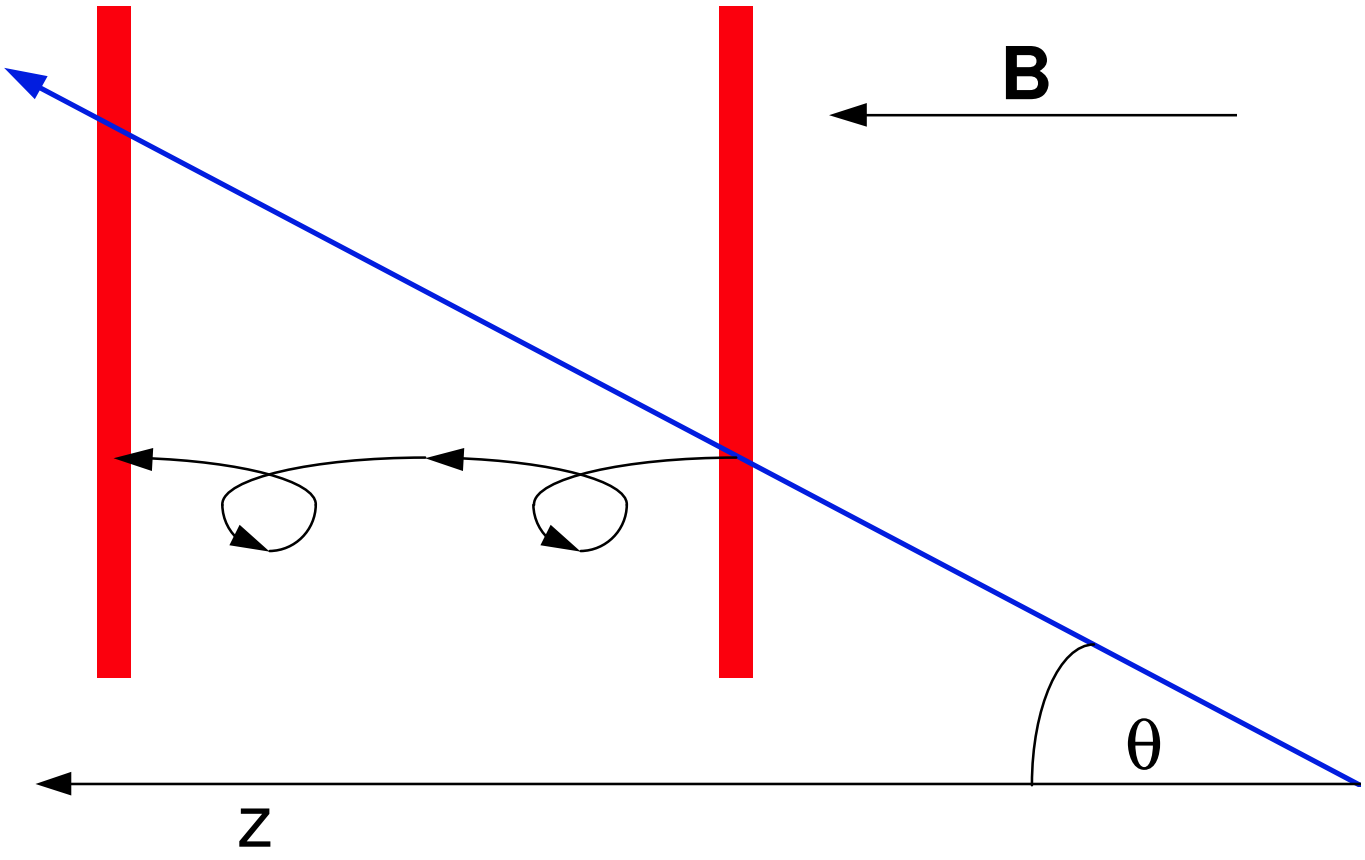
H1sim and δ-rays

- Hypothesis is that a lot of the problems of the planars are associated with δ-ray production.
- Not simulated due to 10 MeV cut-off for δ-ray KE in H1sim.



- Delta-rays closer to beam than primary tracks!

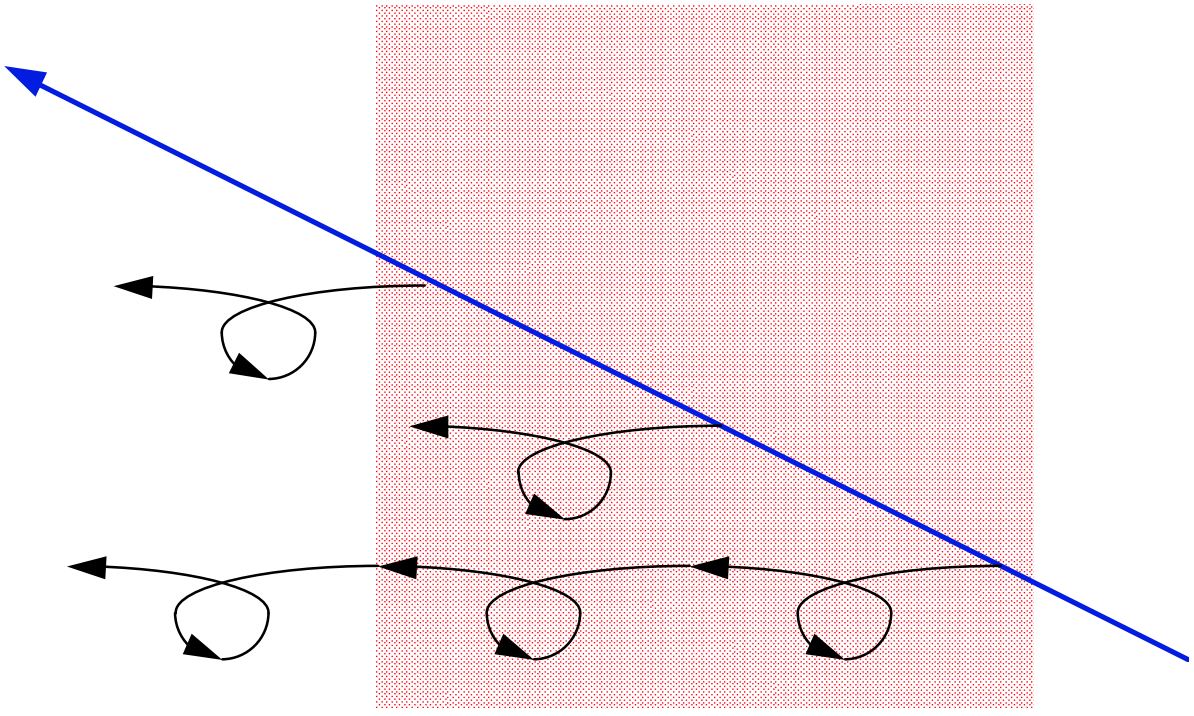
Frequency of δ-ray production

- Distribution of energetic knock-on electrons (pdg)

$$\frac{d^2N}{dT\,dx} = \frac{0.3}{2}\frac{Z}{A}\frac{1}{T^2}\left(\frac{1}{\beta^2} - \frac{T}{2m_e\beta^2\gamma^2}\right)$$

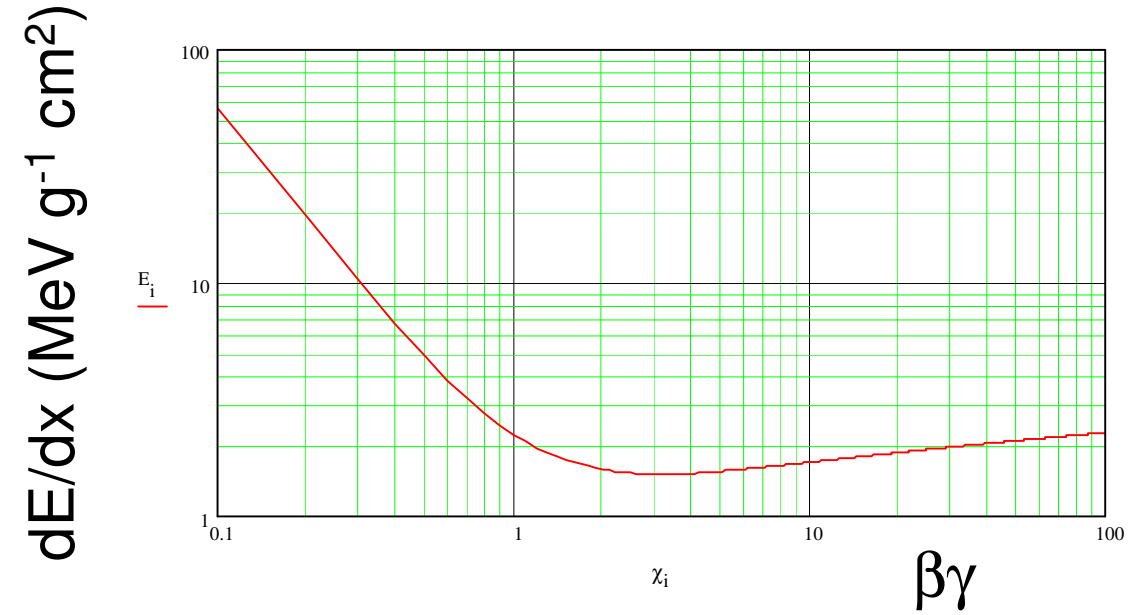
$$\left(MeV^{-1}\,g^{-1}\,cm^2\right)$$

- Integrate over energy and range to get number.
- Need to know relationship between range and energy of δ-ray.

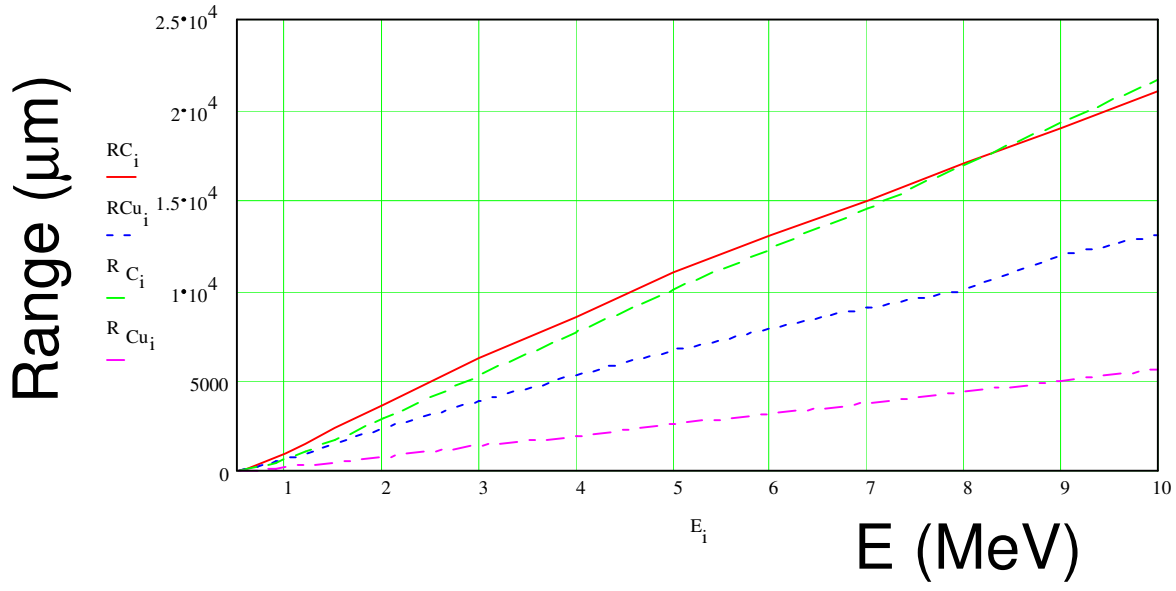


Range/Energy Relationship

- Integrate Bethe-Bloch equation (below for carbon ~ G10)

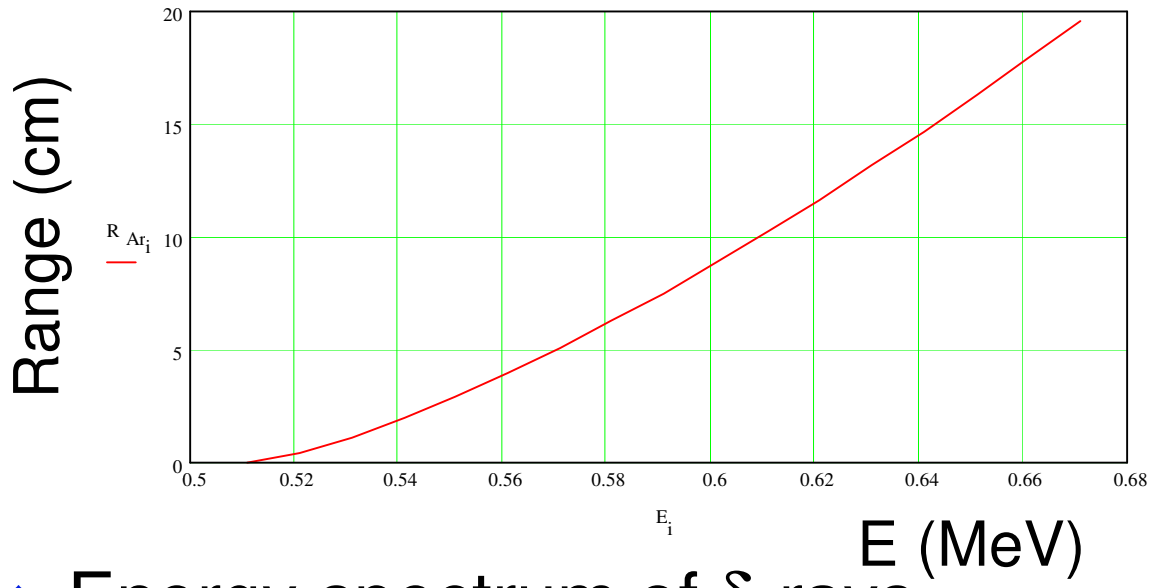


- Resulting range for C and Cu (cf. fit to data on electron range in Al)

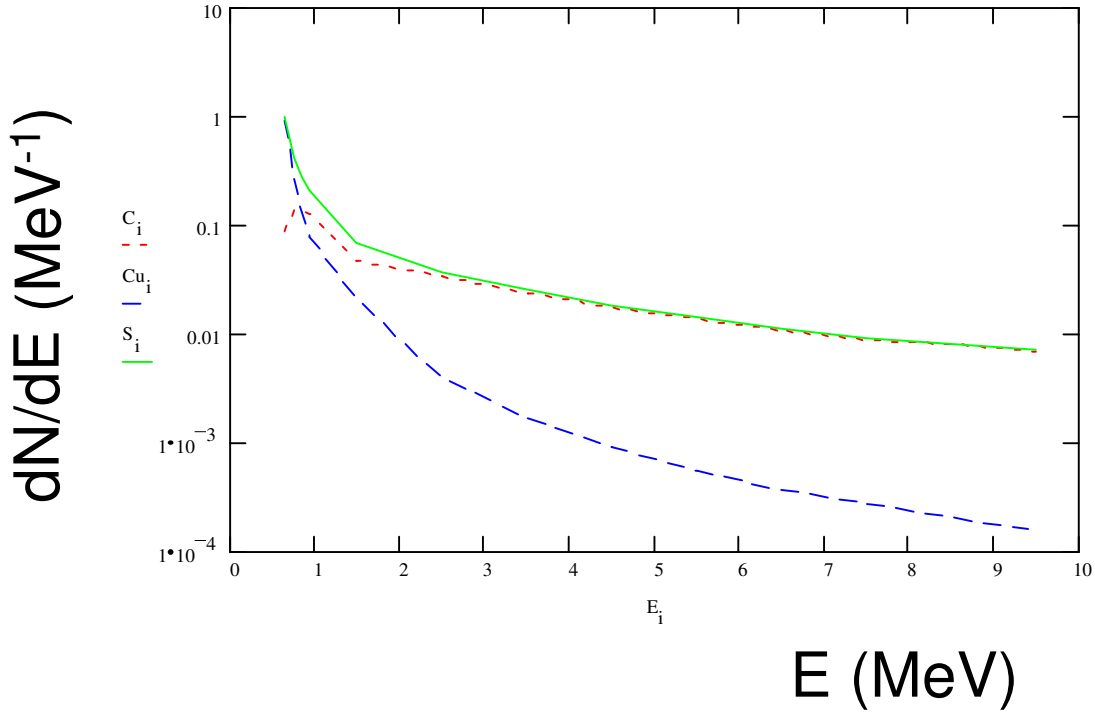


Range and energy cont.

- Approx. range in Ar



- Energy spectrum of δ-rays



Expected Number of δ-rays

- Prob. of δ-ray with E > 0.6 MeV per hadron per planar G10 wall

  $p_c = 0.22$
- Prob. of d-ray with E > 0.6 MeV per hadron per planar Cu strip

  $P_{Cu} = 0.17$
- Add, including mark to space ratio Cu:G10 = 1:1

  $p = 0.37$
- Calculation subject to large uncertainties!
  - Multiple scattering?
  - $m_e < E < 0.6$ MeV?
- Probable that of the order of 40 to 50% of hadron tracks accompanied by δ-ray in planars.

Simulating δ-rays in H1sim

- Steve Burke has managed to get H1sim to run with δ-ray KE cut-off reduced from 10 MeV to 1 MeV.
- Analysed using two-track separation as criterion to define clusters etc.
  - Cluster good if no track within 2 mm in drift.
  - Planar segment good if 3 good clusters.
  - Track good if 2 or 3 planar segments.

H1sim Results

- Track efficiencies etc.

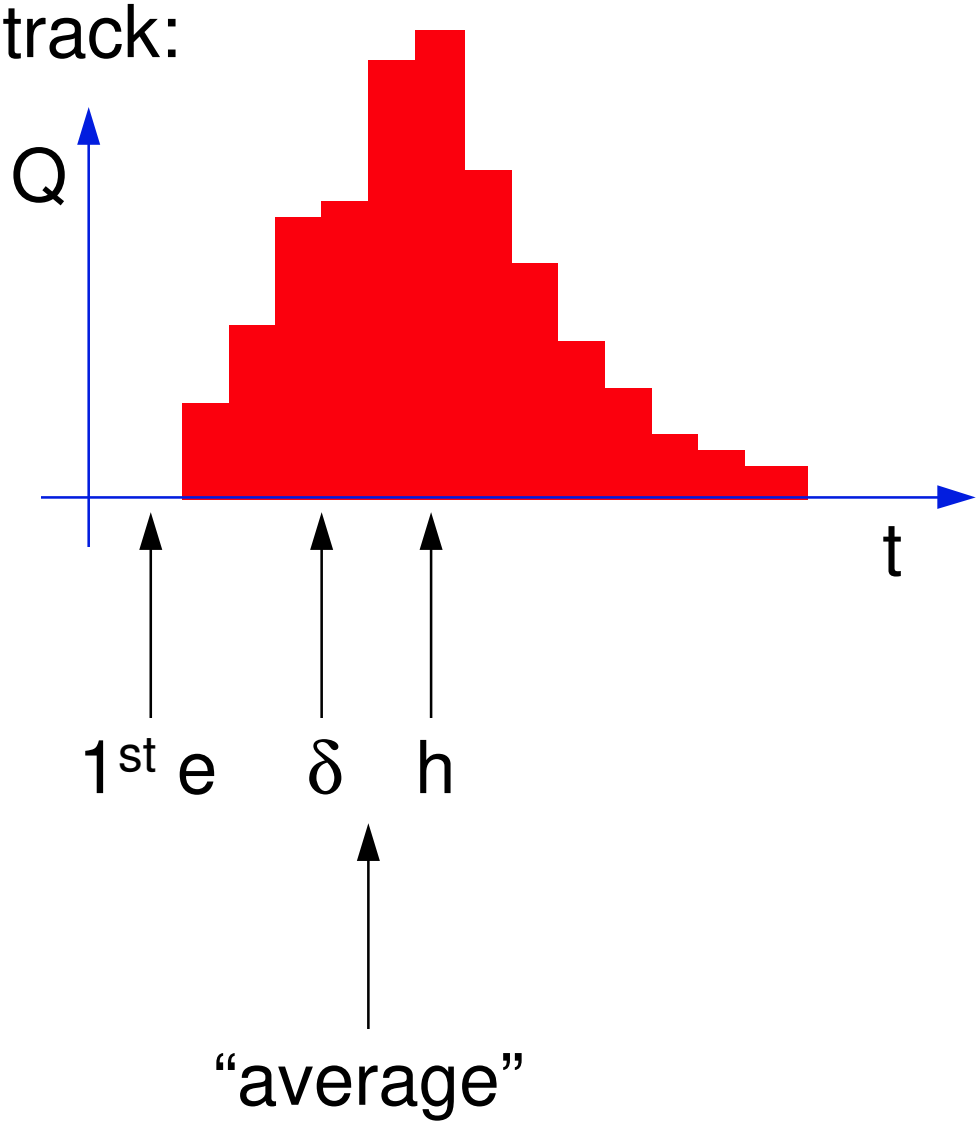
	10 MeV	1 MeV
Efficiency	0.87	0.72
Prop. 3 seg.	0.64	0.44

- Adding extra δ-rays results in many segments being spoiled due to close tracks.
- What effect does upgrade have on efficiency for 1 Mev cut-off?

	Track efficiency
Current FT	0.72
New FT	0.94

Modifications for 1998 running?

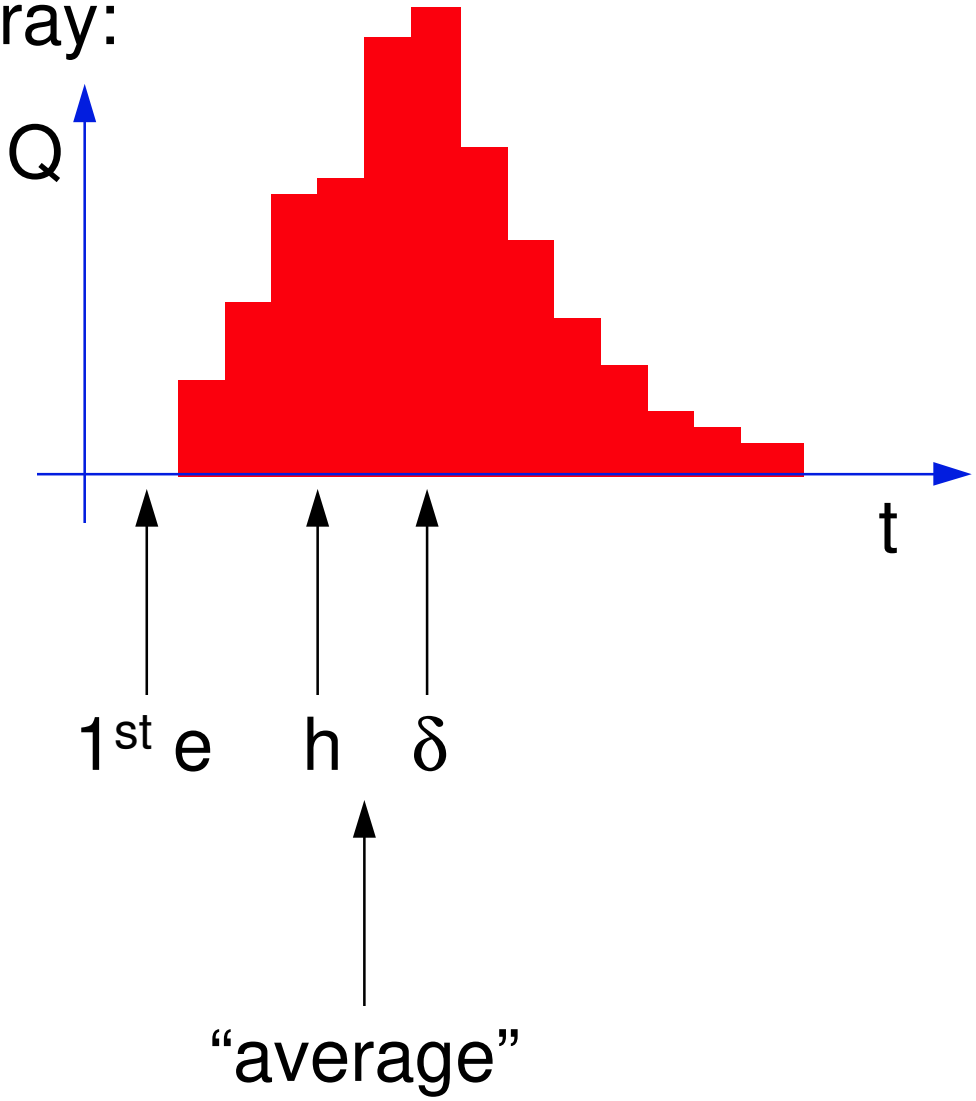
- If δ-rays are problem then shift to "first electron" Qt?
- Consider δ-ray closer to wire than track:



- "Average" slightly wrong, 1st e badly wrong.

Modifications for 1998 running cont.

- Consider track closer to wire than δ-ray:



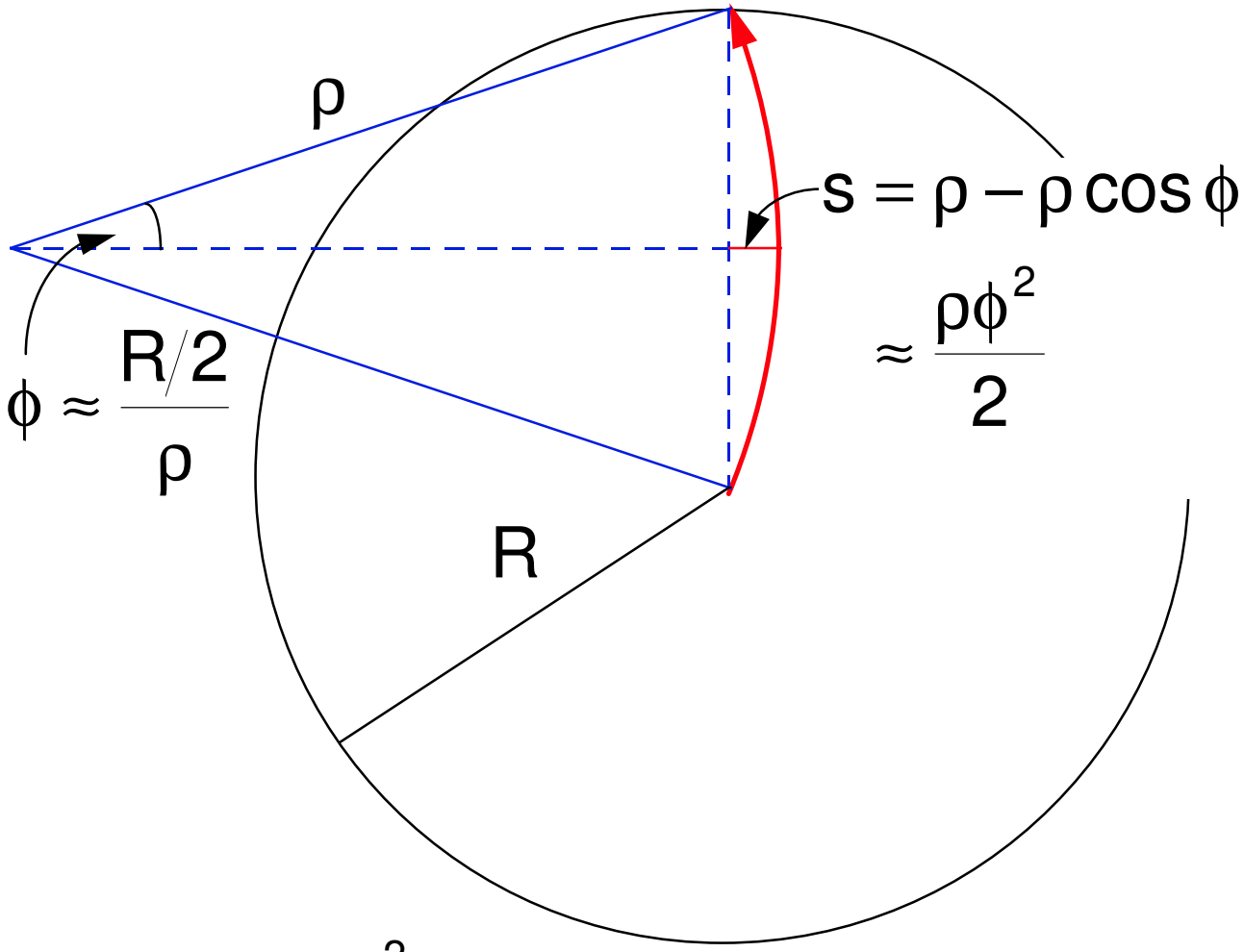
- Now 1st e correct, “average” still slightly wrong.

Modifications for 1998 running cont.

- Is this picture too naive?!
- Better to have something that is right 50% of the time and badly (perhaps recognisably) wrong 50% of the time than something that is always slightly wrong?
- Would mean large amount of work!

Sagitta

- Order of magnitude of shifts necessary given by sagitta.



$$s \approx \frac{\rho}{2}\left(\frac{R}{2\rho}\right)^2 = \frac{R^2}{8\rho}$$

$$\rho = \frac{p_T}{0.3B} \Rightarrow s \approx \frac{0.3R^2B}{8p_T}$$

Sagitta cont.

- Example, track with p_T = 4 GeV, using R = 0.8 m, B = 1.15 T get s = 6.9 mm.
- Need to shift measurements by about twice this amount (1.4 cm!) in order to get significant proportion of wrong charge tracks?
- Explanations?