SVT detector response and quality monitor

Nicola Neri
INFN - Sezione di Milano

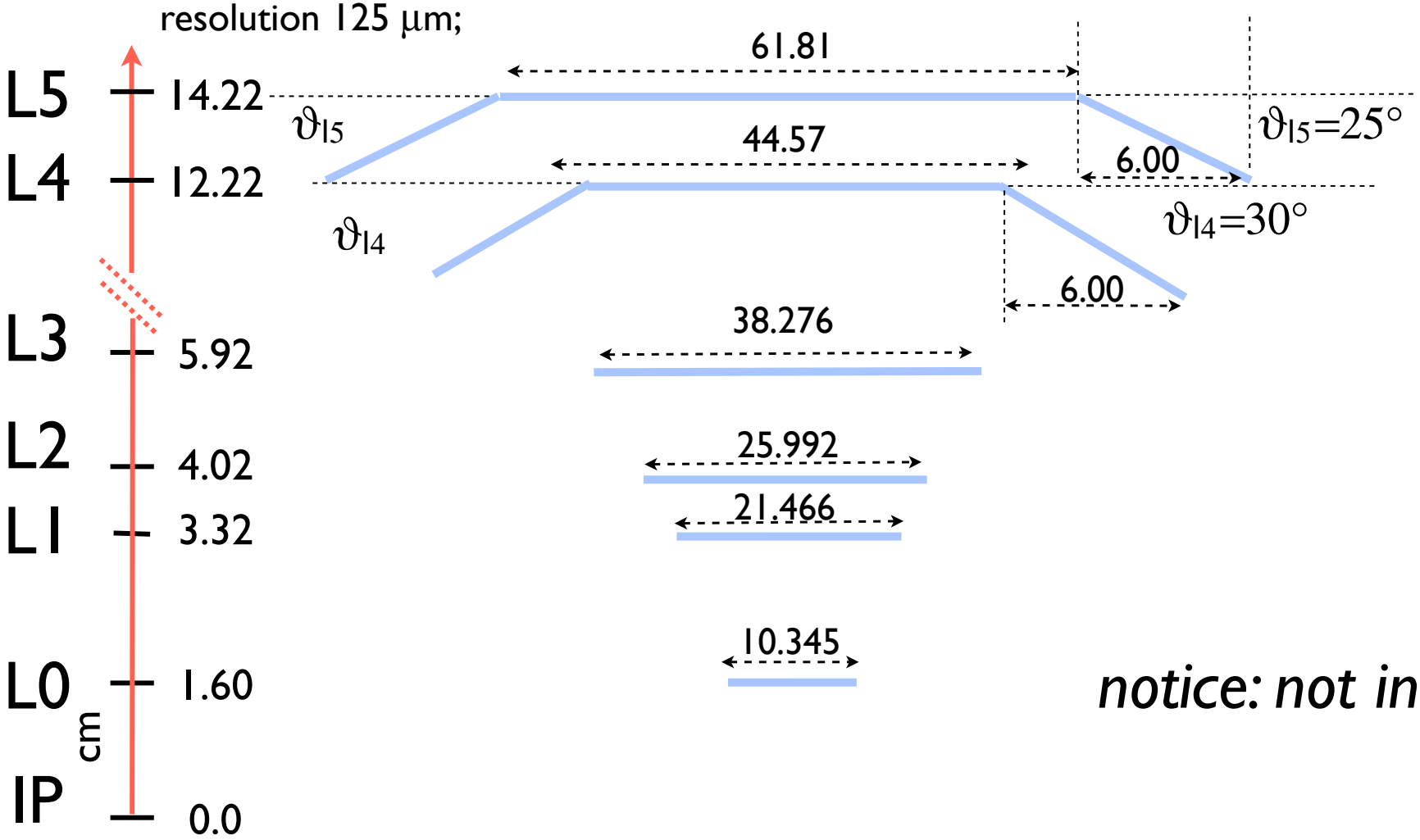
20 March 2012

Outline

- Present status of SVT model in FastSim
- Quality monitor

1. SuperB baseline in Fast Sim:

- SVT baseline: L0 + L1-L5 strip detectors, ±300 mrad angular coverage;
- DCH baseline: 10 SuperLayers (4 cell layers per SL); inner radius 23.6 cm, spatial resolution 125 μm;



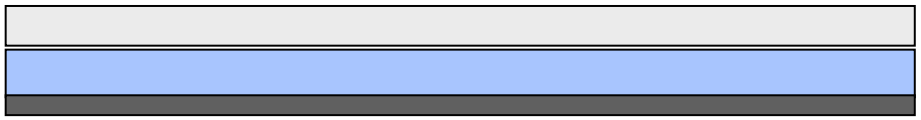
notice: not in scale

Coverage down to 300 mrad FW and BW

Striplet solution

- Module cross section

Fan out
Si sensor
Support



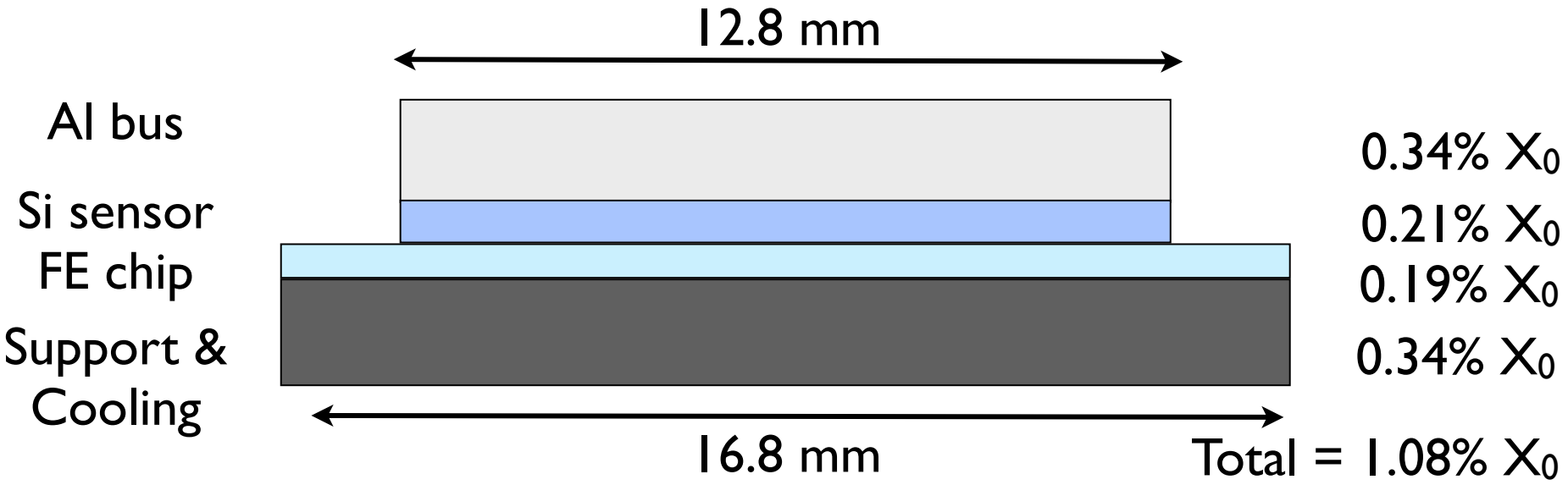
Si sensor overlap 3.4%

0.14% X_0
0.21% X_0
0.05% X_0
Total = 0.40% X_0

Some adjustment of the material budget is probably required for TDR

Hybrid pixel solution

- Module cross section



Some adjustment of the material budget is probably required for TDR

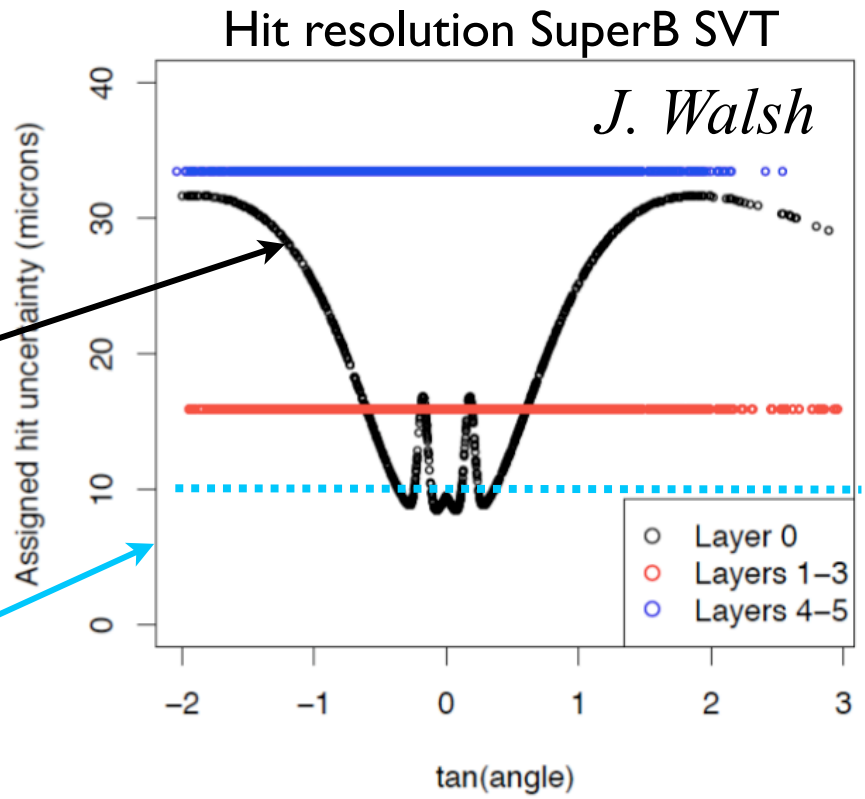
L_0 solutions: striplets vs Hybrid pixels

Hybrid Pixel

- material= 1.08% X_0
- digital readout
- average radius = 1.60 cm
- hit res ~ <14 μm> (ad hoc model)
- hit eff = 95%

Striplets

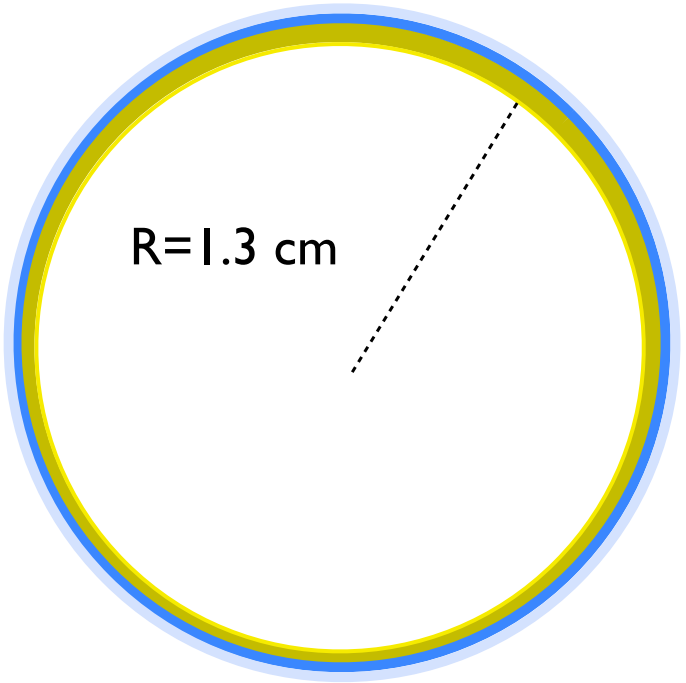
- material= 0.4% X_0
- analog readout
- average radius = 1.60 cm
- hit res ~ 8 μm (core gaussian)
- hit eff = 90%



Some adjustment of efficiency hit values probably required for TDR

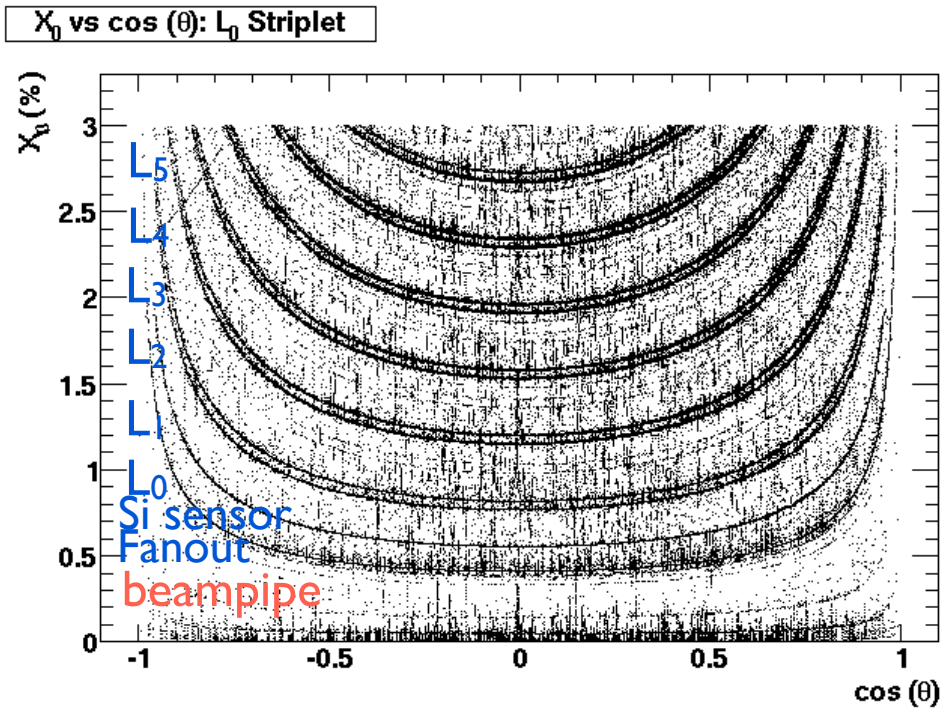
Beam Pipe model

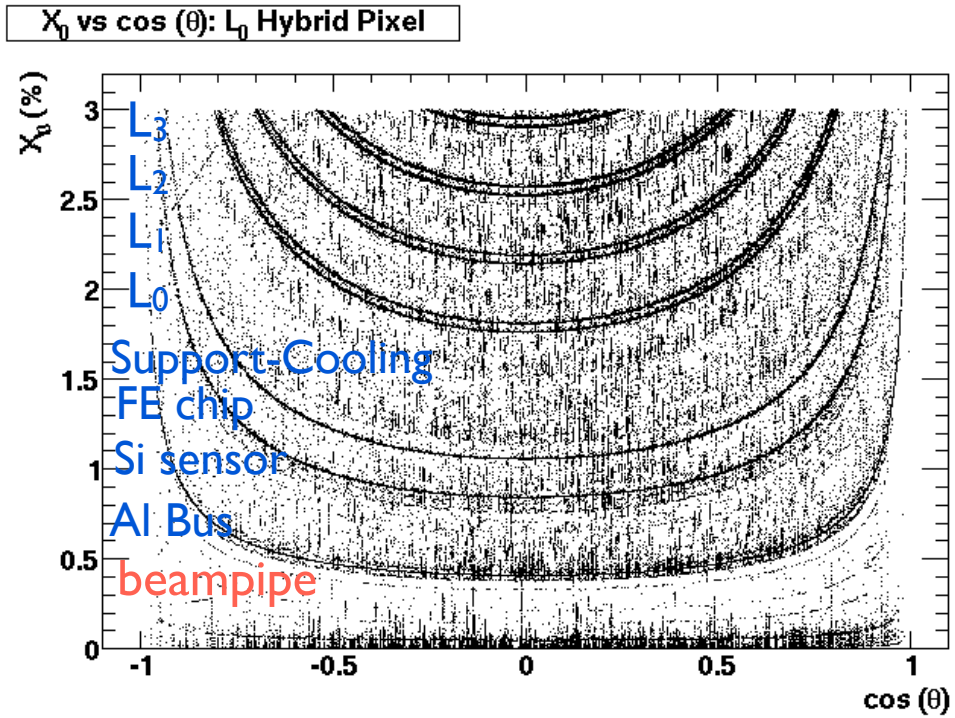
Material	(μm)	X_0(%)
Au	4	0.12
Be	600	0.17
H_20	300	0.08
Ni	7	0.05
Tot	911	0.42



The radius of the beampipe was changed in 2009 from 1.0 to 1.3 cm in order to reduce the bkg in SVT Layer0. This change has to be confirmed with latest beampipe design.

L_0 solutions and SVT material





Total SVT material is about 3.3% (2.4%) X_0 for L_0 Hybrid pixel (Striplets) solution.

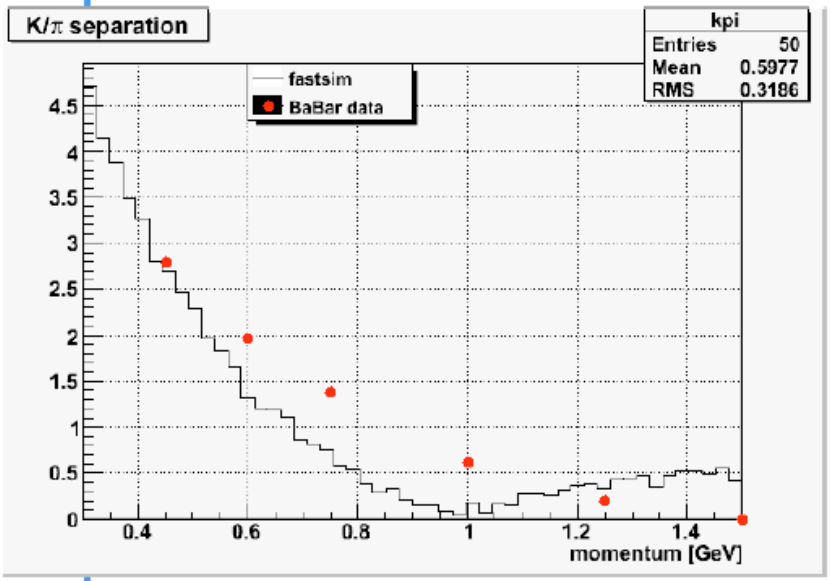
dE/dx parameterization

J. Walsh

For more details: http://agenda.infn.it/conferenceDisplay.py?confId=2661

- Using BaBar PID ntuples $D^{*+} \to D^0\pi^+, D^0 \to K^-\pi^+$
- Extract param. for dE/dx width: $\sigma_{hit} = \alpha < dE/dx >^{\beta} dx^{\gamma}$

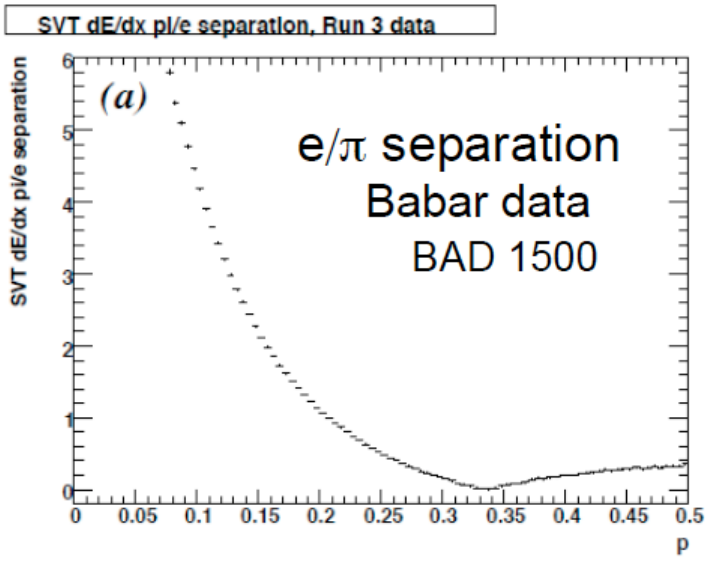
K/π separation



- Minimum of distribution is different in data and fastsim
- Need to extend plot to higher momentum, but I already know that
  - fastsim (.5σ) is better than data (~.2σ)
- This is probably the level of agreement that we can get without modifying how we generate <dE/dx>

PID for low momentum electrons

- A non negligible fraction of tracks from Pair Bkg events is reconstructed in the SVT;
- Studying electron/pion separation using SVT only information would be very useful for bkg rejection;
- Some work has been done by John Walsh when modeling dE/dx response in SVT. See John's talk at FastSim meeting on May 27 2010;
- "Ad hoc" study would be beneficial for a better description of detector performances.



Quality Monitor code

- `PacQA/PacQMonSVT` module is ready (available on svn)

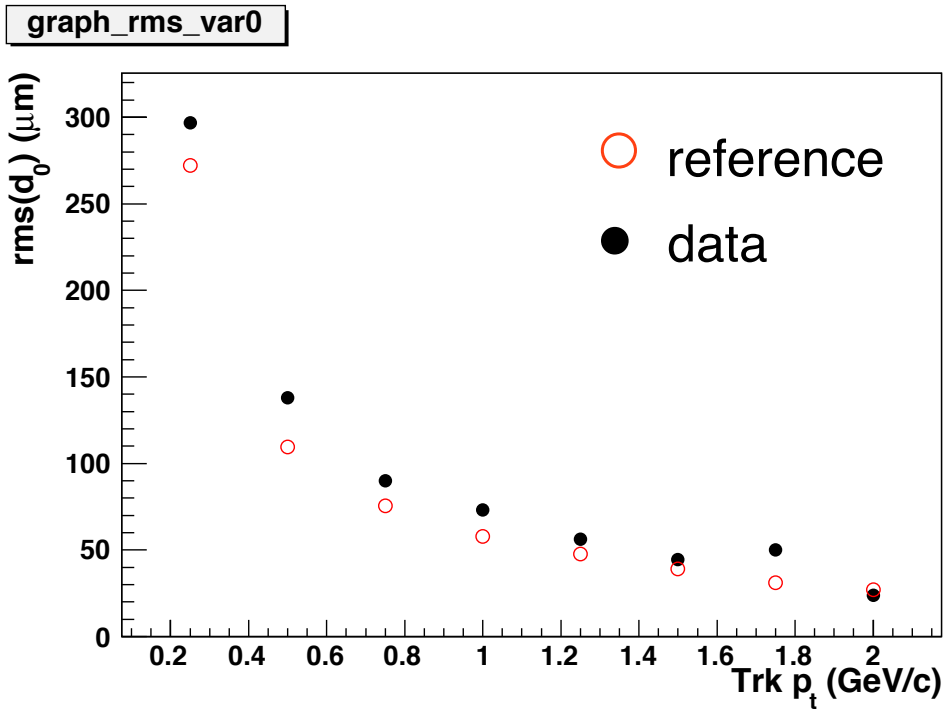
- it is based on Kaltest/Kaltest module used for testing the track fit
- ntuple content is described here:

  http://mailman.fe.infn.it/superbwiki/index.php/FastSimDoc/QualityMonitoring#SVT

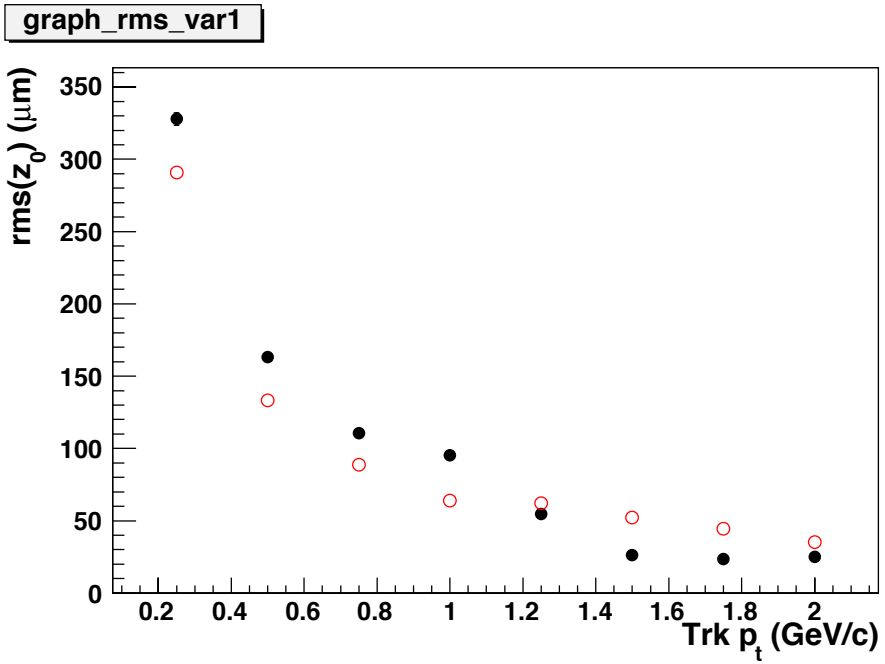
- `PacQA/scripts/svt` is the directory containing the ROOT macro for the QMon analysis (available on svn)

- analyze the output of the `PacQMonSVT` module and produce a ROOT file with the relevant histograms and make also comparison with the reference histograms.
- it requires also a ROOT file in input for reference histograms. Reference histograms are produced using single track pion events. Some differences in comparison plots are expected and due to residual differences in momentum range (in each p_t bin).

Examples of comparison plots

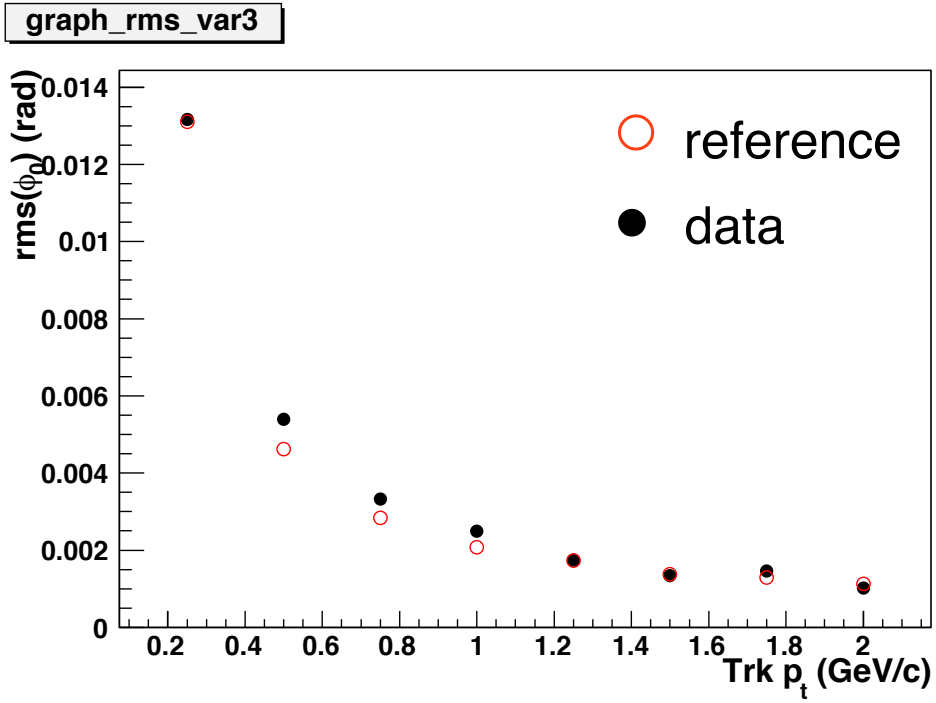


d_0 track parameter resolution vs p_t

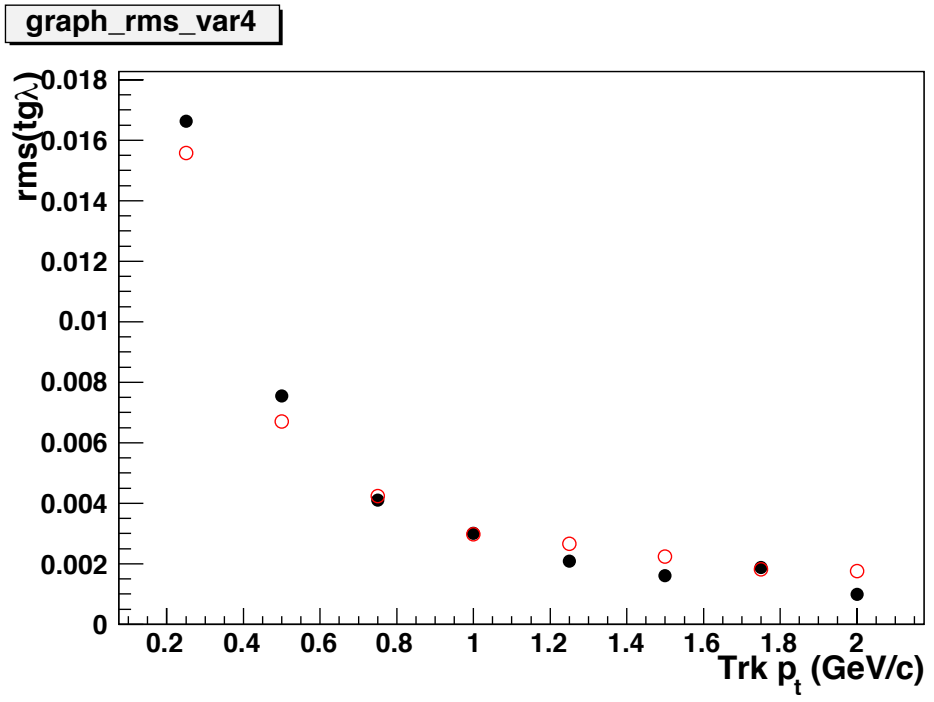


z_0 track parameter resolution vs p_t

Examples of comparison plots

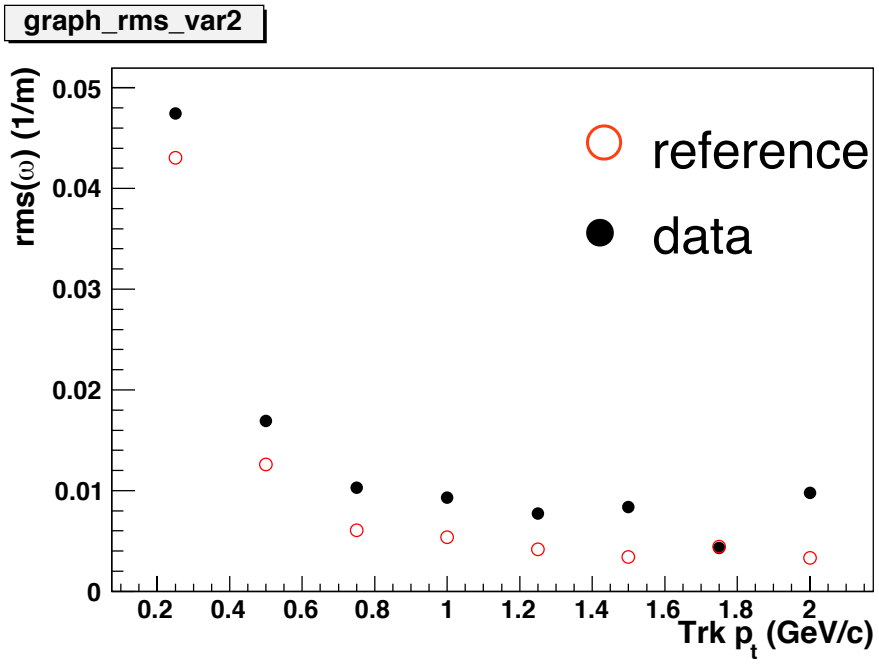


ϕ_0 track parameter resolution vs p_t

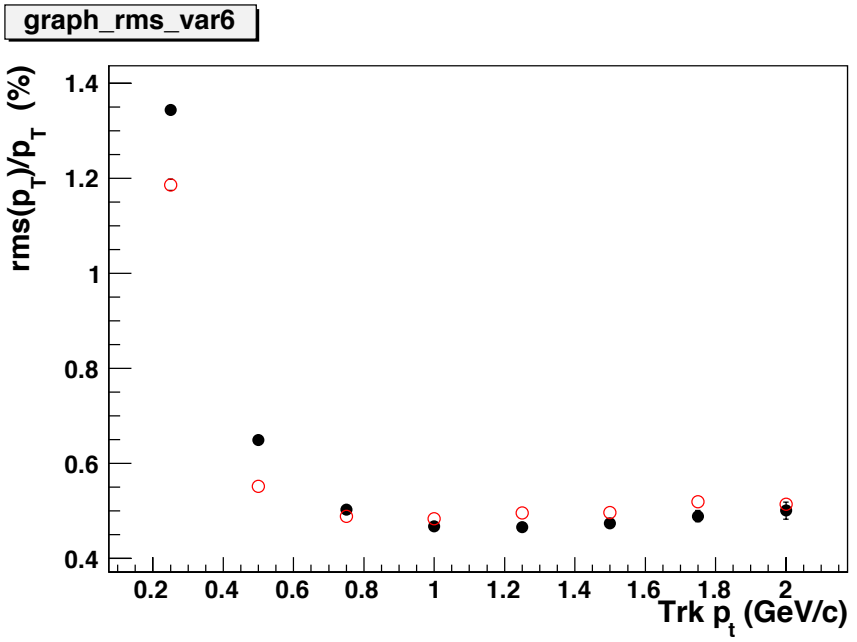


tg(λ) track parameter resolution vs p_t

Examples of comparison plots

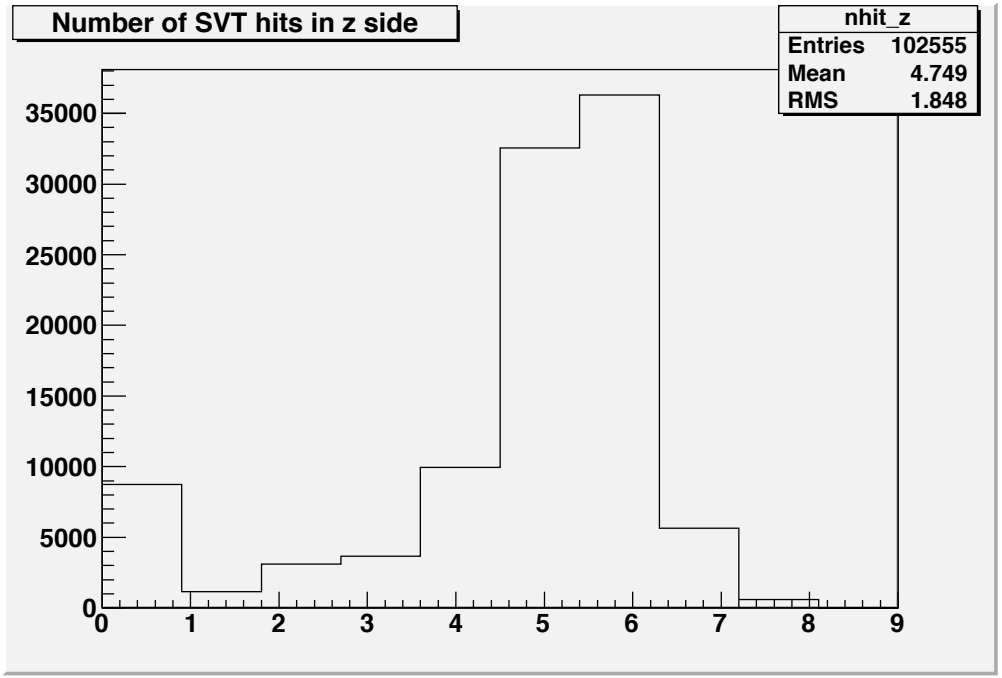


ω track parameter resolution vs p_t

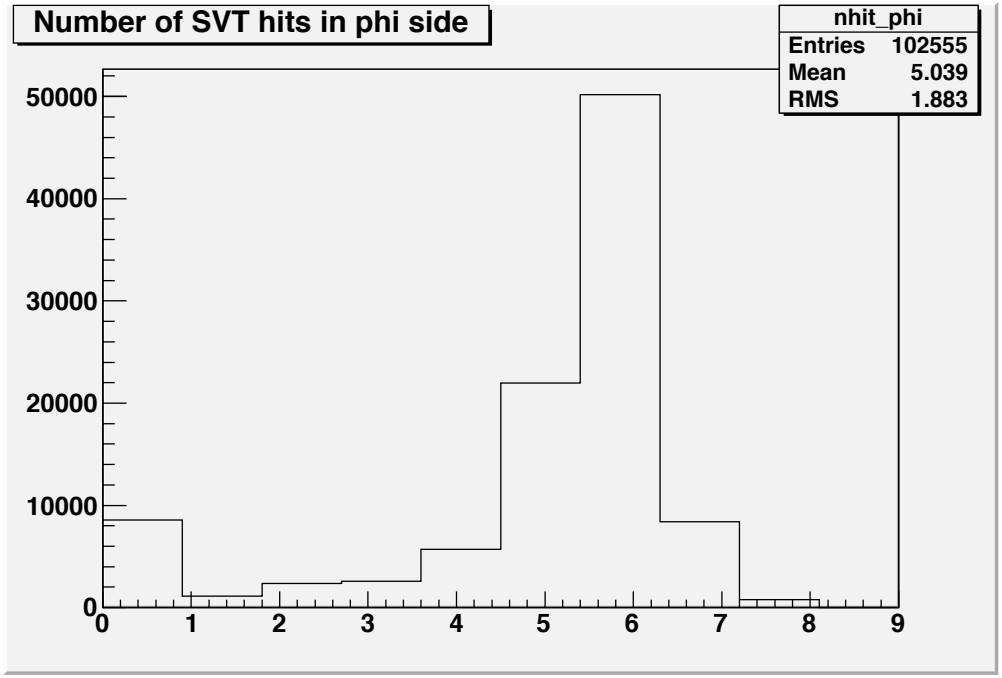


$\sigma(p_t)/p_t$ vs p_t

Number of SVT hits

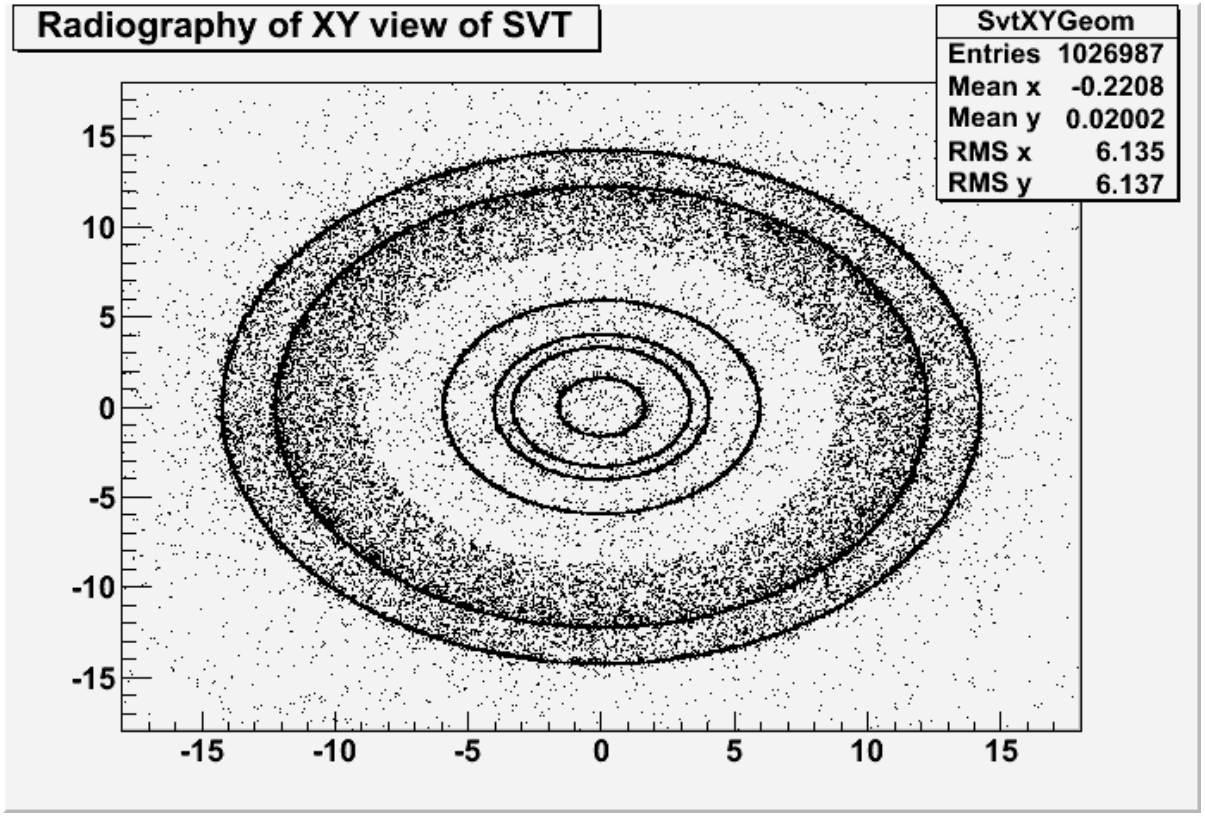


Lower mean for svt z hits wrt phi hits because Layer3 has 60% efficiency, for comparison with BaBar.



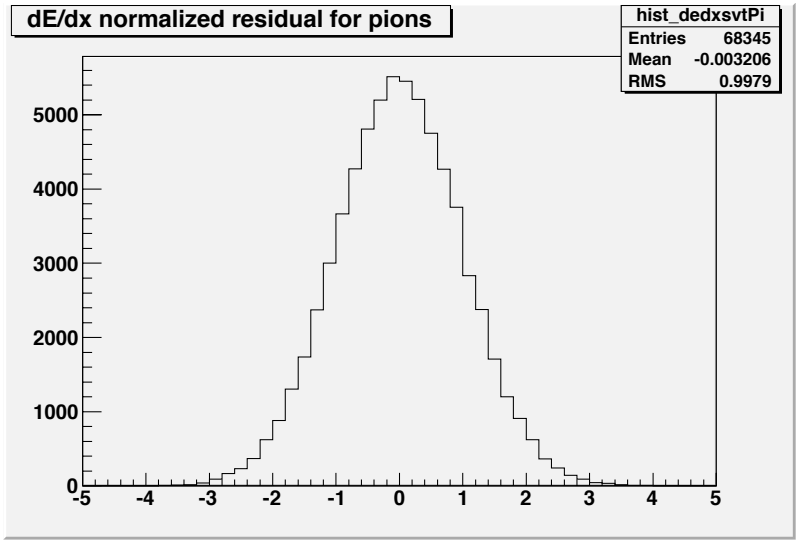
Most probable value is around 6 as expected. Tail at low values due to p_t distribution of tracks and detector inefficiency. nhits>6 due to small detector overlaps.

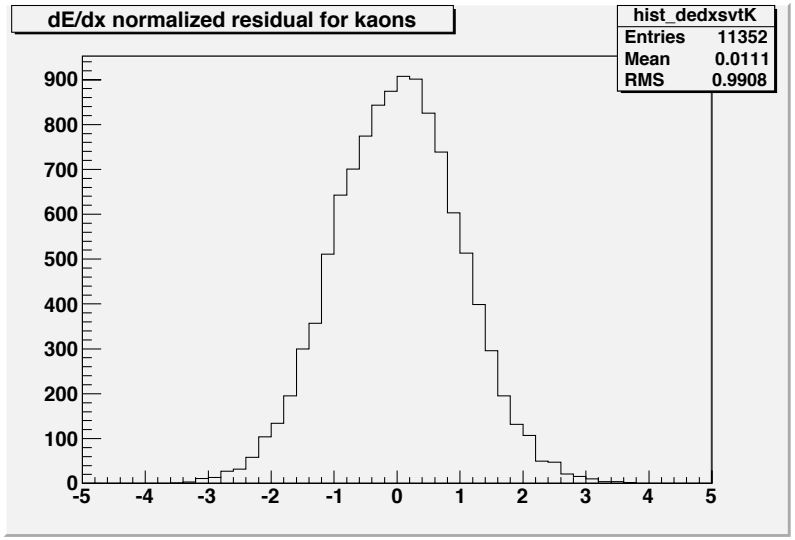
SVT Geometry

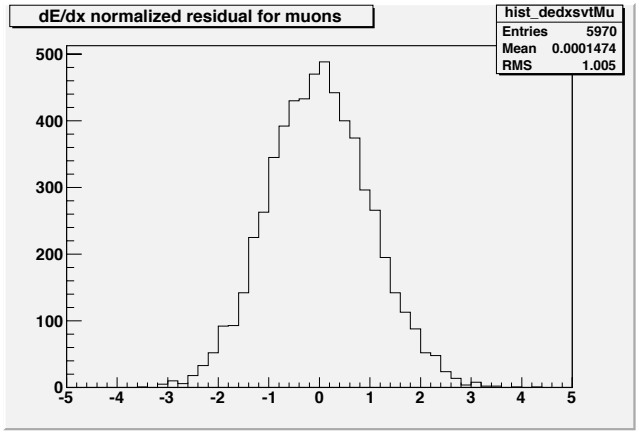


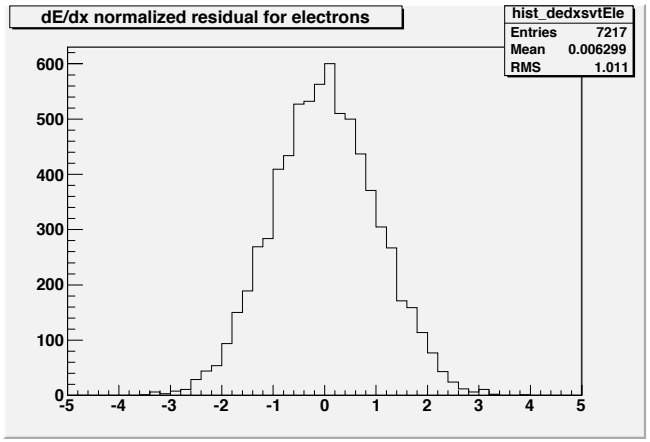
The 6 layer structure is evident from the radiography.

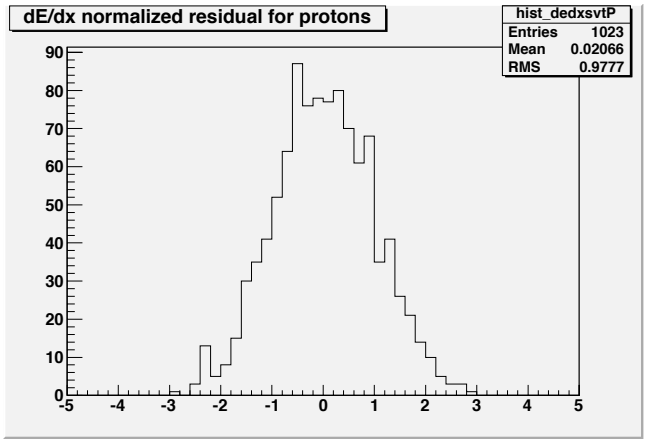
dE/dx normalized residual distributions











Summary

- Detector response is reasonably well modeled in FastSim.
- Few adjustments for material budget and efficiency are probably necessary for TDR studies.
- Quality Monitor is in place. Need some few details (file names, number of events, configurations, etc.) for final version.
- Wiki documentation about QMon for SVT is available at : http://mailman.fe.infn.it/superbwiki/index.php/FastSimDoc/QualityMonitoring#SVT and will be updated.