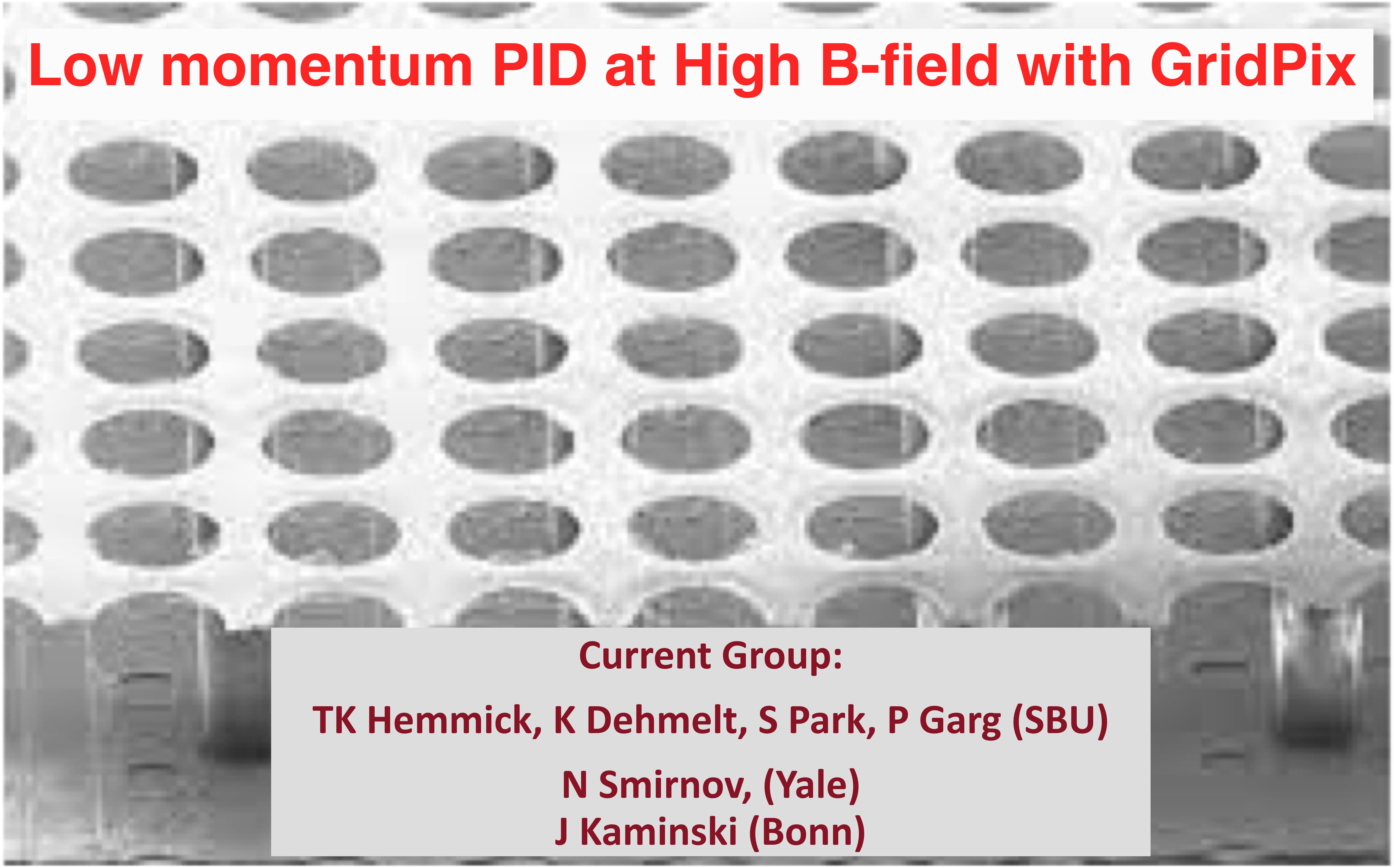


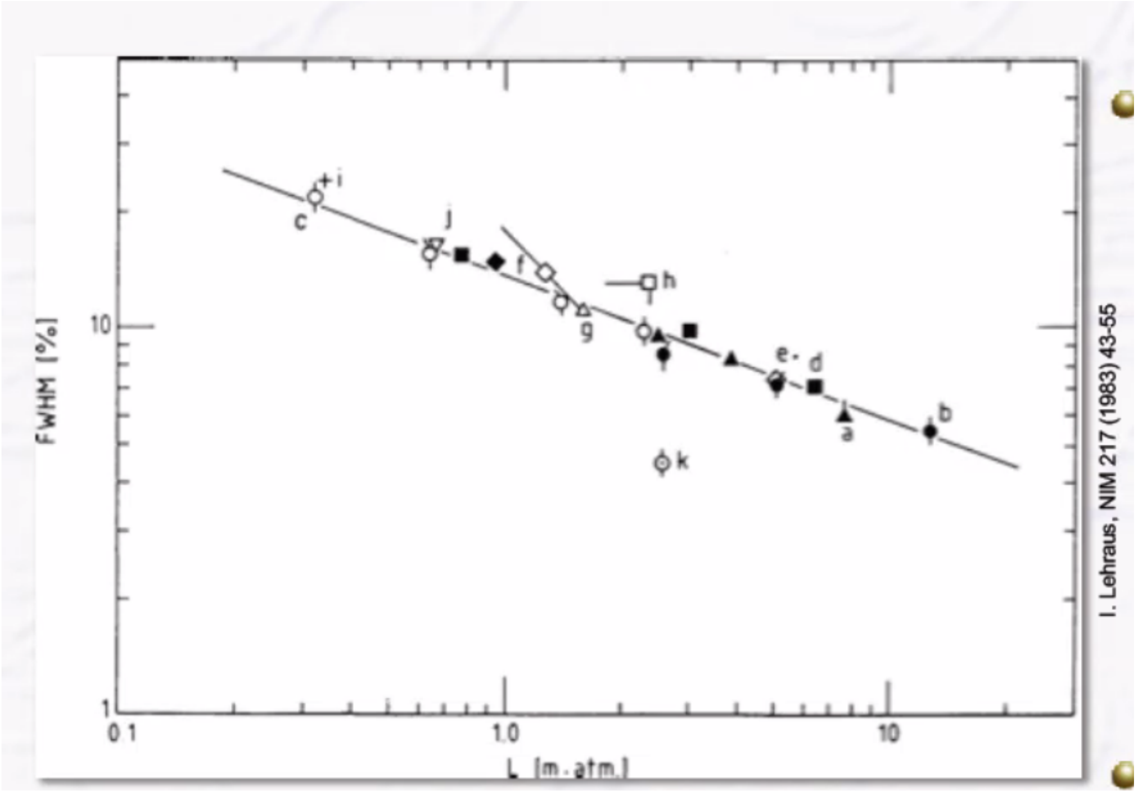
Low momentum PID at High B-field with GridPix

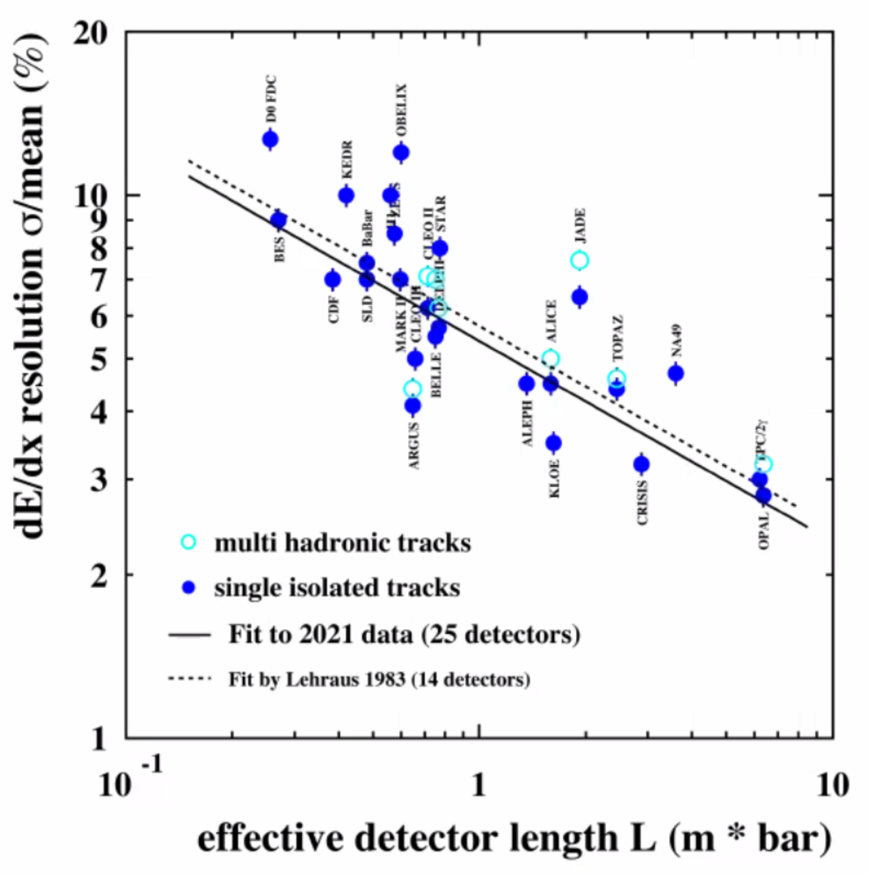
Current Group:

TK Hemmick, K Dehmelt, S Park, P Garg (SBU)

N Smirnov, (Yale)
J Kaminski (Bonn)

RECAP: Anticipated dE/dx Resolution



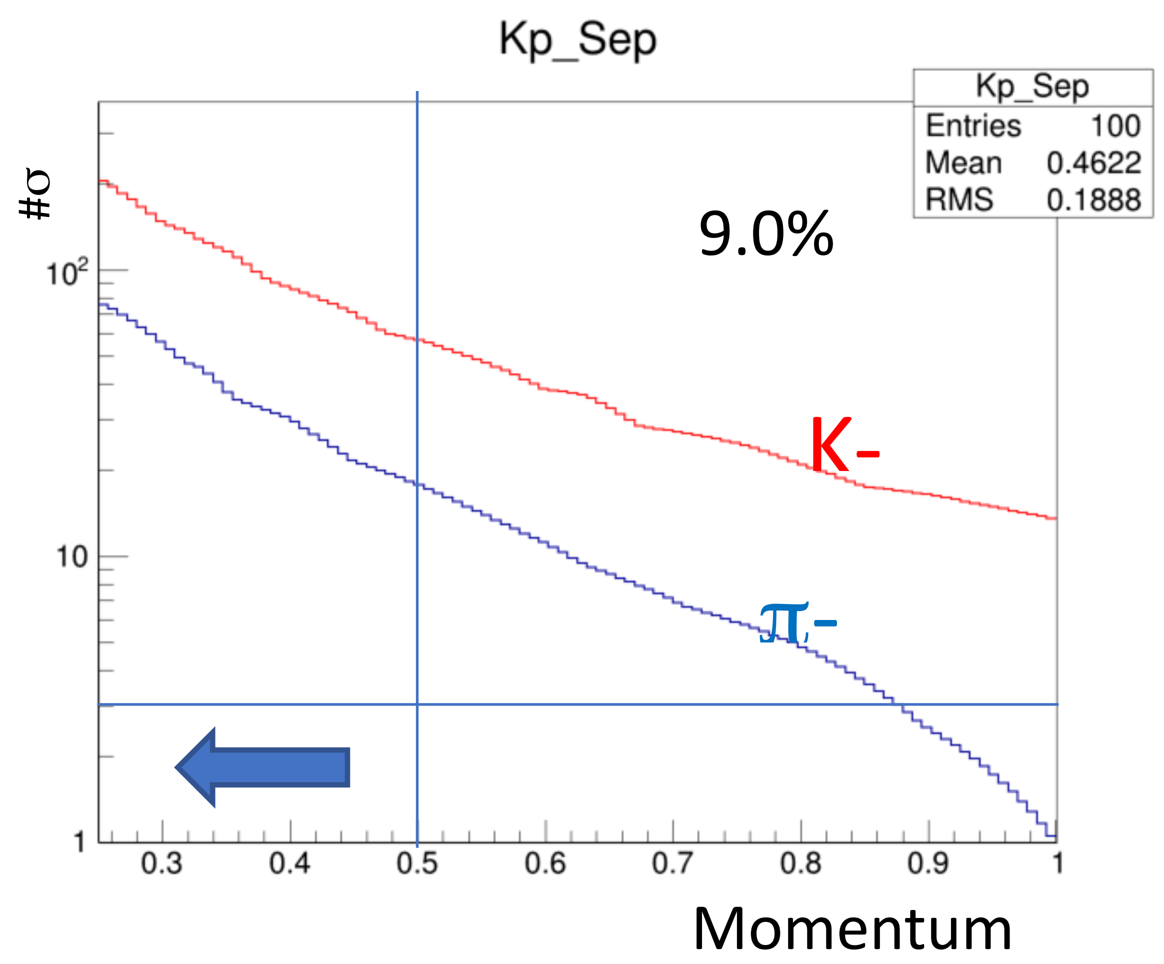


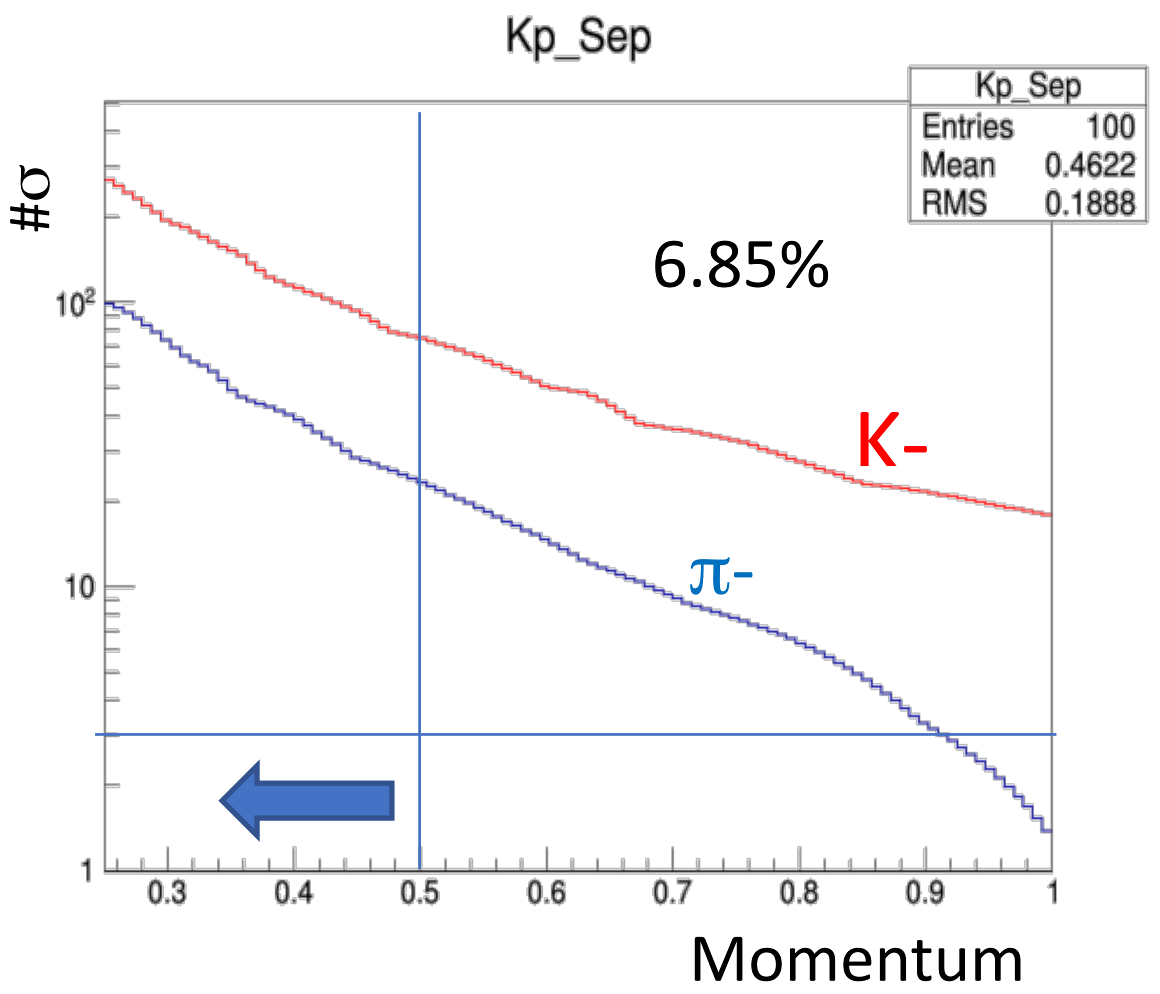
- **Fit by *Lehraus* 1983:**

  dE/dx res. = 5.7 * $L^{-0.37}$ (%)

- **Fit in 2021** (25 large detectors):

  dE/dx res. = 5.4 * $L^{-0.37}$ (%)





Lehraus Plot

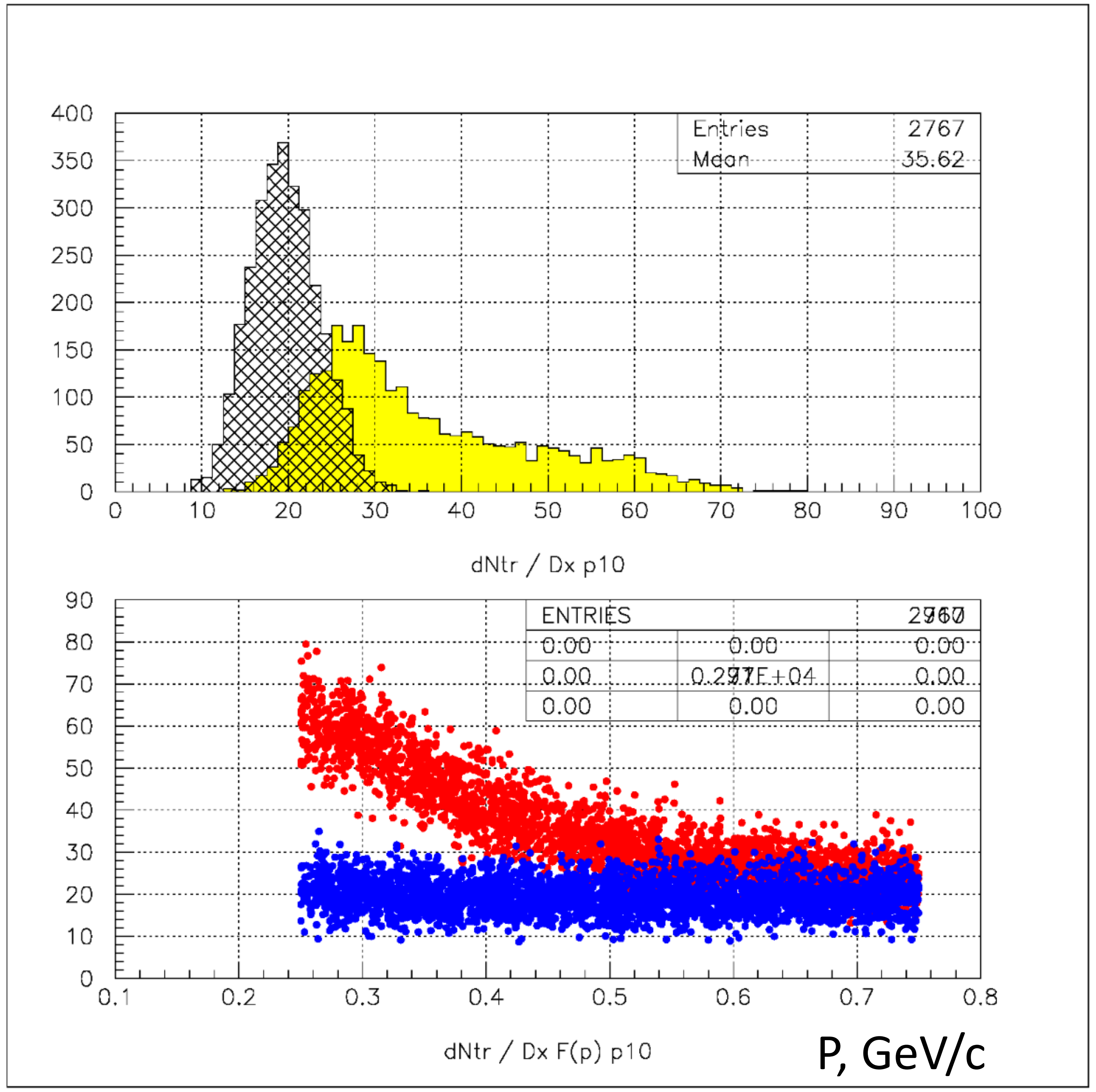
- Using 5.4 as a standard TPC
  - $5.4*(0.25)^{-0.37} = 9.0$
- Measured for GridPIX (truncated Mean)
  - 4.1% at 1 meter
  - $4.1*(0.25)^{-0.37} = 6.85$
    - This was the prior assumption quoted by us.
- Roughly 20 sigma at 0.5 GeV/c
- Useful range overlaps with DIRC

Anticipated dE/dx Resolution for smaller track length?

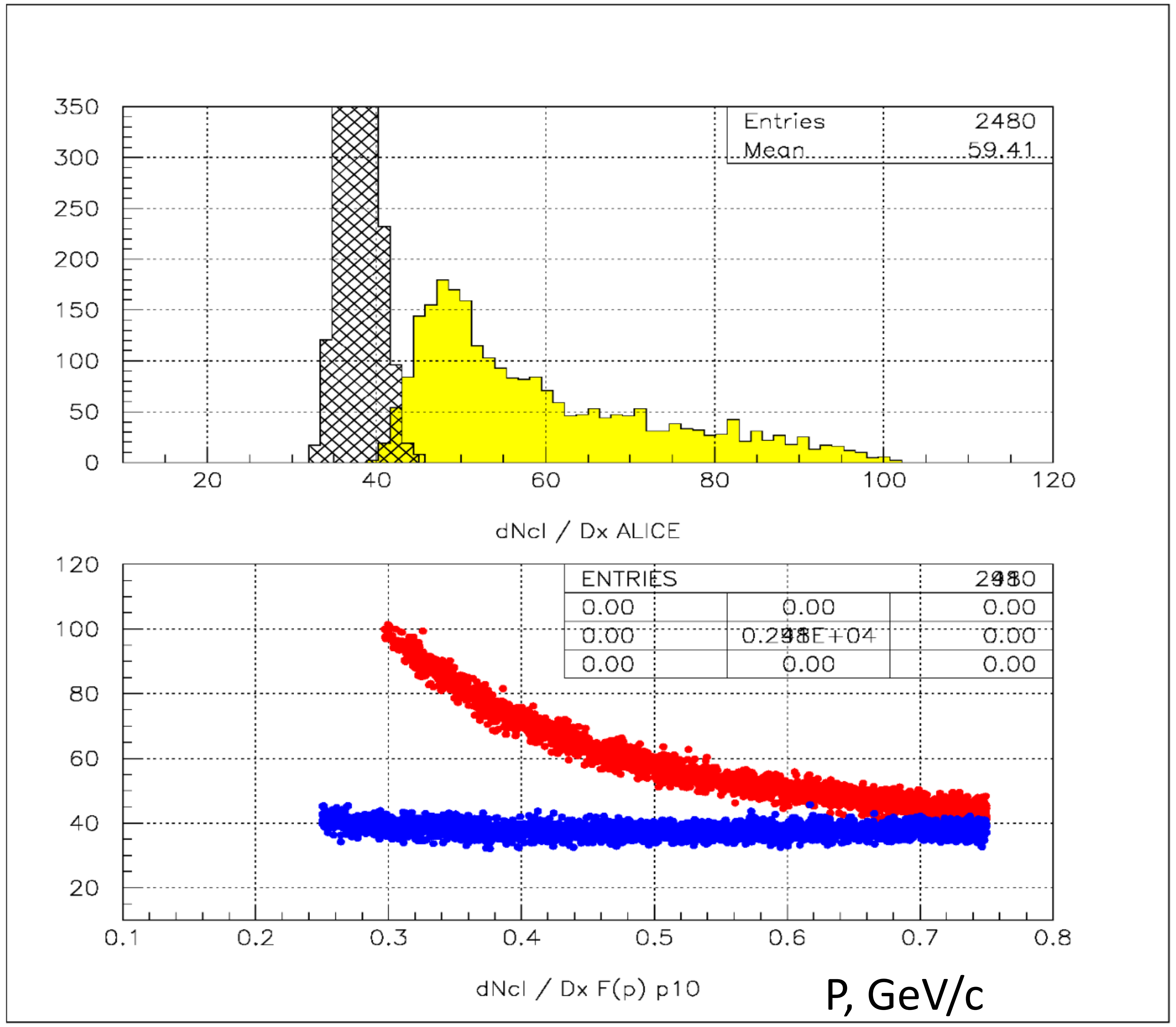
Slides from Nikolai (Yale)

PAI model, P10 Gas, Number of interactions/0.5 cm, ~10 cm Track length

After truncated procedure (60%)



If one can do electron counting



If one can do cluster counting

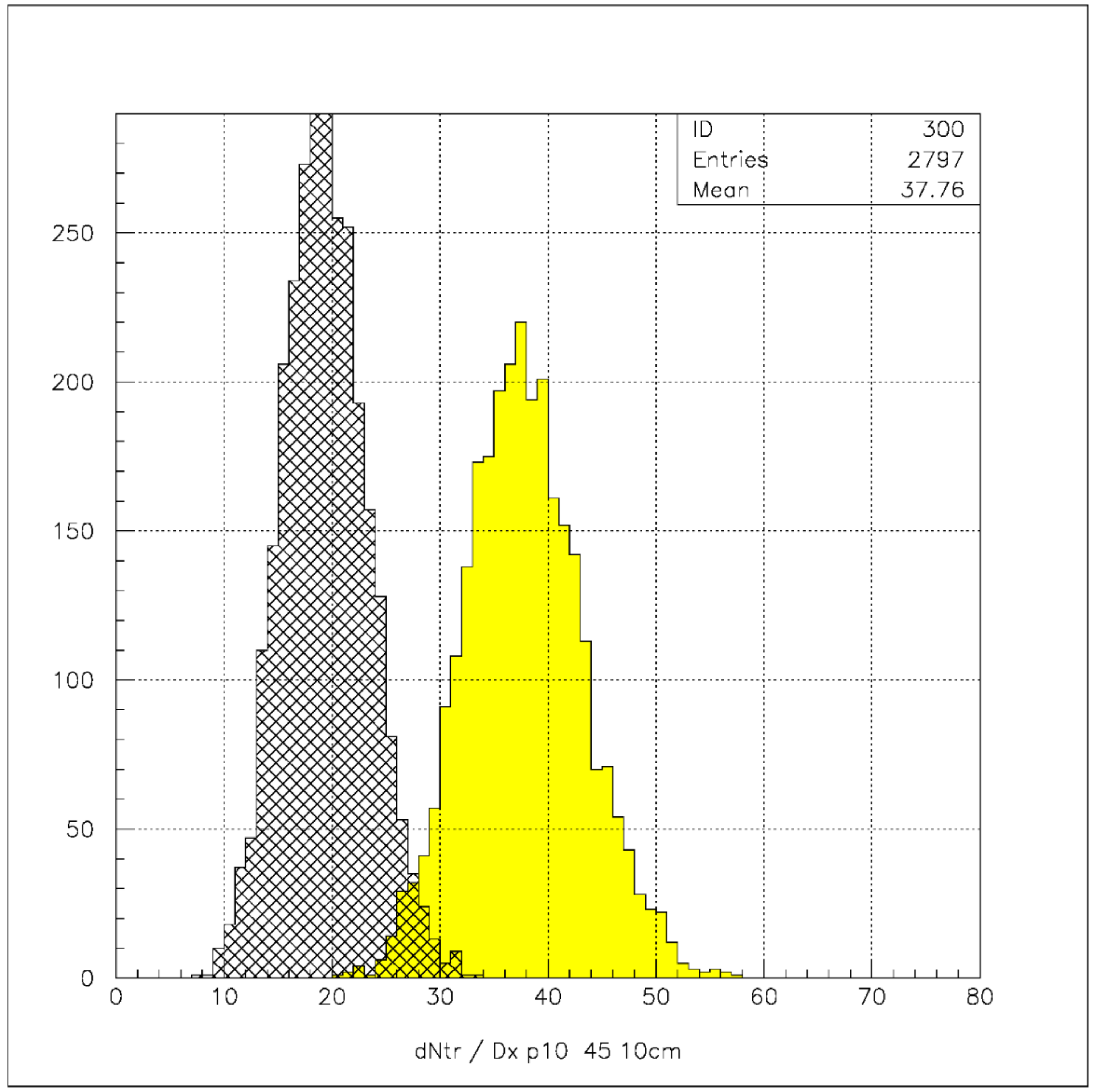
Slides from Nikolai (Yale)

Reaching the overlap with DIRC If one can do electron counting

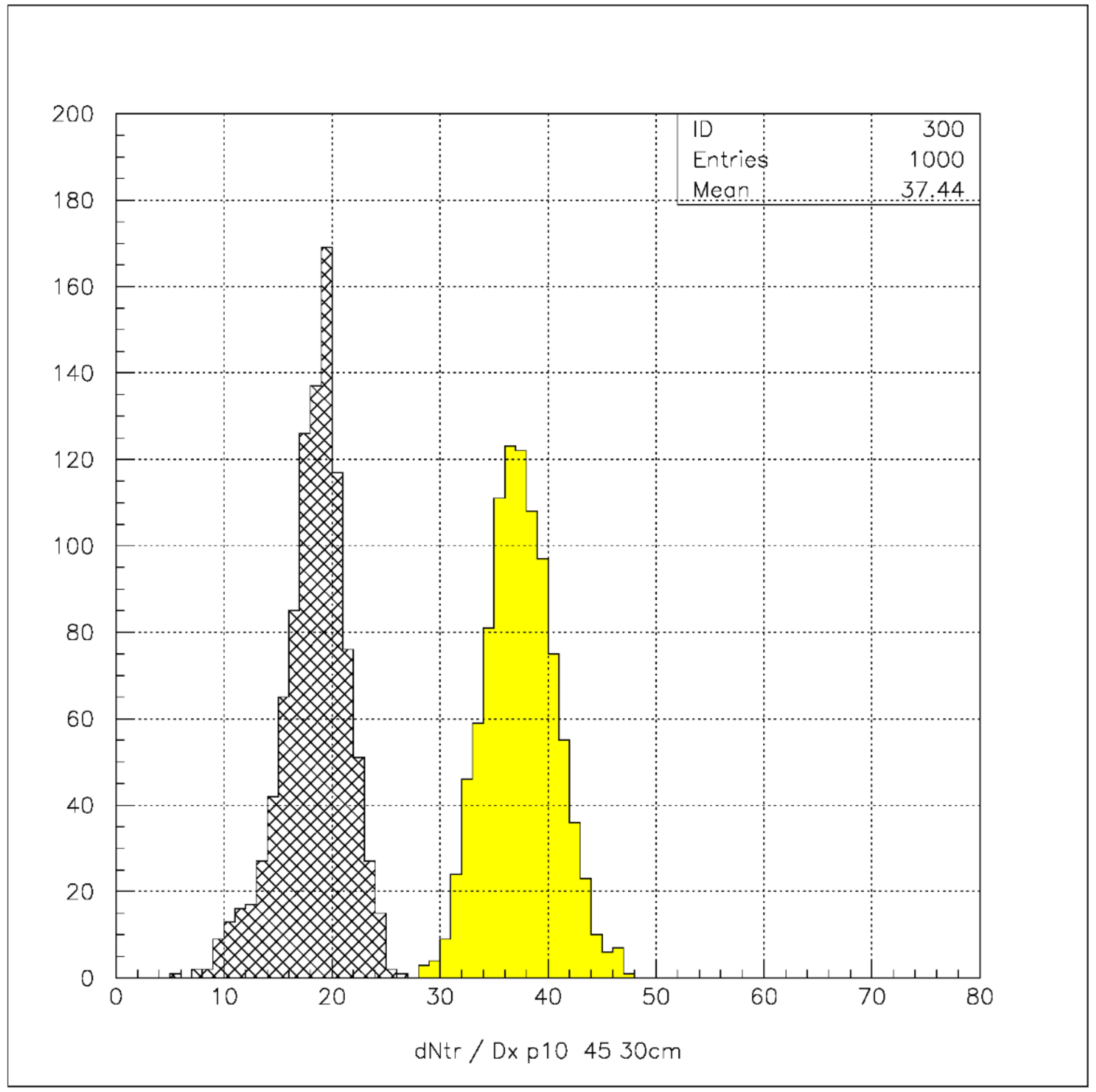
pi / k separation. Number of electrons / 0.5 cm. Select momentum 0.45 GeV/c

~60% truncated

Track length ~10 cm



Track length ~ 30 cm



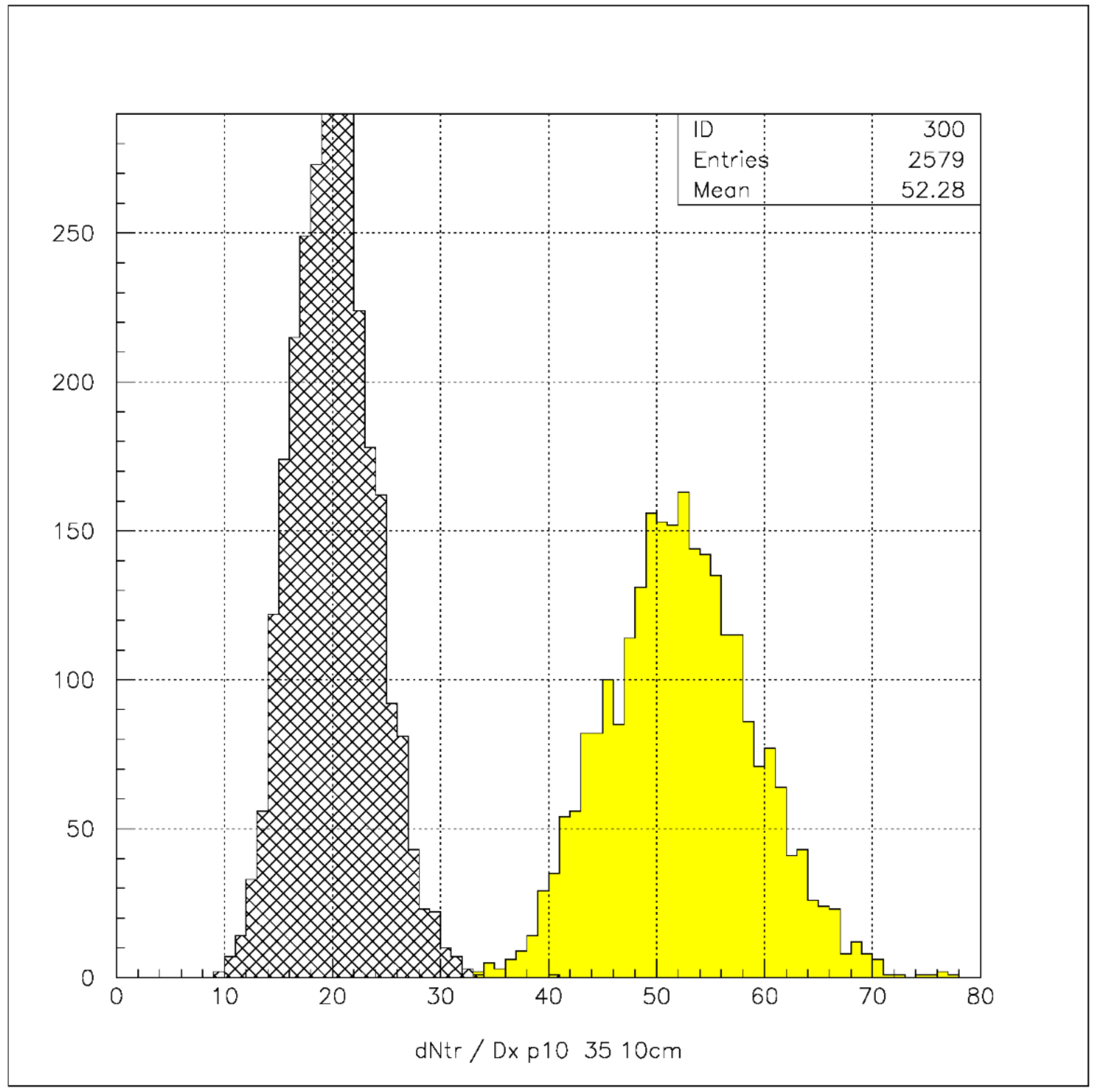
Slides from Nikolai (Yale)

Moderate case scenario   If one can do electron counting

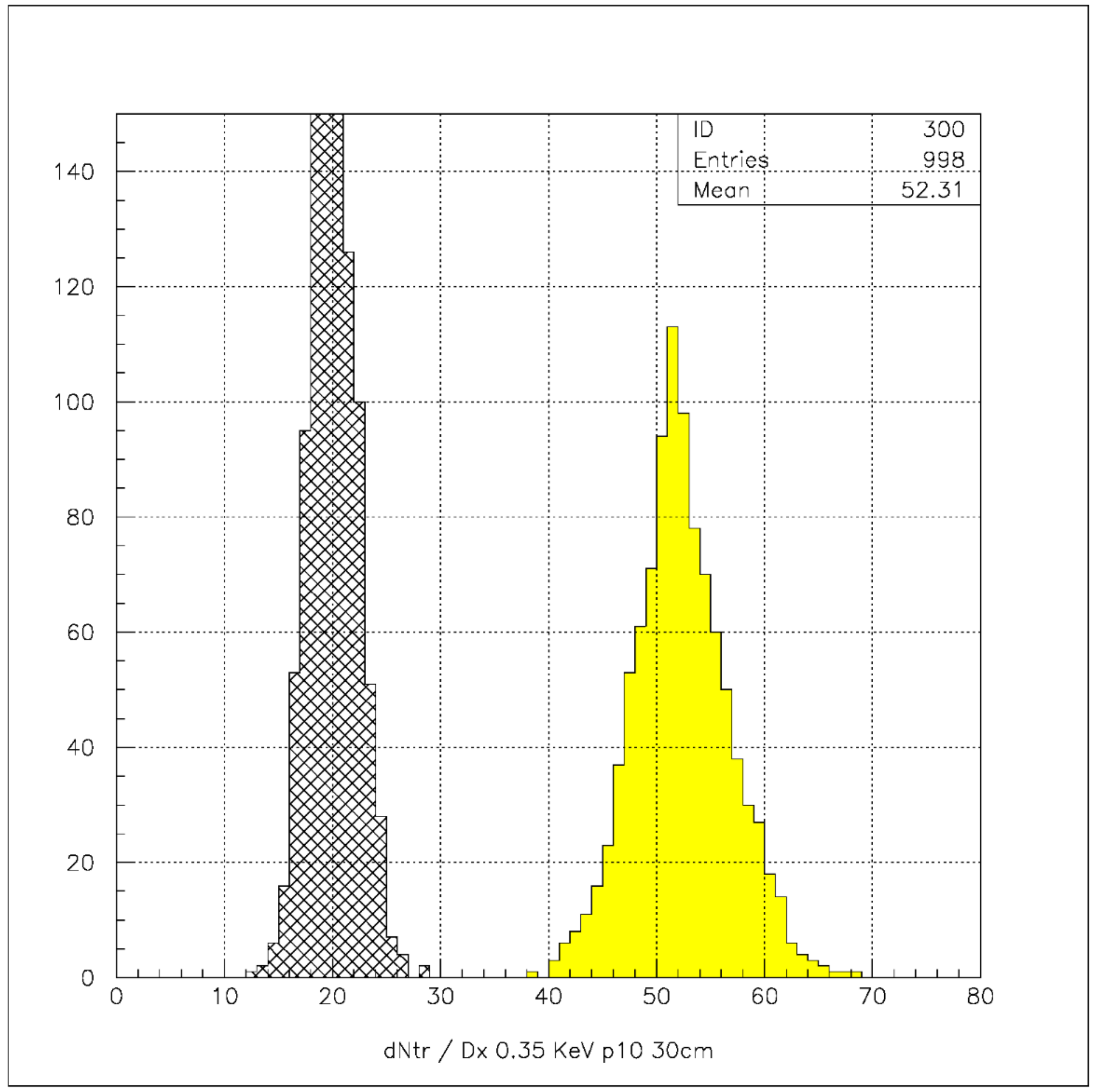
pi/k separation. Number of electrons / 0.5 cm. Select momentum 0.35 GeV/c

~60% truncated

Track length ~10 cm



Track length ~ 30 cm



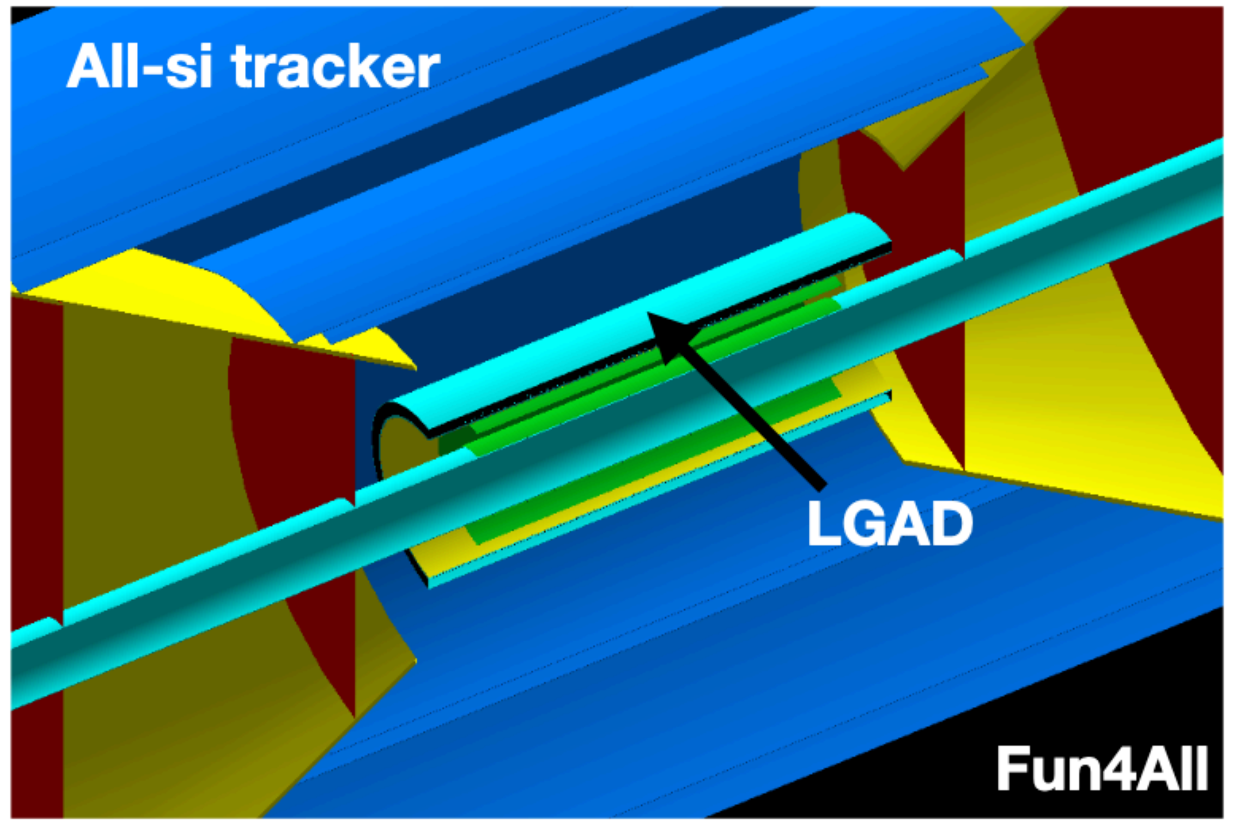
Integration with Si layers

Slide from Wenqing (21/06/14)

LGAD Material Budget and characteristics

https://github.com/reynier0611/g4lblvtx/blob/master/macros/auxiliary_studies/simplified_geometry/G4_TTL_EIC.C

Resolution: $500\ \mu m/\sqrt{12}$

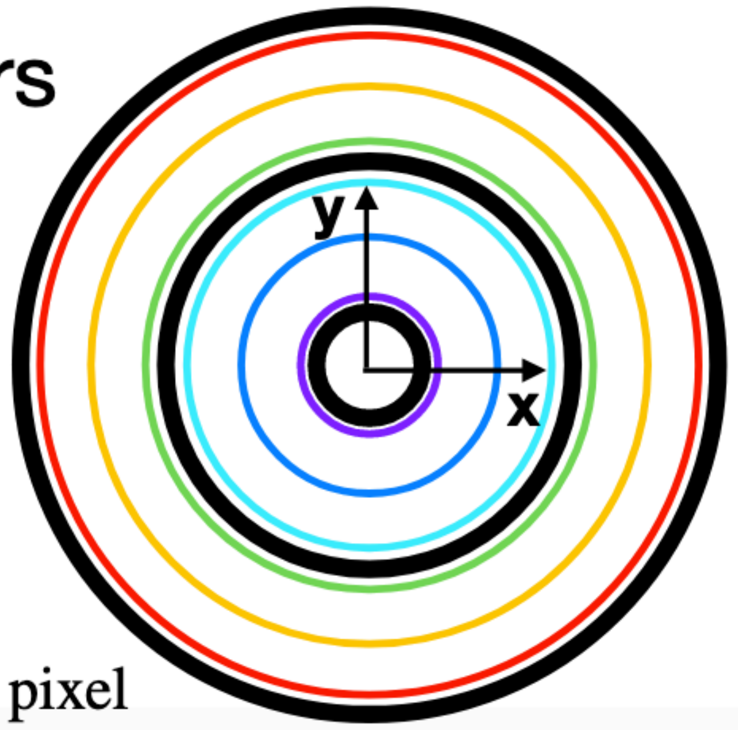


Component	Material	Thickness	X/X0 [%]
Silicon Sensor	Silicon	85 µm	0.091
Metal connection	Aluminum	0.15 mm	0.169
HDI	Kapton	0.2 mm	0.0700
Cooling	Water	1 mm	0.277
Support	Graphite	0.5 mm	0.259
Support Gap	Air	1 cm	0.003
Support	Graphite	0.5 mm	0.259
			1.13

All-silicon tracker layers

Barrel layer	radius [cm]
1	3.30
2	5.70
3	21.00
4	22.68
5	39.30
6	43.23

$10\ \mu m$ pixel



R_{LGAD} = 6.2 cm
R_{LGAD} = 12.6 cm
R_{LGAD} = 19.0 cm
R_{LGAD} = 23.2 cm
R_{LGAD} = 30.1 cm
R_{LGAD} = 37.0 cm

2

- Sangwa (SBU) is co-ordinating with Berkley group to integrate GridPix with Si Layers for tracking with realistic field cage/readout/ material implementation.

Two possibilities:

1) 23.2 cm to 37 cm (~10 cm track length) Mag Field will add to it also.

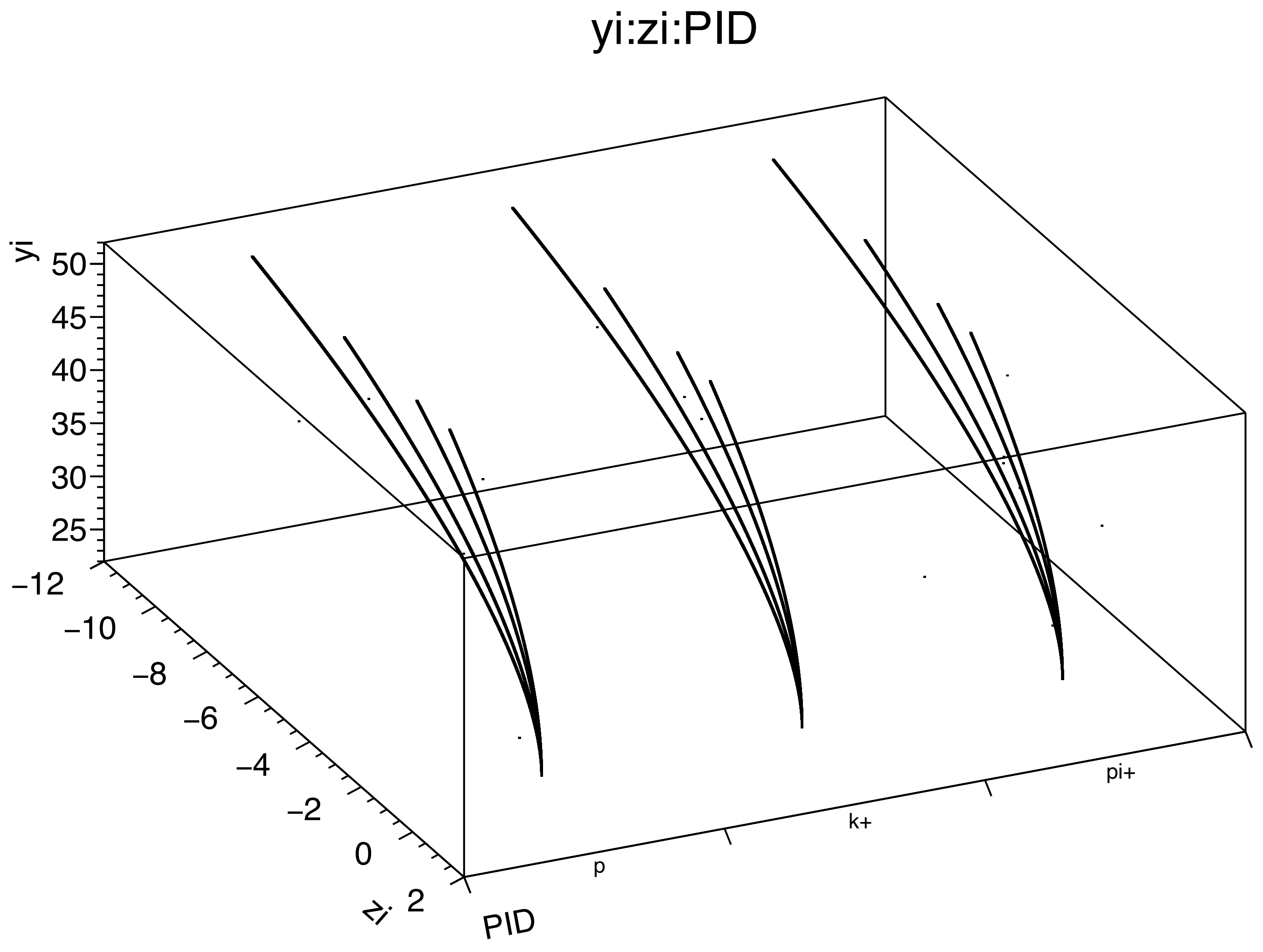
2) 6.2 cm to 37 cm (~30cm track length)

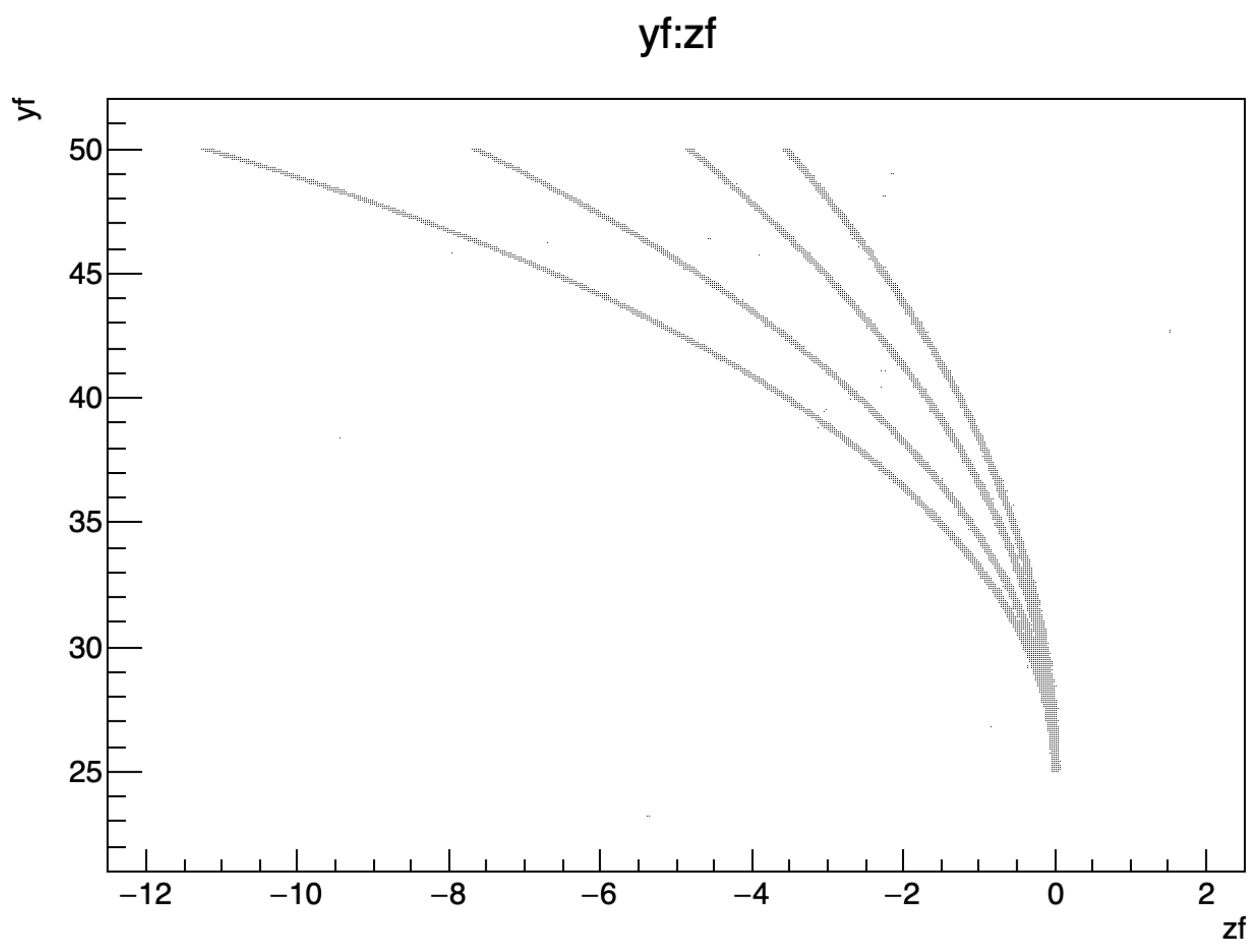
Benefits: Cooling drop with reduced Area

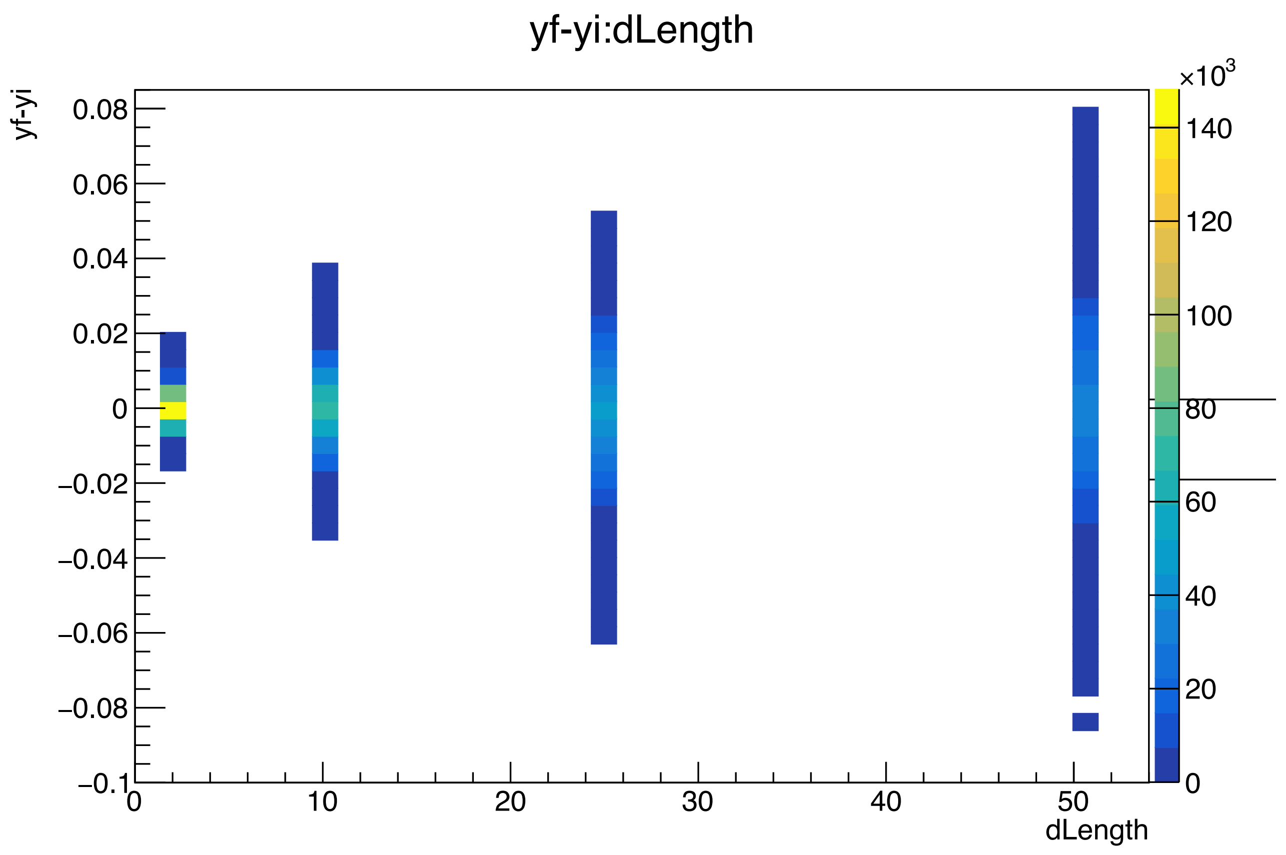
a) for short track length : 45% of our initial proposal in terms of **cost+Power+radiation length+Mass of supplies**

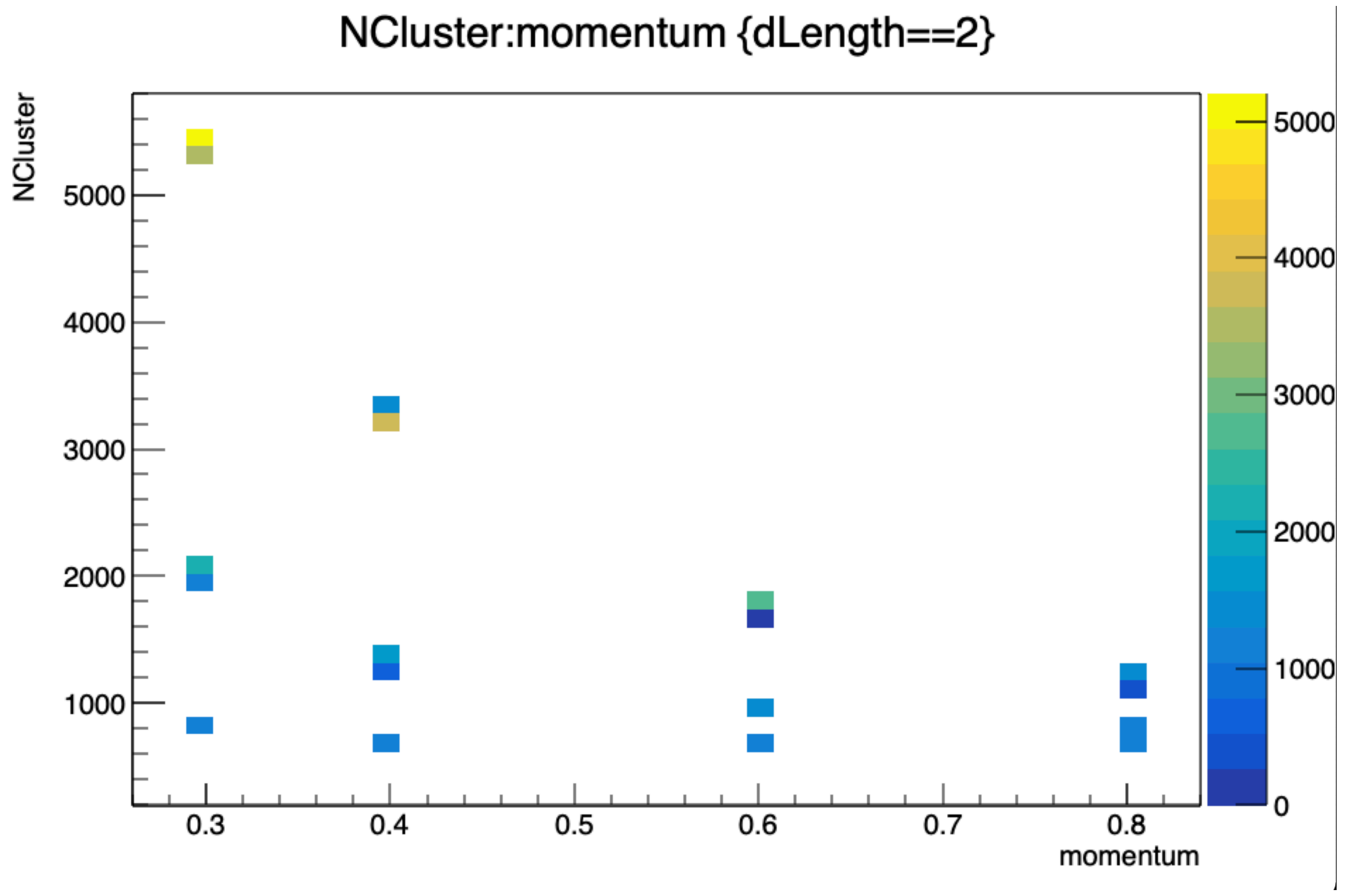
b) Even larger track 0f 24 cm: **75% of our initial thought (were doing from 25cm to 50 cm)**

Garfield++ to check primary ionization etc. in DD4HEP implementation



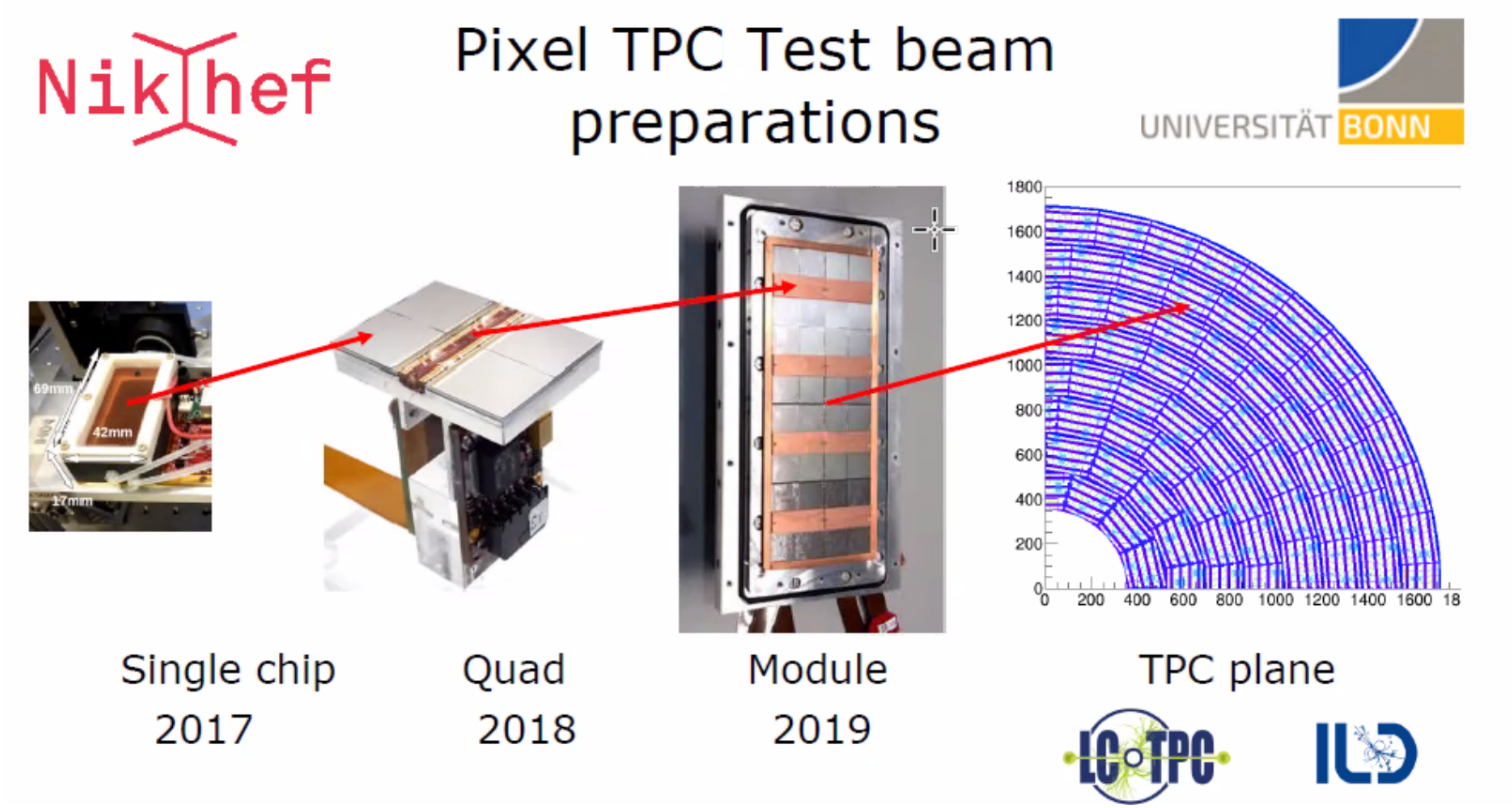






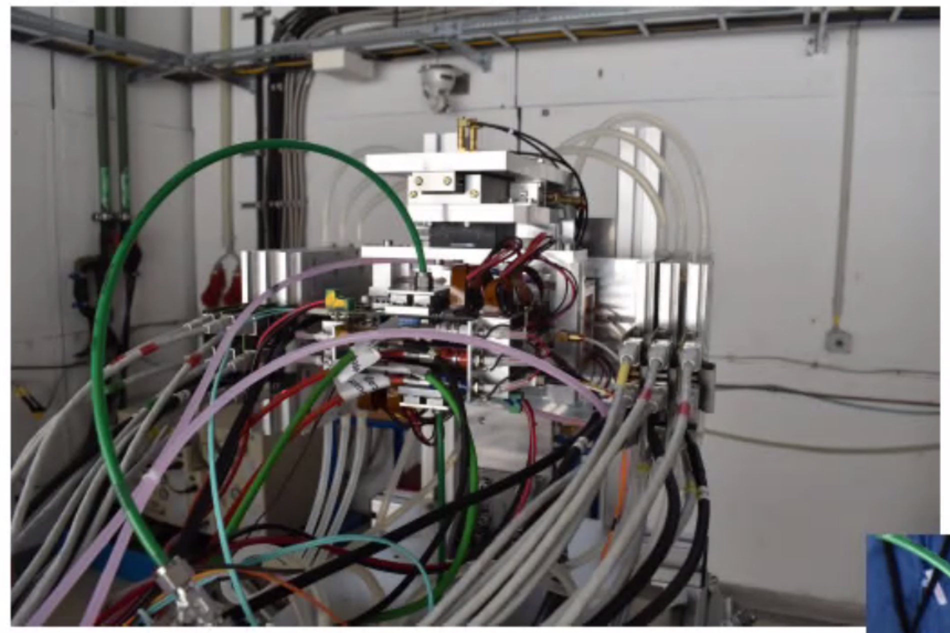
Ongoing Test Beam with GridPix Readout at DESY

from: Jochen Kaminski (Bonn)

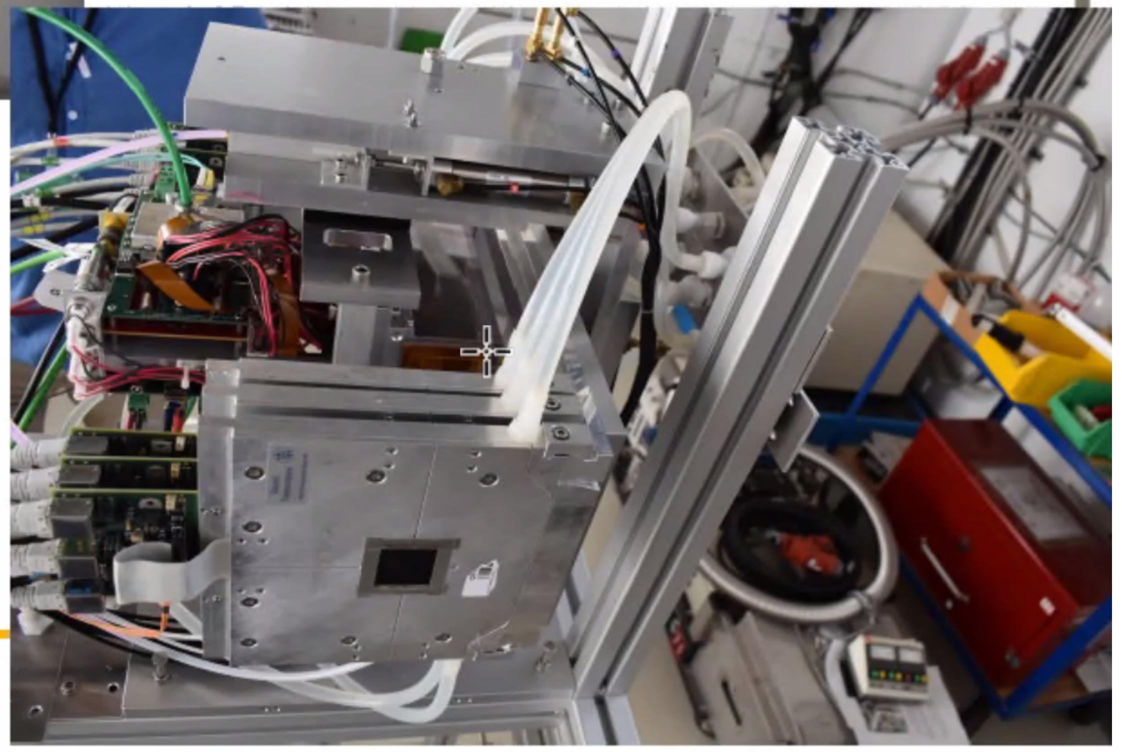


Slides from Jochen (Bonn)

Pictures of the Setup



Last week everything was set up together with the EUDET telescope Azalea.



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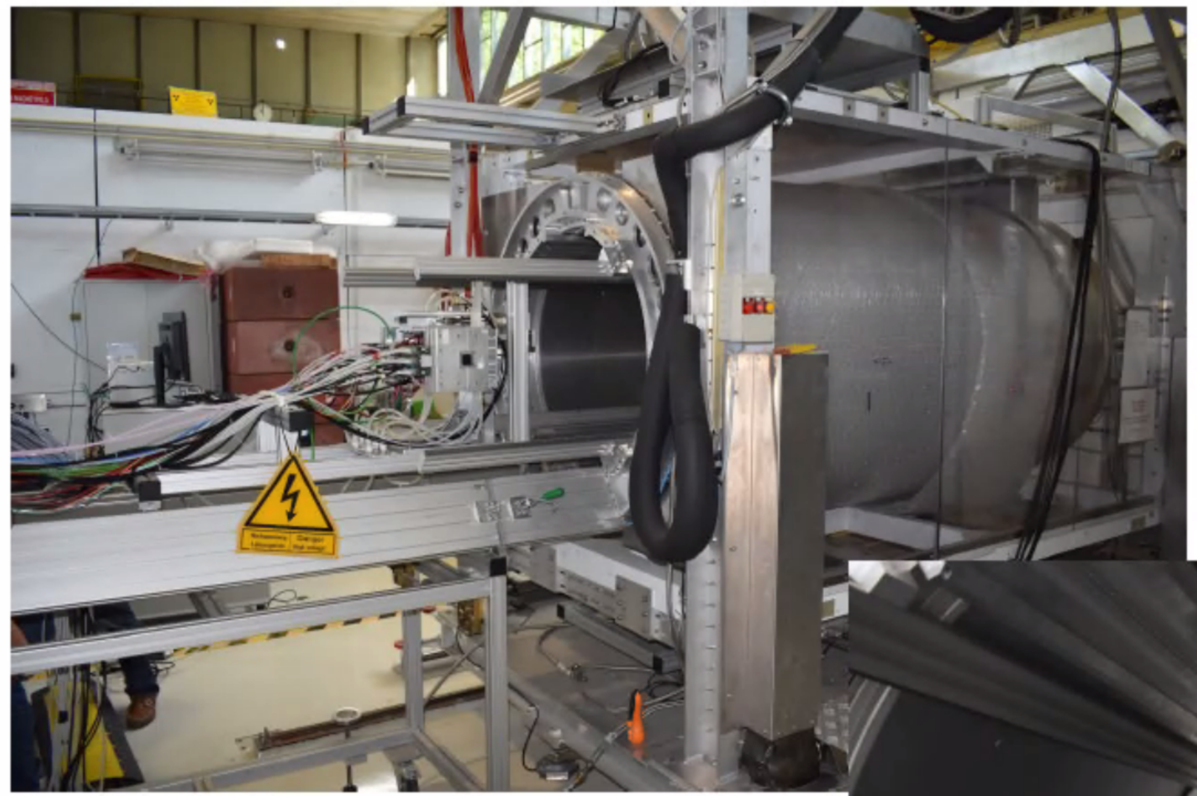
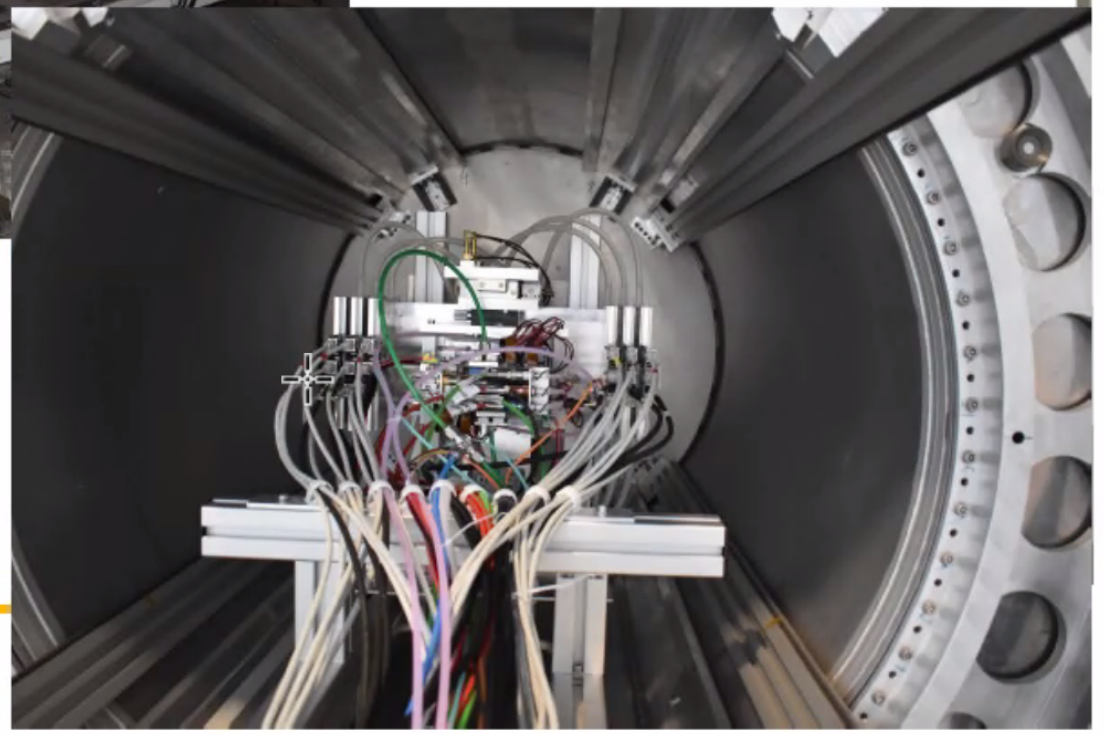
Setup in PCMAG



It was pushed into the magnet.

After some problems with HV lines, everything worked fine.

Started productive data taking on Sunday.



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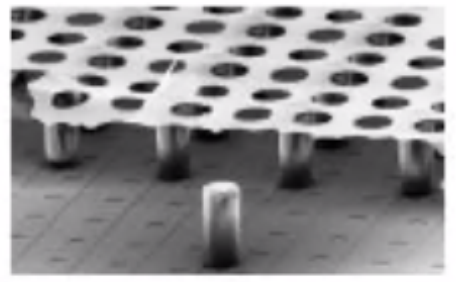
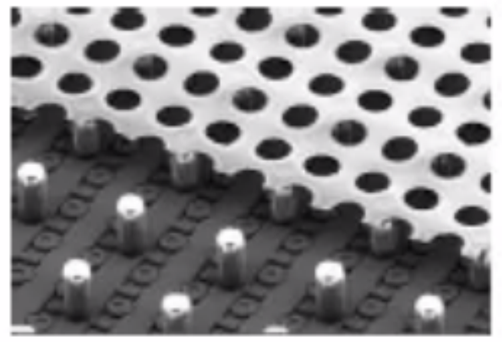
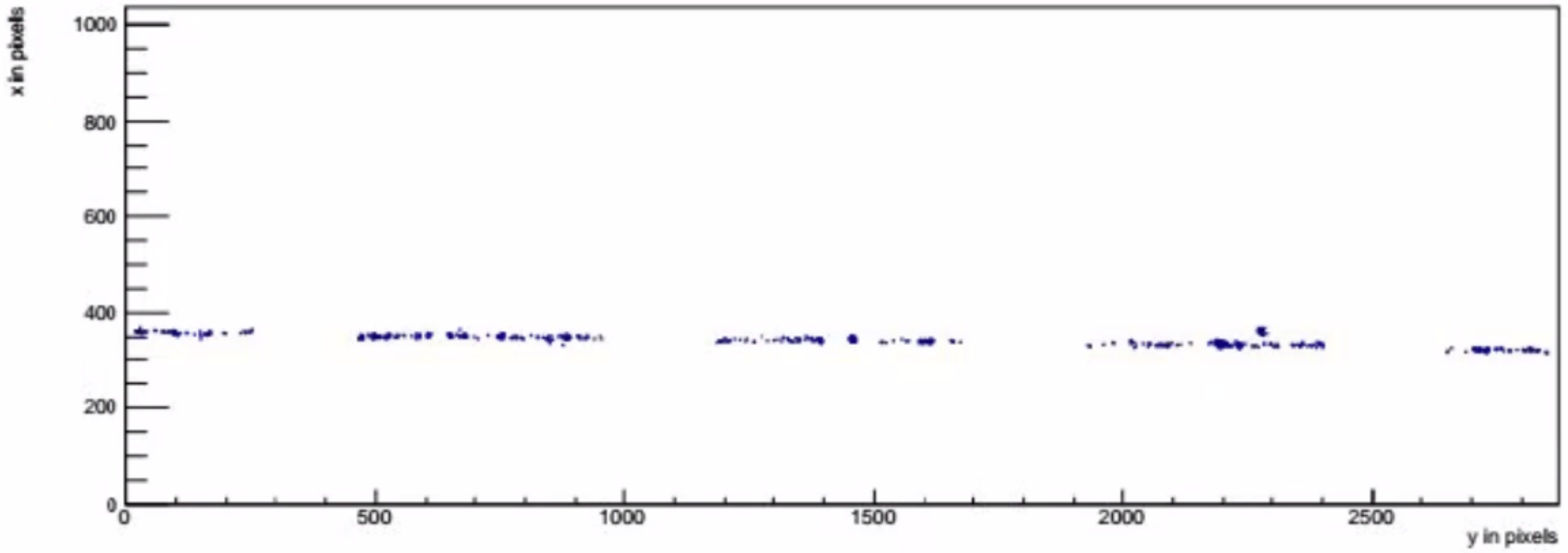


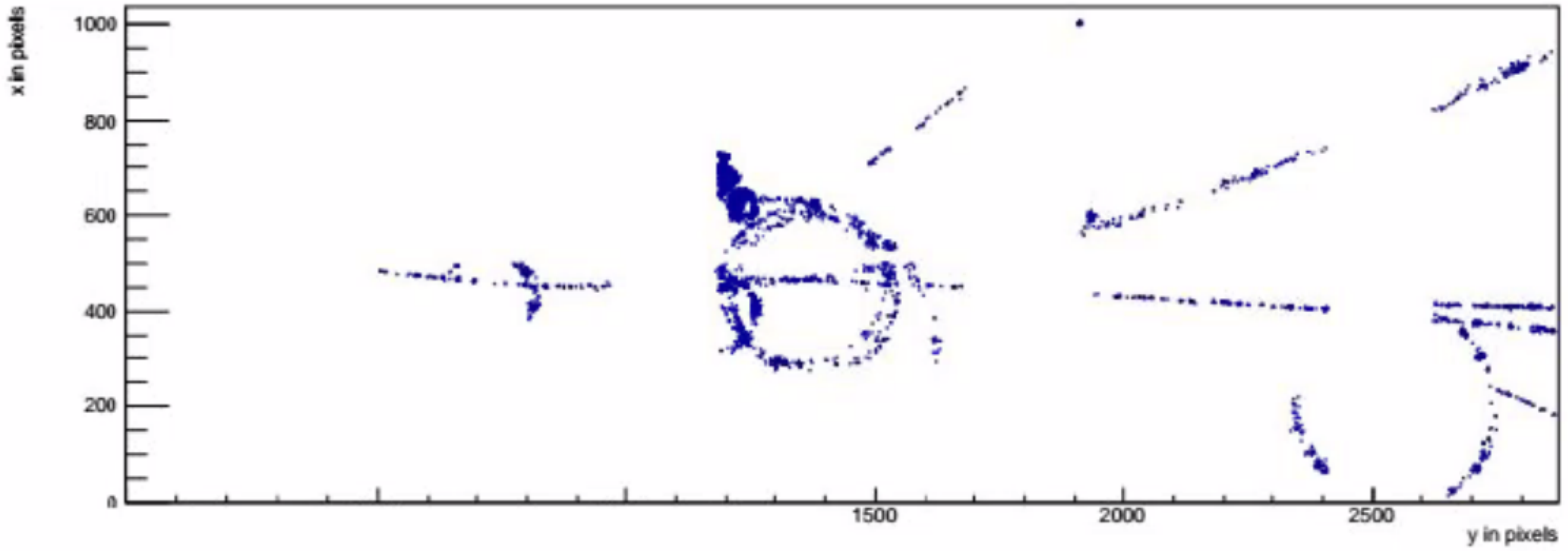
Event Pictures at B = 0.5 T



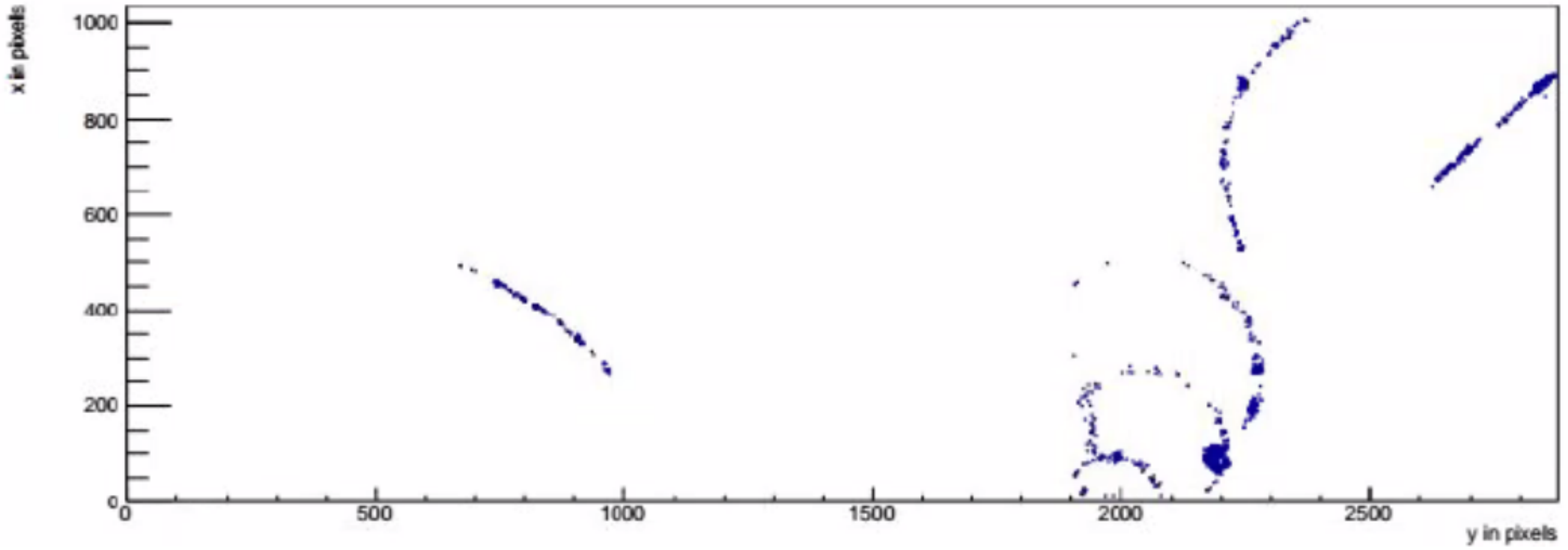
Slides from Jochen (Bonn)



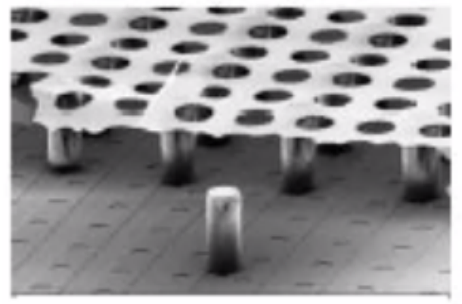
Tracks at
Drift d = 0.5-1.5 cm
T2K gas
B =0.5 T
p = 6 GeV/c



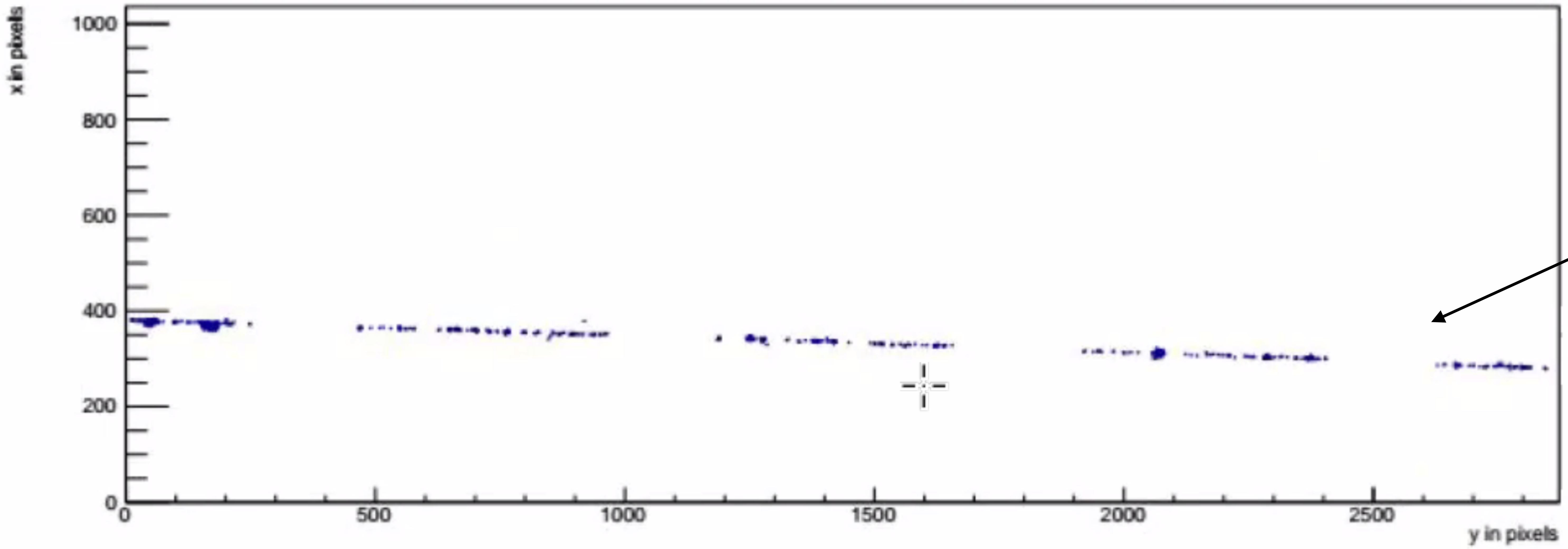
Topological Decays can be identified also



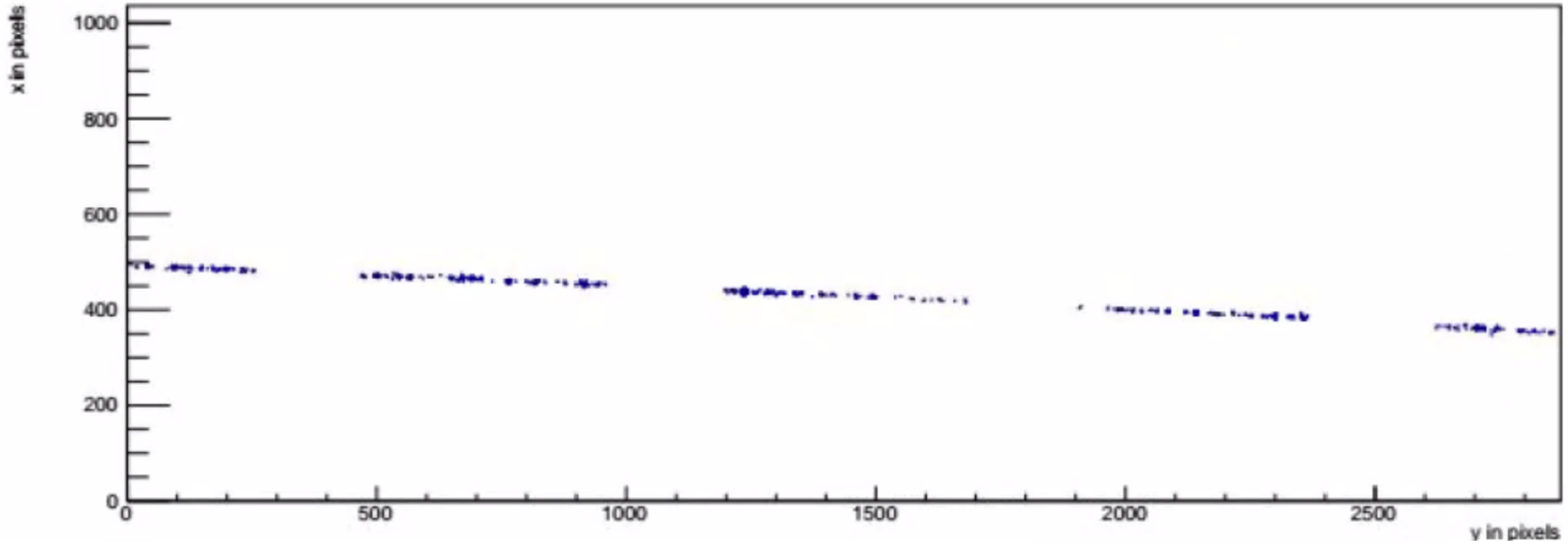
Slides from Jochen (Bonn)



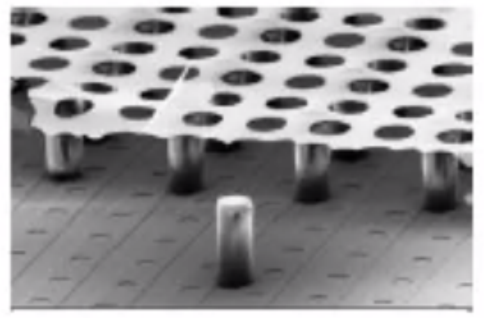
Event Pictures at B = 1 T



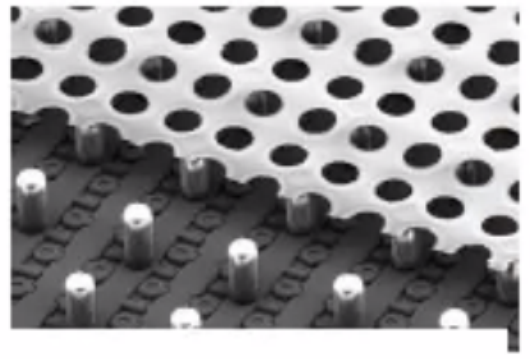
TimePix4 will have less dead area

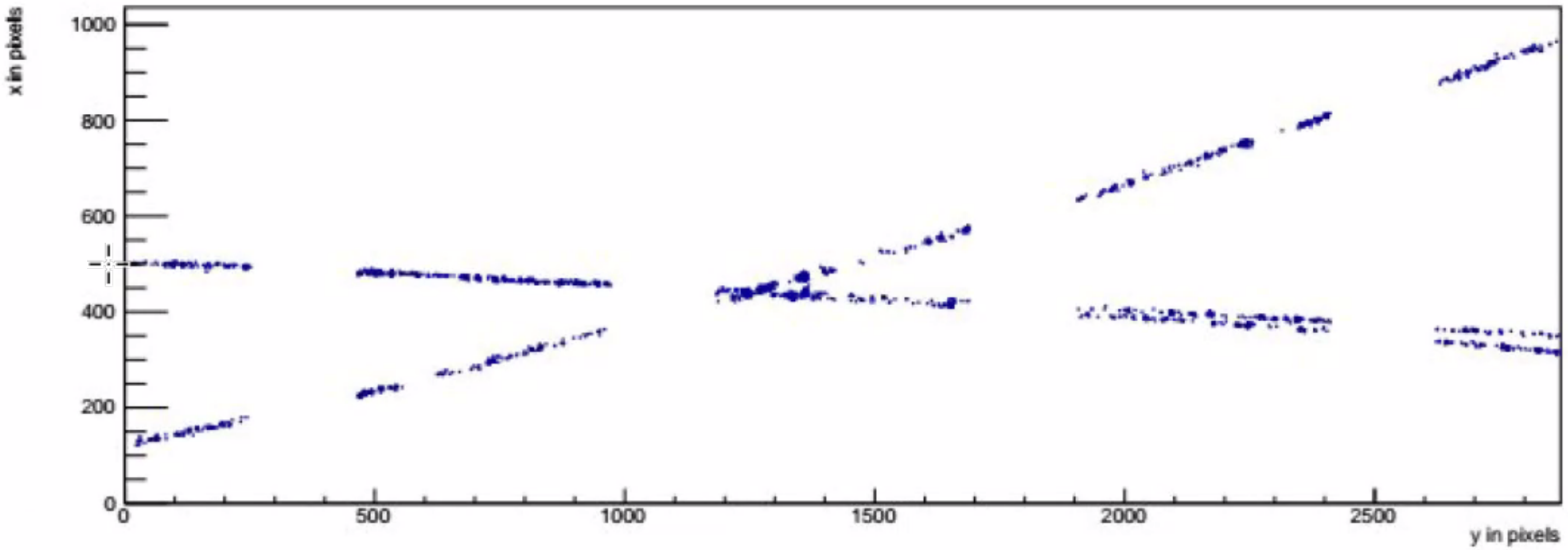


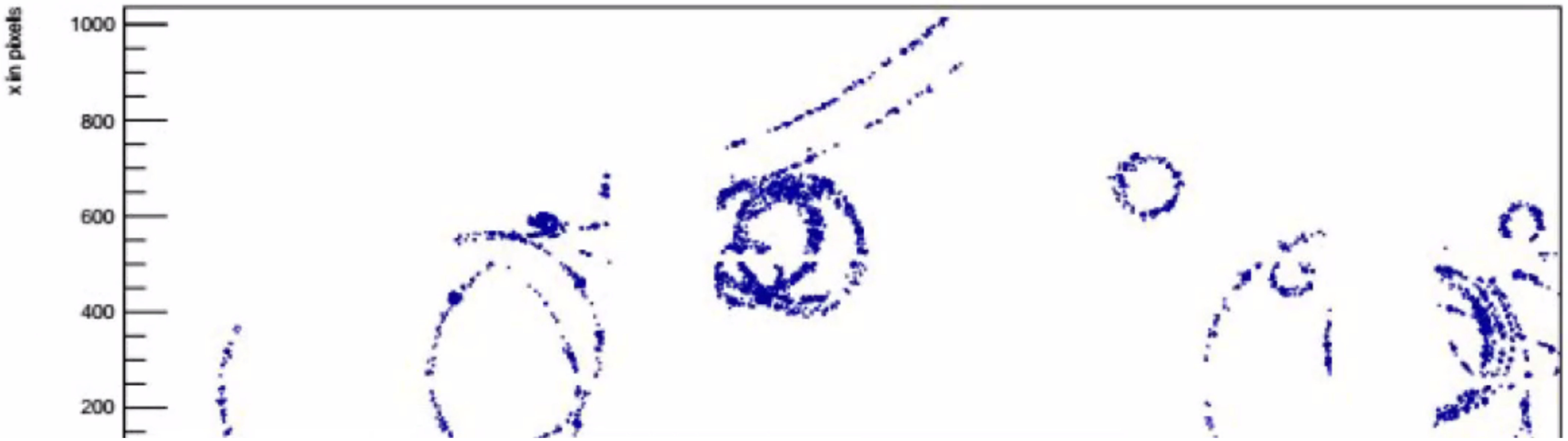
Slides from Jochen (Bonn)



Event Pictures at B = 1 T







Slides from
Jochen (Bonn)

Easy to identify delta-electron clusters