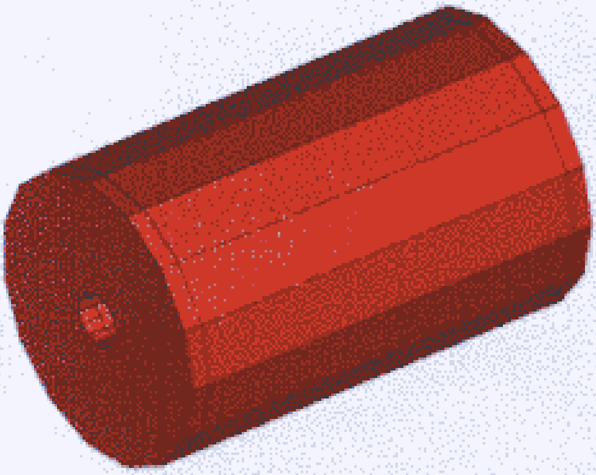
ECFA/DESY Workshop, DESY, September 2000

TPC in the TDR

Markus Schumacher , DESY

- Why a TPC ?
- Endplate design
- Gas & Field Cage
- Read out technology
- Pad geometries
- Electronics
- Costs

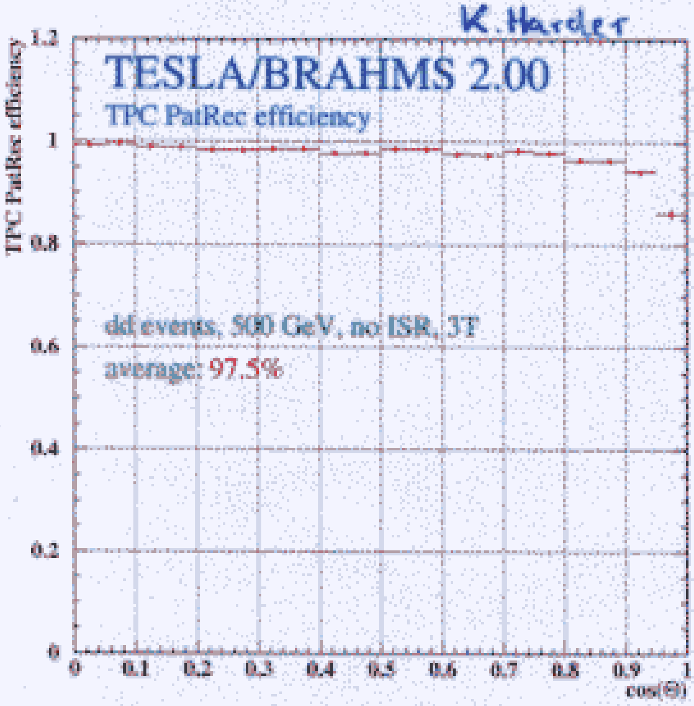
Why a TPC ?

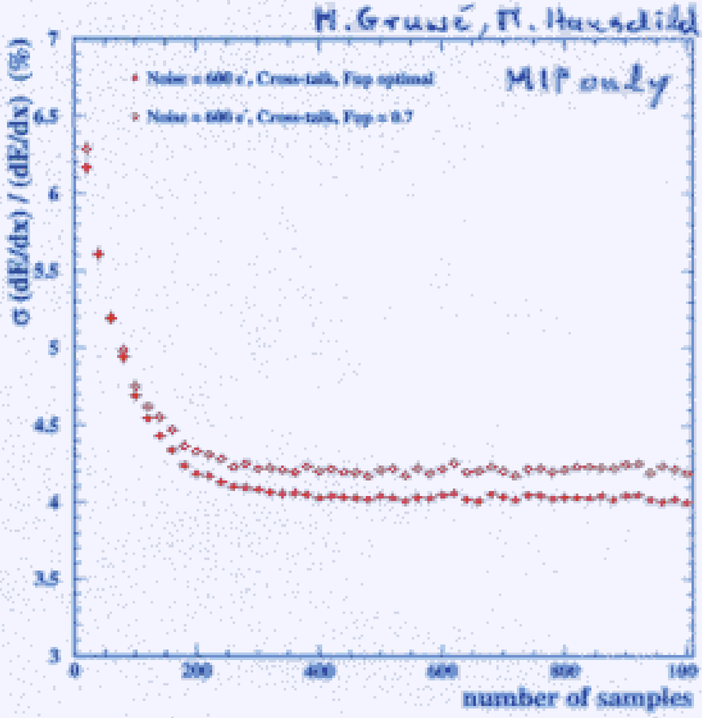


$l = 5m,\ r_i = .32m,\ r_A = 1.70m$

- true 3-dimensional track points
- high redundancy ($\geq$ 120 track points)
- low material $\leq 3\% X_0$
  (gas + inner field cage)
- $\delta p_t / p_t^2 = 2.8 \times 10^{-4}$ for $\sigma_{point} = 140 \mu m$

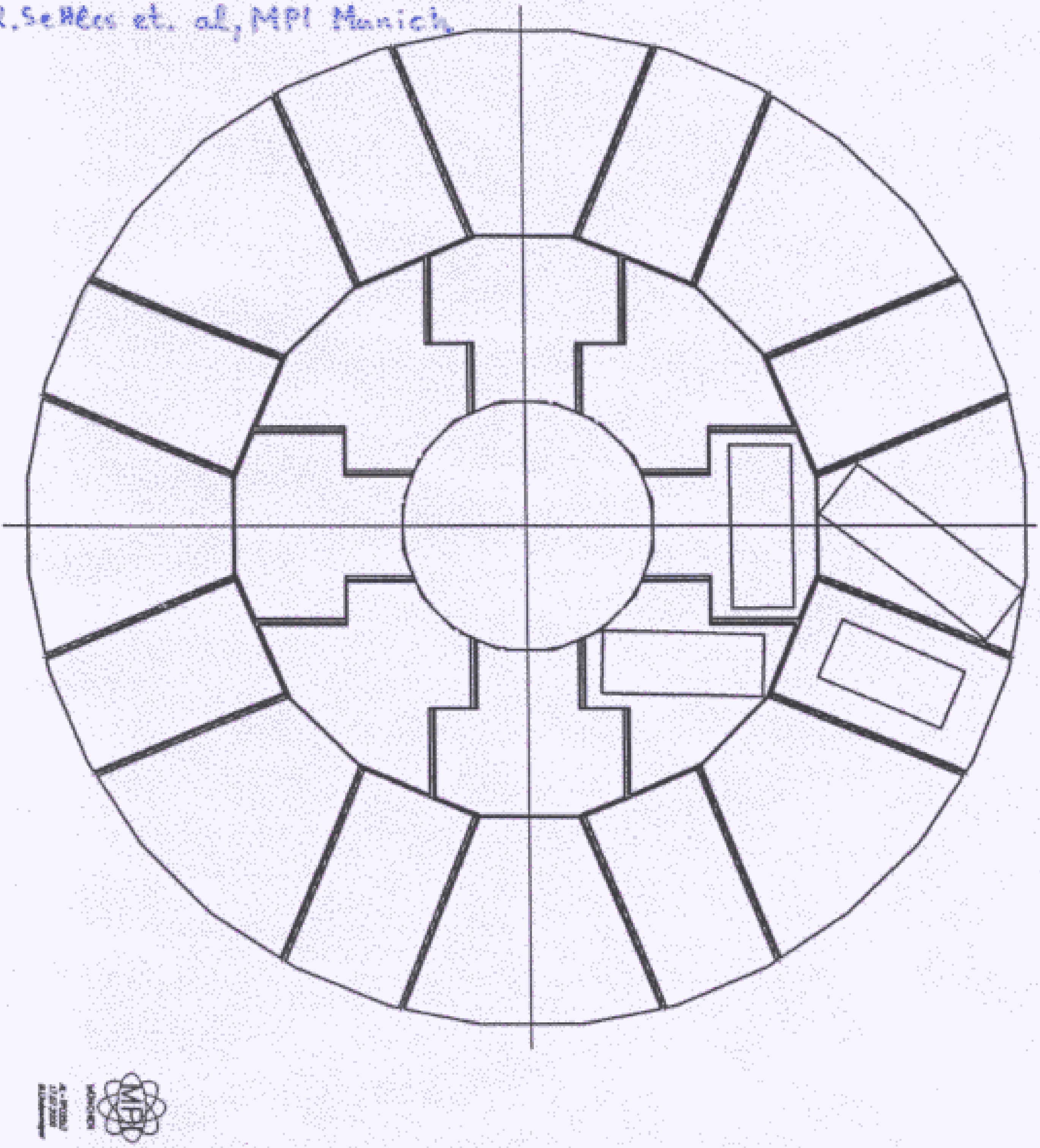
- simple and efficient pattern recognition
- particle identification via dE/dx measurements





Endplate Design

R. Settles et. al, MPI Munich



Gas, Field Cage

Gas

Mixture $Ar - CO_2 - CH_4$	σ_n $[barn]$	E_{max} $[V/cm]$	v_{dmax} $[cm/\mu s]$	D_l, D_t $\mu m\sqrt{cm}$
90-0-10	34.0	135	5.47	368, 55
90-5-5	18.0	450	4.92	217, 119
90-10-0	2.0	750	4.99	184,152

find compromise between: $\sigma_n \leftrightarrow E_{max}, v_{dmax}$

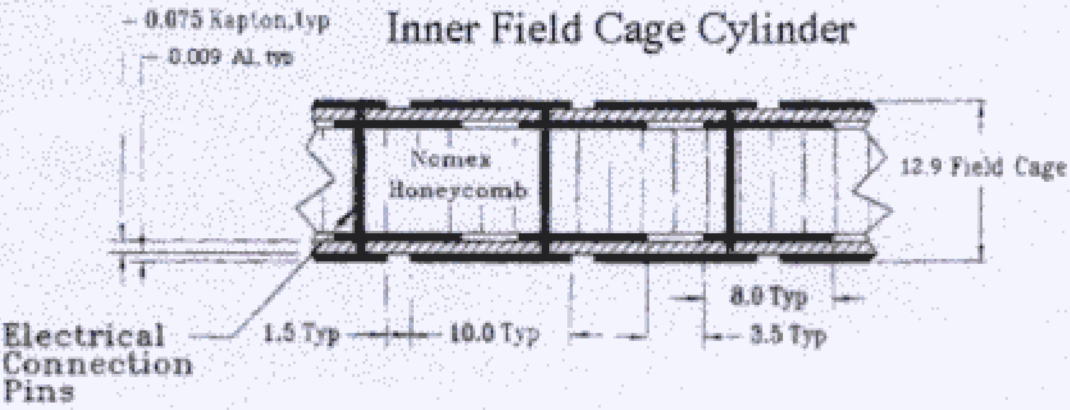
now in DESY setup: 92-5-3

Field Cage

STAR type field cage

OK for up to 100 kV

movable for maintenance of inner detectors



Read out technologies

- aim: untriggered running
- hope: no gating needed with alternative read out technologies

- main option: double (triple) GEM for read out

  second option: Micromegas (P.Colas et al., Saclay)

  several advantages above wire chambers

  · shorter pulses (only e^- signal) $\longrightarrow$ better intrinsic $r\phi$ and z resolution

  · no (small) track angle, $\vec{E} \times \vec{B}$ effects due to 2-dim. symmetry

  · lower mass due to simpler support structure

  · suppression of ion feedback ($\leq 1\%$?)

    needs confirmation by further ongoing R&D

    (at Aachen, Berkeley, Carleton, Hamburg, Karlsruhe, Orsay, Saclay)

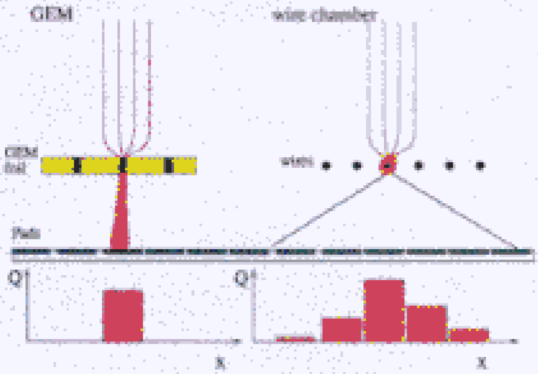
    + possibly gating grid triggered by bunch trains

- fall back solution: traditional wire chambers (see CDR)

Pad Geometries

problem: resolution might degrade

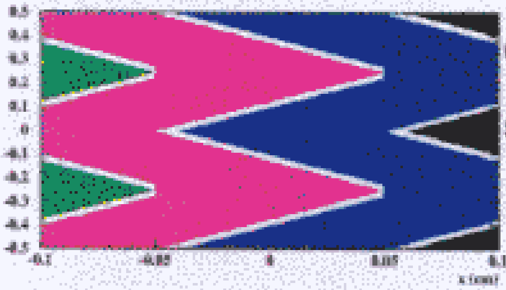
when using GEMS with large pads



- number of channels: 1.5 million ⇒ pad area $10mm^2$

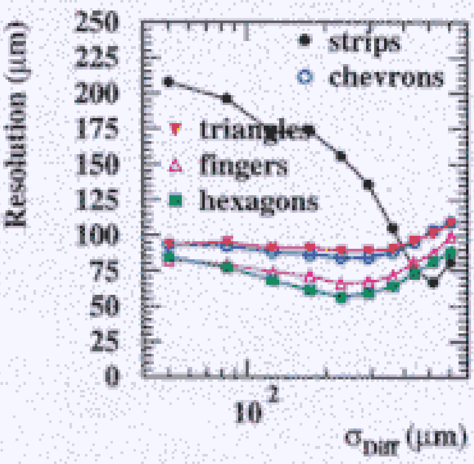
- which pad geometry (alternatives to rectangular strips)?

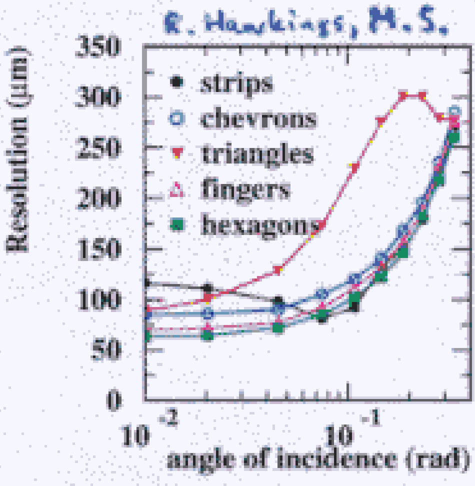
(1) use charge signal only:



chevrons (10 mm × 1m) meet $\sigma_{point} = 140\mu m$

smaller dependence on drift lenght and track angle





(2) use charge and induction signal (Carleton):

hexagon shape (→ M. Dixit's talk in R&D session)

center distance 2.5 mm, $\sigma_{point} \approx 60\mu m$

Electronics, Costs

Electronics

- demands: sampling and digitization on endplane

  early zero supression

- starting point: STAR type electronics (so far up to 40 MHZ)

  ongoing R&D at Berkeley (M. Ronan et al.)

- induction signals need sampling at $\geq$ 100 MHz

  ATWD chip technology at Berkeley ($\rightarrow$ LC-Note)

  Carleton: readout out of GEM induction signal with FADCs

Costs

- estimate will be based on STAR and ALICe TPCs

  STAR: 25 million $

  ALICE: 17 MCHF