Summary of DCH sessions

Giuseppe Finocchiaro & Mike Roney

SuperB DCH Meeting
Oct 9, 2009

Presentations

- Frontend Electronics - Giulietto Felici (*LNF*)
- Study of beamstrahlung background n-tuples - Giuseppe Finocchiaro (LNF)
- Update on DCH Background evaluation - Riccardo Cenci (PI)
- A possible forward endplate design - Christopher Hearty (*UBC/IPP*)
- Report on setup at LNF - Riccardo De Sangro (*LNF*)
- Report on setup at UVic Julia Franta (*University of Victoria*)
- Garfield studies - status report Gocha Tatishvili *(Carleton*)

Frontend electonics – status

Giulietto Felici (*LNF*)

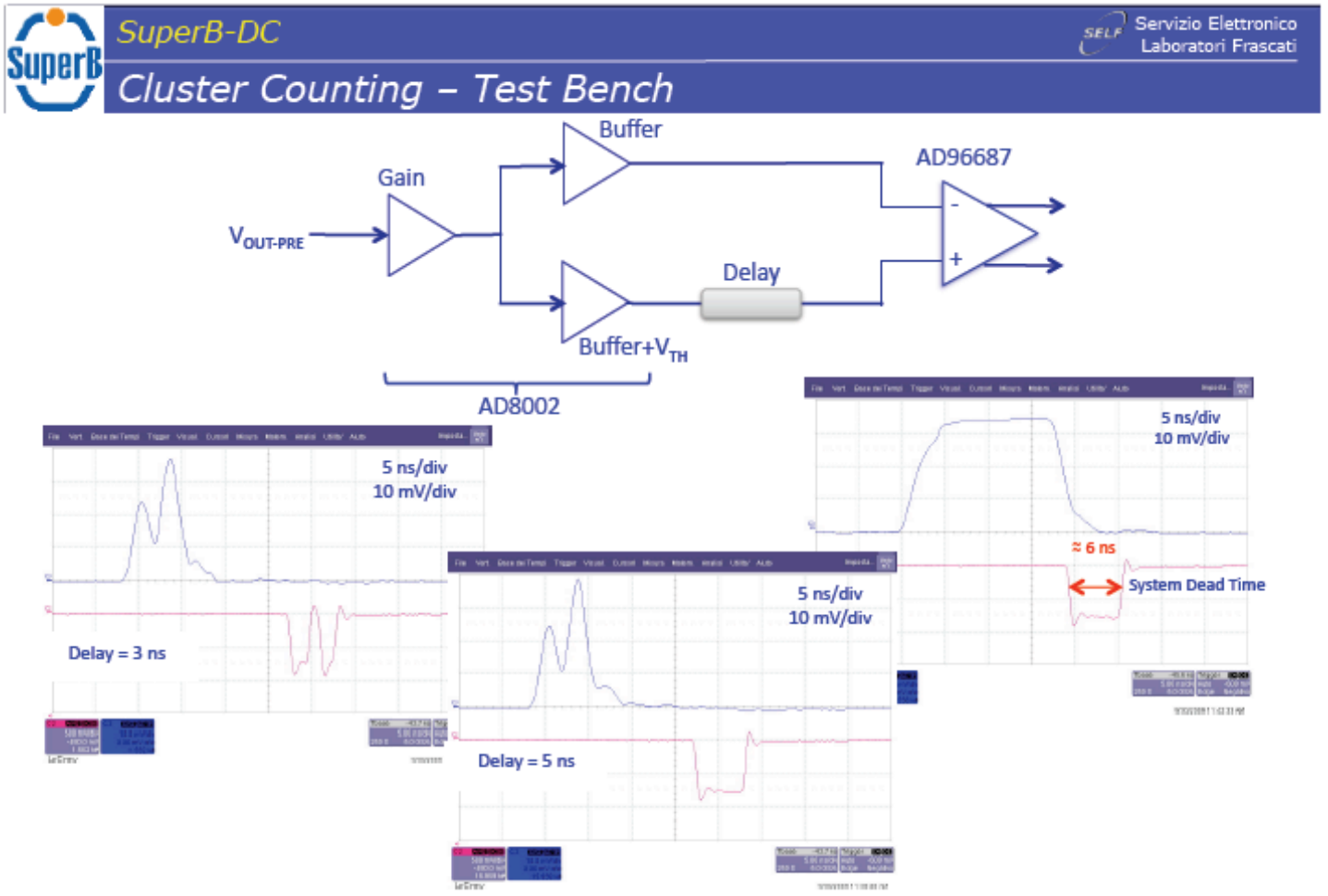
- Chamber prototype instrumentation (KLOE DC FEE) → Setup completed within October
- Cluster counting feasibility study → Setup completed within November
  - local derivative method
  - oscilloscope acquisition
- RO architecture
  - BaBar "like" (Cluster counting option ?)

To start the work on the RO architecture some information about the foreseen working conditions are required :

- Background rate
- Trigger rate (Lev 1 & 2)
- Power Dissipation
- Material Budget (DC end plates)

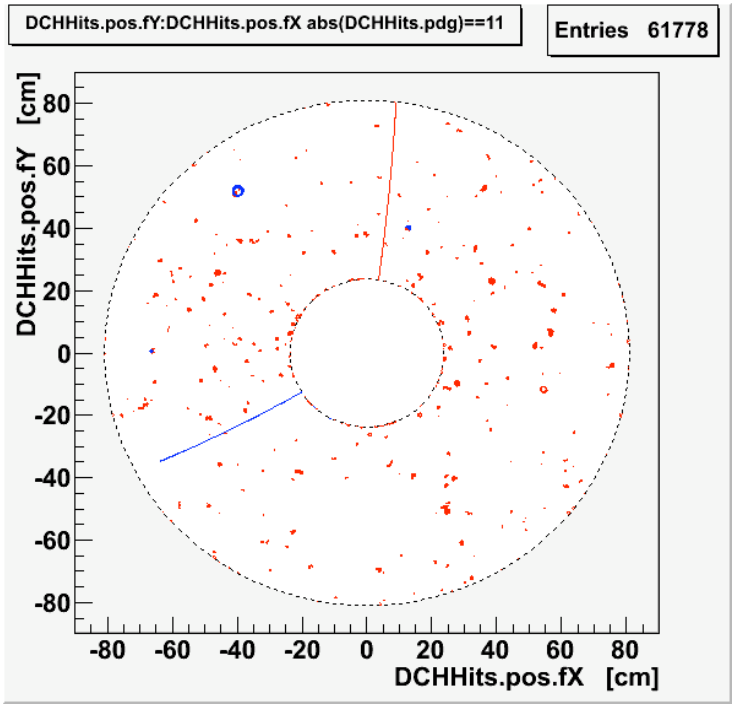
Frontend electonics – status

Giulietto Felici (*LNF*)



Beamstrahlung Background ntuple studies Giuseppe Finocchiaro

Preliminary estimate of the rates in the DCH counting the number of spiraling e^+e^- tracks in the X-Y hit distribution.



- I count 232 low energy spirals (plus the 2 high PT tracks)
  - N.B. in the exercise shown at the previous DCH meeting I had counted 213 spirals
    - accuracy of "by eye" estimate is probably ~10%

Beamstrahlung Background ntuple studies Giuseppe Finocchiaro

f = fraction of hit cells averaged over the whole drift chamber in 1μs
$N_{stereo} = L_{DCH}/w_{cell}$*stereo_angle

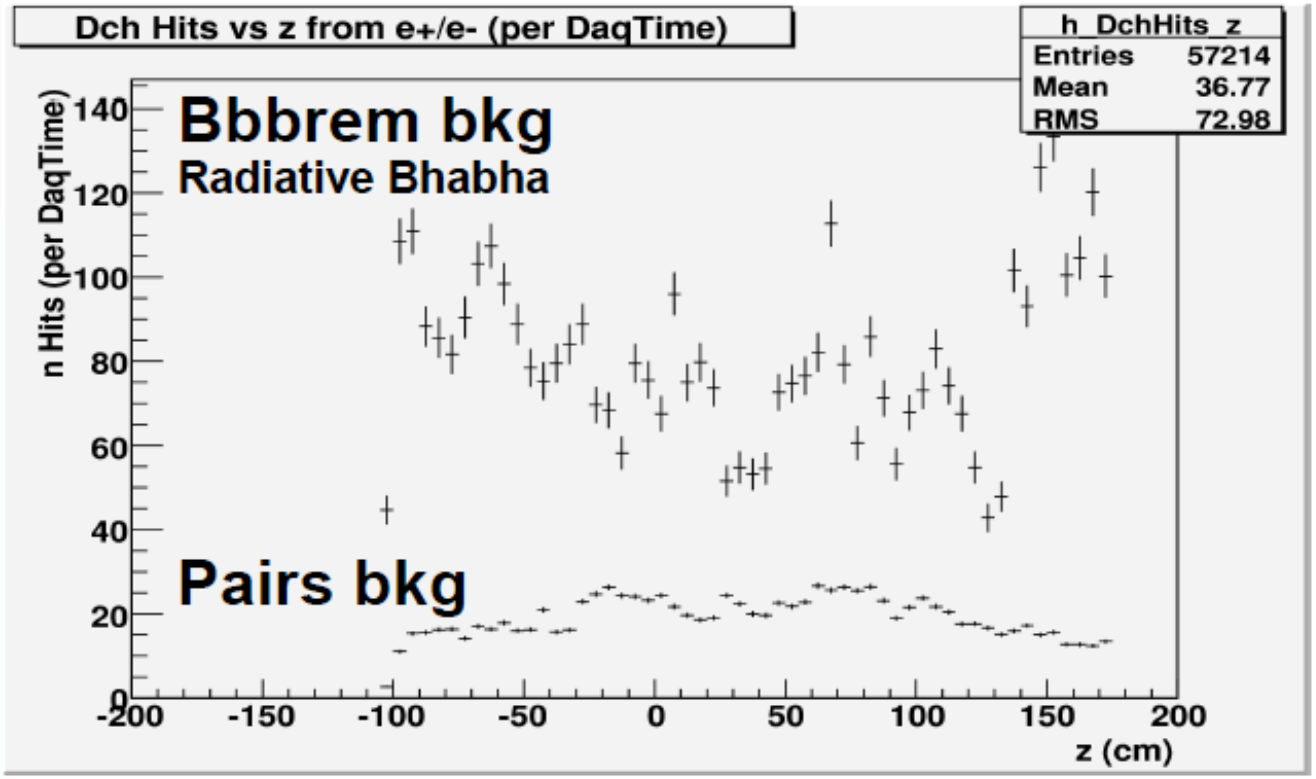
SLs	f_{axial}	$\langle N_{stereo} \rangle$	f_{stereo}
1,2,3	76/1344/6.1=0.93%	2764/18.2*0.051= 7.7	0.93%*7.7 = 7.2%
4,5,6	64/2048/6.1=0.51%	2764/18.2*0.060= 9.1	0.51%*9.1 = 4.6%
7,8,9,10	92/3712/6.1=0.41%	2764/18.2*0.071=10.8	0.41%*10.8=4.4%
1-10	232/7104/6.1=0.54%	2764/18.2*0.051= 9.1	0.54% *9.1=4.9%

- Is there a z dependence?
- background hits from this particular source (low PT spirals traversing the whole chamber length) would not indicate large correlations with z
- Are there other dangerous background sources?
- What safety factor should we add (x3, x5 …)?

FullSim Background studies: beamstrahlung & Pairs production

Riccardo Cenci (PI) **Bruno v00-01-04, r247**

DCH Hits vs z



- Not weighted by released energy
- Bump on fwd direction for Radiative Bhabha, pretty flat for Pairs bkg

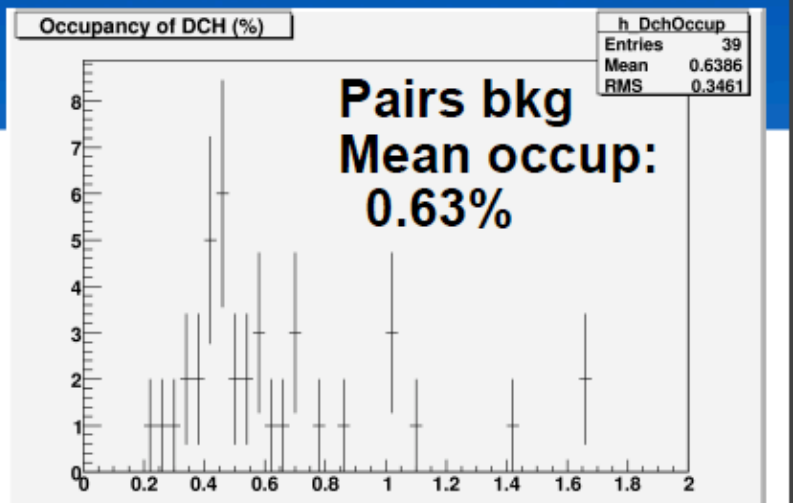
FullSim Background studies: beamstrahlung & Pairs production

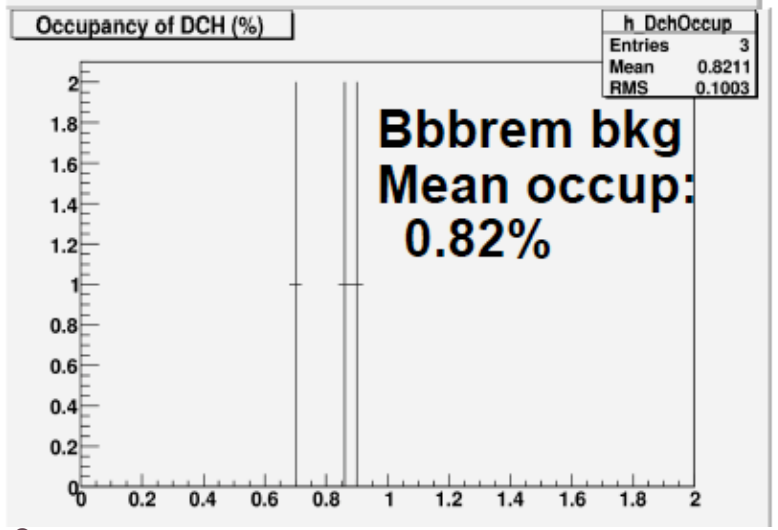
Riccardo Cenci (PI) **Bruno v00-01-04, r247**

Number of cells with energy > 0 during a Daq time slot (1μs)

DCH Results

- Dividing by total number of cells...
- **Occupancy 1.5%** (found bug in the code respect to the values shown at Dch Meeting)





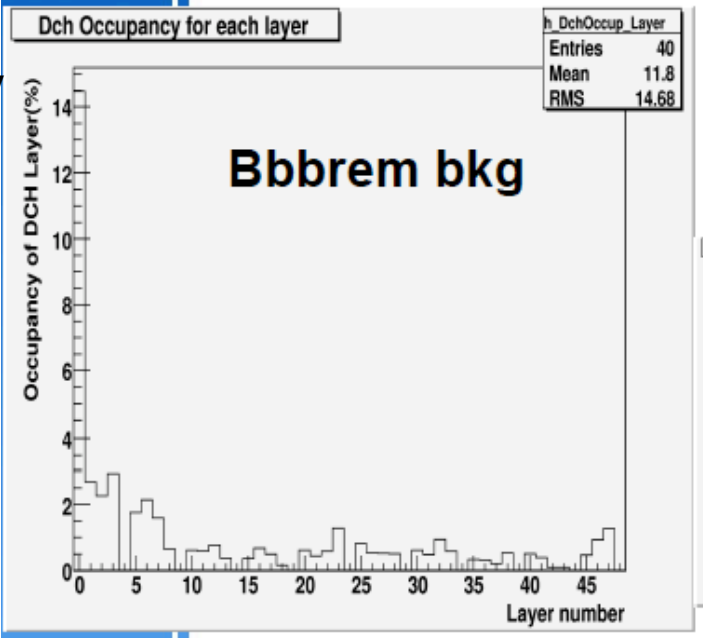
FullSim Background studies: beamstrahlung & Pairs production

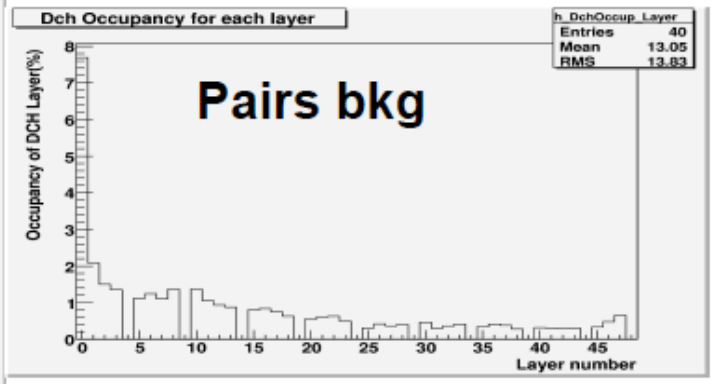
Riccardo Cenci (PI) **Bruno v00-01-04, r247**

Backgrounds mostly from interactions on chamber wall

reasonable occupancy except for inner layer

DCH Occupancy per layer

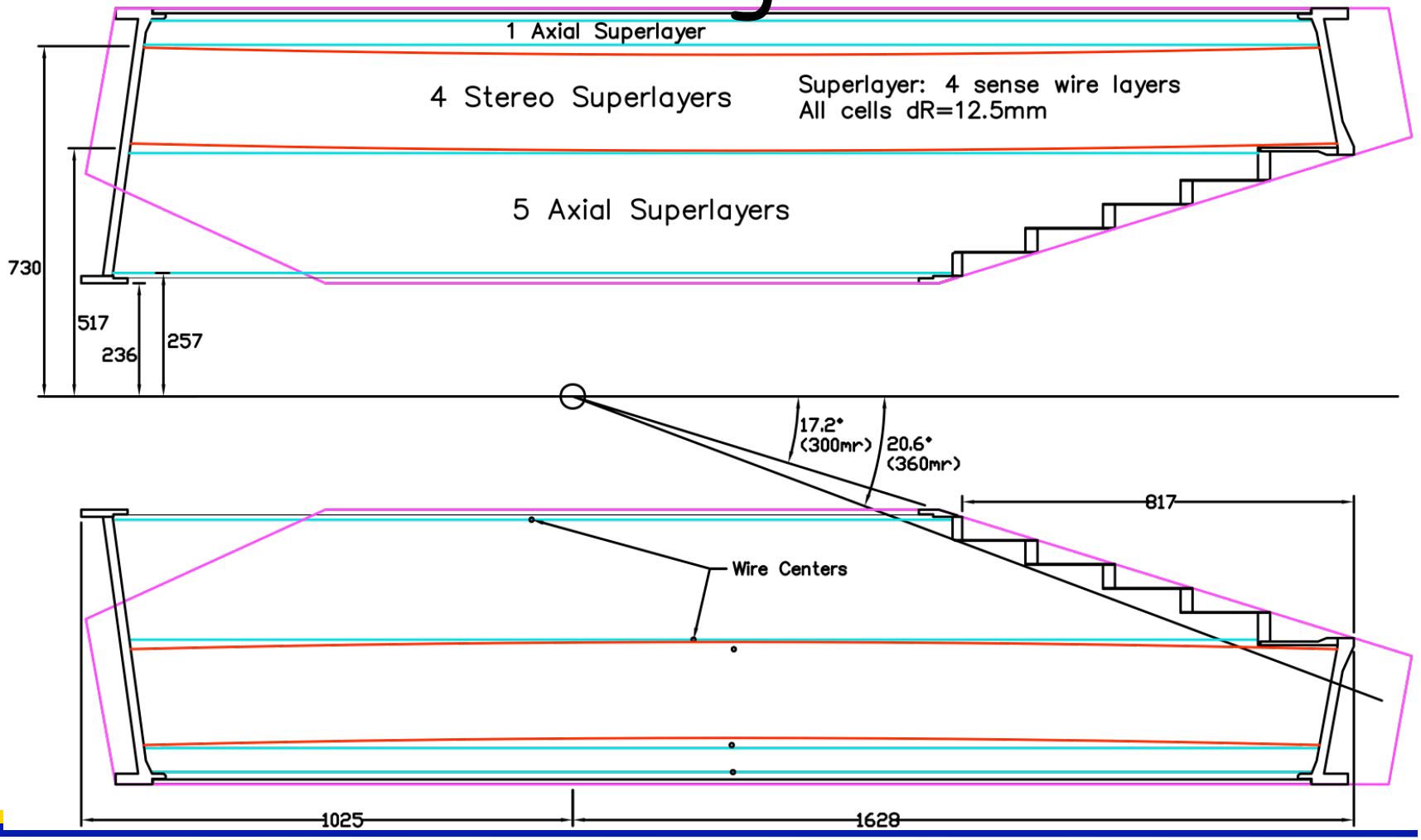




- Occupancy by layer, same y scale
- 22% total on layer 0
- Reasonable occupancy on other layers, not so correlated with r

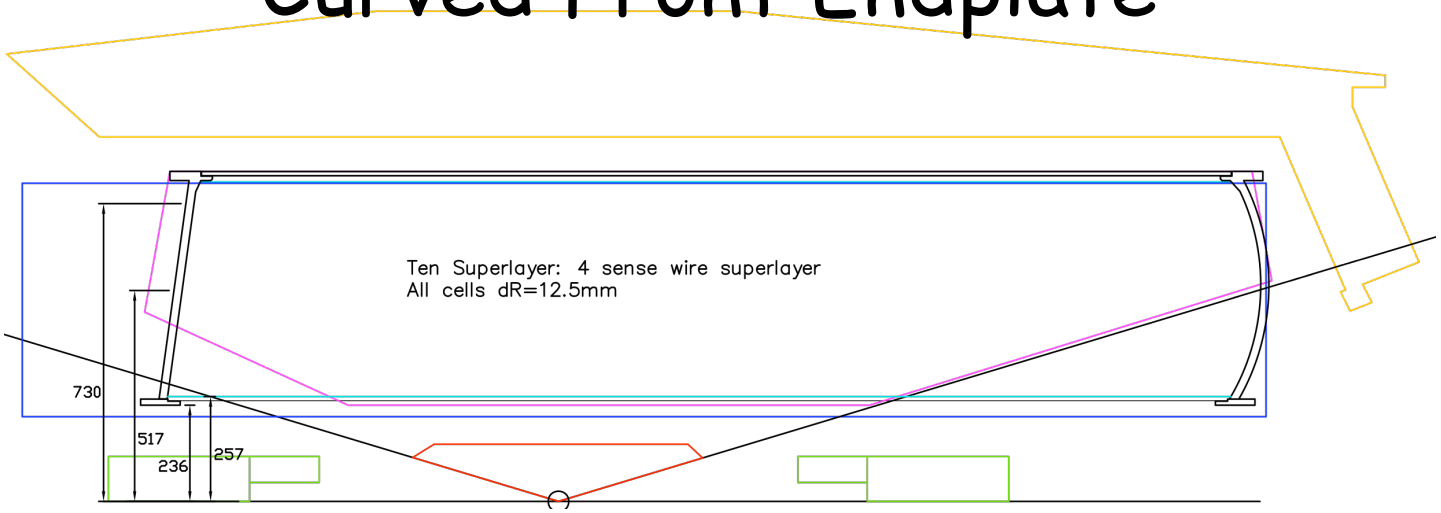
Some DCH Endplate Geometries Chris Hearty

"Wedding Cake"



Some DCH Endplate Geometries Chris Hearty

Curved Front Endplate



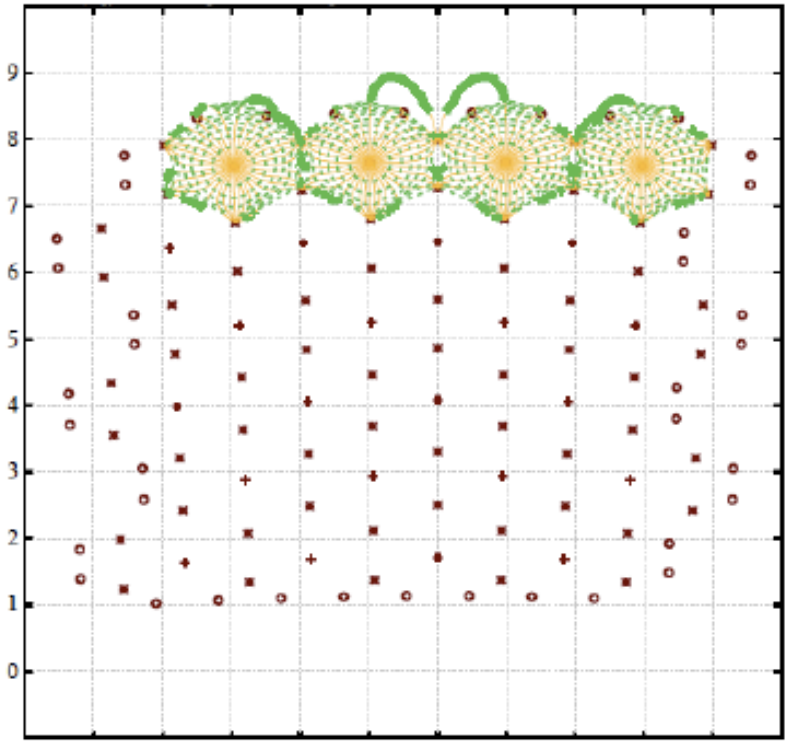
NOTES:

- All drawings by Robert Henderson
- Endplates, including wedding cake, could be carbon-fiber
- Inner section is 20 axial layers; could be organized as five superlayers for trigger, but no transitions between layers (unlike stereo).
- Depending on backward calorimeter, maybe a flat backward endplate.
- Location of front endplate depends on PID

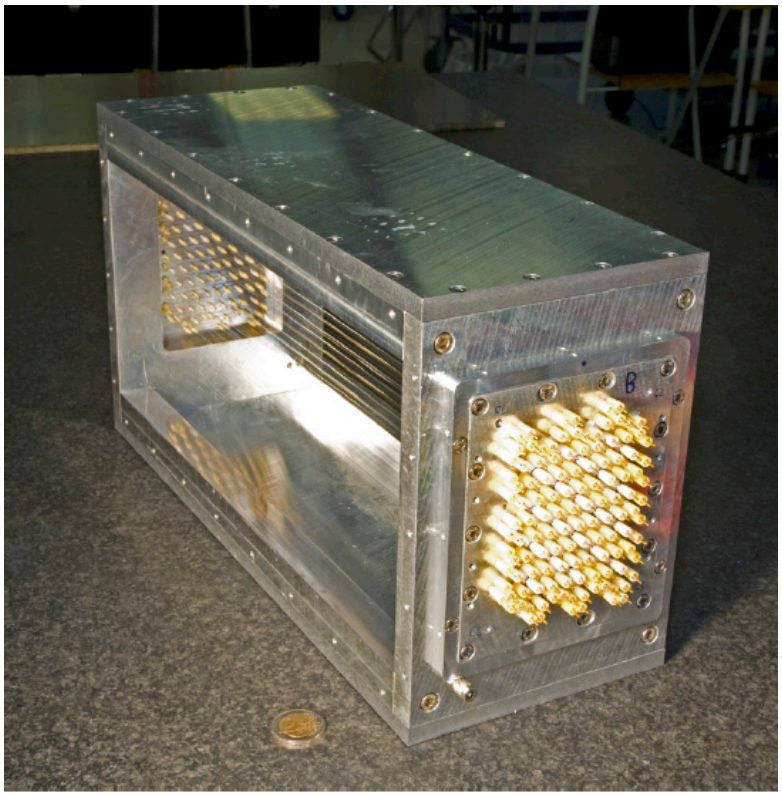
Report on setup at LNF Riccardo De Sangro

Prototype Layout

- Cell geometry à la BaBar
- 4x6=24 hexagonal cells, all instrumented
- 60 field wires, 40 guard wires total 124 wires
- Wires
  - sense: W, 25 μm ∅;
  - field: Al, 80 μm ∅
- pins: delrin 3mm ∅



Report on setup at LNF Riccardo De Sangro



Plans for December

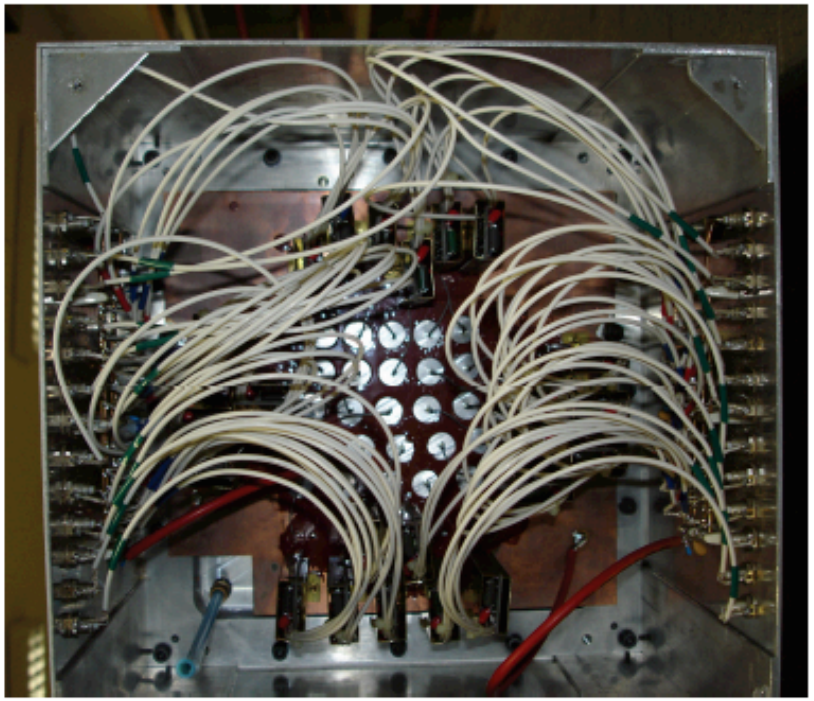
- Fully commission prototype
- Complete DAQ to include MT and Proto 1.0
- Complete offline software to extrapolate tracks in the prototype cells
- First resolution plots with CR tracks extrapolated in the prototype cells with the external tracker

Report on setup at LNF Riccardo De Sangro

Cluster Counting Tests

PLAN

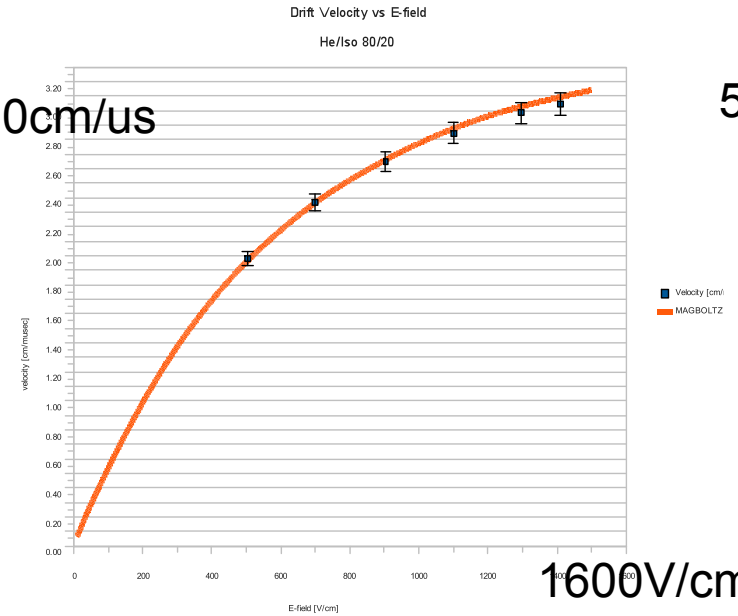
- Instrument KLOE prototype with:
  - 2-3 channels of CC electronics developed in Frascati
  - 2-3 channels of CC electronics from Lecce
  - 2-3 channels of CC electronics from J.Vav'ra



Report on setup at UVic Julia Franta & Mike Roney

Status of validation studies of magboltz (code that simulates wire chambers) – uses a mini-TPC with laser illuminating Al dots on cathode

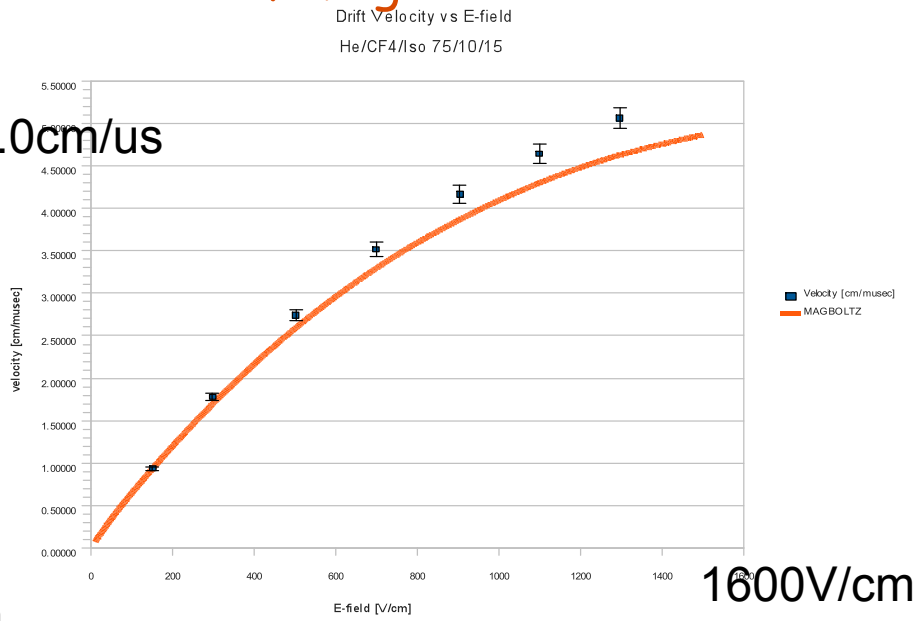
He/Isobutane 80/20
velocity vs Edrift
data cf magboltz



3.0cm/us

1600V/cm

He/CF_4/Isobutane 75/10/15
velocity vs Edrift
data cf magboltz



5.0cm/us

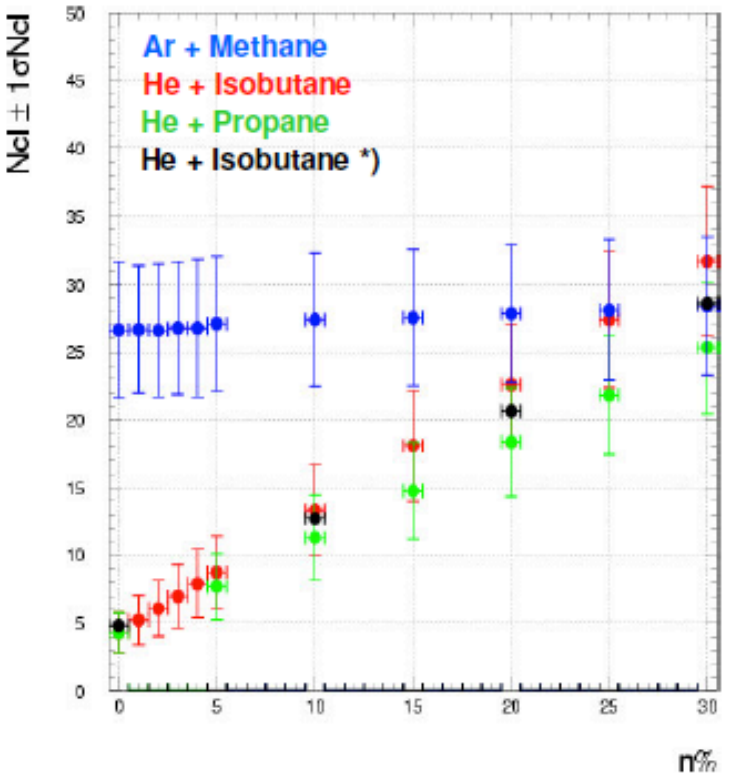
1600V/cm

Garfield studies - status report Gocha Tatishvili *(Carleton)*

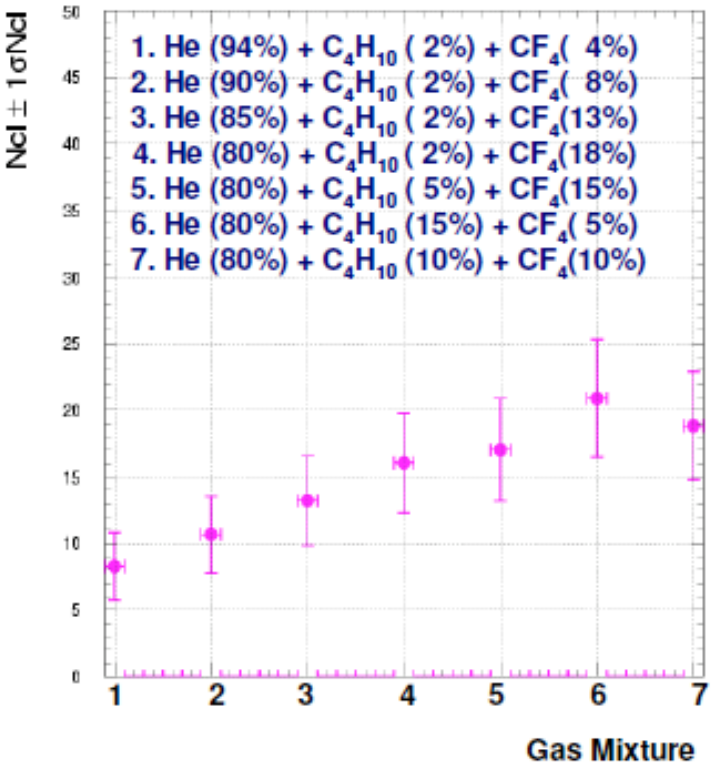
Cluster Statistics Study Using Garfield / Magboltz / Heed Simulation

Cluster Statistics for Different Gas Mixtures

Gas Composition: (100-n)% Basic Gas + n% 2nd comp.



Three comp. Gas Mixtures



*) Expected values by A. Sharma, F. Sauli, "Low mass gas mixtures for drift chambers operation", NIM in Physics Research A 350 (1994) 470-477.

M Roney Victoria

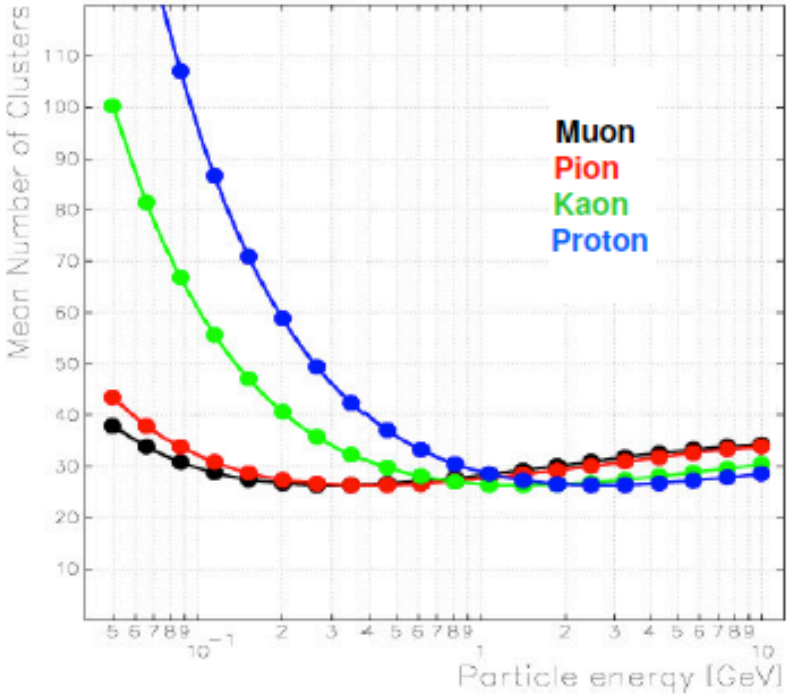
Garfield studies - status report Gocha Tatishvili *(Carleton)*

Cluster Statistics Study Using Garfield / Magboltz / Heed Simulation

Particles Separation

2cm length samples corresponding to μ, π, K, p crossed drift tube in He (90%) and Isobutane (10%) gas mixture.

He / Isobutane (90% / 10%)



Cluster counting provides factor two better resolution compared to classical charge determination.

H.A. Walenta, et al., NIM, 161 (1979) 45 gives a theoretical evaluations of dE/dx resolution.

For 100 samples with sampling length (2cm) σ = 4.5%.

For pions in minimum ionizing region Ncl~13 / 1cm for 100 times sampled tracks σ ~2%.

Garfield studies - status report Gocha Tatishvili *(Carleton)*

Cluster Statistics Study Using Garfield / Magboltz / Heed Simulation

Cluster Counting Algorithm

GARFIELD SIMULATION (HEED CLUSTERING MODEL) & SIGNAL

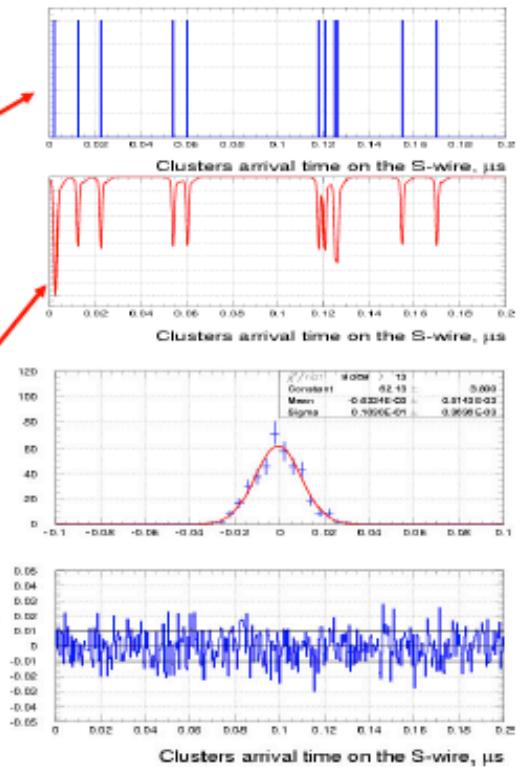
CLUSTER TABLES

SELECTION OF TRACKS WITH GIVEN # CLSUT.

SIGNAL CONSTRUCTION

Experimental Setup Functions:
TRANSFER FUNCTION
NOISE FUNCTION

CLUSTER COUNTING ALGORITHM



As a transfer function we used a naive approximation - double Gaussian function with shifted central values.

As a noise function we used a random variable with a Gaussian distribution.

Summary

Progress on :

- FE electronics
- background studies
- mechanical/geometrical design
- prototype preparations
- gas studies in lab
- gas simulation studies
- potential for cluster counting for dE/dx and improved position resolution