- Effect of Magnetic Field on VXD Performance
- Response of DEPFET Sensors to Inclined Tracks

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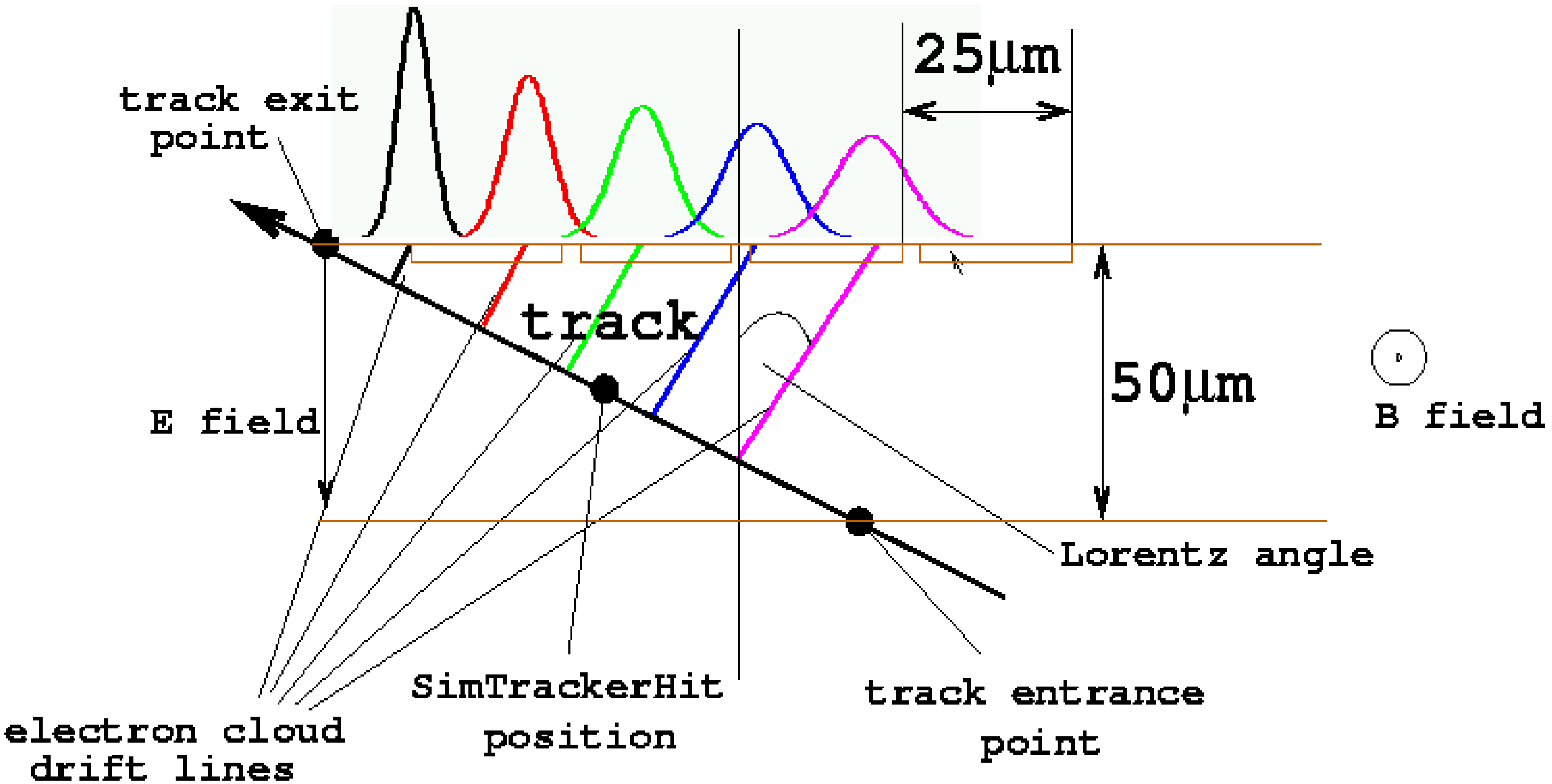
Lorentz Effect



$$\tan\theta_L = \mu r_H B$$

Reference Points

- θ_L has been measured @ 4T field

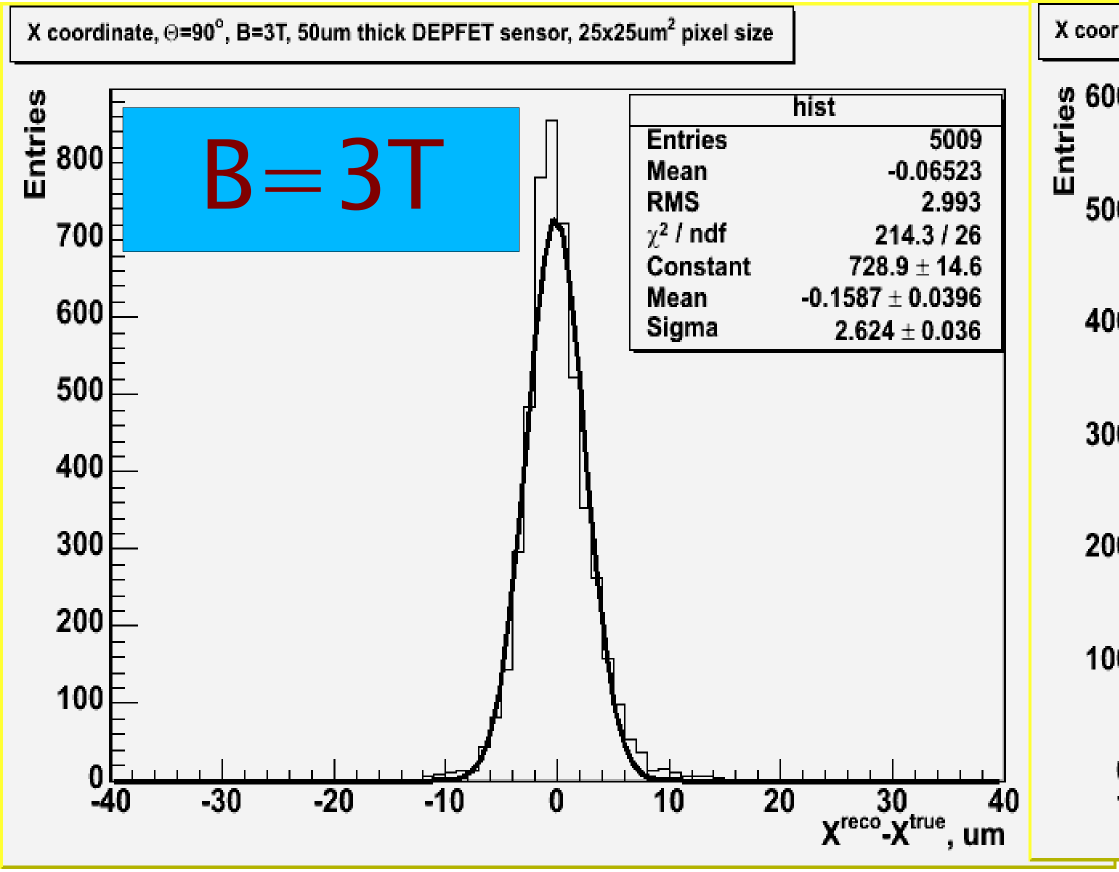
- $\theta_L(4T) = 33^o$ [W.Boer *etal.* NIM A461 (2001) 200]

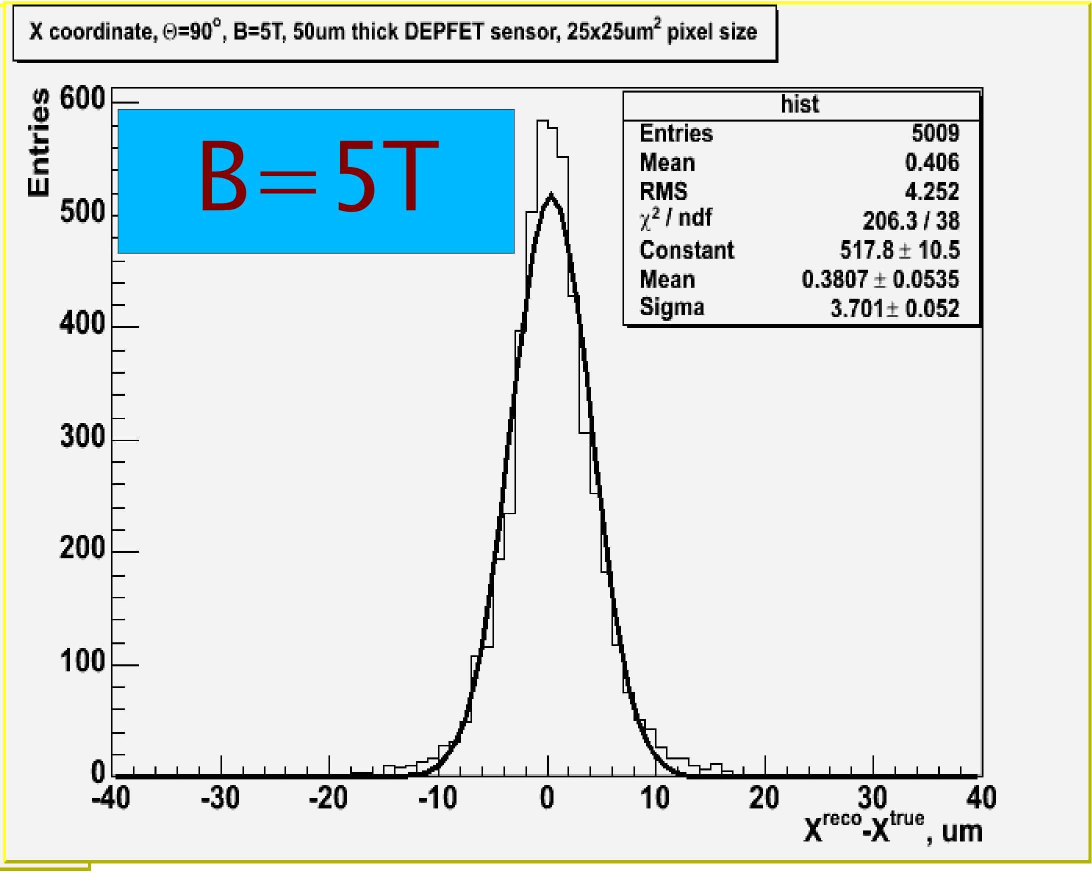
- Experimental data and theory : $r_H(B) \approx 1$ ⇨

- $\tan\theta_L(B) = \tan\theta_L(B_0) \times B/B_0$: $B_0 = 4T$ ⇨

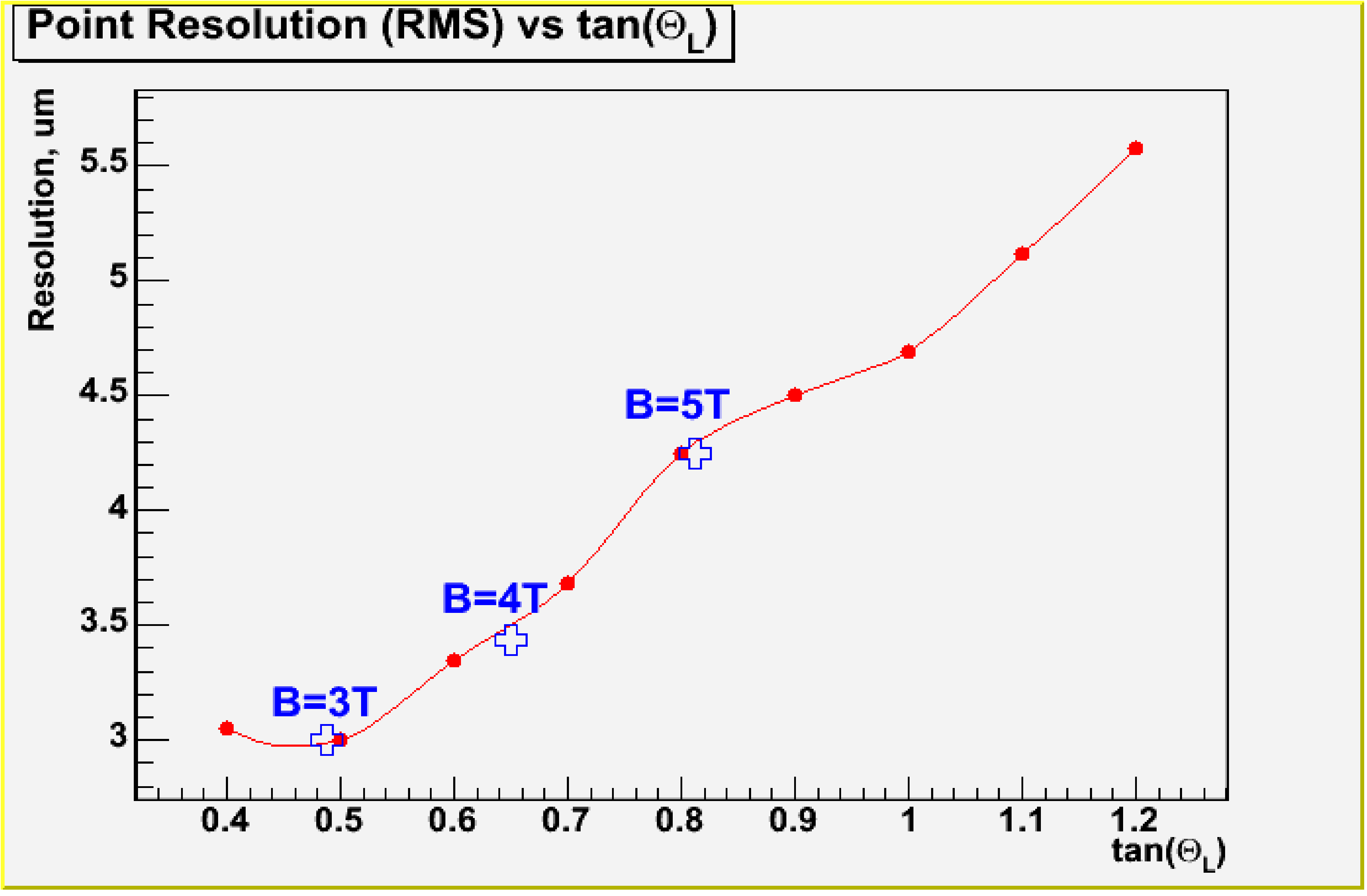
  - $\tan\theta_L(3T) \approx 0.49$ (GLD);
  - $\tan\theta_L(4T) \approx 0.65$ (LDC);
  - $\tan\theta_L(5T) \approx 0.81$ (SiD);

R-Φ Resolution for normally incident tracks

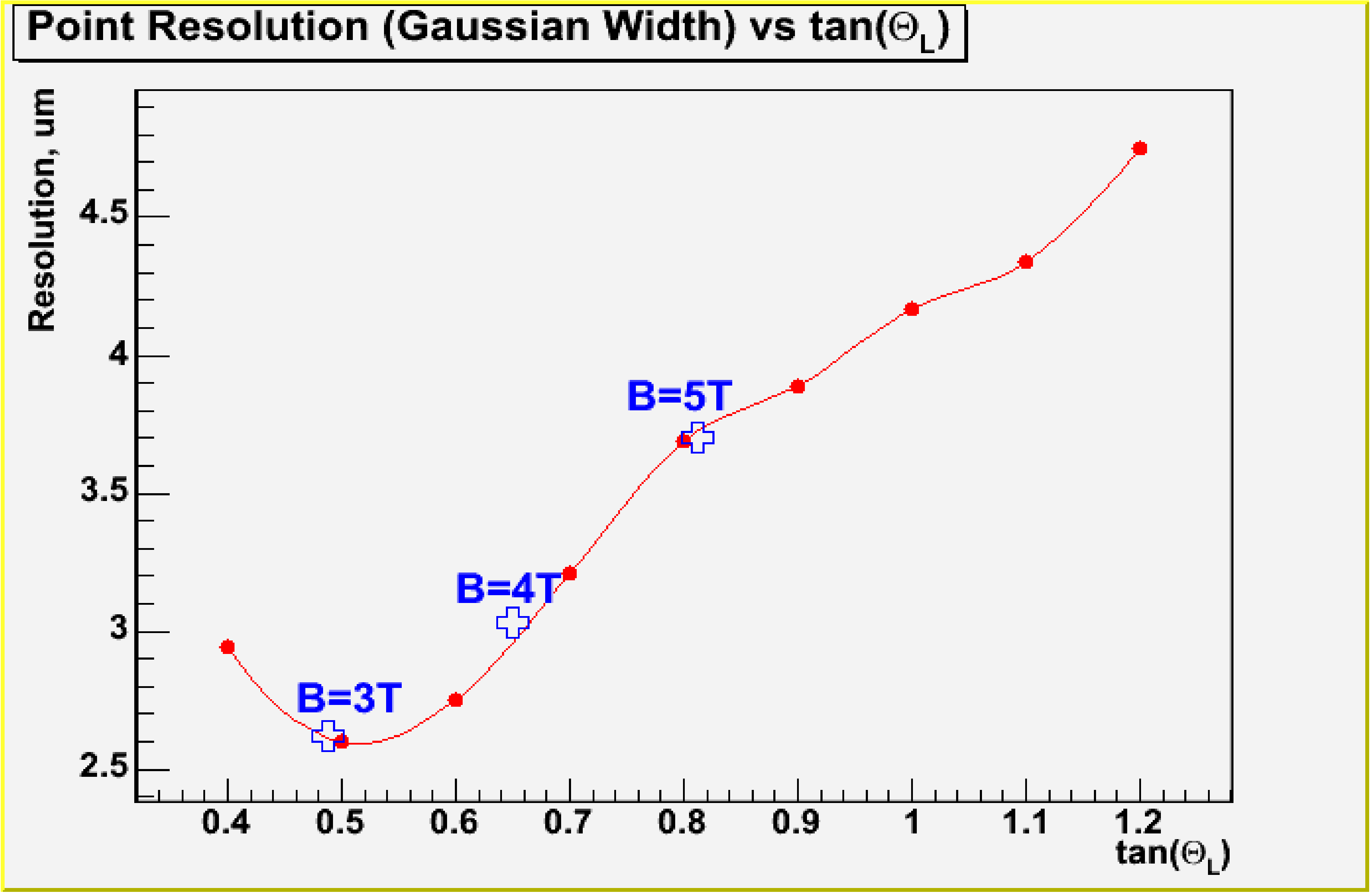




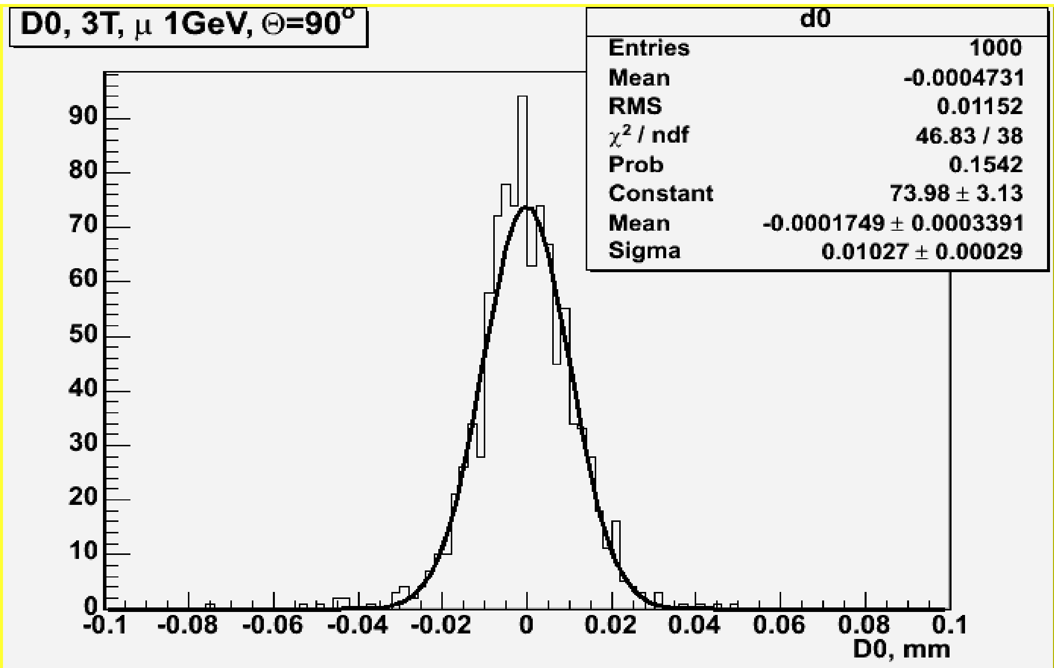
R-Φ Resolution

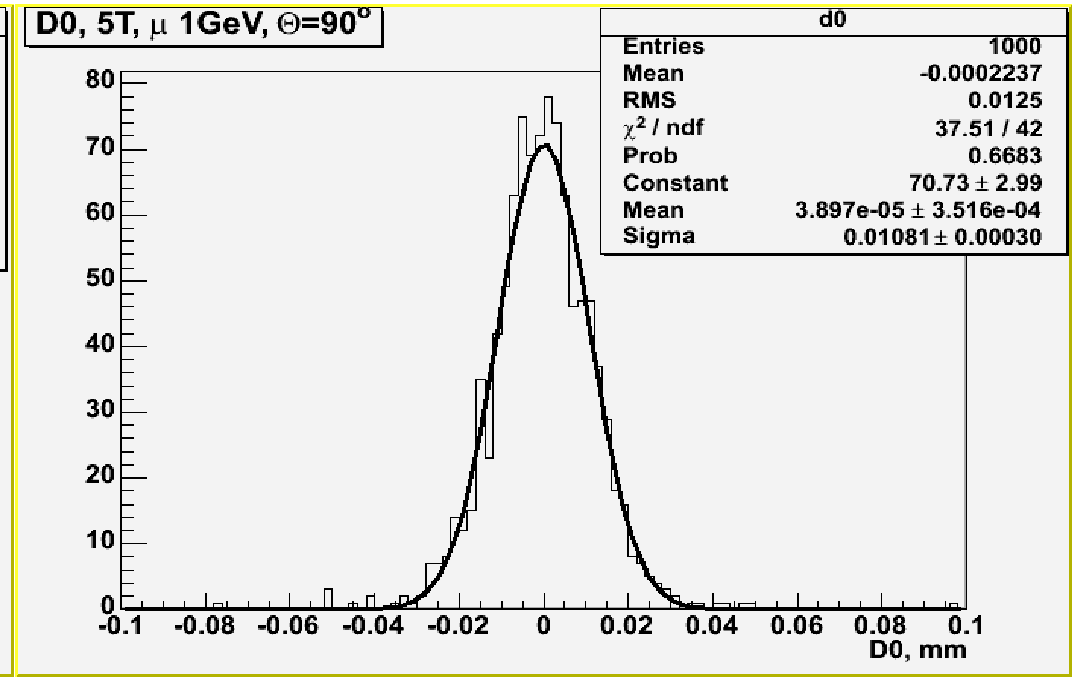


R-Φ Resolution



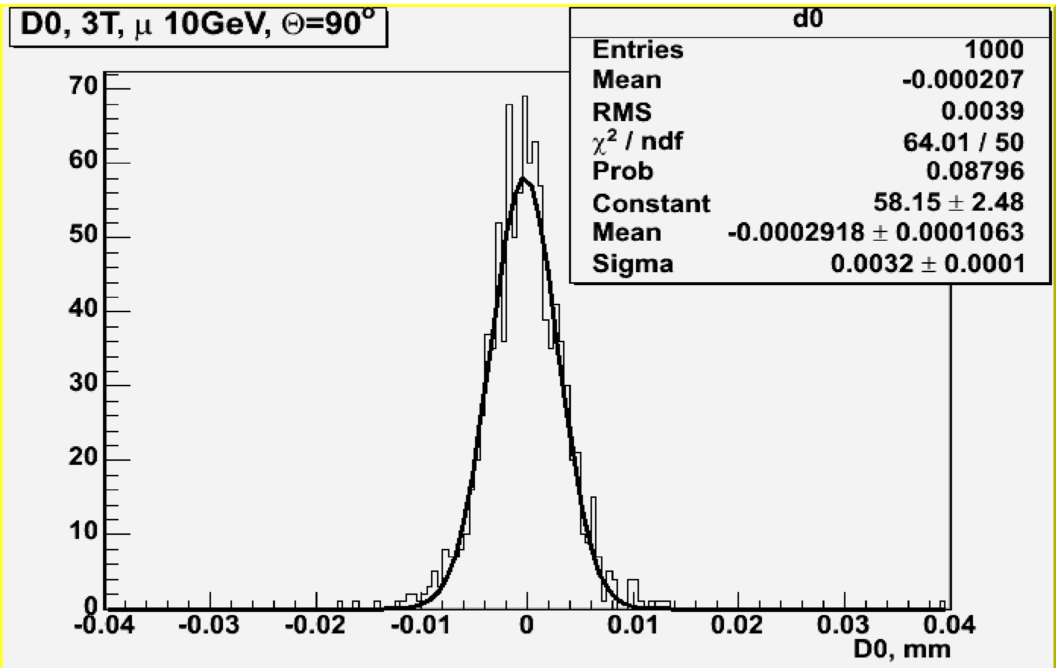
IP Resolution (low p_T tracks)

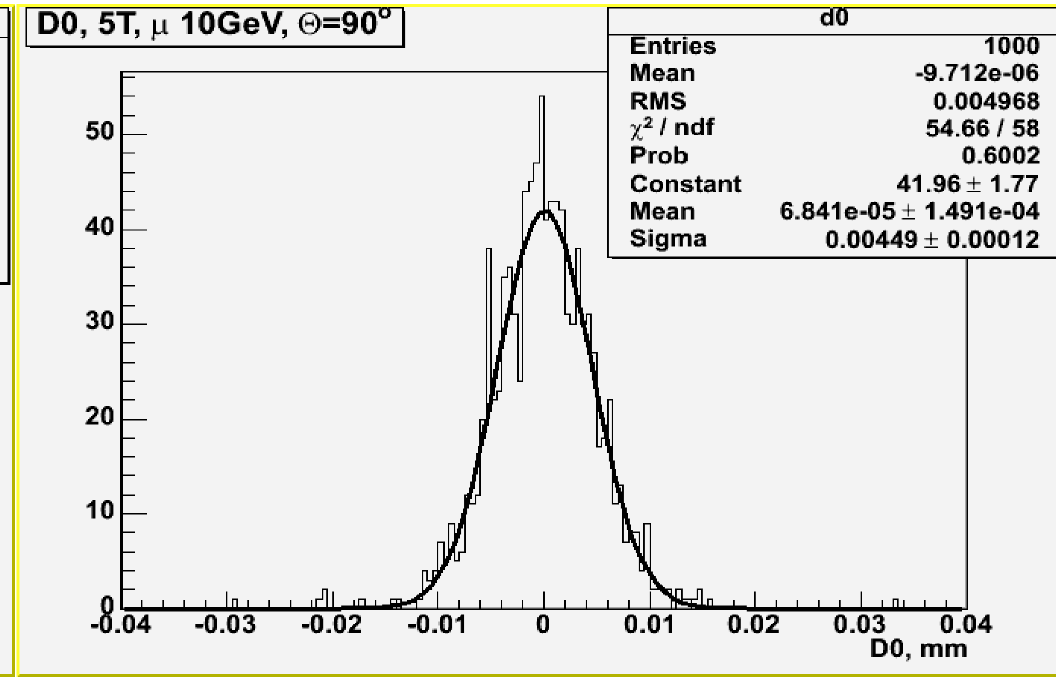




IP resolution dominated by multiple scattering [b-term ; $\sigma = a \oplus b/p_T \cdot \sin^{3/2}\theta$] ⇨ marginal B-field effect

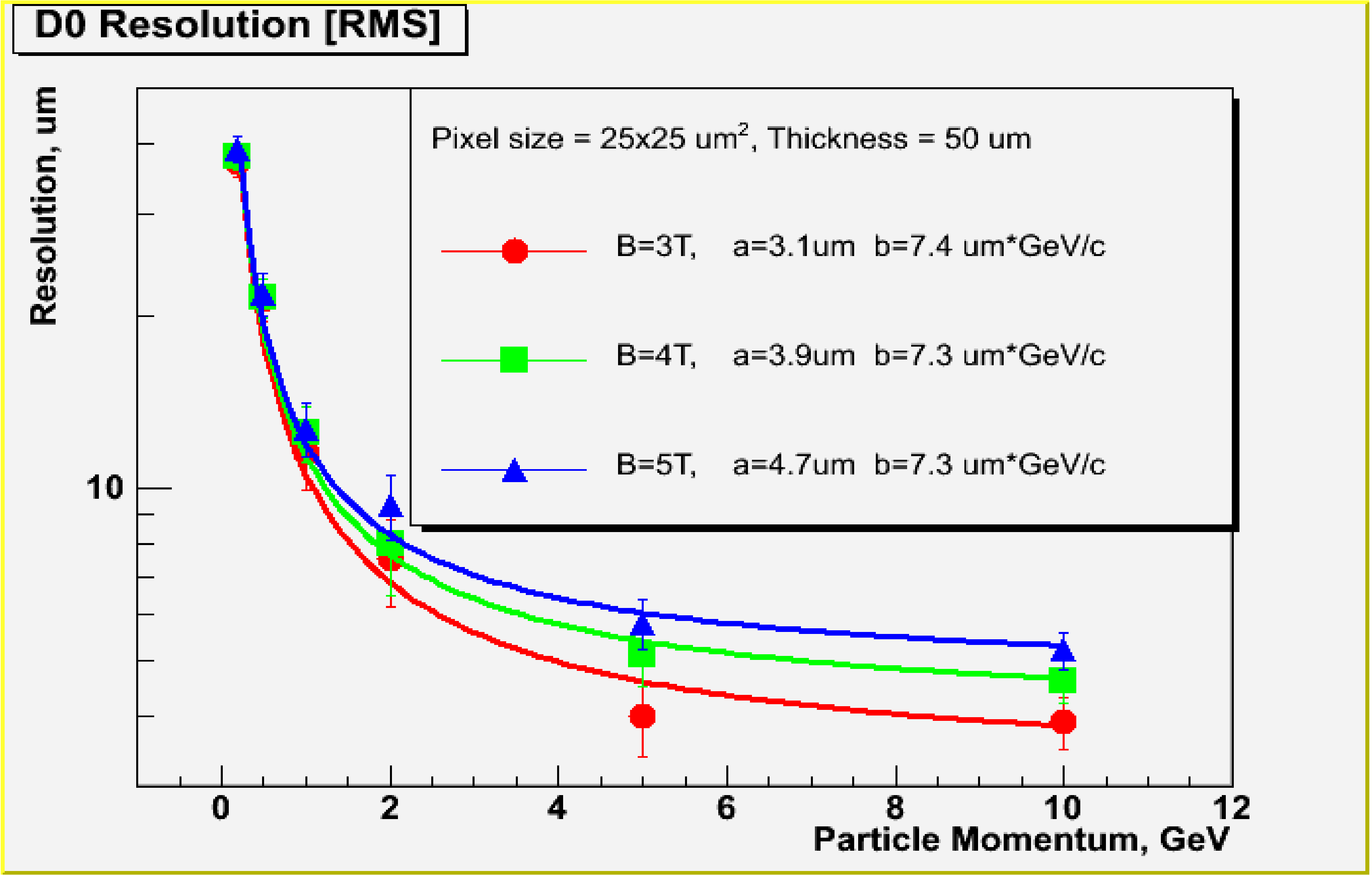
IP Resolution (high p_T tracks)



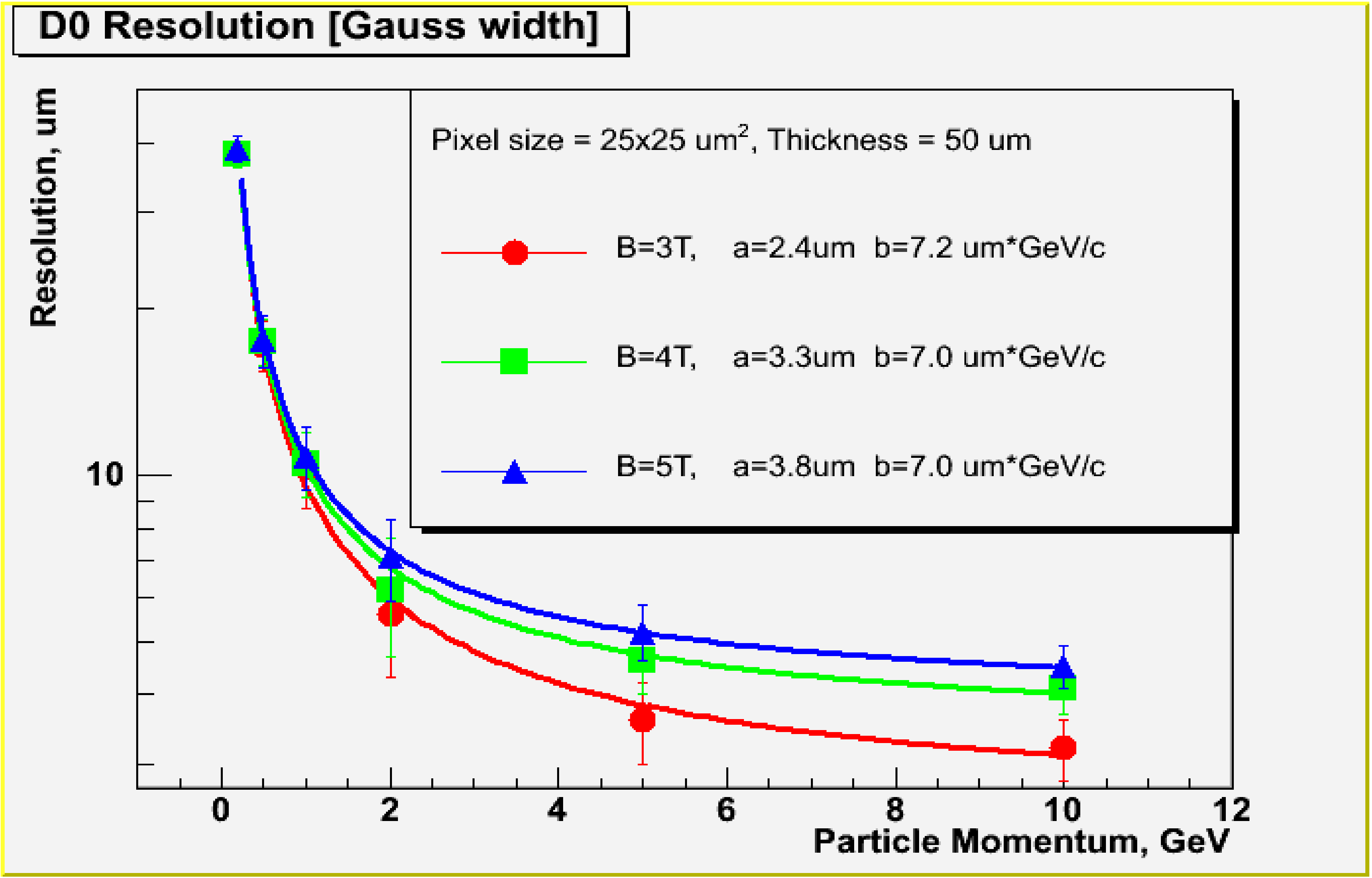


IP resolution dominated by spatial point resolution [a-term ; $\sigma = a \oplus b/p_T \cdot \sin^{3/2}\theta$] ⇨ sizable B-field effect

IP Resolution [RMS]



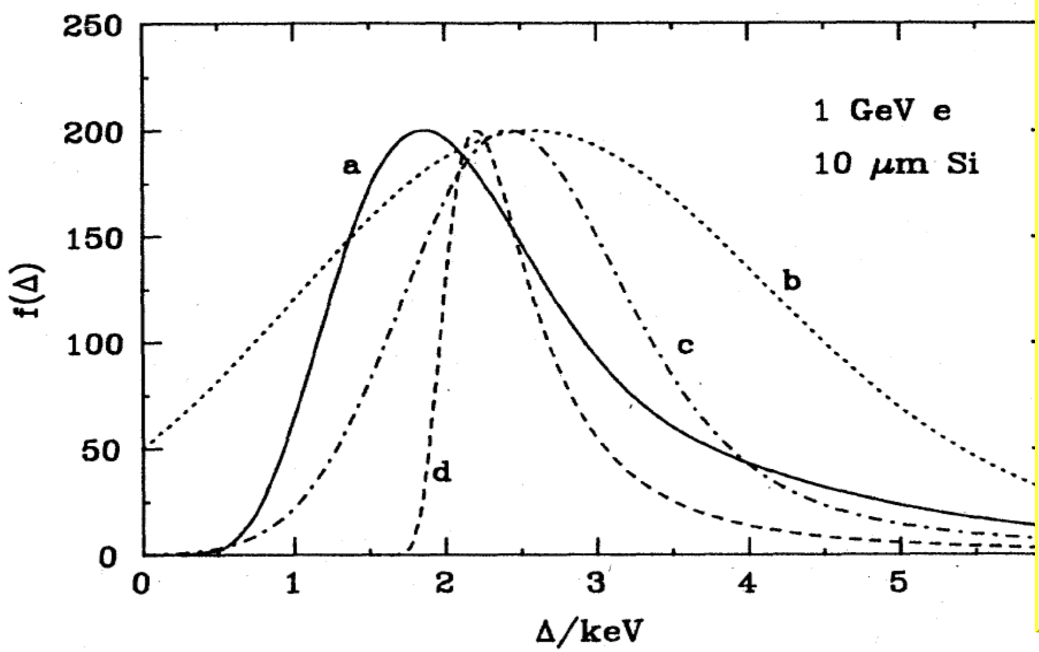
IP Resolution [Gauss Width]

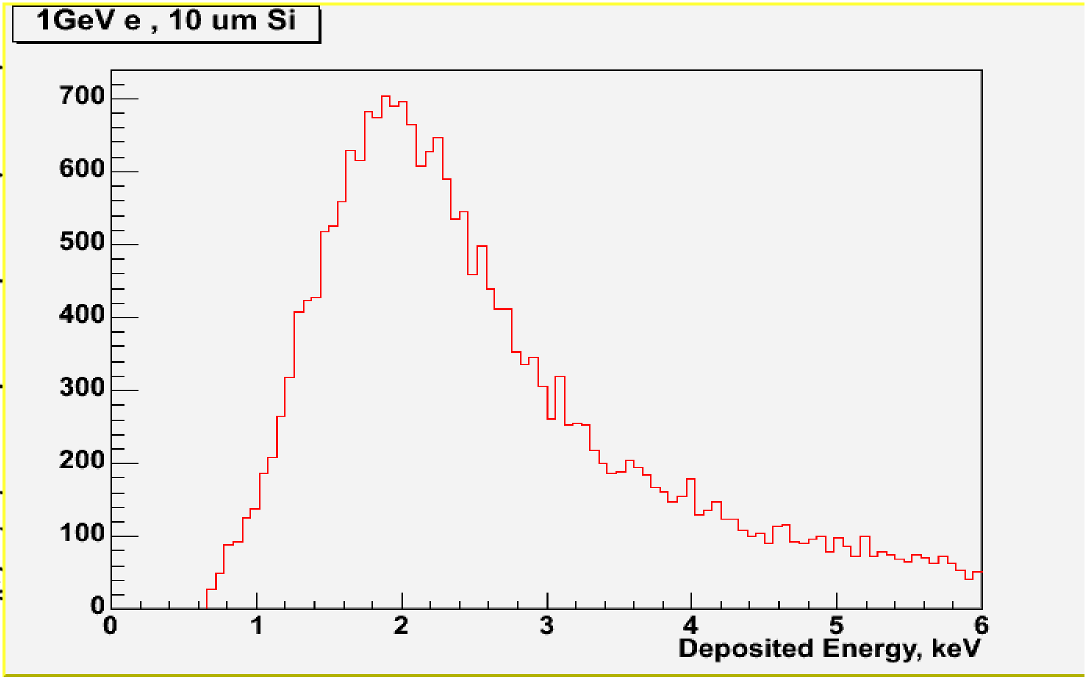


Is G4 Simulation of E_{loss} Fluctuations @ Short Flight Distances reliable?

H.Bichsel
Rev. Modern Physics 60-3 (1998)
plot a)

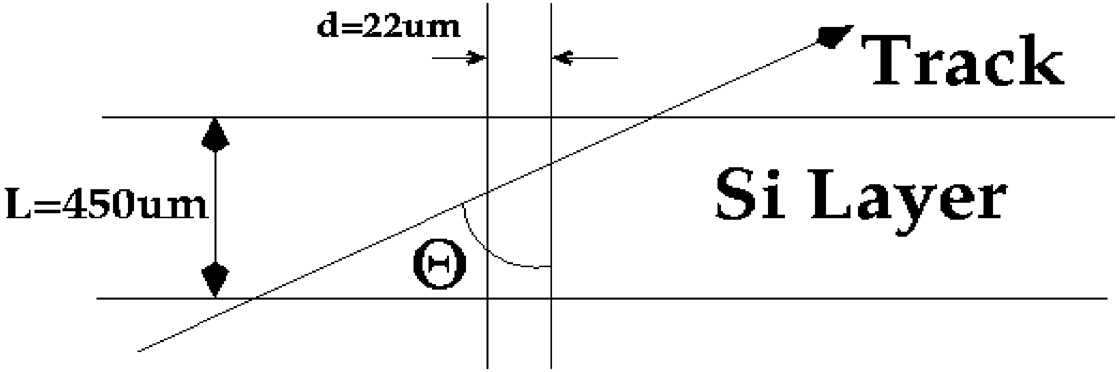
G4 Simulations





DEPFET Sensor Response to Inclined Tracks

- **Particularly interesting data**
  - Allow to check simulation of straggling functions at short flight distance / thin Si sensors

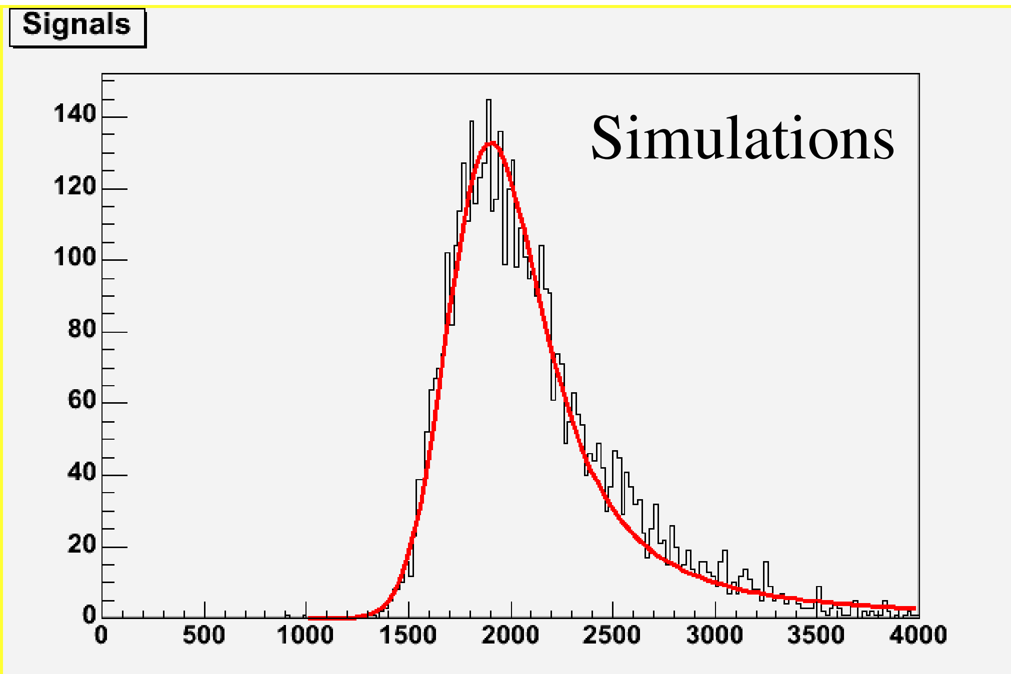


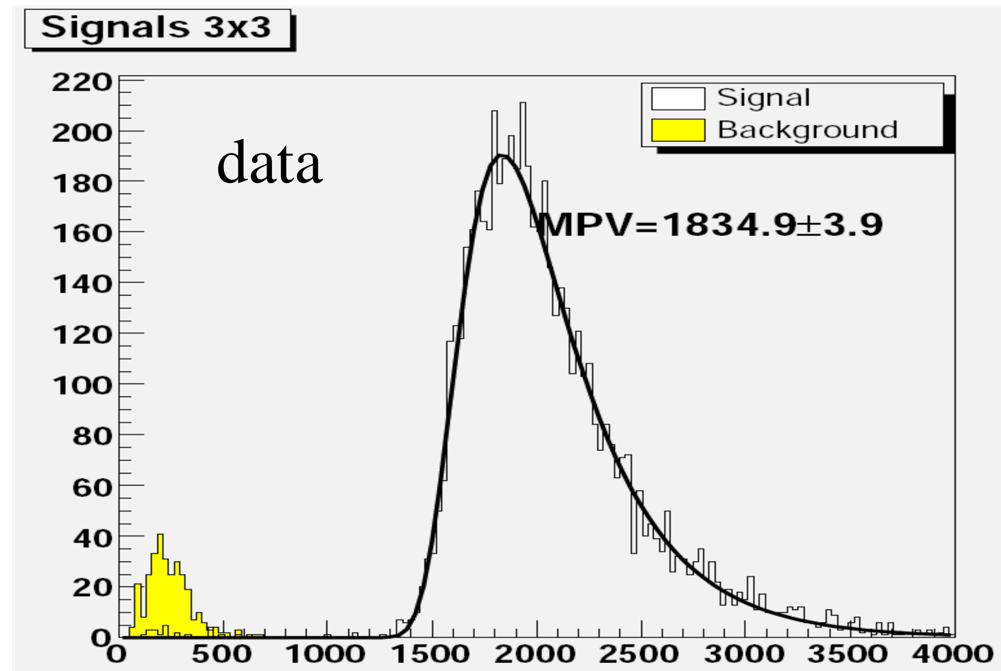
G4 Simulations can be probed @ a scale ≈ d/sinθ;
d – pixel size;
θ - track incidence angle

Analyzed DEPFET Matrix (Hyb2A):

- Pixel dimensions : D_x = 36 um, D_y = 22 um;
- Layer thickness = 450 um ; electronic noise = 300 e$^-$
- Rotations up to 40^o around X axis [θ-rotations] and Y axis [ϕ-rotations] are performed

Total Cluster Amplitude (Normal Track Incidence)



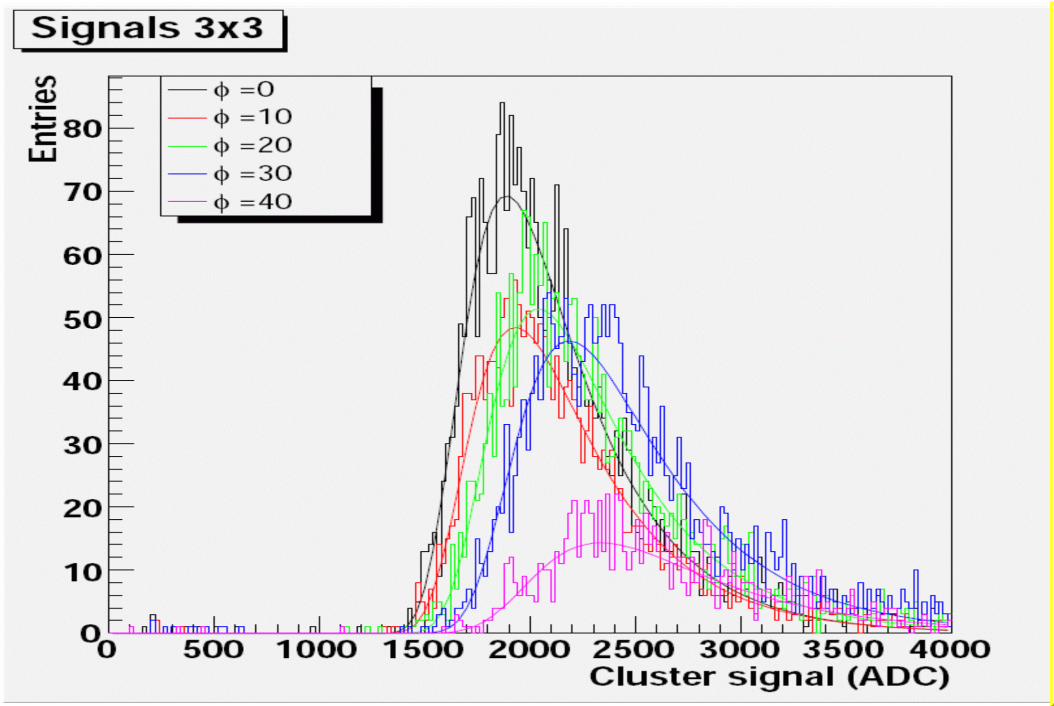


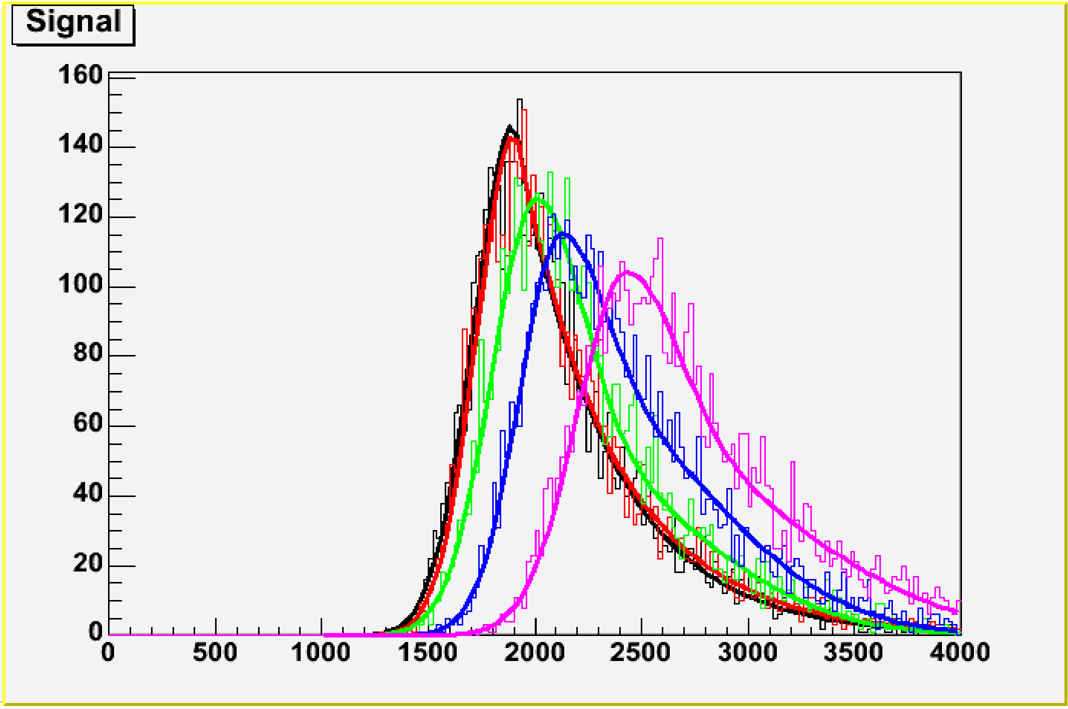
Data collected at normal track incidence is used to derive coefficient converting E_{loss} into ADC counts

Amplitude Distribution vs Incidence Angle

Testbeam data

Simulations

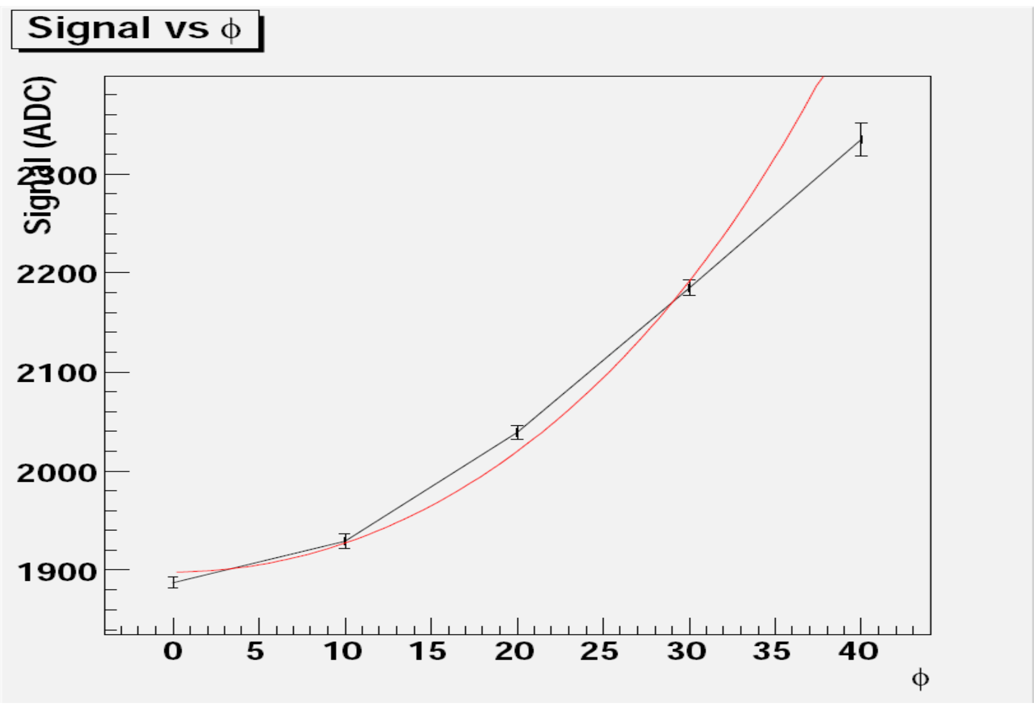


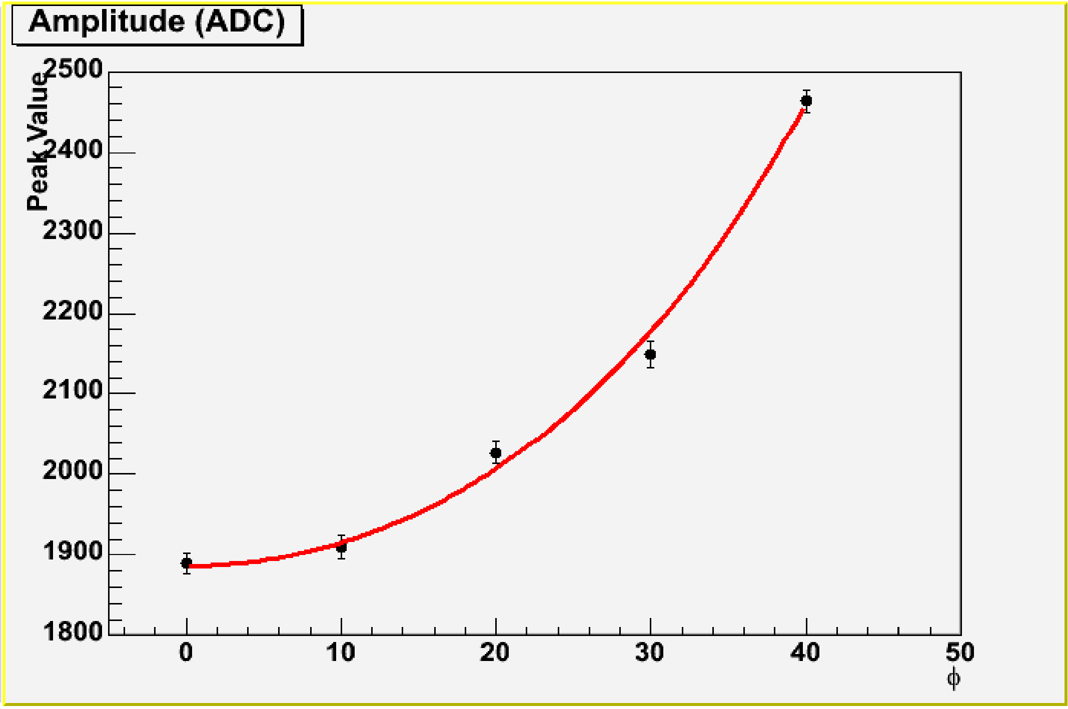


Peak Value vs Incidence Angle

Testbeam data

Simulations

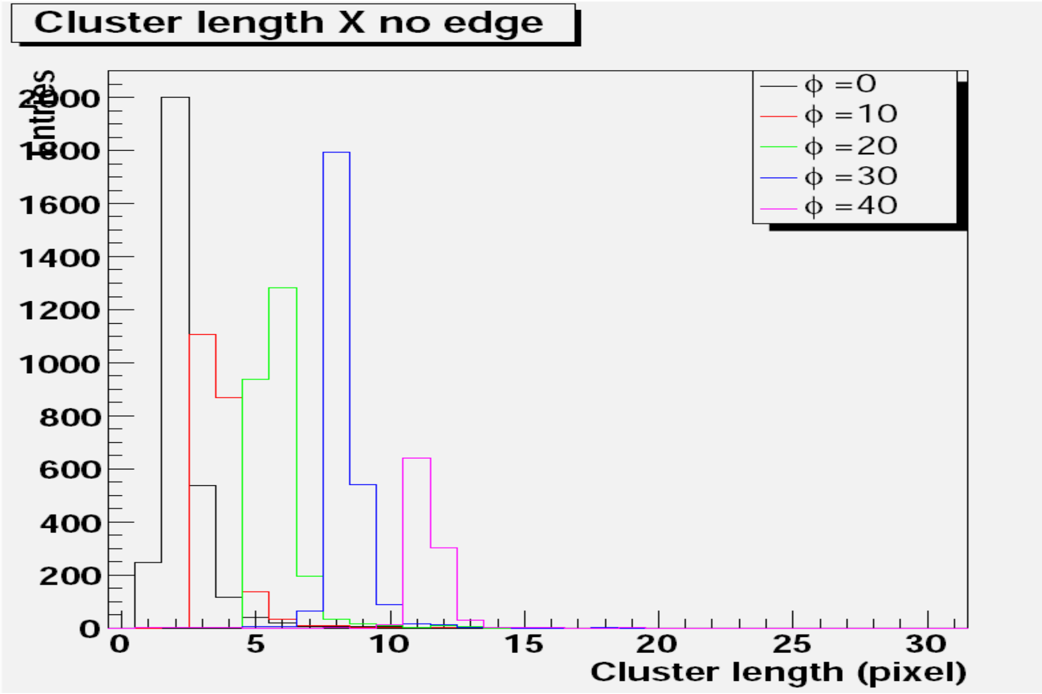


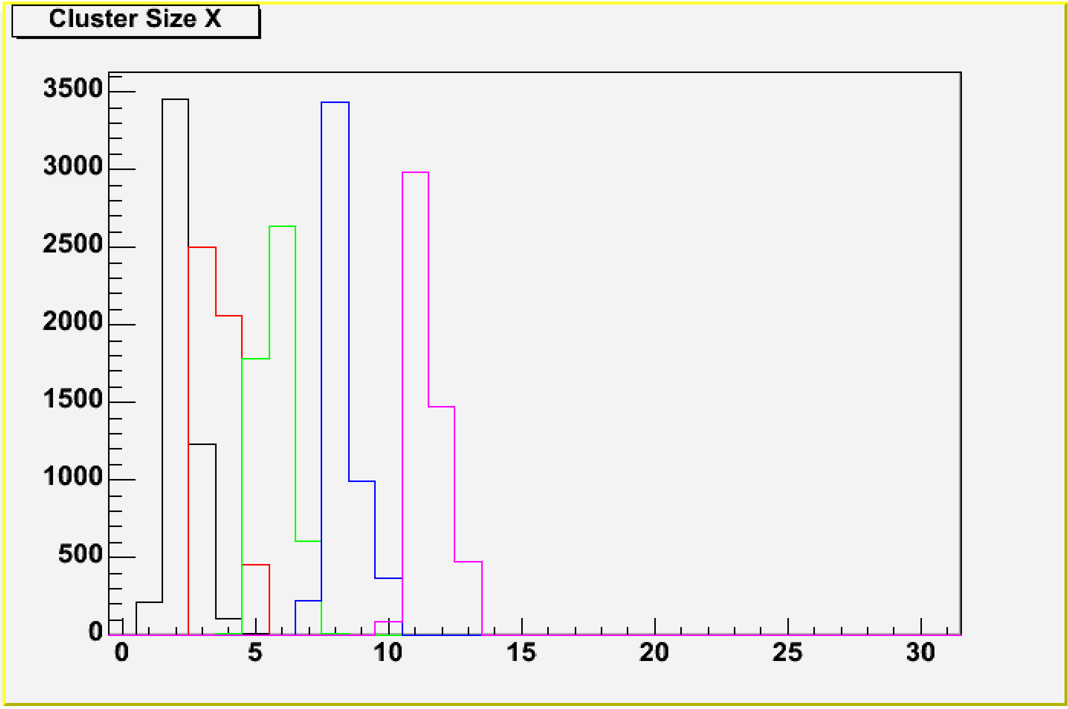


Cluster Length X vs Incidence Angle

Testbeam data

Simulations

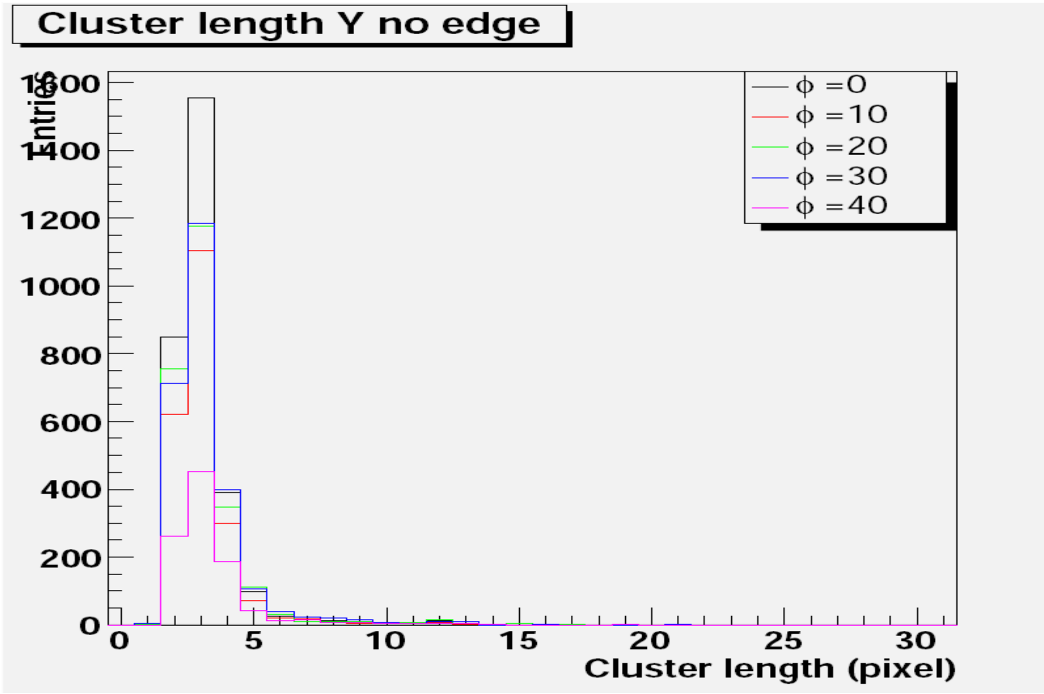


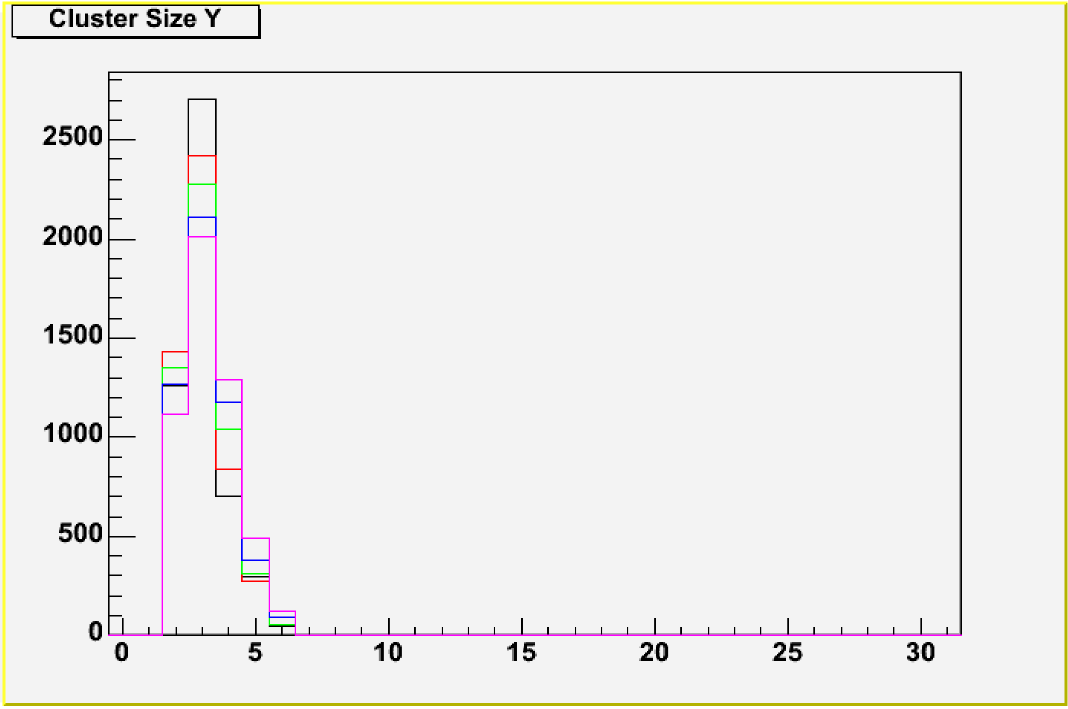


Cluster Length Y vs Incidence Angle

Testbeam data

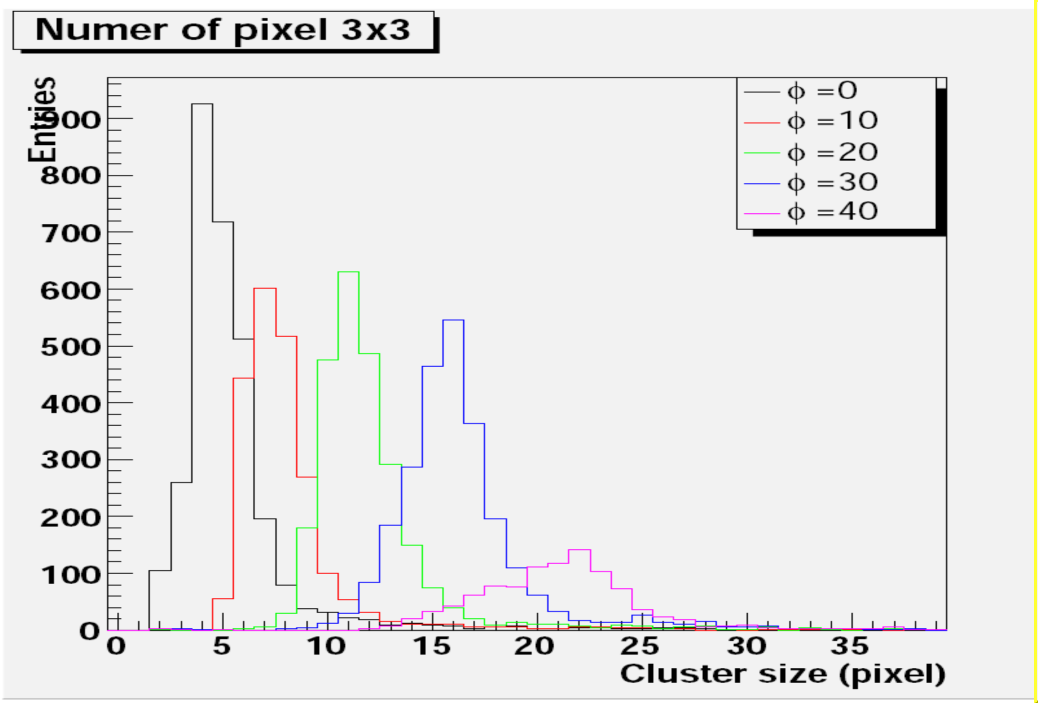
Simulations



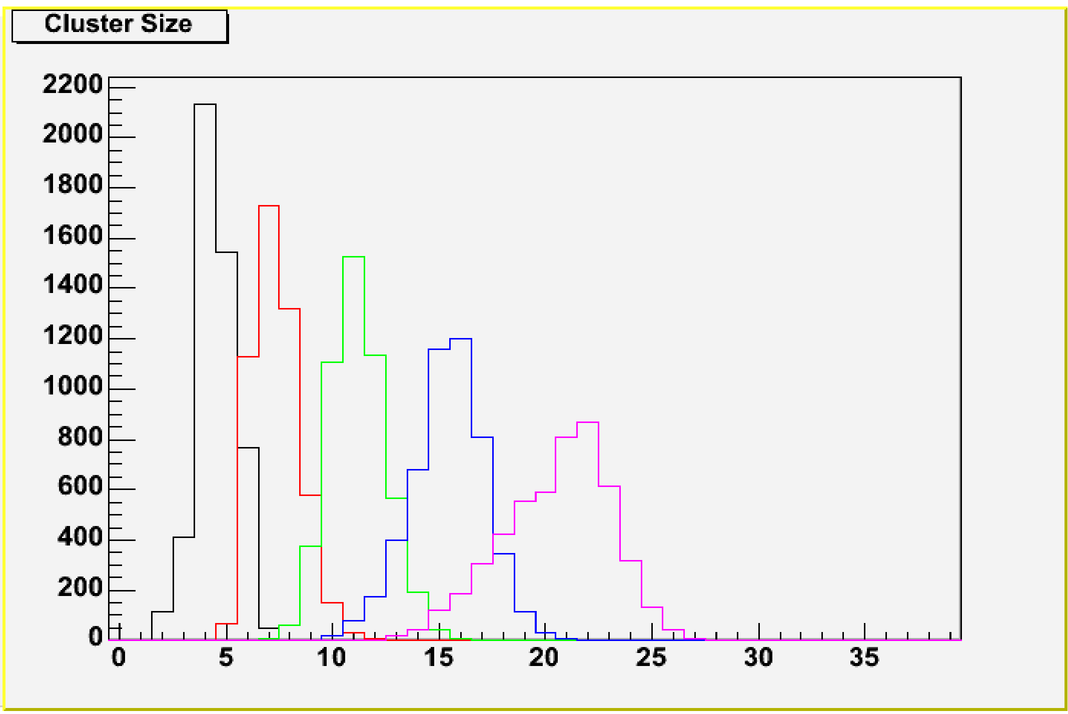


Cluster Size vs Incidence Angle

Testbeam data



Simulations



Probing Straggling Functions @ short flight distance

- Validity of G4 simulation of energy loss fluctuations @ short flight distances can be probed by investigating distributions of signal projection on pixel rows (columns) perpendicular to the inclined track momentum

- Probed scale :

$$D_{x,y} / \mathtt{sin}(\theta,\phi), \; D_{x,y} \text{ being pixel dimensions}$$

- Expected mean signal on central rows (excluding edges) :

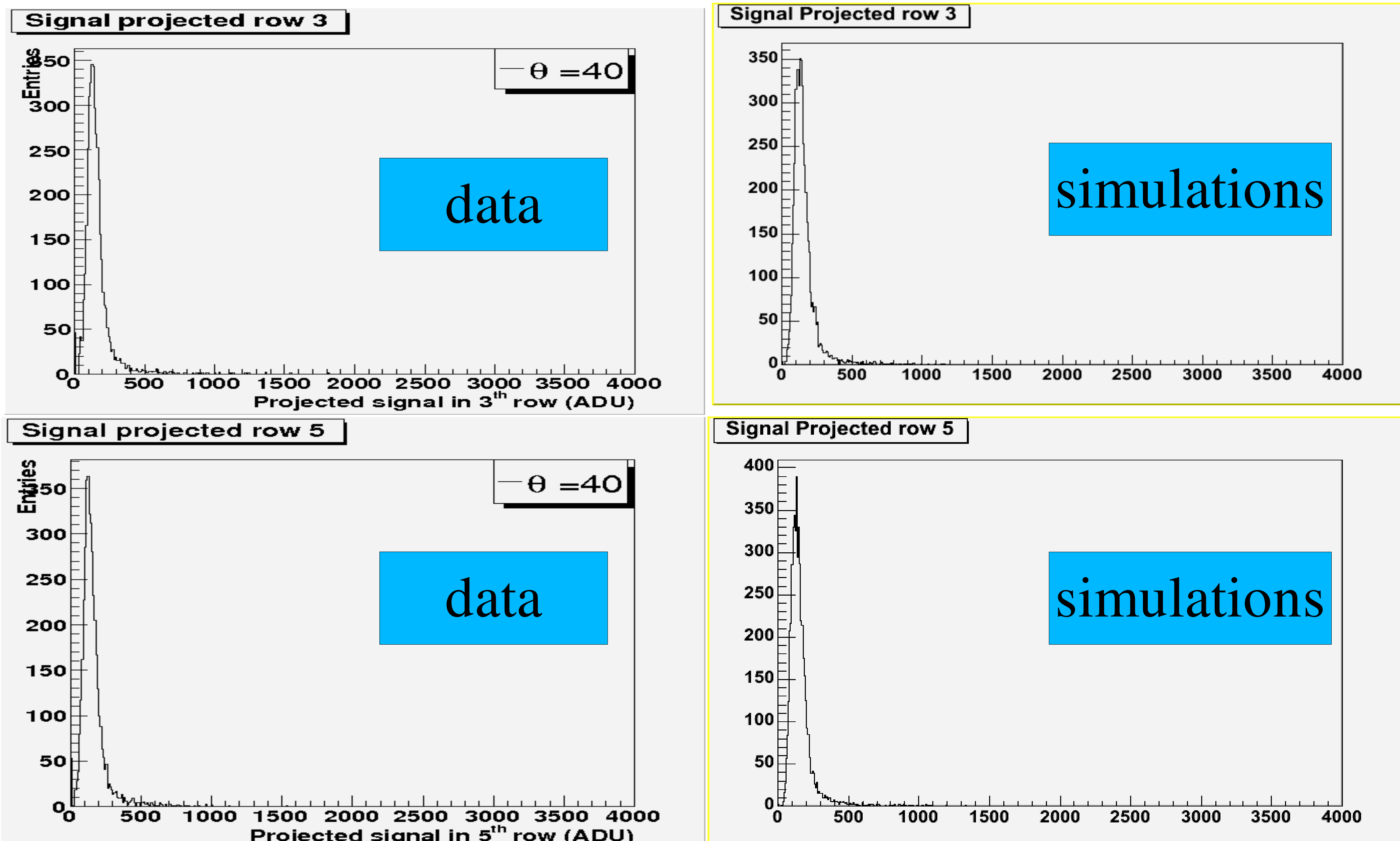
$$A_{\mathtt{row,column}} \approx A_0 D_{x,y} / \left(L \cdot \mathtt{sin}(\theta,\phi)\right),$$

L is layer thickness,

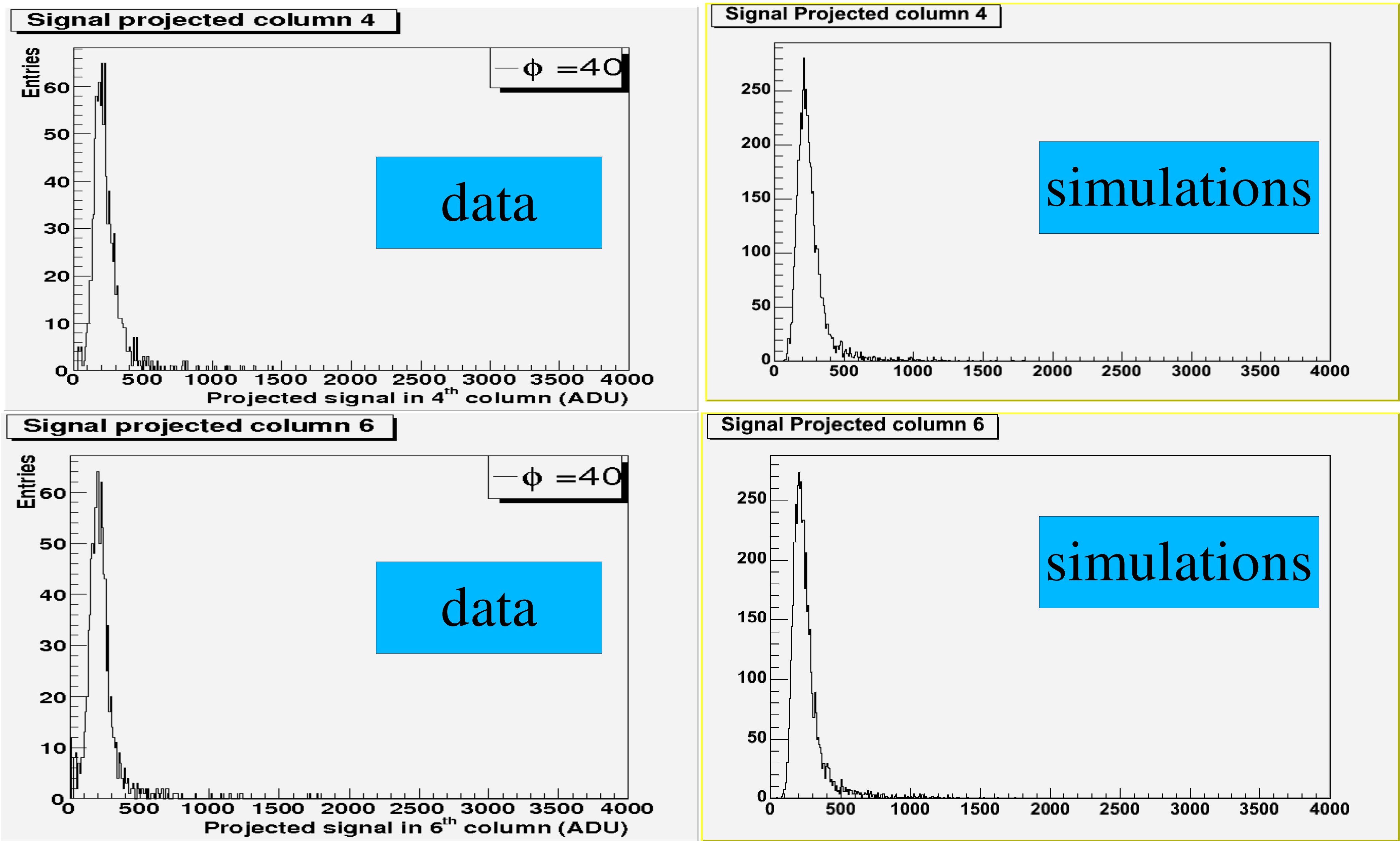
A_0 is total cluster amplitude for normally incident track

- In the following only few representative columns(rows) are shown

Signal projected on pixel rows [θ-rotation; θ=40°]



Signal projected on pixel columns [ϕ-rotation; ϕ=40°]



Concluding Remarks (1)

- Simulation study of magnetic field effect on the DEPFET based VXD performance is performed
- Effect is evaluated in terms of single point and impact parameter resolution
- No drastic deterioration of VXD performance with increasing magnetic field is found
- At 5T field VXD performance still meets ILC physics requirements

Concluding Remarks (2)

- Simulations of DEPFET sensor response to inclined tracks are performed and compared to testbeam data
- Simulation of E_{loss} fluctuations is verified @ short flight distance of ionizing particles utilizing testbeam data collected at track incidence angles up to 40^{o}
- These data allow to probe E_{loss} fluctuations @ a scale of $\mathtt{d}/\mathtt{sin}\theta \approx \mathtt{30um}$, where $\mathtt{d}$ is the pixel dimensions and θ is the track incidence angle
- Good agreement between simulations and data is found giving confidence in Geant4 MC simulations