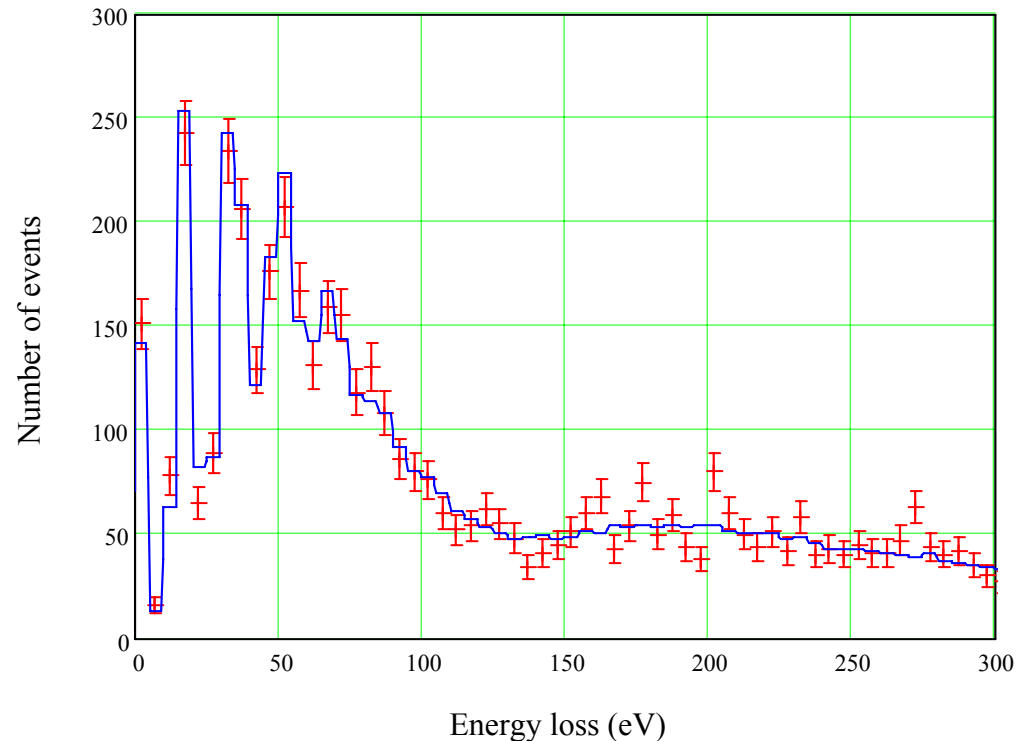


# CPCCD Position Resolution

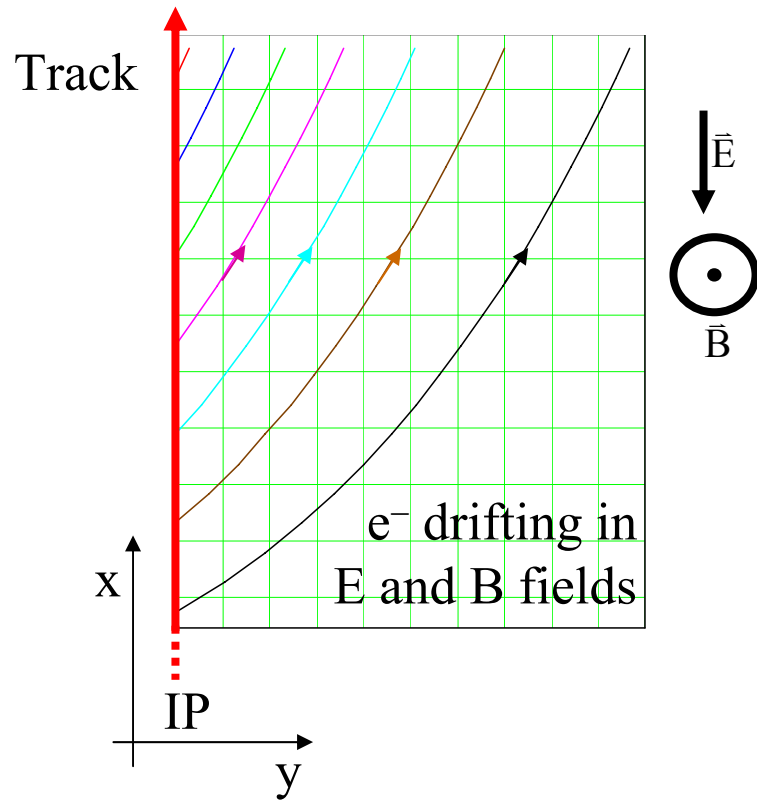
- Resolution of SLD CCDs (measured in experiment!)  $\sim 3.5 \mu\text{m}$ , what expected for CPCCD?
- Look at expected resolution of position reconstructed using centre of gravity of charge distribution as function of angle of tracks and B-field strength.

- Model charge creation and transport including effects of energy loss fluctuations...

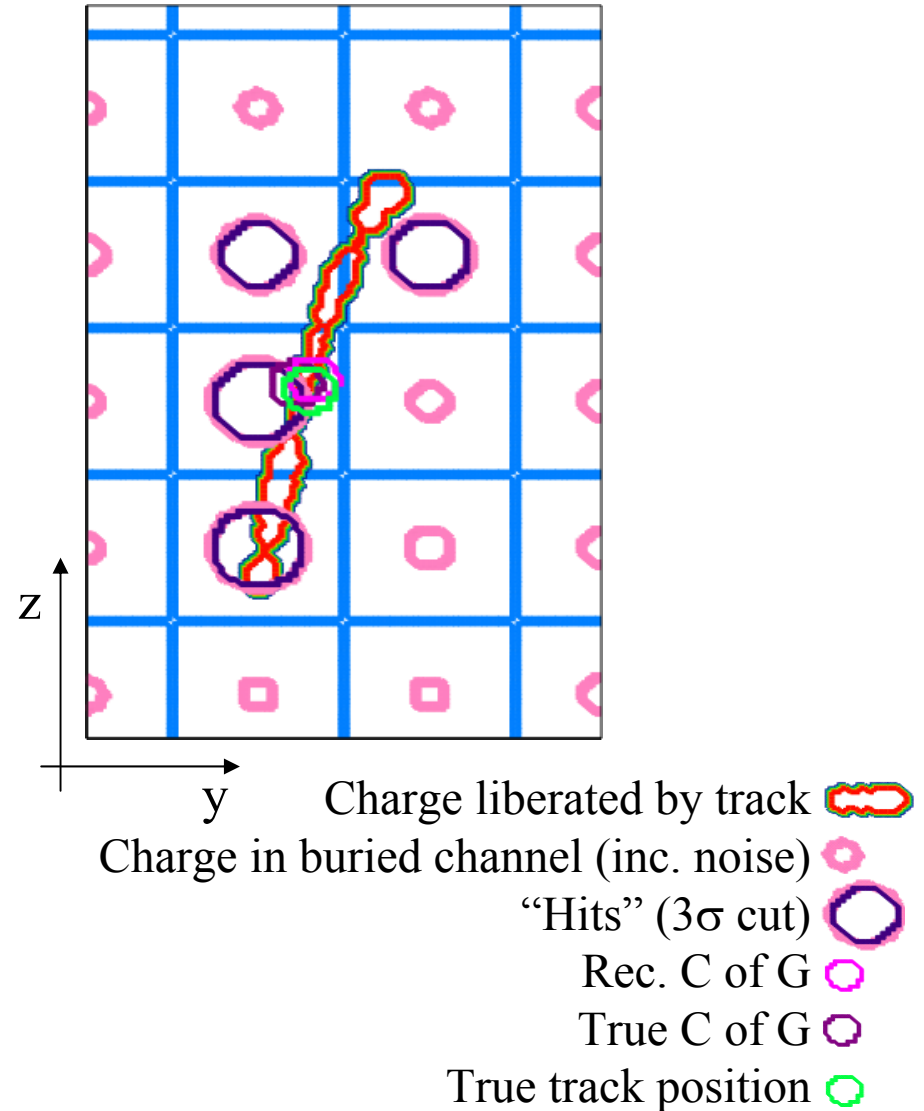


# CPCCD Position Resolution

- ...magnetic field

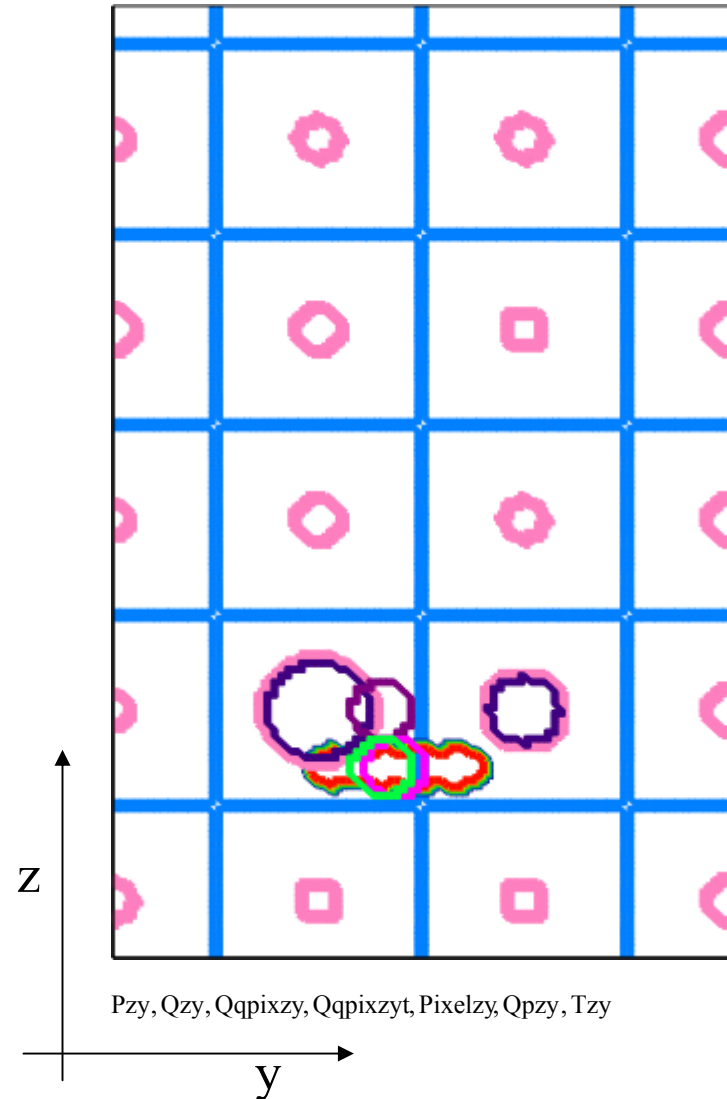


- ...noise and diffusion, but not yet multiple scattering or alignment.



# Charge sharing and resolution

- CPCCD fully depleted, so no field free region in which charge can spread over large distance.
- Charge sharing occurs due to diffusion, but only over 2...3  $\mu\text{m}$  in drifting through 20  $\mu\text{m}$  thick epitaxial layer.
- Where charge collected only in one pixel, expect resolution to be  $20 \mu\text{m}/\sqrt{12} = 5.8 \mu\text{m}$  (e.g. z coordinate opposite).
- Charge sharing leads to improved resolution (e.g. y coord. opposite).
- Lorentz angle effects help to spread charge in y direction.



# Resolution as function of track angle and B field

- Study resolution as function of track angle.

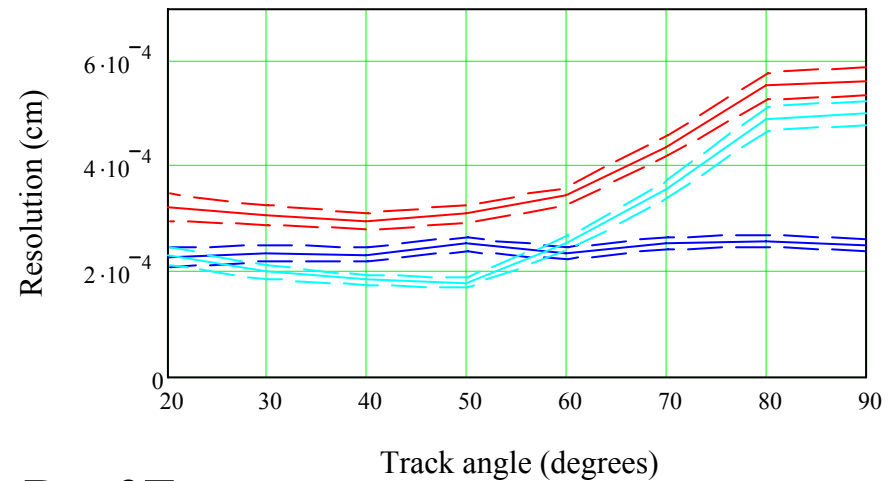
- Legend:

- ◆ — total resolution
- ◆ — y resolution
- ◆ — z resolution

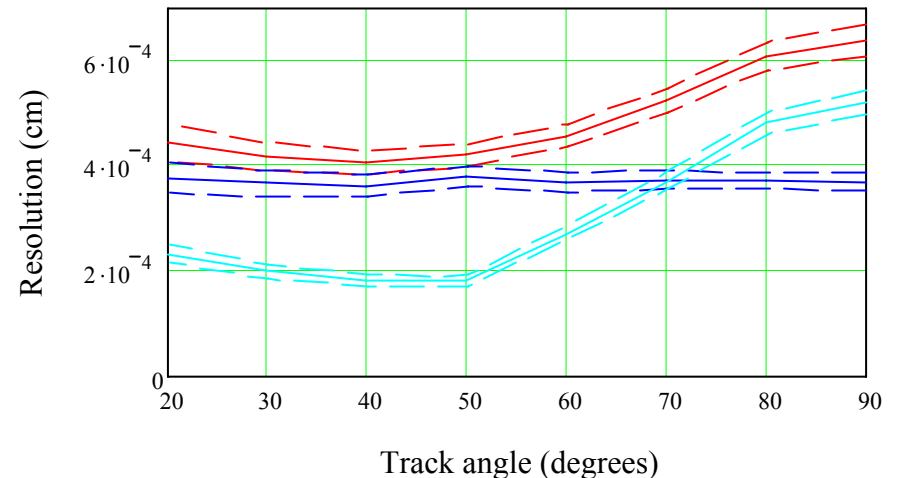
- Res. in y  $\sim$  independent of track angle.

- Res. in z less good at  $\theta = 90^\circ$  as no charge sharing, in forward region angle of tracks causing sharing, res. improves.

- $B = 5T$

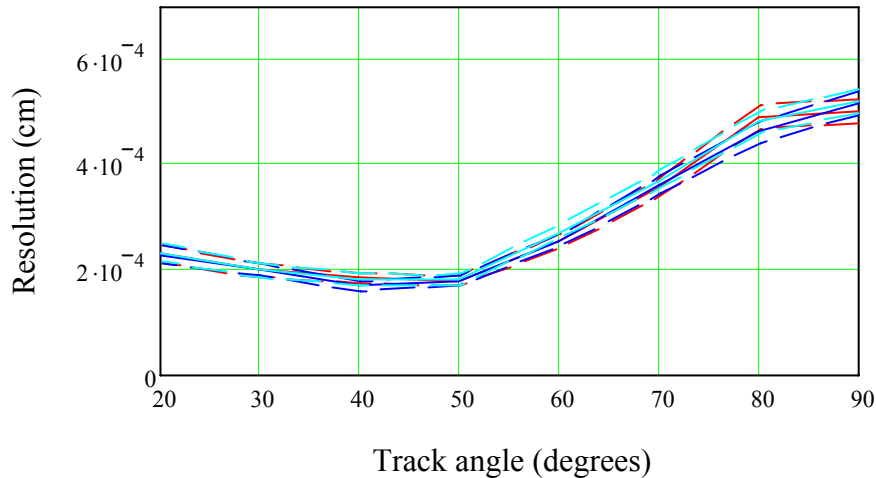


- $B = 3T$



# Resolution as function of track angle and B field

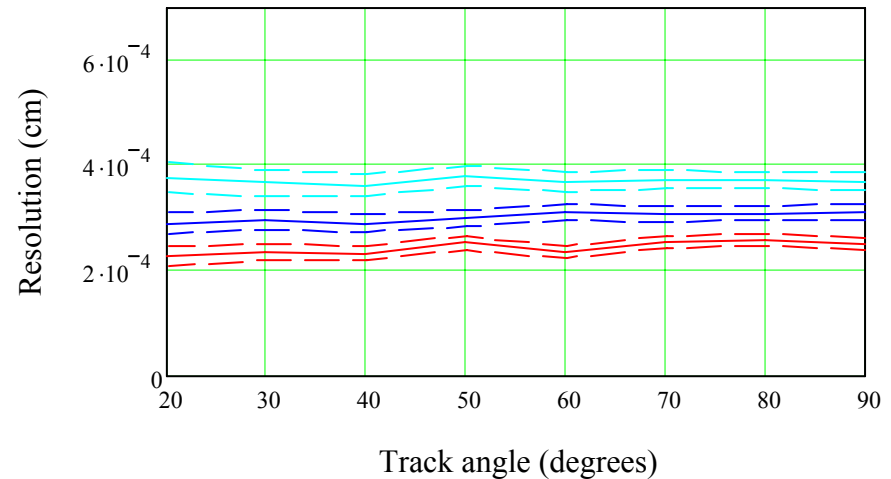
- Resolution in z ~ independent of B field.



## Legend:

- ◆ — B = 5T
- ◆ — B = 4T
- ◆ — B = 3T

- Improvement of y resolution due to Lorentz angle effects clearly visible, resolution better for larger B.

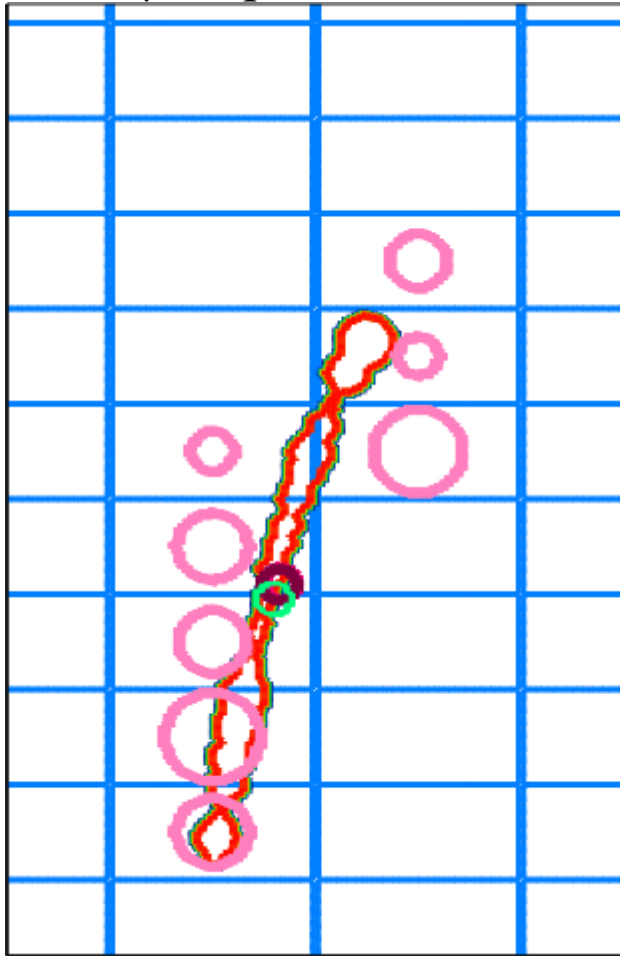


## Legend:

- ◆ — B = 5T
- ◆ — B = 4T
- ◆ — B = 3T

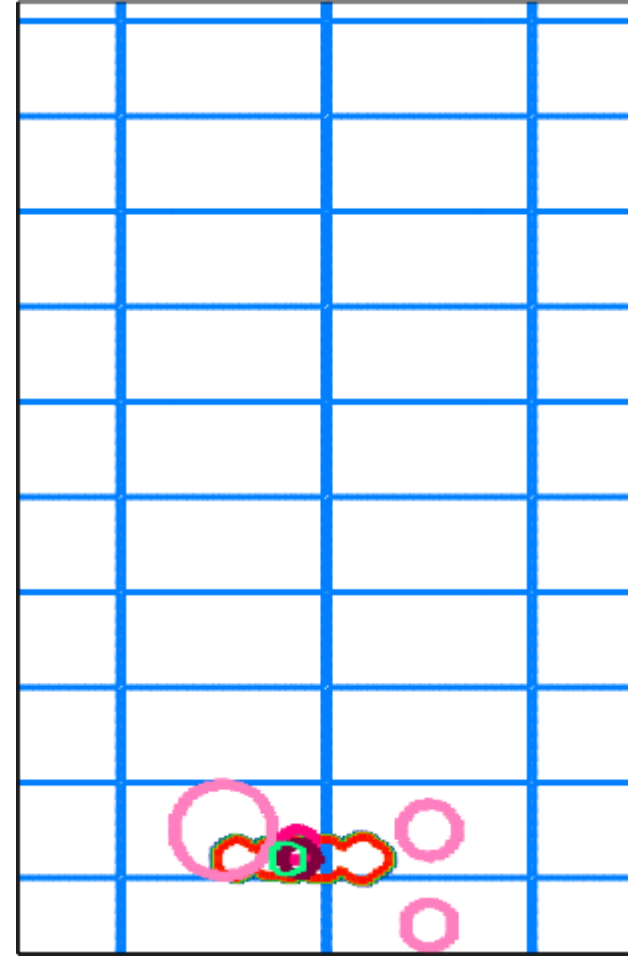
# Improving z resolution

- $20 \times 10 \mu\text{m}^2$  pitch.



Pzy, Qzy, Qqpixzy, Pixelzy, Qpzy, Tzy

- Gives  $\sim 2 \mu\text{m}$  z resolution at  $\theta = 0$ .

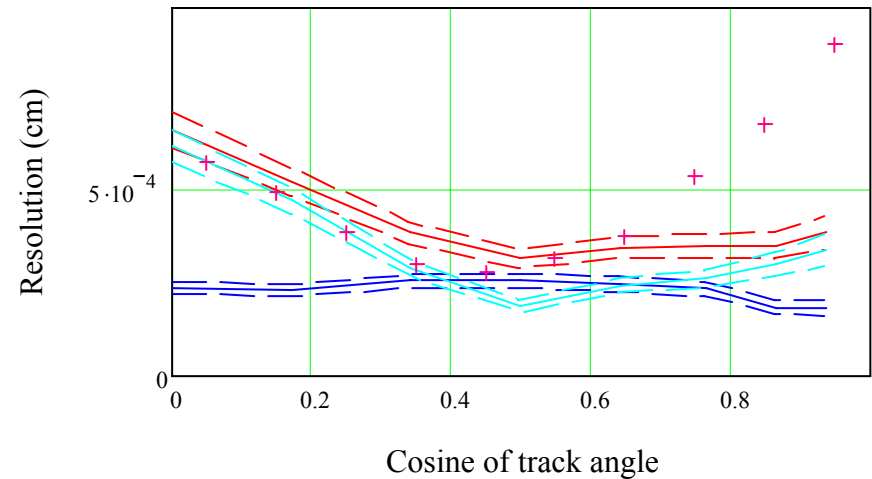


Pzy, Qzy, Qqpixzy, Pixelzy, Qpzy, Tzy

# A caveat – simulation of DEPFET

- Simulate DEPFET (fully depleted) with thickness  $50\ \mu\text{m}$ , guess at E-Field, 4T magnetic field.
- Resolution in good agreement with Geant 4 simulation by Alexei Raspereza (reported in Bangalore) for  $\cos\theta < 0.5$ , but sharp deterioration of at large angle not reproduced.
- Not sure which is correct: sort out at Ringberg!

- DEPFET simulation compared with Geant 4 results for z resolution:



# Summary

---

- Resolution of fully depleted CPCCD in y about  $3\ \mu\text{m}$  for  $B = 4\text{T}$ , better for larger, worse for smaller B.
- Cause is charge sharing between pixels induced by Lorentz angle effects.
- Resolution in z for tracks with polar angle  $90^\circ$  about  $5\ \mu\text{m}$ , improving to about  $2\ \mu\text{m}$  at larger angles the, before deteriorating slightly(?) at largest angles.
- Cause is charge sharing due to track angle and fluctuations in charge deposition.
- Consequences for physics?