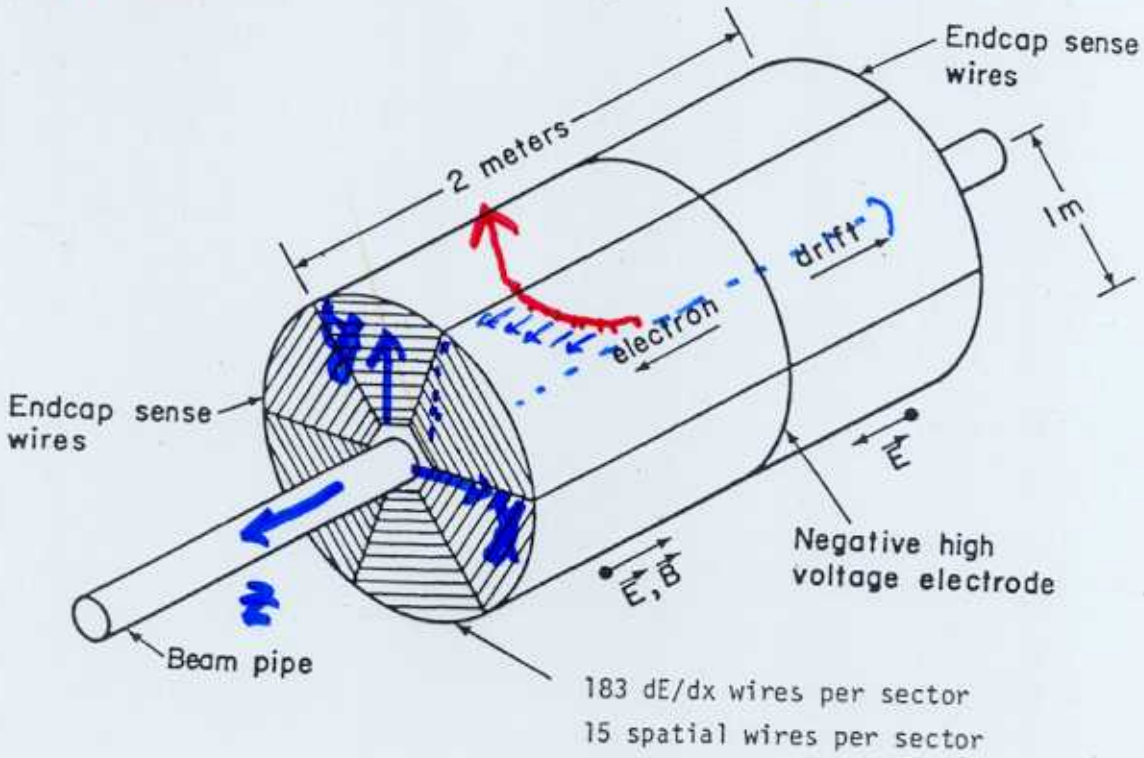
R & D

New

y1119aBeckercol

Time Proj. Chamber

Nygren, LOL

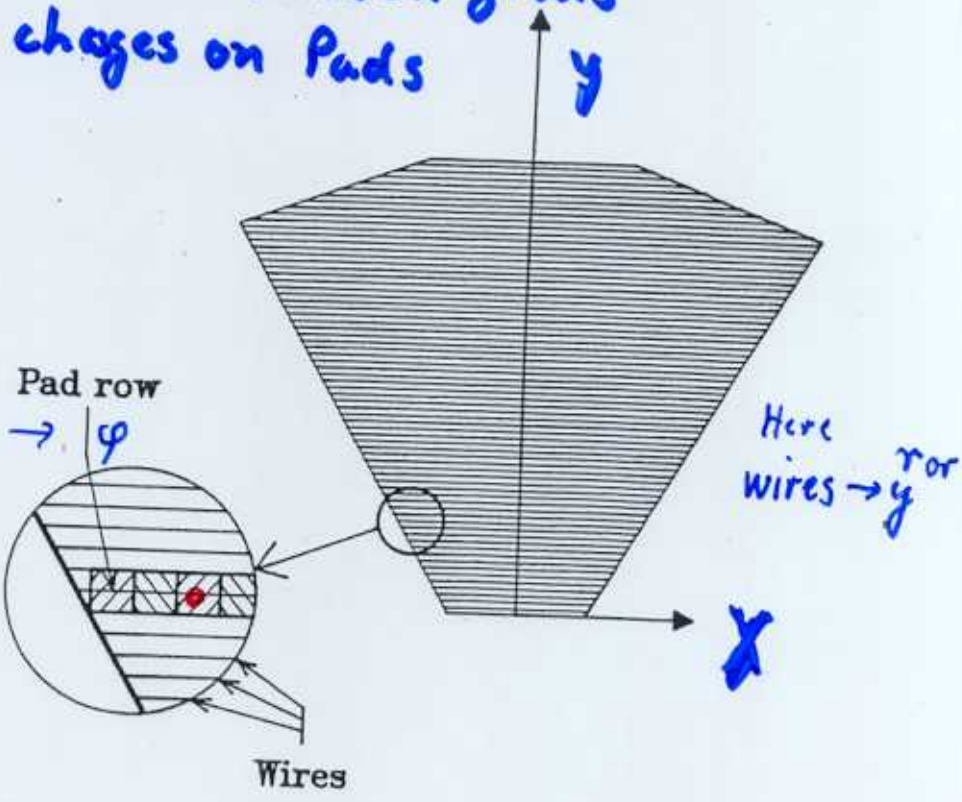


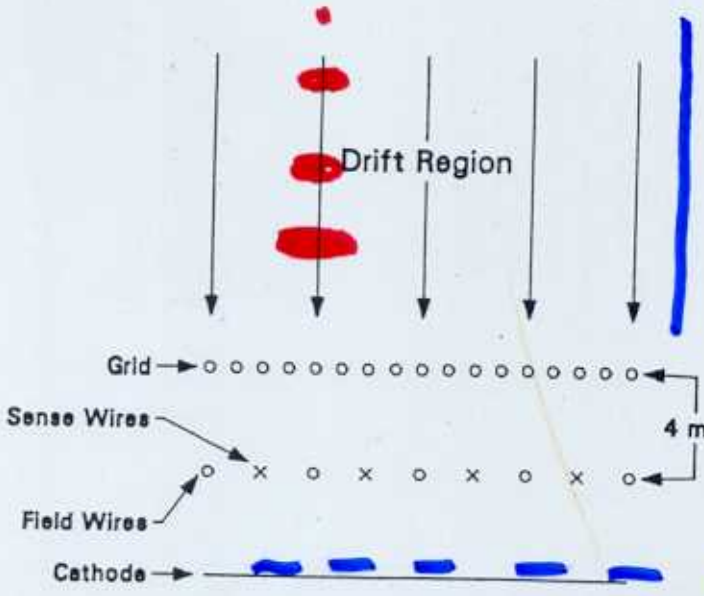
(M.D. Shapiro, thesis, 1984)

z - long drift, diffusion small $\vec{B} \parallel \vec{v}$

x - } wires behind Frisch grids
y - } induce chages on Pads

3D





$z = v \cdot t \sim 1\,m!$

pads

NO!

$\perp$ Diffusion:

$$n(r) = \frac{1}{(4\pi Dt)^{3/2}} e^{-\frac{r^2}{4Dt}}$$

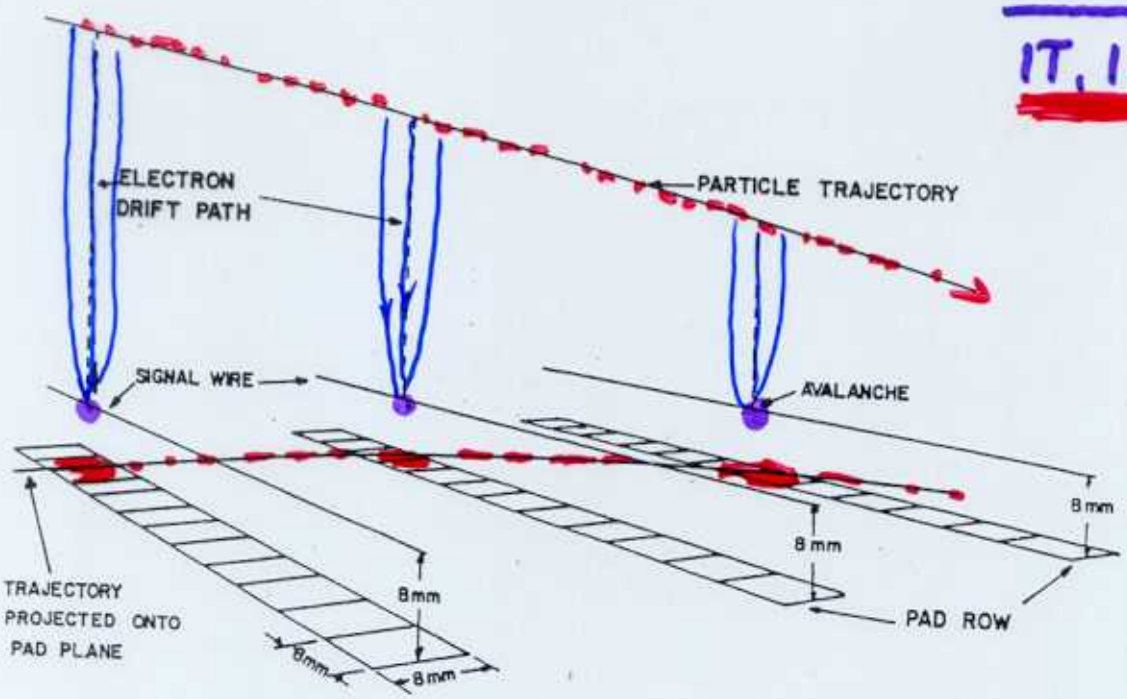
$\sigma \approx 200\,\mu m \sqrt{l\,[cm]} \approx 2\,mm!$

Nygren: $\propto \frac{D}{1+\omega^2\tau^2}$

$\omega = \frac{eB}{m}$ cyclotron

τ = mean time collisions

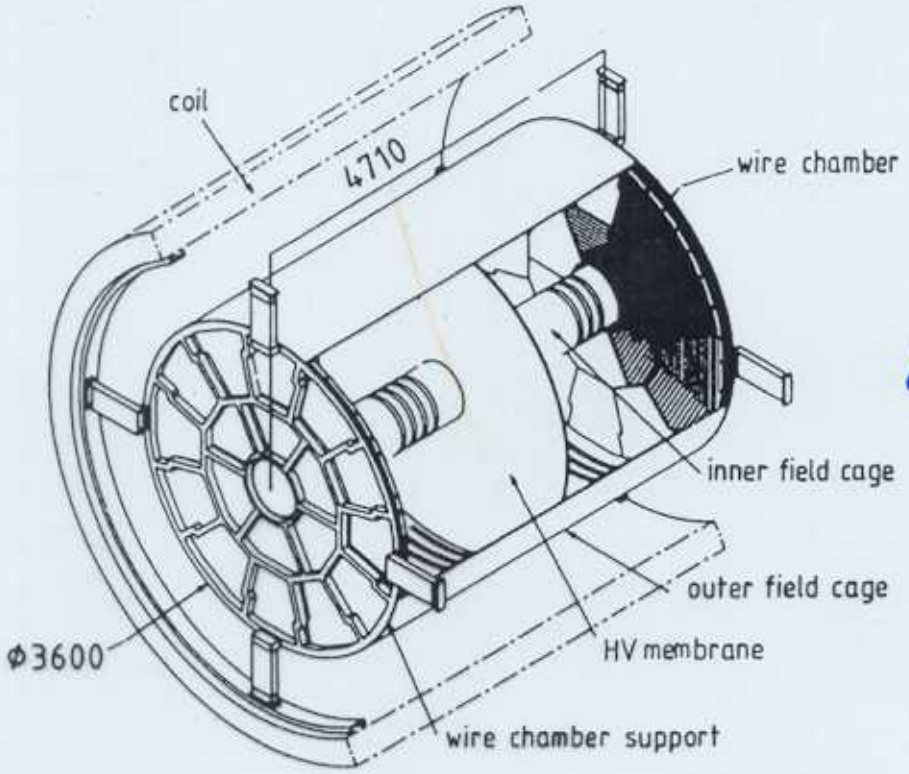
1T, 1atm $\sigma \simeq 200\,\mu m$



→ DIFFUSION confined $\vec{E} \parallel \vec{B}$

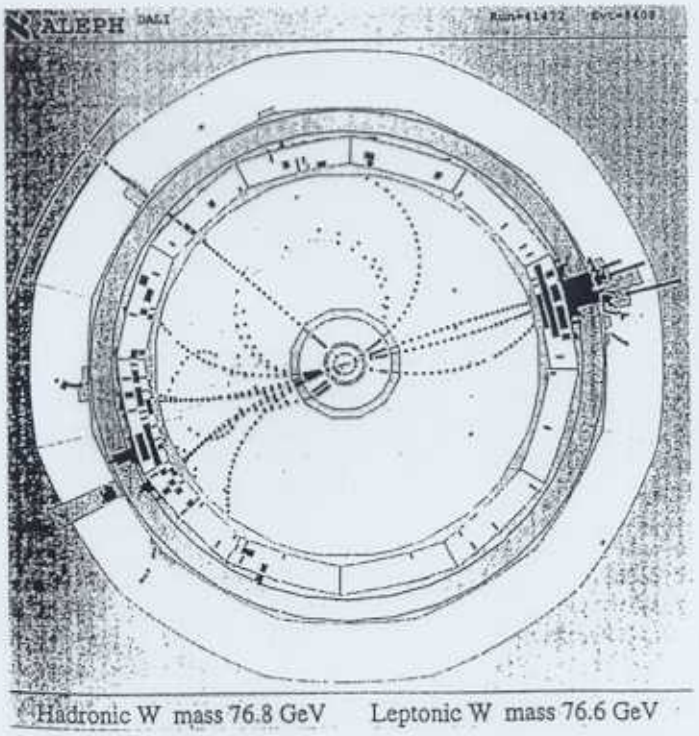
LARGEST in PAST

ALEPH TPC @ LEP



$Ar : CH_4$

Typical event display



1989 - 2000

Main design parameters of some TPCs built up to date. 93

Detector	Vol [m^3]	Drift Length [m]	Gas	P [atm]	Drift Time [μs]	Drift Field [V/cm]	B [T]	Pads	Wires
PEP-4	≈ 6	2×1	Ar/CH_4 (80/20)	8.5	20	750	1.3	13824	2196
TOPAZ	9.7	2×1.22	Ar/CH_4 (90/10)	3.5	23	353	1.0	8192	2800
DELPHI	14	2×1.34	Ar/CH_4 (80/20)	1.0	20	149	1.2	20160	2304
ALEPH	43	2×2.22	Ar/CH_4 (91/9)	1	42	115	1.5	41004	6336
TRIUMF	≈ 1	2×0.35	Ar/CH_4 (80/20)	1	≈ 5	250	0.9	7632	144
NA35	3	1.0	Ar/CH_4 (90/10)	1	19	120	0	11520	no readout
NA36	0.26	0.5	Ar/CH_4 (87/13)	1	8	150	2.7	–	7680
BNL810	0.4	0.6	Ar/ Isobutane/ Metylal (79/16/5)	1	≈ 22	330	≈ 0.5	–	≈ 8000
HISS	1.1	0.75	Ar/CH_4 (90/10)	1	≈ 15	120	1.3	15360	no readout
WA71	0.026	0.16	Ar/ Isobutane (70/30)	1	4	1000	1.2	192	32

STAR ....

Parameters characterizing the performance of some TPCs .

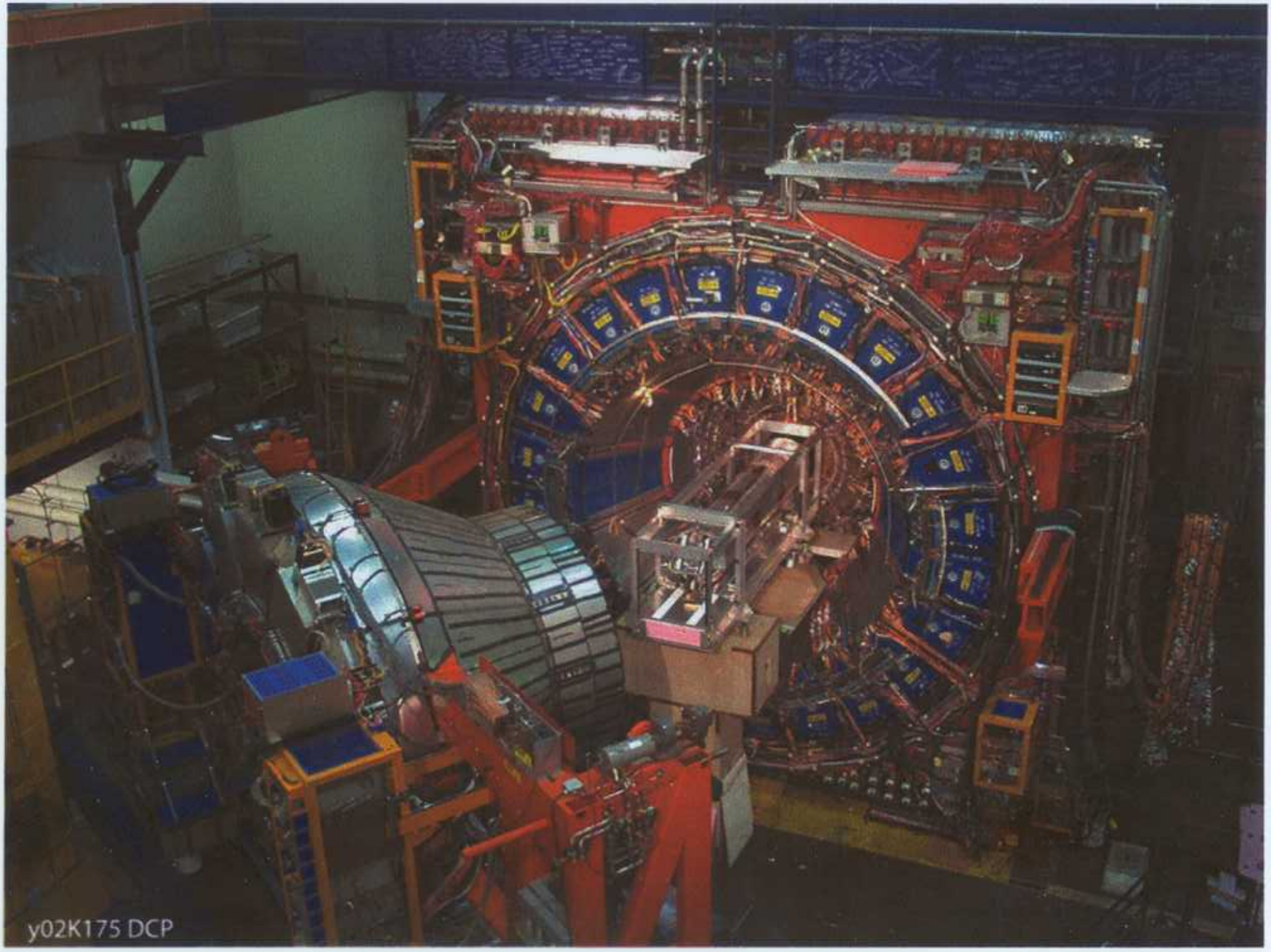
Detector	Single Coordinate Resolution σ_L [mm]	σ_T [μm]	Pad Response σ_{PRF} [mm]	Two-Track Separation Δ_L [cm]	Δ_T [cm]	Momentum Resolution $\delta p_T/p_T^2$ $[(GeV/c)^{-1}]$	dE/dx Resol. [%]
PEP-4	0.34	160	3.6			0.065	3.5
TOPAZ	0.34	185	4.2			0.012	4.6
DELPHI	0.8	230		≈ 1.0	≈ 1.5	≈ 0.005	≈ 6.5
ALEPH	0.7	170	3.5	≈ 2	≈ 1.5	0.0012	4.5
TRIUMF	1	170	3.6			≈ 0.2	
NA35	0.25	430	≈ 2.8	≈ 1		0.003	–
NA36	1.2	740	–	≈ 1	≈ 0.5	0.005	–
BNL810	0.9	900	–	≈ 0.3	≈ 0.7	0.035	–
HISS	1	$200 - 500$	≈ 1	≈ 1.5			
WA71	0.2	≈ 500	≈ 5				

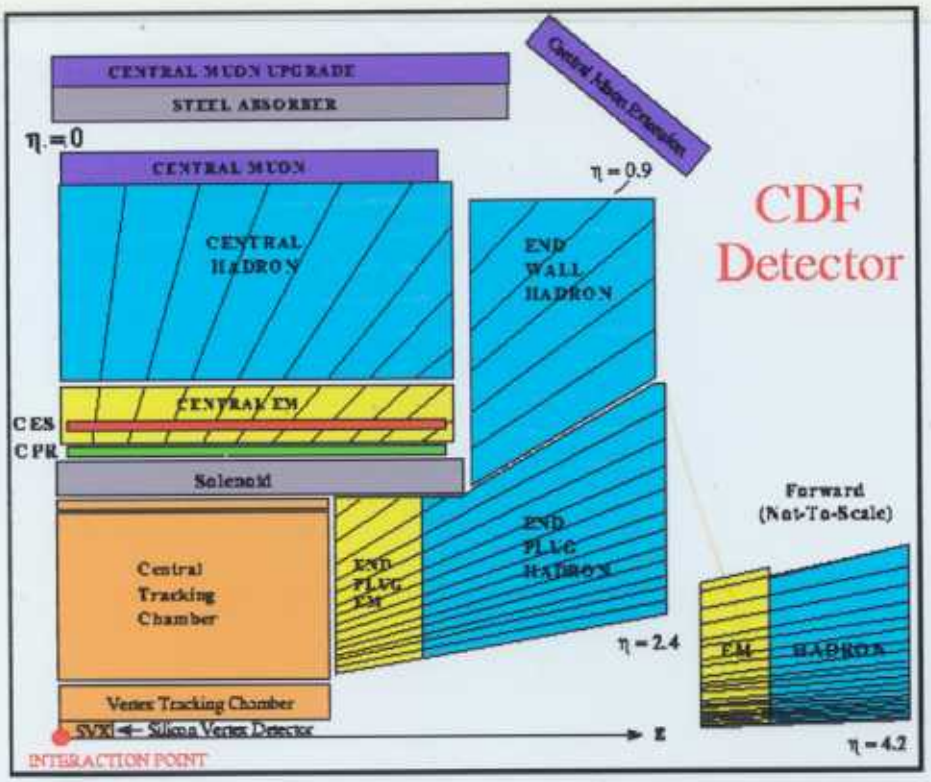
GOOD..

Powerful

3D

PRESENT


CDF
y02K175 DCP



UPGRADED

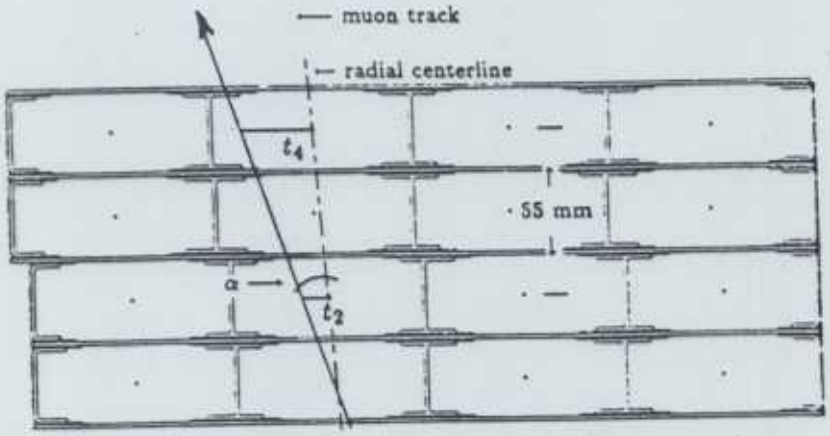
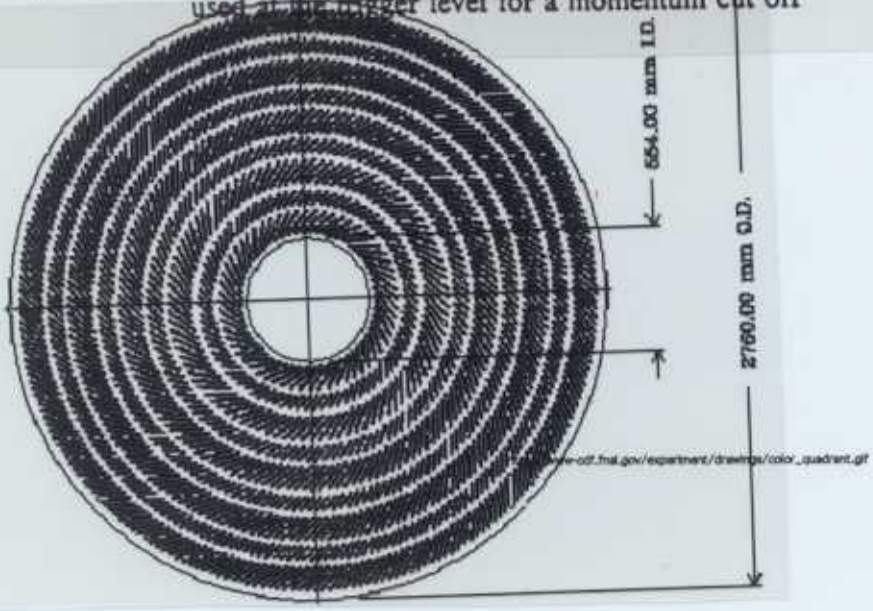


Fig. 27 Central muon chambers of Ref. 53, t_2 and t_4 are used at the trigger level for a momentum cut off

Ar: C_2H_6 0° Ethanol

σ_x ~ 250 μm

Q division σ_z = 1.2 mm



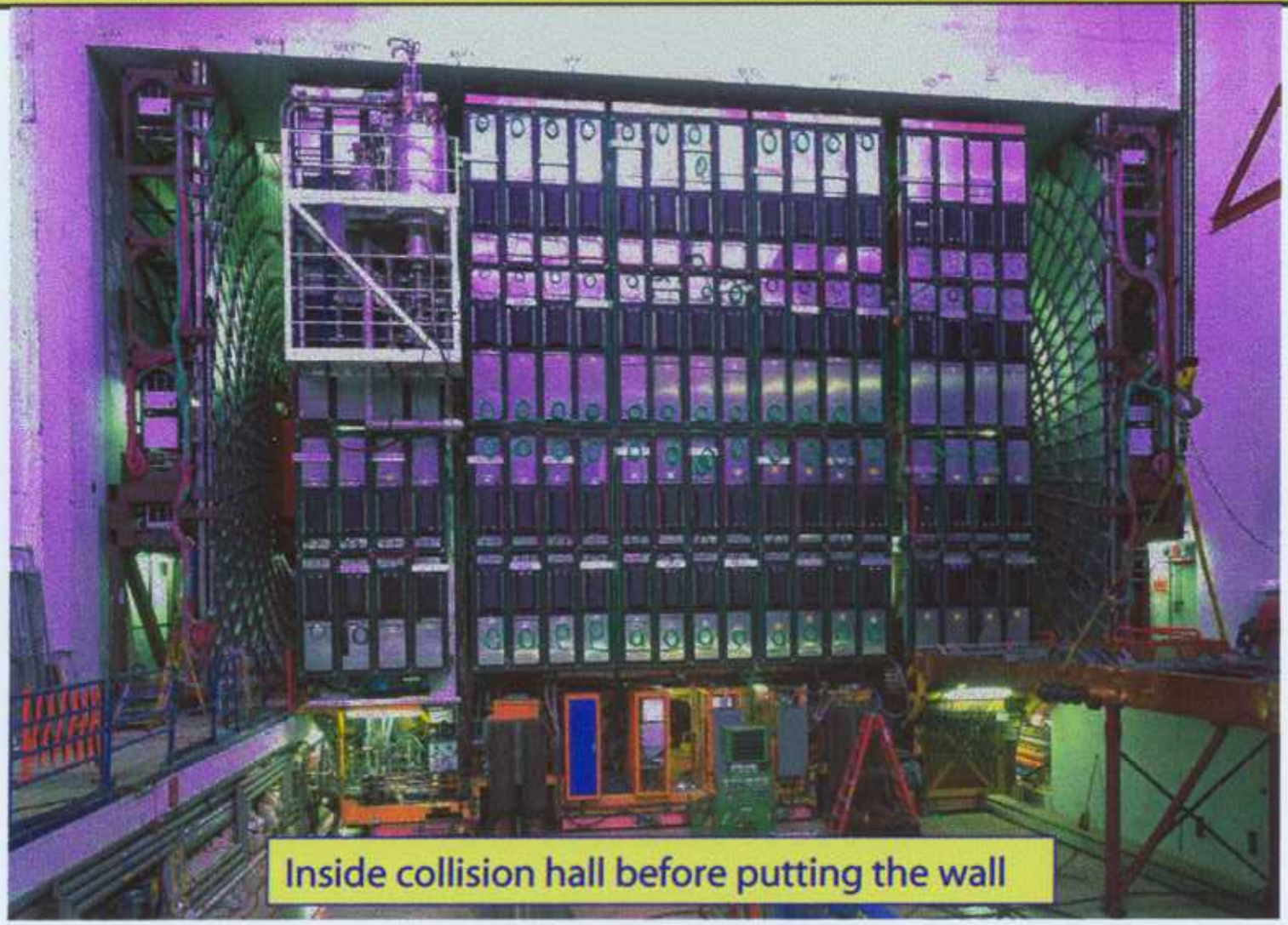
fast gas

CENTRAL TRACKER

→. Drift d/z

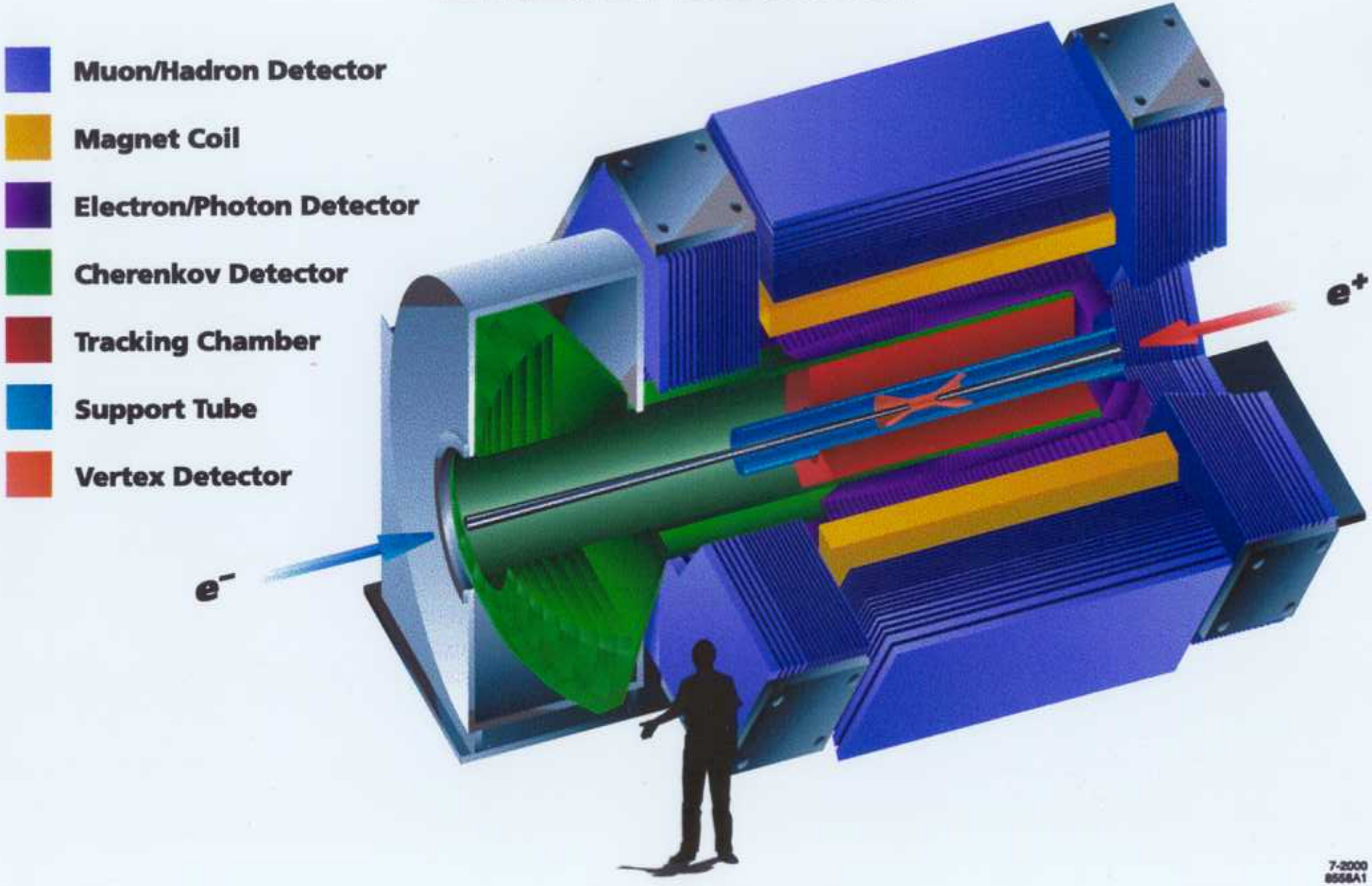
. faster Gas

The Upgraded DØ Detector



Inside collision hall before putting the wall

BABAR Detector



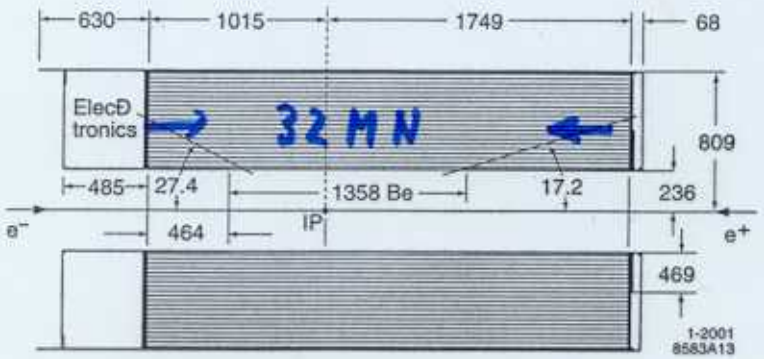
7-2000
8558A1

y02K171

BABAR

Mixture He : C_4H_{10}	80:20
Radiation length	807 m
Primary ions	21.2/cm
Drift velocity	22 μm/ns
Lorentz angle	32°
dE/dx resolution	6.9%

B. Aubert et al. / Nuclear Instruments and Methods in Physics Research A 479 (2002) 1–116



40 layers 7104 drift cells

HEXAGONAL + 1960V G ≈ 5·10⁴

1.5T

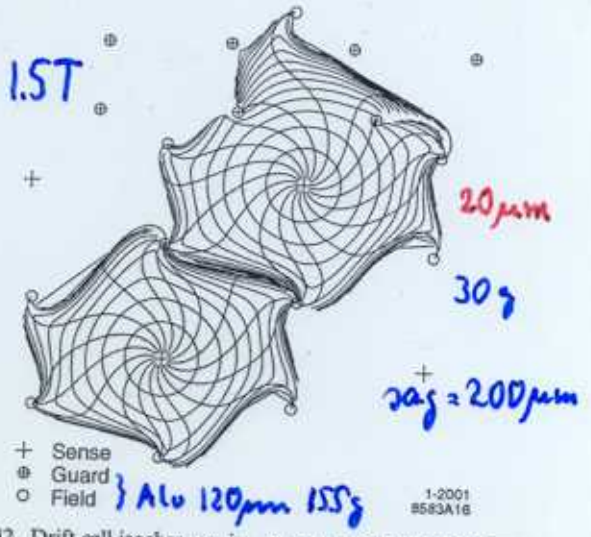
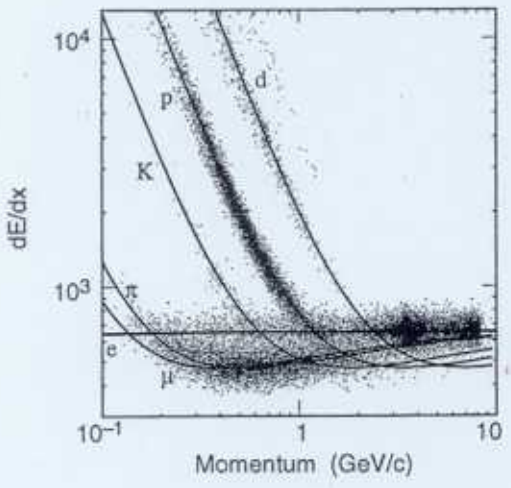
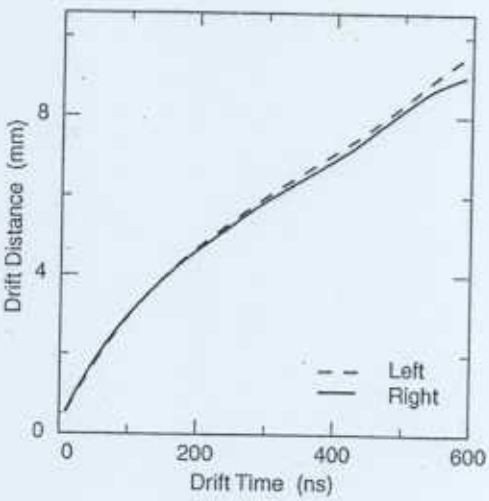


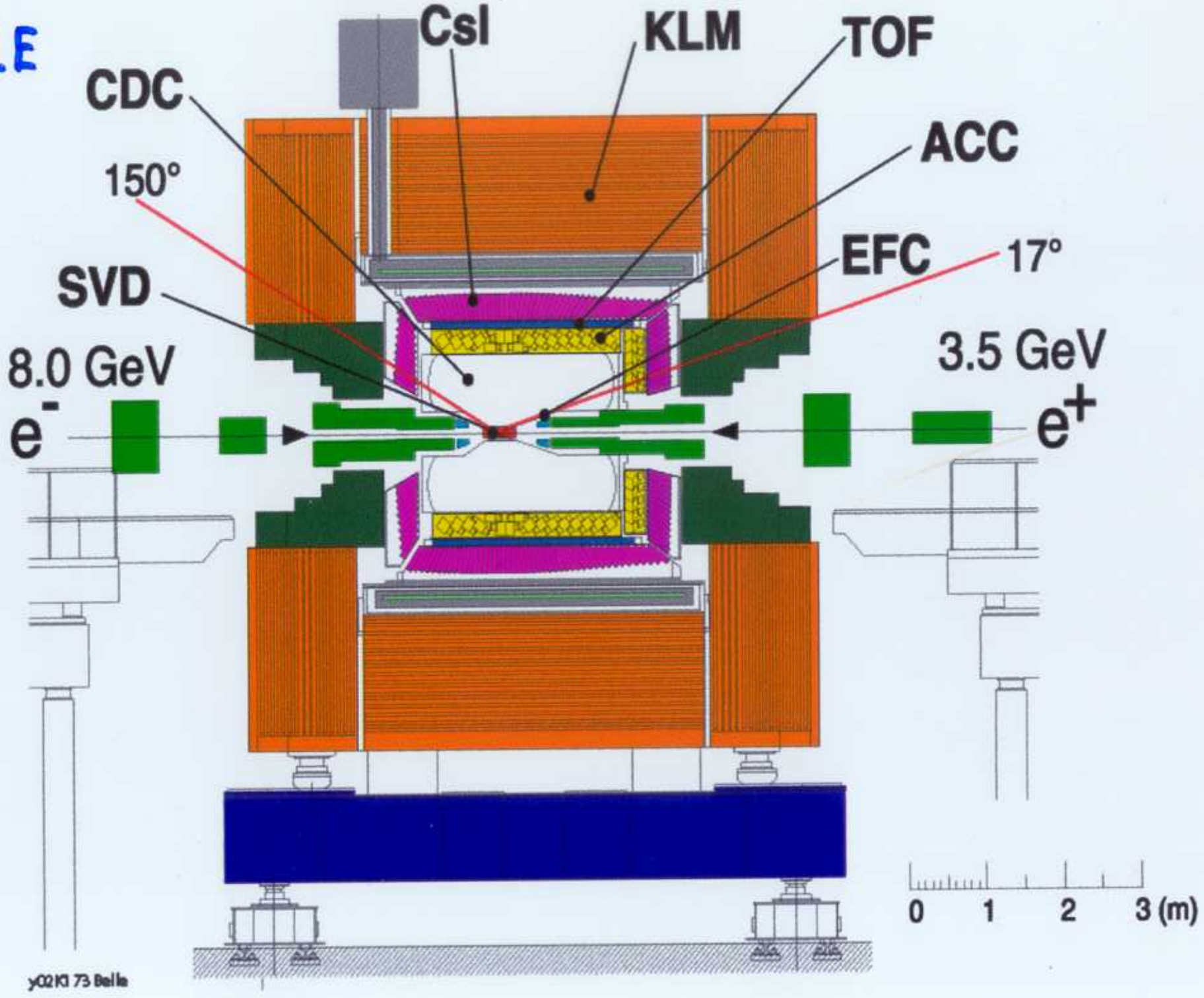
Fig. 32. Drift cell isochrones, i.e., contours of equal drift times of ions in cells of layers 3 and 4 of an axial superlayer. The isochrones are spaced by 100 ns.



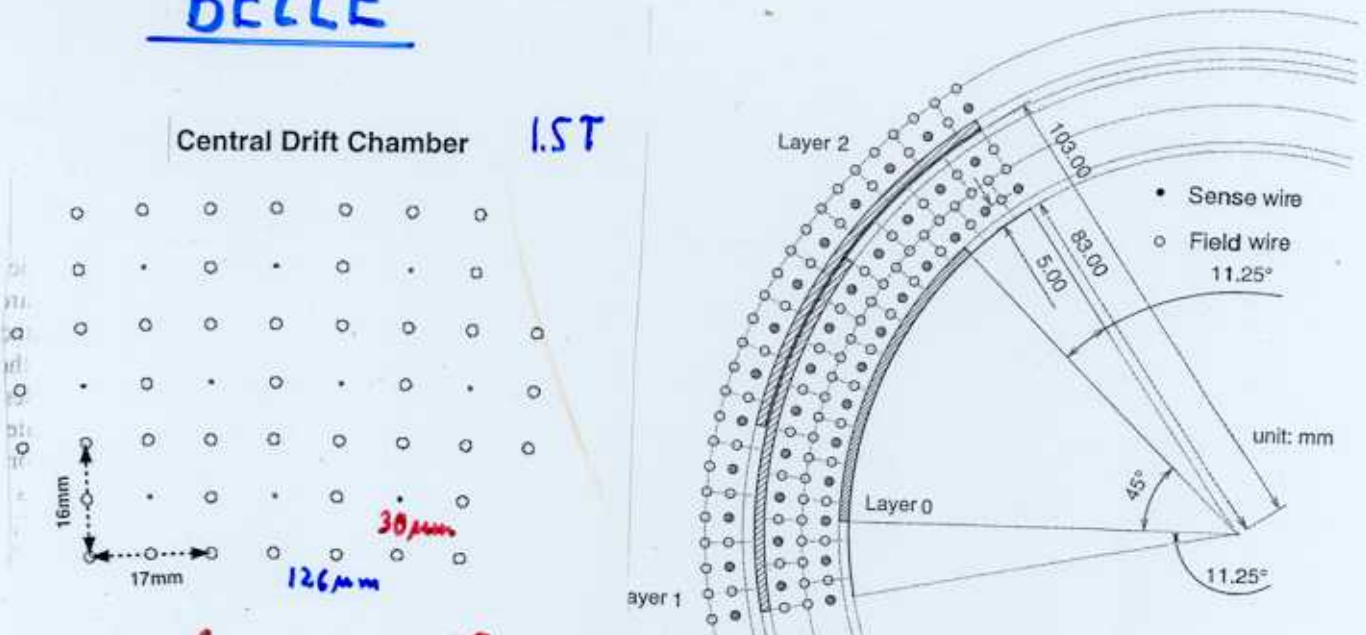
Curves = Bethe-Bloch



BELLE

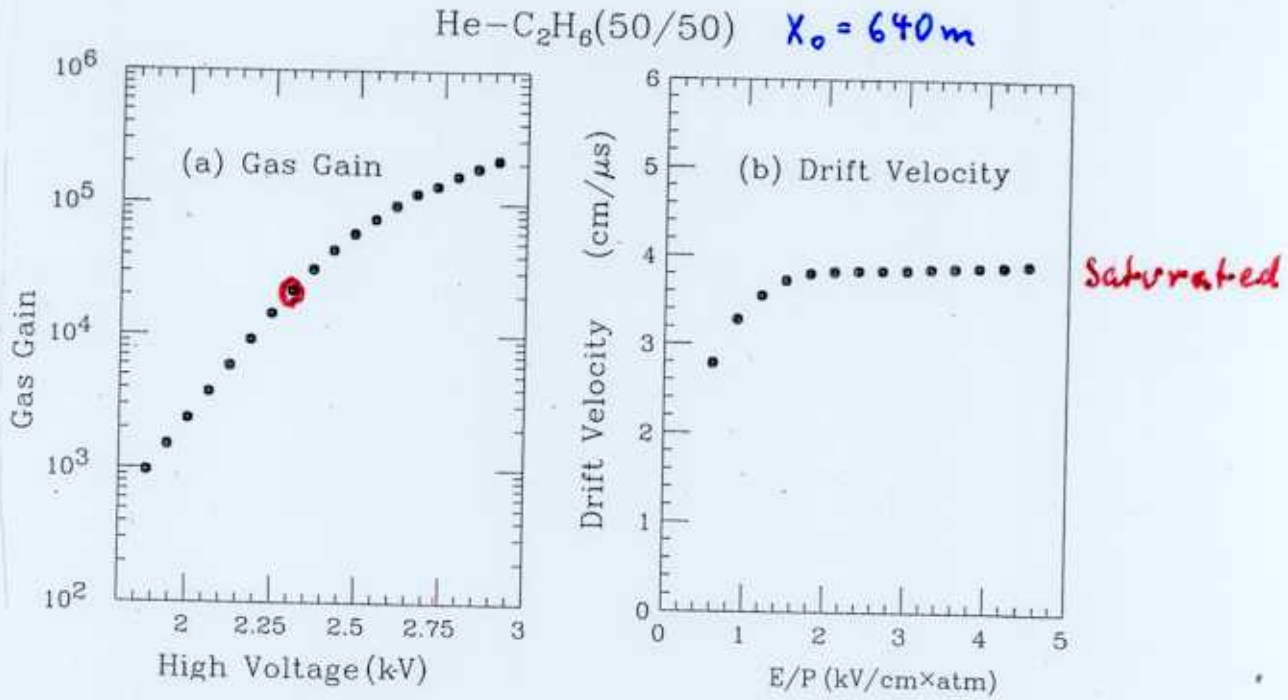


BELLE



$\delta_x \approx 160\,\mu m$ $\delta_z \approx 3\ (0.6)$ mm cathode strips

A. Abashian et al. / Nuclear Instruments and Methods in Physics Research A 479 (2002) 117–232



$\frac{dE}{dx} \sim 7.5\%$