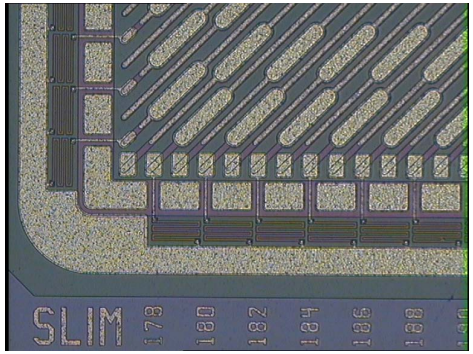
Update on Trieste Activities

Lorenzo Vitale

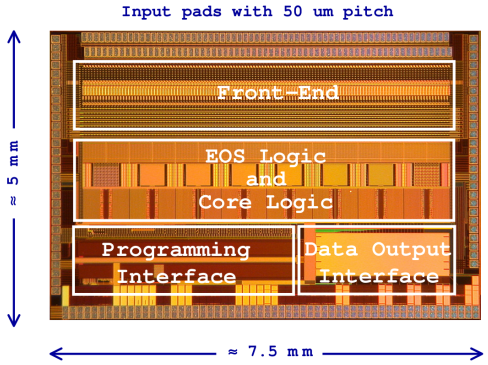
University & INFN Trieste

on behalf of Trieste SuperB Group

Luciano Bosisio, Pietro Cristaudo, Livio Lanceri, Irina Rashevskaya, Carlo Stella



Summary



Group is involved in strip(lets) detectors and in DAQ with FSSR2 (still used for beam tests)

Ongoing activities :

- Sensors and Fanout specifications for the TDR
- Beam Test in Sept. (Spare telescope modules construction and striplets run)
- dE/dx in SVT Studies with Bruno
- Irradiation tests

Sensors and Fanout for TDR

- L.B. has had a preliminary contact with Hamamatsu, Micron, FBK-irst, Sintef, CiS, (E2V) for the procurement of double sided silicon strip sensors for the 6 layers of SVT. News from our last meeting: it seams feasible to increase the metalization thickness to reduce R_{series}
- For the fanouts of layers 1-5 we are considering CERN and also possible alternatives (e.g. two Italian companies TVR and Cistelaier)

Activities

- Measurement of the parameters of the striplets sensor, and possibly an estimate of the radiation effects
- L1-5 Definition of the sensor charateristics (dimentions , strip pitch, bias resistors, …). (Layout → 2012)
- L1-5 Estimate of the modules capacity and series resistance.
- Beam Test …

Spare telescope modules and beam test (Sept. 2011)

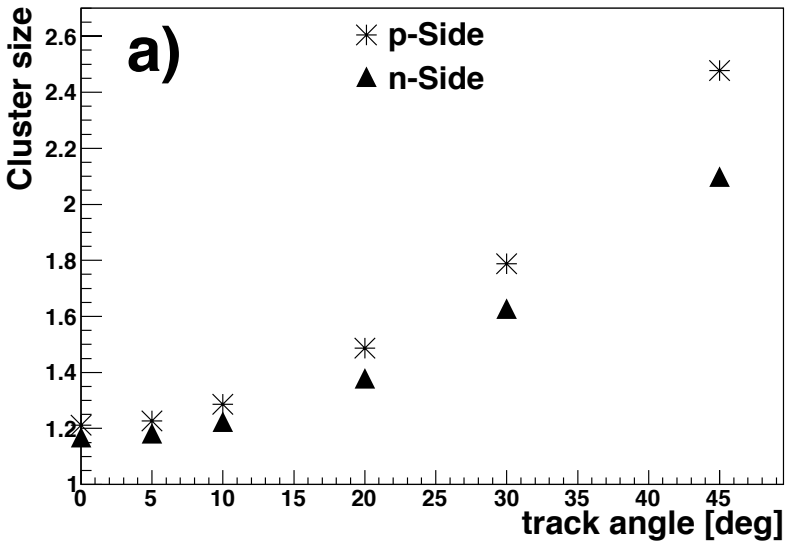
- We are building other 4 telescope modules with a FSSR2 in order to a have a 3+3 telescope configuration; 5 were already available and used in 2008-2009 beam tests in a 2+2 configuration.

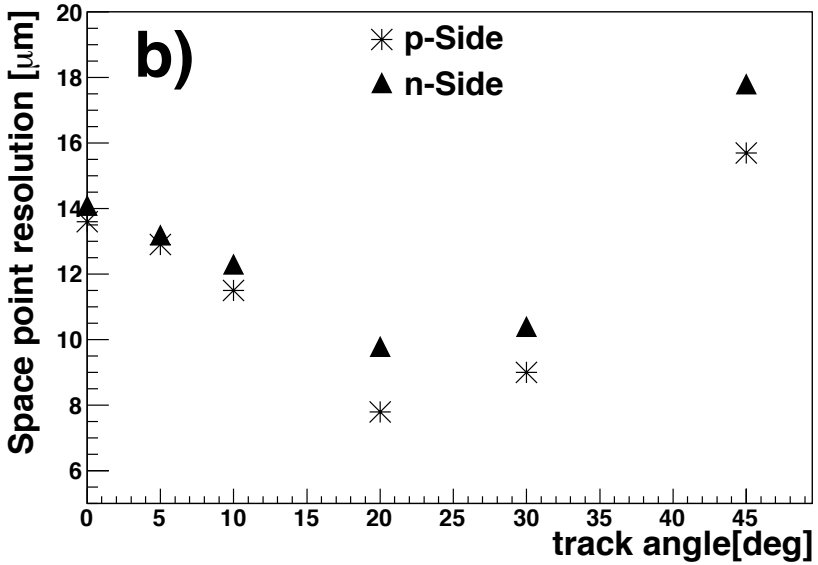
- A striplets module was also tested in 2008, and it can be tested again at higher angles and lower thresholds.

Striplets results in 2008

Detector	Striplets		Telescope	
Polarity	p-side	n-side	p-side	n-side
Noise (e^- RMS)	560	978	400	742
S/N	29	16	60	32
Gain (mV/fC)	96	67	97	67
Thr.Dis. (e^- RMS)	565	600	565	600

125ns shaping time.
Expected noise 320e-
for C=4pF Tele (≈Striplets)





Eff./Reso. for the Striplets

ϑ in degrees	p-side Eff within 80µm* (80/cosϑ)	n-side Eff within 80µm (80/cosϑ)	p-side Spatial Resolution	n-side Spatial Resolution
0	98.2	98.3	13.6	14.1
5	97.2	97.9	12.9	13.2
10	97.7	97.8	11.5	12.3
20	97.8	97.9	7.8	9.8
30	98.0 (98.0)	98.2 (98.2)	9.0	10.4
45	98.0 (98.3)	96.7 (97.1)	15.7	17.8
60	**95.5 (98.0)**	**90.5 (97.2)**	**To be defined**	**To be defined**
70	**78.9 (98.9)**	**78.8 (98.7)**	**To be defined**	**To be defined**

At 45° start deteriorating

*≈ 5 s.d. of residual distribution

dE/dx in SVT

- Carlo Stella (diploma student) is studying dE/dx in the 6 double layers of SVT
- Study was driven by FSSR2 (that provides a 3-bit ADC information for each recorded hit)
- We started looking at full simulated events BRUNO (with 200 μm cylindrical Layer0)
  - e+e-e+e- (pairs) 160k events
  - Single particle (momentum distributions as inclusive *soft π's* from ϒ(4s) and cc) 50k

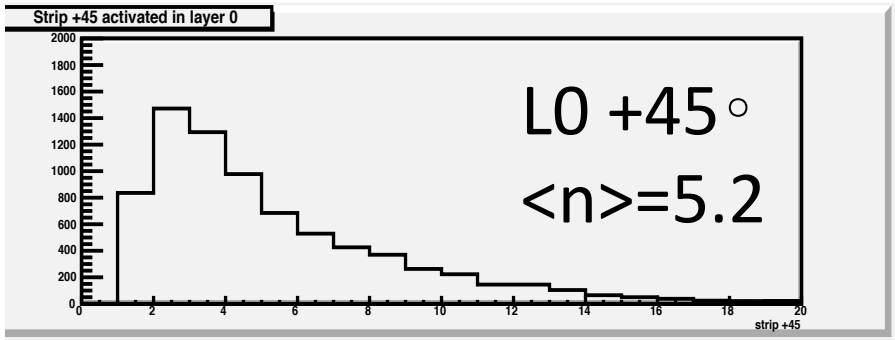
dE/dx in full simulated data

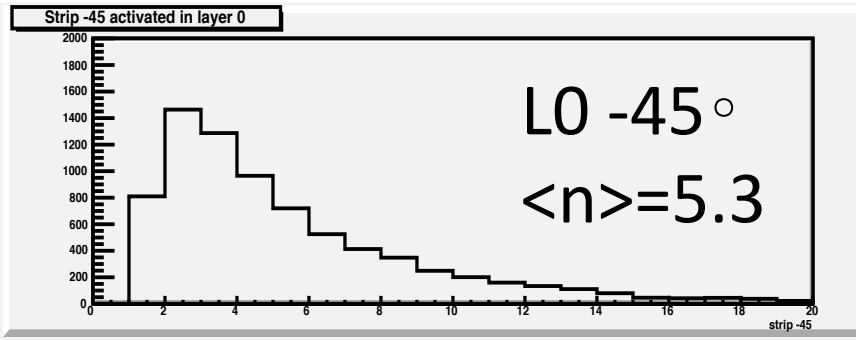
- "Digitized" dE: the strips have
  - Striplets pitch in Layer0 and the BaBar pitch in L1-5
  - share released energy: a flash ADC scheme a la FSSR2 with linear and logarithmic thresholds:

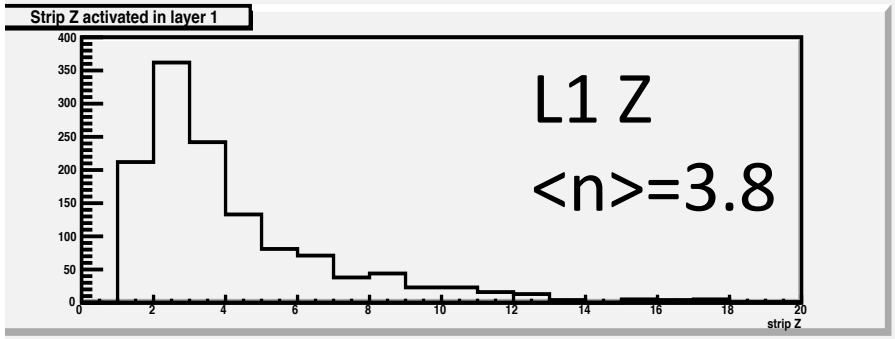
	1	2	3	4	5	6	7	8
Linear	0.20	0.35	0.50	0.65	0.80	0.95	1.10	1.25
Log	0.20	1.23	1.74	2.47	3.50	4.96	7.04	10

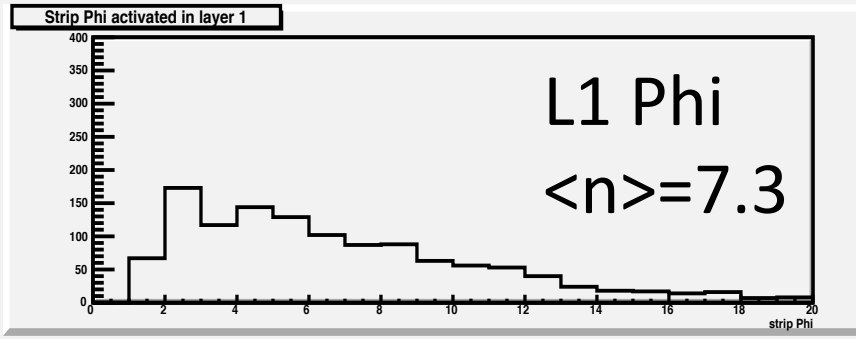
- We are trying to understand several things:
  - What resolution can be achieved with 3 bits
  - How FSSR2 thresholds need to be set
  - What is the optimal number of adc bits (3-4 bits)

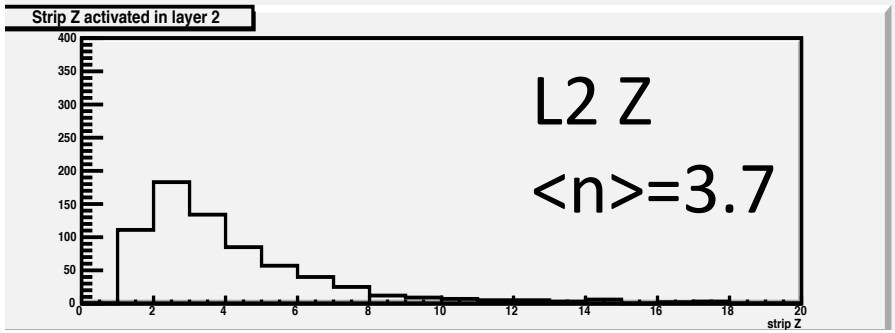
Strip multiplicity e± from pairs after a 1st threshold cut on 20% Mip

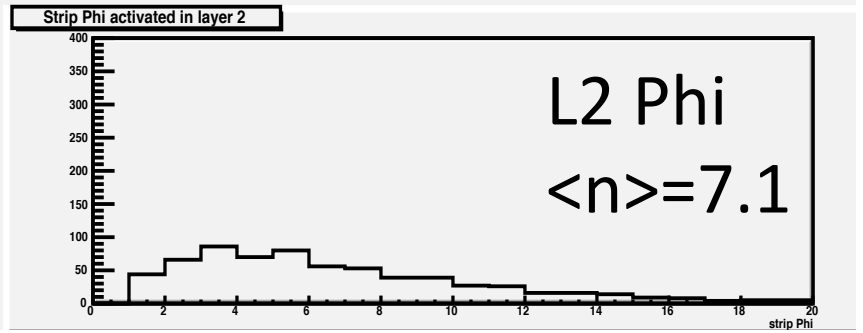








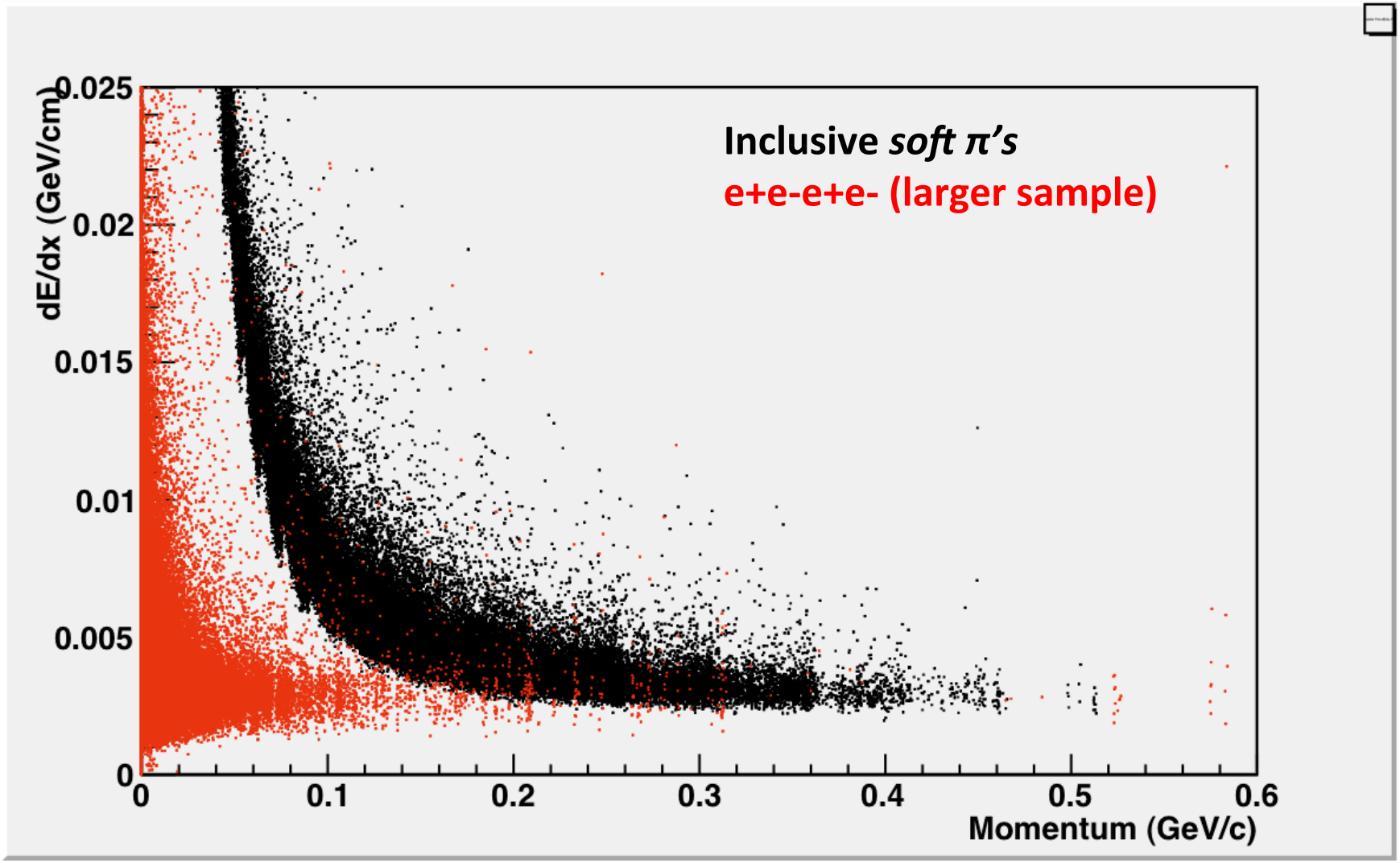




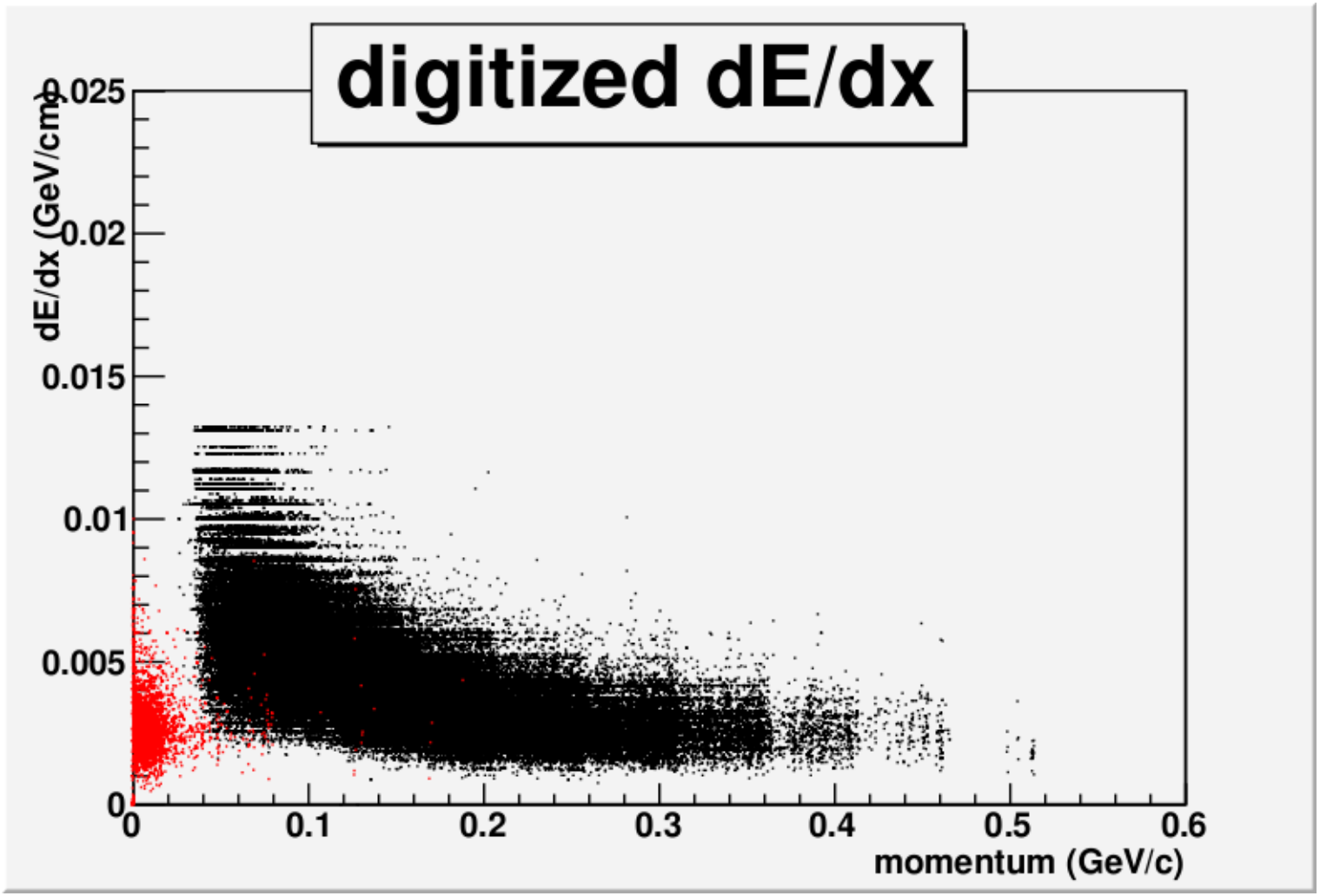
Average strip multiplicity for e± from pairs (*soft π's)*

Layer	RO PitchZ (or +45◦) µm	<n>_Z	RO PitchPhi (or -45◦) µm	<n>_Phi
0	50	5.2 (4.1)	50	5.3 (4.0)
1	100	3.8 (4.2)	50	7.3 (2.8)
2	100	3.7 (4.1)	55	7.1 (2.6)
3	100	3.9 (4.0)	55	8.2 (2.5)
4	210	1.6 (2.0)	100	3.9 (1.9)
5	210	1.9 (2.1)	100	3.1 (2.4)

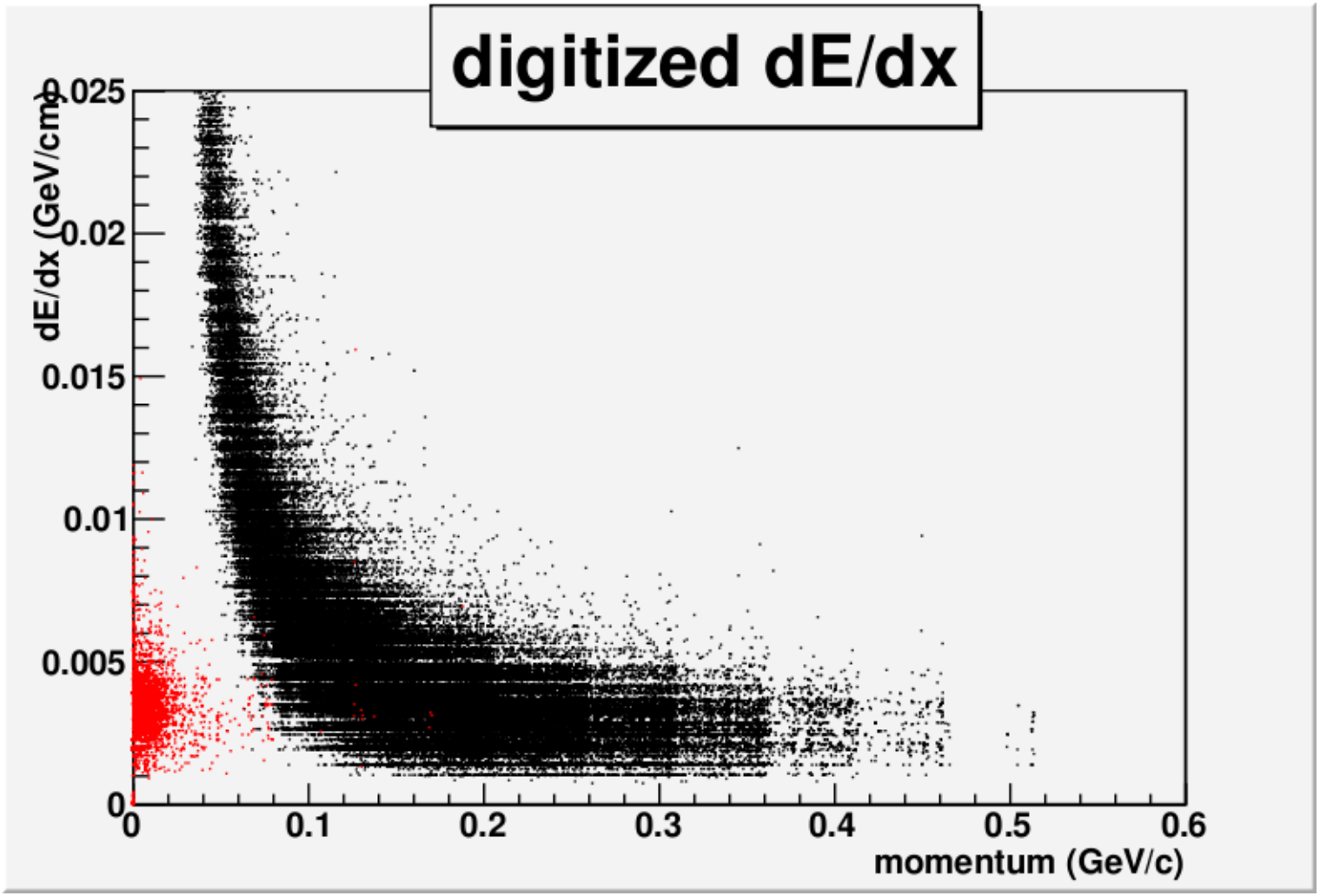
Initial dE/dx info from BRUNO



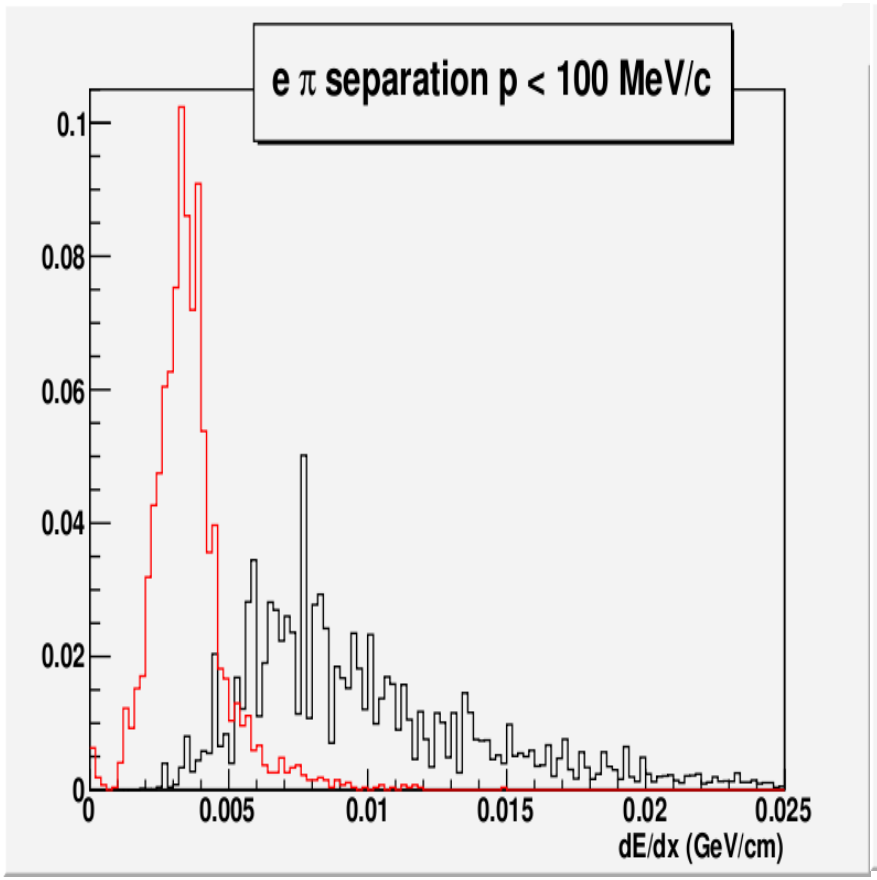
“Digitized” dE/dx for Phi strips
8 linear Thresholds 0.2Mip-1.25Mip

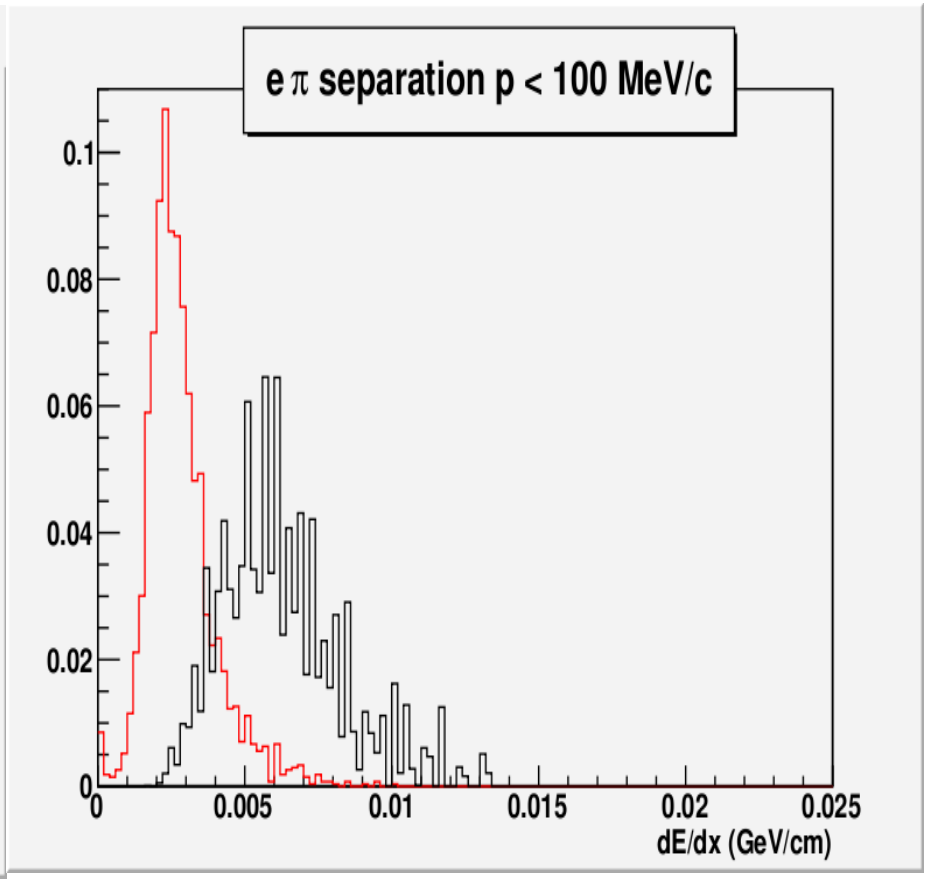


“Digitized” dE/dx Phi strips
8 log Thresholds 0.2Mip-10Mip



e-π separation after digitized dE/dx





dE/dx in SVT

- Landau fits in different momentum intervals are in backup slides
- Some technical problems for e± larger sample
- For Z strips there is a bias when 1 strip only is fired
- For Striplets similar results (but same results for ±45◦)
- Need to make more cross checks
- No room in this presentation for all details

(Carlo can make a longer presentation in SVT meeting)

Summary dE/dx in SVT

- Tools are useful and promising.
- Work still in progress:
  - Quantify the e-π separation within different options (tracks vs clusters only, 3-4 bits)
  - Compute rates and normalizations
  - Input welcome

Backup Slides

SuperB SVT
Silicon Sensor Suppliers

Issue separated tenders for Layer 0 and for Layers 1-5

- different thickness (and wafer size?)

==> some suppliers could fabricate only one of the two

Mail enquiring for interest sent to:

- Micron
- Sintef
- CiS (Erfurt, D)
- Hamamatsu

Time frame for market survey: early 2012

Silicon Sensor Suppliers

Description sent to the potentially interested suppliers:

Preliminary description of the Silicon Microstrip Sensors for the Silicon Vertex Tracker at the Super-B-Factory

Inner Layer (LY0):
- Double Sided Microstrip Sensors
- 200 µm thick
- Size ~ 102 mm X 20 mm (--> does not fit on a 100 mm wafer)
- AC-coupled, with polysilicon resistors (R ~ 1 Mohm)
- 50 µm strip pitch on both sides
- ~ 25 good sensors needed

Outer Layers (LY1-5):
- Double Sided Microstrip Sensors
- 300 µm thick
- 6 different models, differing in size and strip pitch (including one with trapezoidal shape); they all can fit on a 100 mm wafer
- AC-coupled, with polysilicon resistors (R ~ 5-10 Mohm, depending on model)
- 50-150 µm strip pitch
- ~ 600 good sensors needed

Answers received so far

- Micron
  - Very much interested, can make both types
- CiS
  - LY1-5 OK, for LY0 maybe in one year
- Hamamatsu
  - Answer received from Japan headquarters:
    - They work on 150 mm wafers only
    - Minimum thickness 320 µm *(acceptable for LY1-5 ?)*
- Sintef
  - Responsible person was absent; I will meet him this week in Trento
  - From their published realizations, I think they can make both types; we must see if they are interested

What about FBK-irst?

- They have the technical capability for LY 1-5

- They are not in a position to supply LY0 sensors
  - 200 µm 2-sided processing OK

  BUT
  - Wafer size presently limited to 100 mm
  - Fab line upgrade to 150 mm under discussion, but not feasible soon enough to participate in this supply

- I will be in Trento this week, will talk to them

A second possible supplier in UK?

- Mail from A. Bevan: E2V (http://www.e2v.com), known for CCDs and CMOS image sensors, could be interested in supplying strip detectors (??).

- He will investigate….

- The step does not look a simple one: strip detectors (not to mention double-sided ones) have different processing requirements from CCDs and CMOS image sensors…

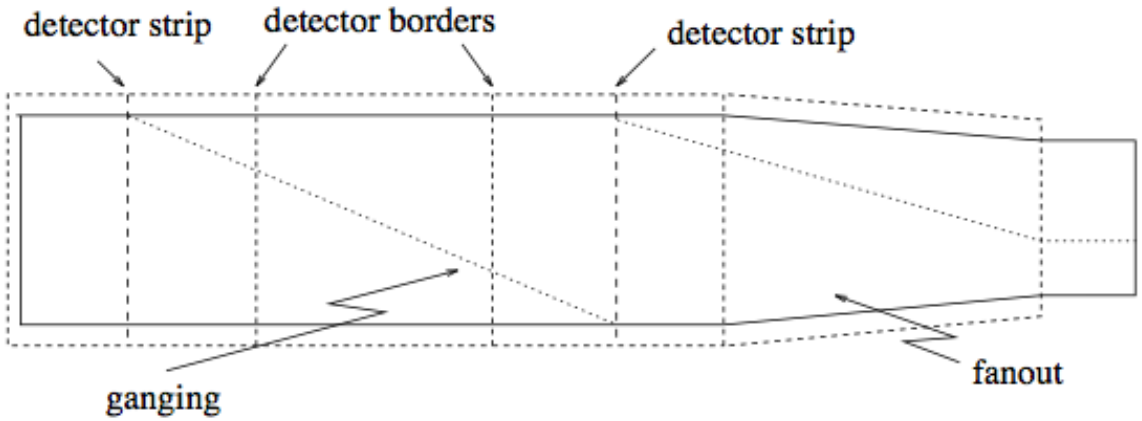
Some Final Fanout parameters from BaBar

Biblio: TDR, BaBar Notes 376 (Fanout specs), 307 (Assembly), 312 (Final Geom), 273 (Numbering Conventions), 306, 392, BaBar detector.

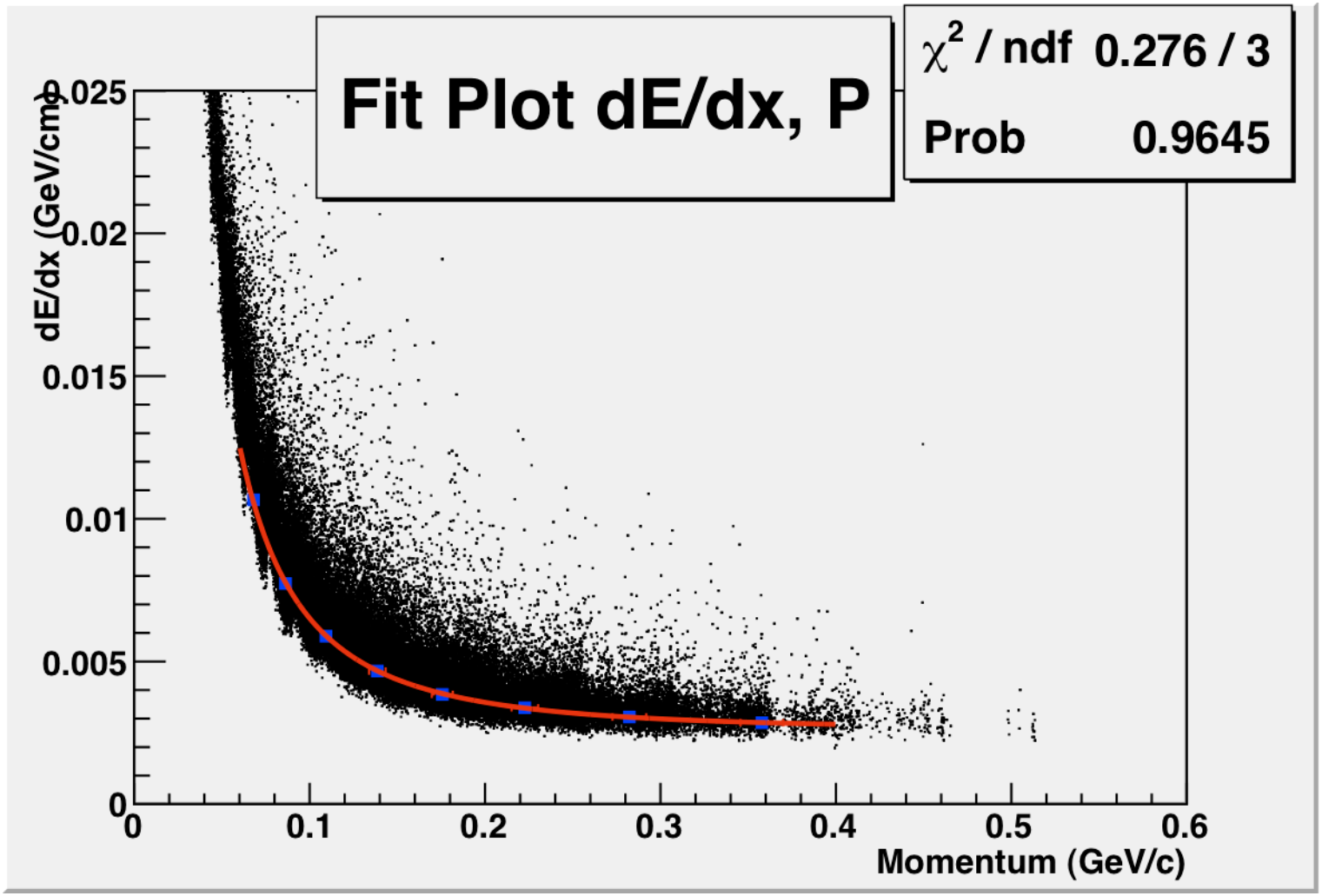
- 50 µm thick Upilex substrate
- 4.5 µm Cu layer deposited on 150 nm layer of adhesive Cr
- <1 µm Au layer on another 150 nm layer of Cr
- Average rad. length 0.03%X_0
- R=1.6 Ω/cm R_{IS}>2MΩ
- C_{IS}=0.52pF/cm

Some Fanout parameters from BaBar (cont.)

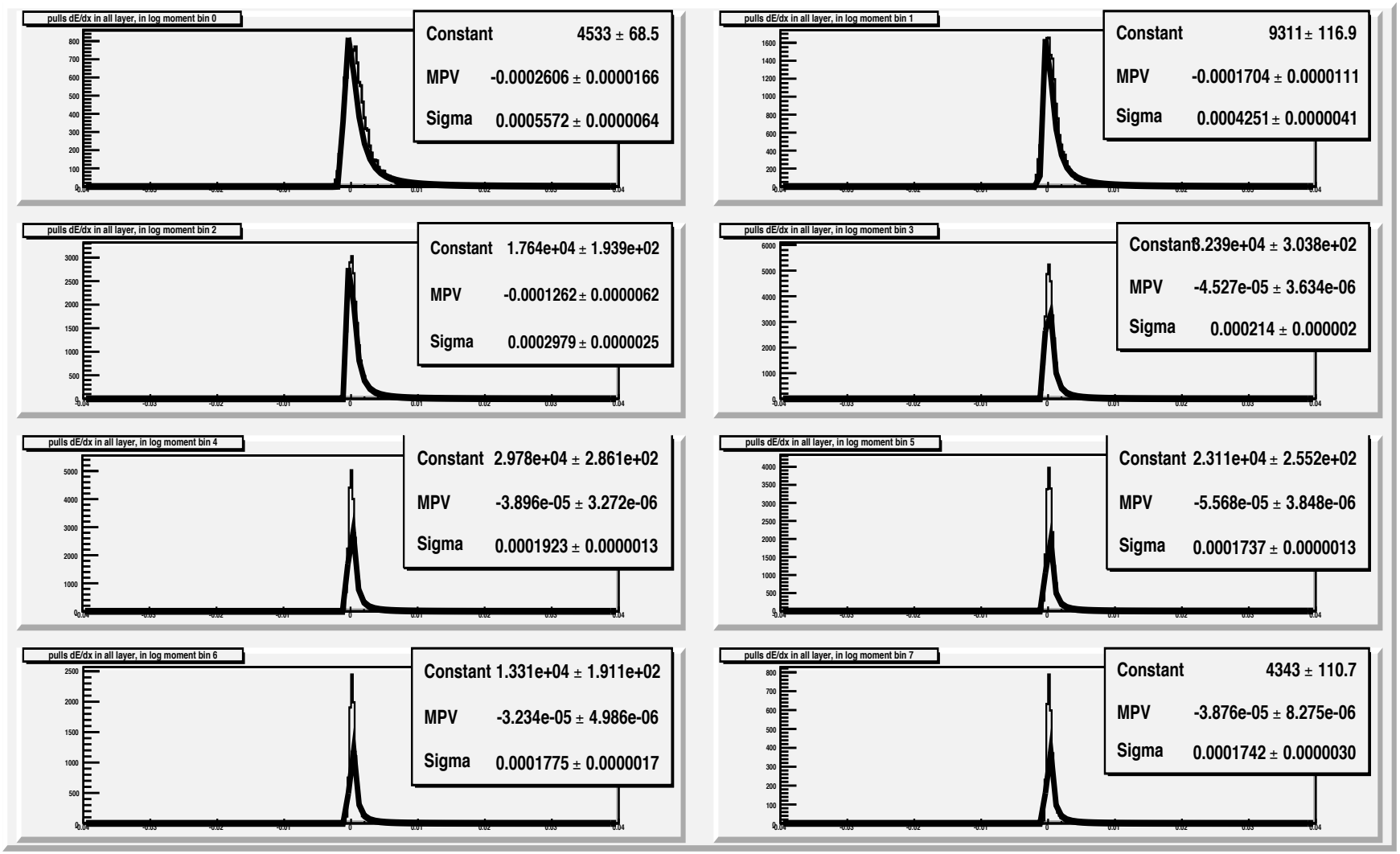
- 28 different designs to accommodate all layer specs: 01 02 03 4A 4B 5A 5B; Forw Backw; Z Phi.
- Total 208 fanouts for the 6 6 6 16 18 modules
- Minimum pitch 41 µm (on wafer type VI Wedge)
- Line width depends on strip pitch, 30(70) µm on 100 (210) µm strip pitch, reducing to 20 µm on electronics side (min. 8 µm)
- 2x Ganging on Layers Z 4 & 5 (from 55% to 98.9 %)



Fit of initial dE/dx info for π



dE/dx π in 8 p slices (60-400MeV/c)



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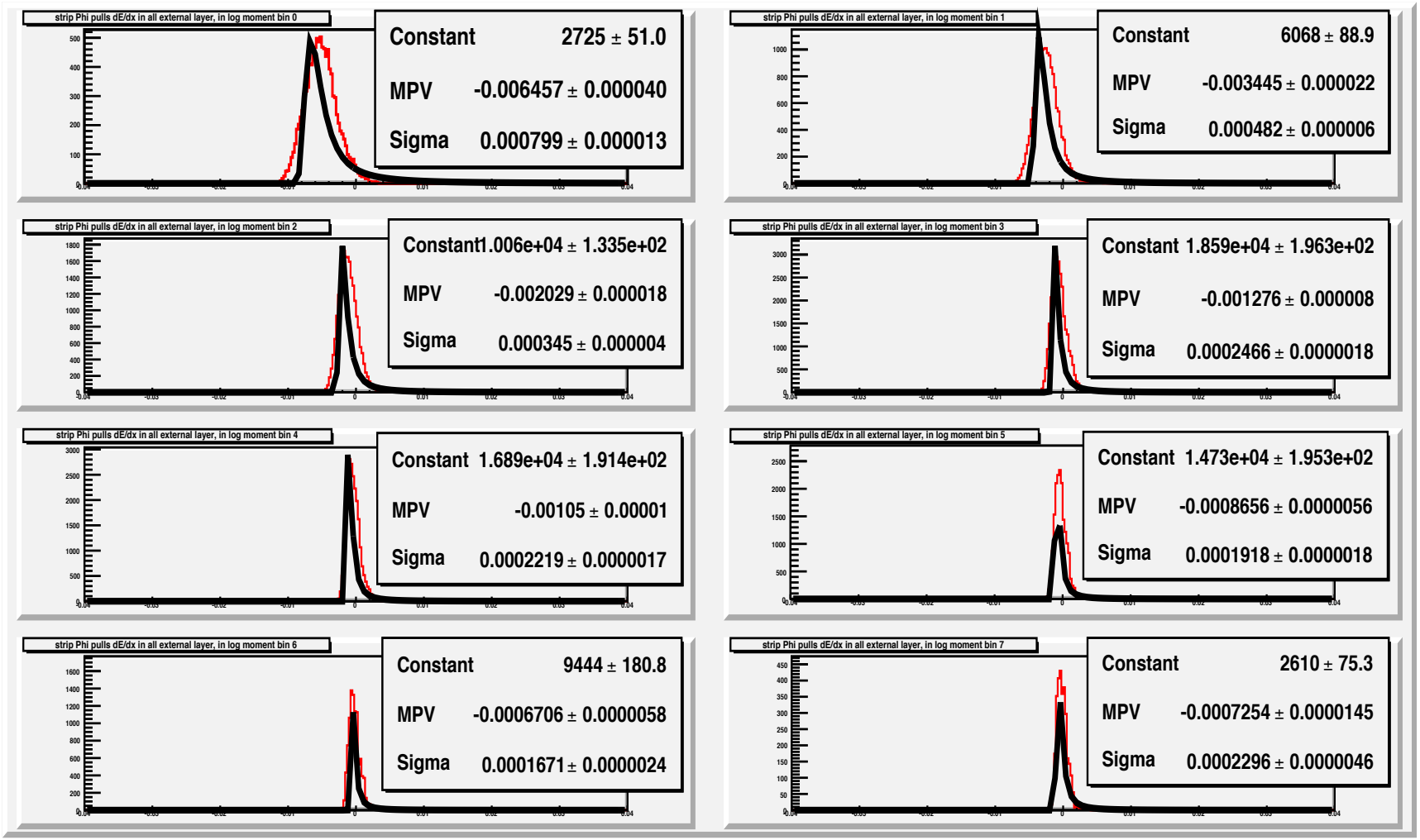

“Digitized” dE/dx Phi strips
8 log. Thr 0.2Mip-10Mip