DCH Summary

3rd SuperB Collaboration Meeting

LNF 22 March 2012

Presentations

[274] **Updates on mechanics**
by Stefano LAUCIANI (LNF)
(Aula A-1 Bldg 36: 11:30 - 11:50)

[275] **Discussion on tracking efficiency vs. occupancy level**
(Aula A-1 Bldg 36: 11:50 - 12:10)

[267] **BTF beam test analysis/1**
by Giuseppe FINOCCHIARO (LNF)
(Aula A-1 Bldg 36: 09:00 - 09:20)

[268] **BTF beam test analysis/2**
by Marcello PICCOLO (LNF)
(Aula A-1 Bldg 36: 09:20 - 09:40)

[262] **DCH trigger timing performances with proto2**
by Paolo BRANCHINI (ROMA3)
(Aula A-1 Bldg 36: 09:40 - 10:00)

Presentations … cont

[263] **dE/dx performance and Aging**
by Mr. Rocky SO (University of British Columbia)
(Aula A-1 Bldg 36: 11:30 - 11:50)

[264] **Performance of amplifier prototype in the TRIUMF beam test**
by Dr. Christopher HEARTY (University of British Columbia/IPP)
(Aula A-1 Bldg 36: 11:50 - 12:10)

[265] **Noise lower limit for Cluster Counting front-end electronics + update on detection efficiency of cluster counting algorithms using Garfield simulated data sets**
by Giulietto FELICI (LNF)
(Aula A-1 Bldg 36: 12:10 - 12:30)

[266] **FastSim Cluster Counting improvements**
by Mr. leonid BURMISTROV (LaL)
(Aula A-1 Bldg 36: 12:30 - 12:50)

[269] **Update on backgrounds in the DCH**
by Riccardo CENCI (PI)
(Aula A-1 Bldg 36: 15:00 - 15:20)

[270] **Cluster counting analysis of test beam data**
by Mr. Samuel DEJONG (University of Victoria)
(Aula A-1 Bldg 36: 15:20 - 15:40)

[273] **Discussion on future beam tests**
(Aula A-1 Bldg 36: 15:40 - 16:00)

[271] **DCH Enveloppe in Reality and in FastSim+dE/dx and dN/dx Simulation in FastSim**
by Mr. Jean-Francois CARON (The University of British Columbia)
(Aula A-1 Bldg 36: 16:00 - 16:20)

Backgrounds – R. Cenci

Conclusions

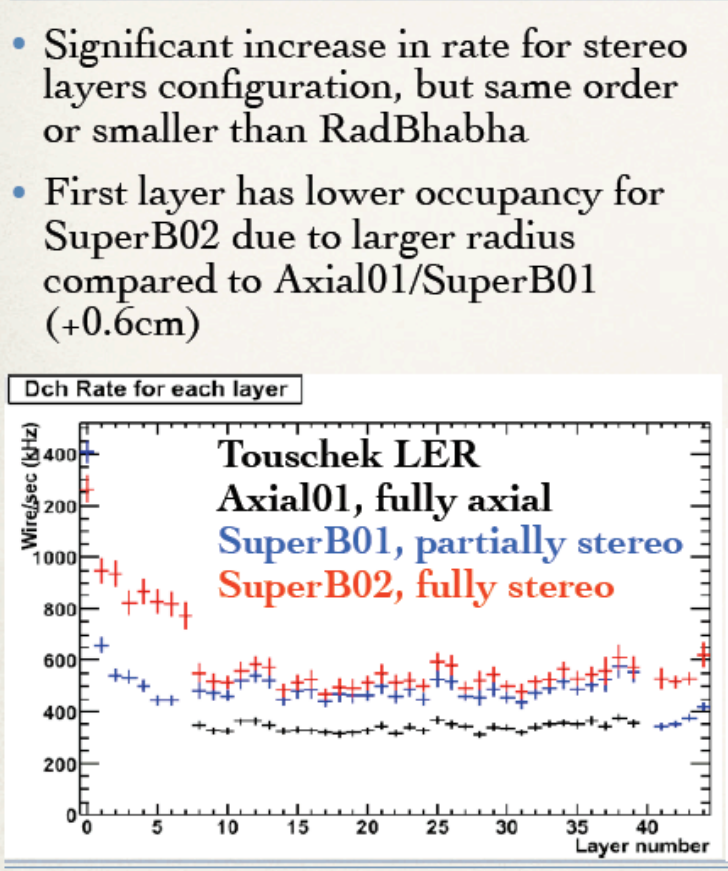
- Updated results from different background sources simulated with same configuration: Beamgas HER added plus normalization
- 2photons bkg estimation is affected by magnetic field around IP and generator cuts
- Rate from Beamgas HER is similar to Touschek HER. Waiting for Beamgas from LER
- Rate increase due to stereo layers is similar for different contributions, larger when contribution has tracks coming through the endplates
- Radiation dose on electronics is low, ~1krad
- New production should be ready in a month or so

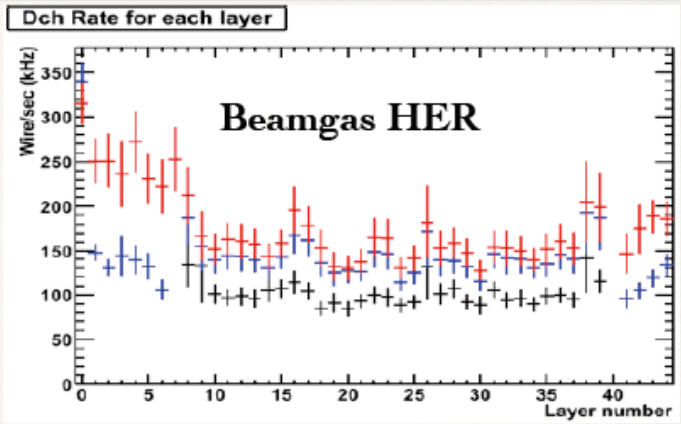
Adobe Acrobat Pro

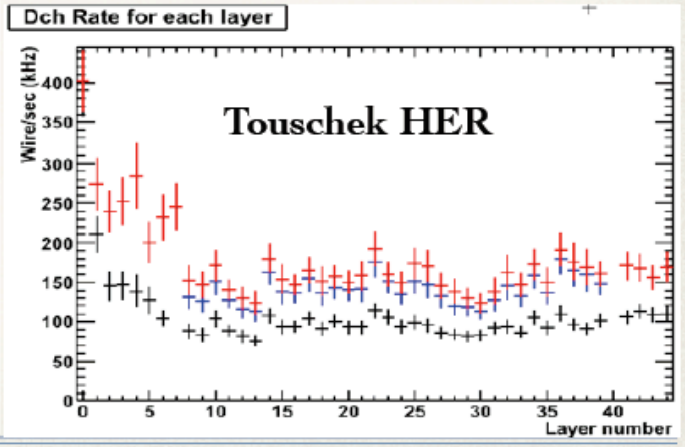
Backgrounds

Dch Occupancy, stereo

- Significant increase in rate for stereo layers configuration, but same order or smaller than RadBhabha
- First layer has lower occupancy for SuperB02 due to larger radius compared to Axial01/SuperB01 (+0.6cm)







wires/sec (kHz)

Riccardo Cenci 4 SuperB Collaboration Meeting, QMUL, London, Sep 13, 2011

Backgrounds

Dch Rate, stereo

- Updated table, including normalization correction

Avg. Rate [kHz](Occ.)	Axial01	SuperB01	SuperB02
Pairs	1421	1680	1927
RadBhabha	2366	3250	3929
Touschek HER	109	144	176
Touschek LER	393	503	601
Beamgas HER	114	144	177
TOTAL	**4403**	**5721**	**6810**

Backgrounds

Dch Electronics

- 3 silicon plates behind the backward endplate to simulate the electronics
- No significant variation for dose, beamgas HER contribution similar to Touschek HER

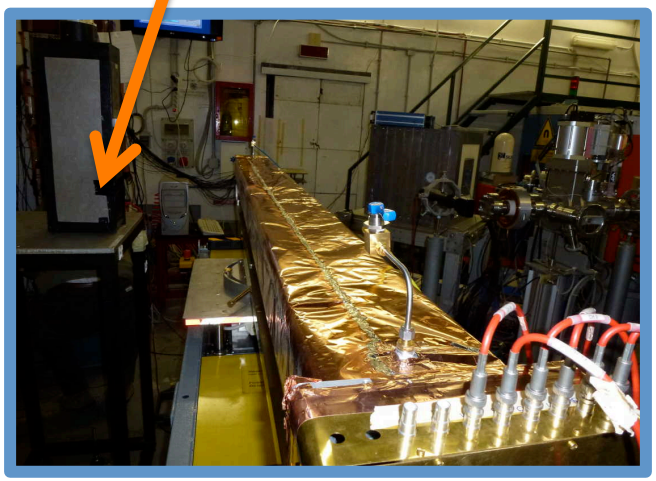
Dose [krad] (1y)	Plate 1	Plate 2	Plate 3
Pairs	0.16	0.16	0.16
RadBhabha	0.68	0.78	0.99
Touschek HER	0.005	0.003	0.003
Touschek LER	0.16	0.18	0.21
Beamgas HER	0.005	0.004	0.002
TOTAL	**1.01**	**1.13**	**1.37**

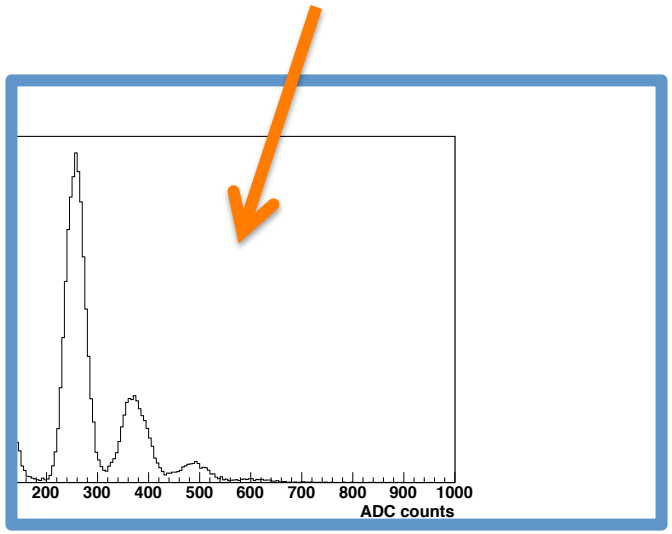
Beam test of Prototype2 at BTF

- *2.5m* long prototype with 28 sense wires arranged in 8 layers
  - Goal: study DCH response from single clusters in a realistic environment, and serve as a test bench for the final FEE and for test o DCH trigger implementation

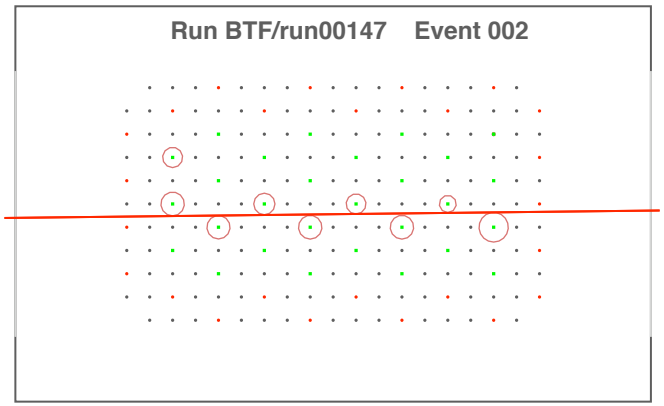
Beam test of Prototype2 at BTF

- *Chamber mounted on moving table and rotating support, allowing*
  - *vertical displacements*
  - *horizontal displacements (beam close or far from the preamp side)*
  - *"θ" and "ϕ" rotations*
- *We explored 3 different gas mixtures, using a few HV settings*
- *Lead-Fiber calorimeter used to select n. of electrons*



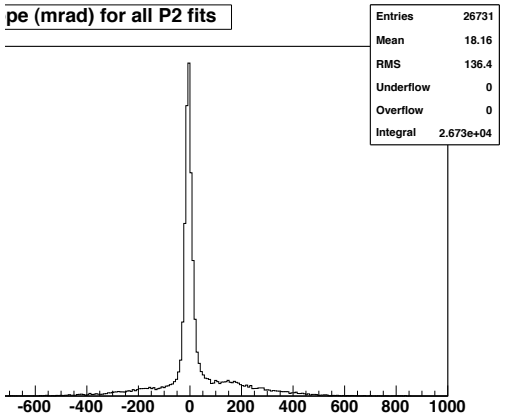


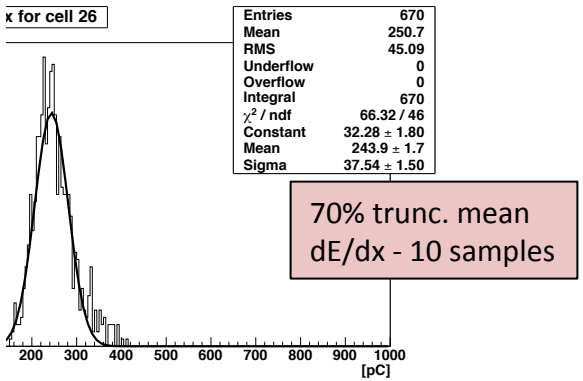
Analysis of Proto2 data



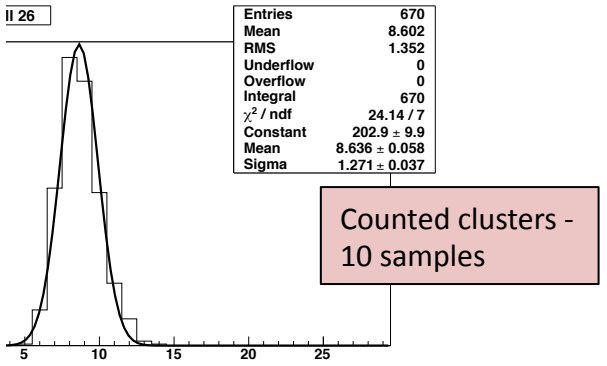
Analysis status will be reviewed during the meeting. Examples:

- Tracking
- comparison of cluster counting and dE/dx performances





70% trunc. mean dE/dx - 10 samples



Counted clusters - 10 samples

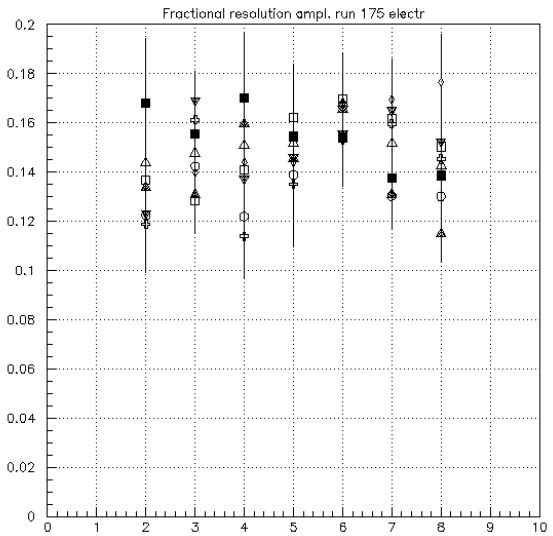
LNF Beam test – electrons

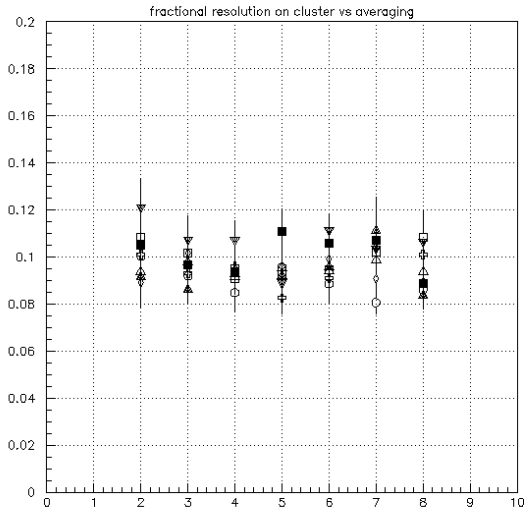
90/10 He/Isobutane:

~40% improvement from Cluster Counting cf truncated mean

Seen in cosmics; Confirmed in LNF electron test beam

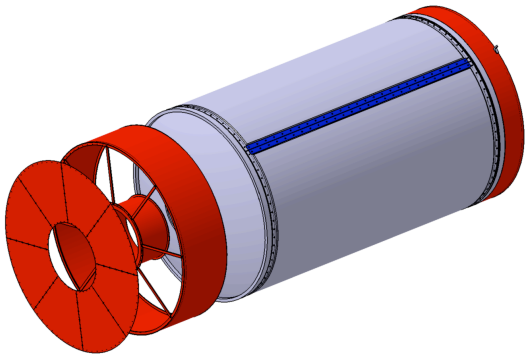
80/20: don't see an improvement



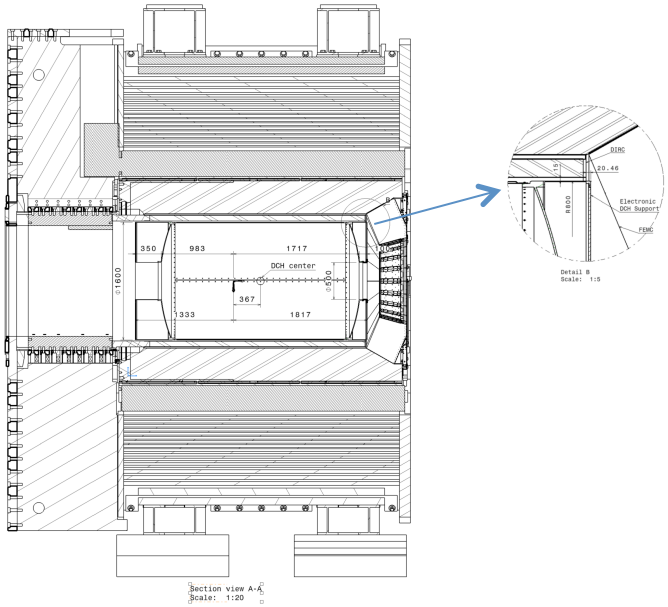


Mechanical Structure

- More Progress on the DCH technical design, including:
  - services (shielding, support for electronics)



  - integration



Preamp Noise Calculations

- Wire termination resistor is one of the main noise sources of the system (≈ 2200 erms @ 3ns peaking time)
- An equal amount of noise can be estimated for a high bandwidth preamplifier thus the system total amount of noise is about 3100 erms ≈ 0.5 fC
  ES: LNF proto2 gain ≈ 8 mV/fC (@ 250 MH BW) → Noise ≈ 4 mV rms (≈ 26 mV pp)
- Single electron cluster charge collected on the wire @ nominal gas gain = 10^5

$$10^5 \times 0.5 \times 0.25 \times 1.6\times10^{-19} \approx 2\ fC \rightarrow 1\ fC$$

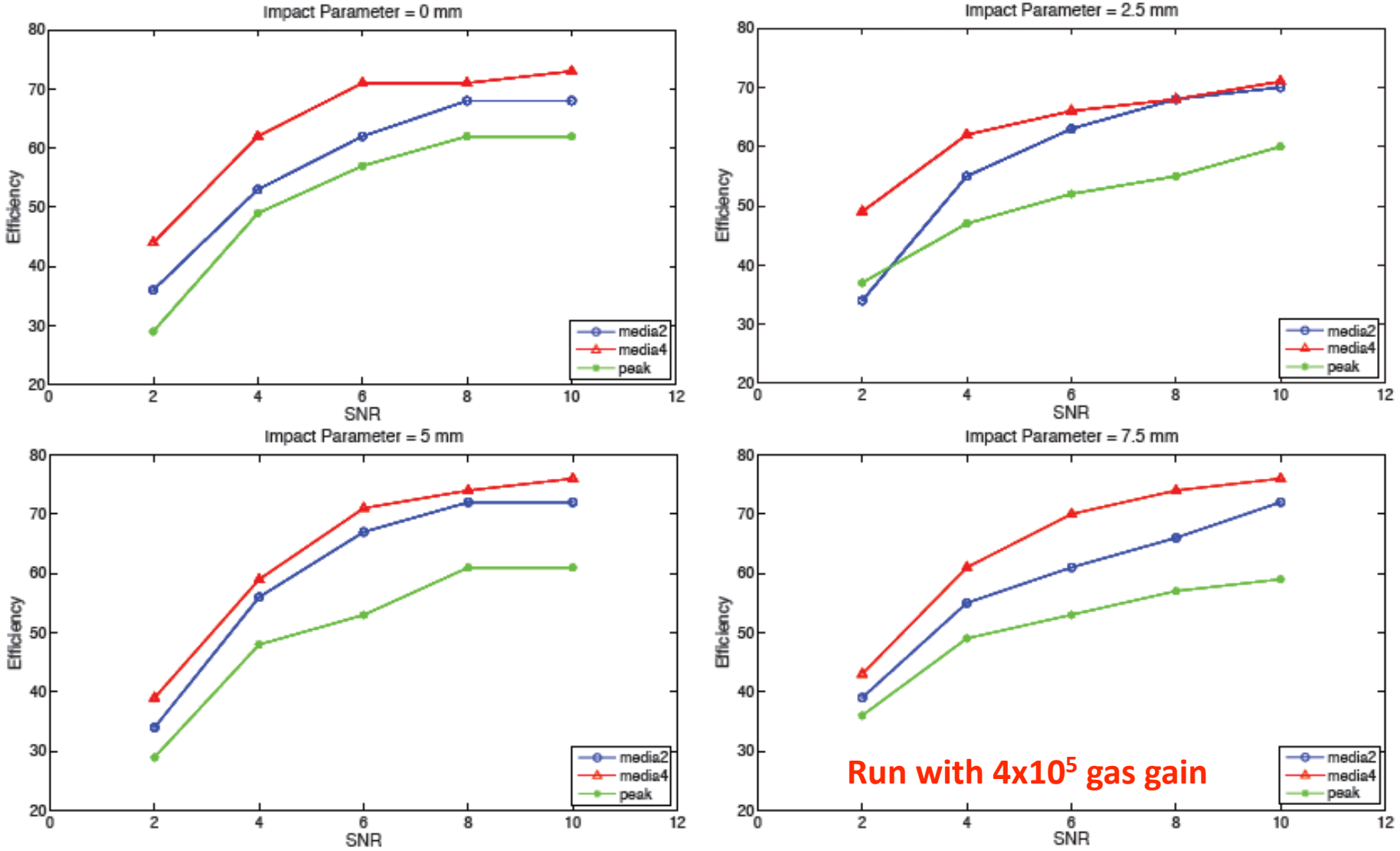
- 10^5: charge division due to termination resistor
- 0.5 × 0.25: charge collected percentage (approximation)
- 1.6×10^{-19}: gas gain fluctuation (upper limit)

DCH operated @ 10^5 nominal gas gain corresponds to a SNR ≈ 2

SuperB-DCH Cluster Counting Efficiency

Servizio Elettronico Laboratori Frascati

Cluster detecting algorithms comparison – Threshold @ 2.5 σ

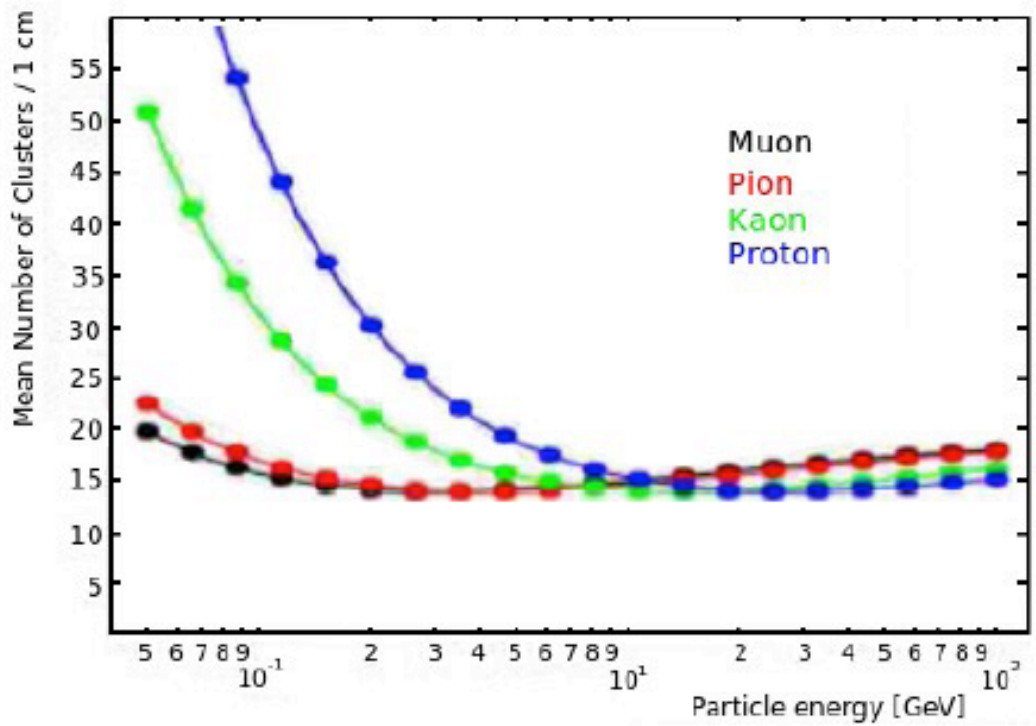


- *Operating region around SNR = 8 can be inferred*
- *External noise pickup reduces efficiency because higher thresholds must be required*

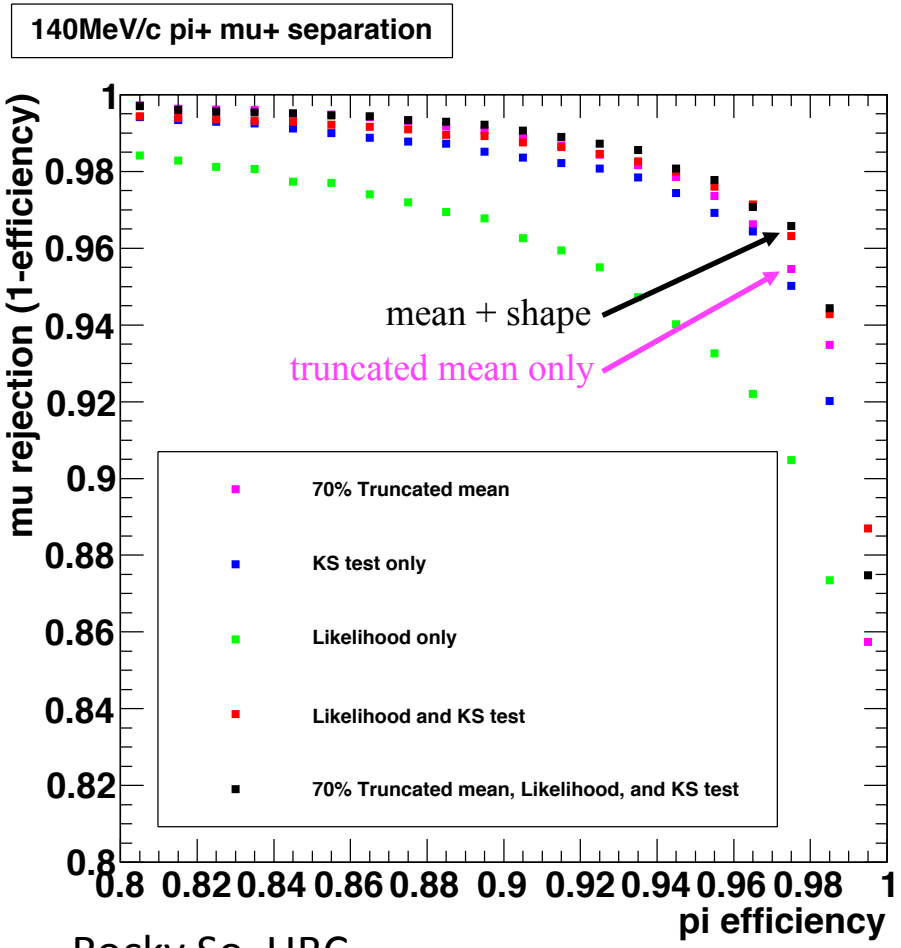
TRIUMF testbeam data

- Looking at data in 80/20 and 90/10 for three momenta:
  - 140MeV/c, 180MeV/c, 220MeV/c

dE/dx at 140MeV mu-pi is similar to pi-K at ~1 GeV



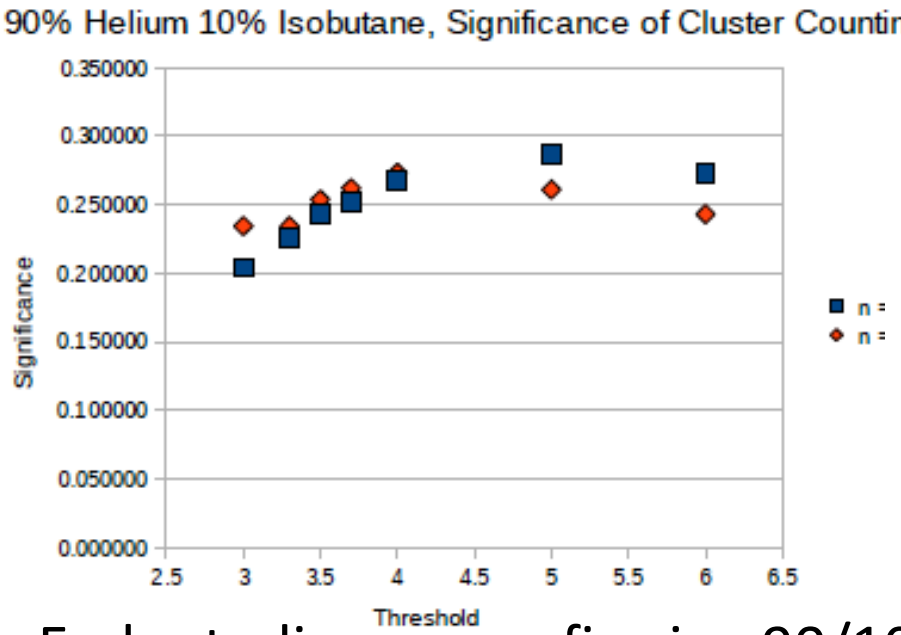
TRIUMF DCH beam test dE/dx analysis – Rocky So



Rocky So, UBC

- Study PID performance using standard readout for comparison to cluster counting.
- Can perhaps do better than traditional truncated mean by looking at distribution of energies among the samples recorded by 40 layer DCH.
- dE/dx plus cluster counting should give best performance

Cluster Counting in 90/10 in TRIUMF testbeam – Sam Dejong



$$Significance = \frac{(\pi_{mean} - \mu_{mean})}{\sqrt{\pi^2_{RMS} + \mu^2_{RMS}}}$$

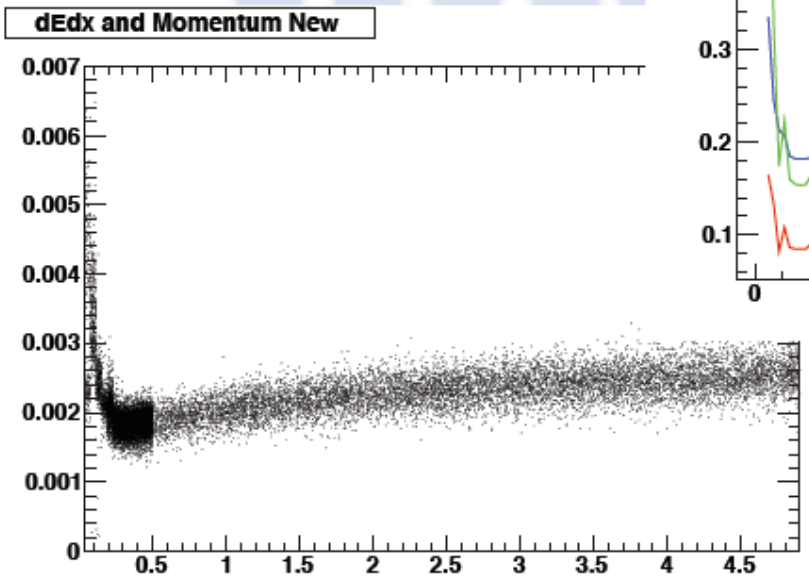
Early studies…. confirming 90/10 is more suited than 80/20 for Cluster Counting

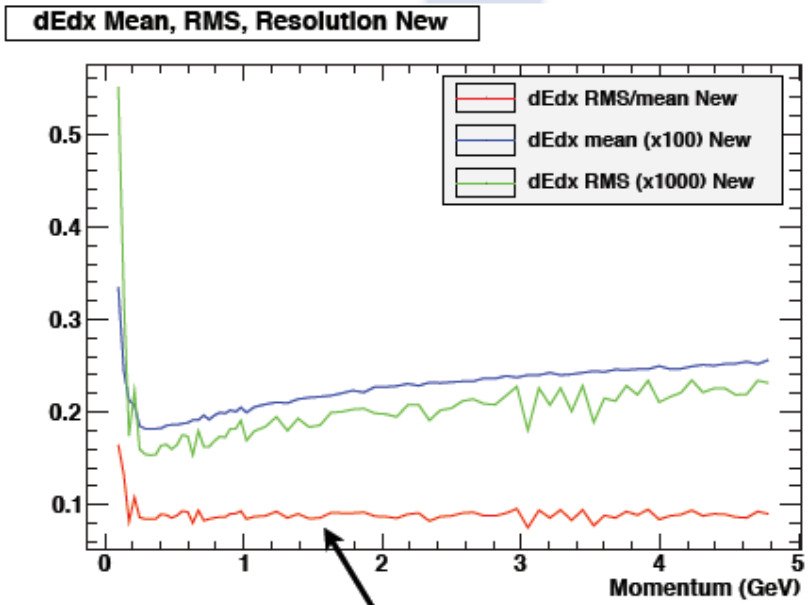
Now focusing on understanding noise and developing Cluster Counting algorithms

dE/dx resolution in FASTSIM requires tuning
Jean-Francois Caron

Preliminary Results

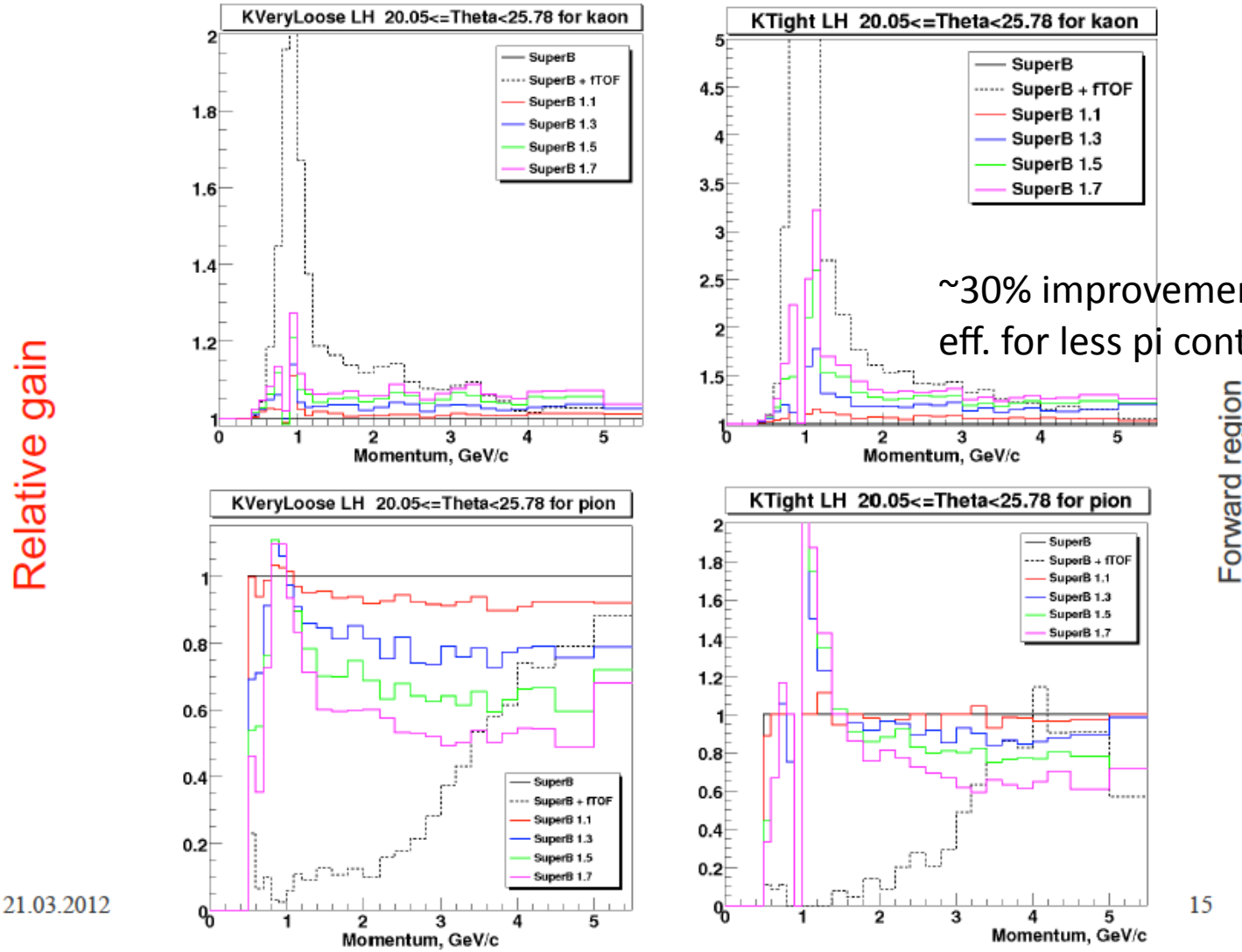
FastSim V0.3.1, single muons at pi/2, new dE/dx configuration





As claimed by BaBar

Benefit of Cluster Counting in Forward Region – Leonid Burmistrov



~30% improvement in eff. for less pi contamination

21.03.2012

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Testbeam planning this year

- August test of single-cell 2.7m prototype in TRIUMF testbeam – test next version of Montreal preamp
  - use higher BW digitizer
- LNF electron test beam in June with Proto-2 28 cell prototype
  - plan for putting it in TRIUMF mu-pi testbeam in October or November
  - test Montreal preamp