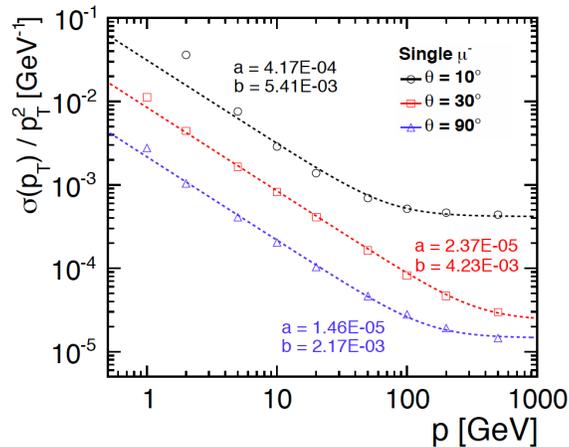


Documents authorised: PDG booklet, lecture notes.

1

The figure below provides the expected relative resolution on the transverse momentum at high momentum for a given collider experiment. Explain the behaviour of the resolution in function of the momentum. The polar angle θ is defined between the direction of the total momentum p , and the beam direction. While the transverse momentum p_T is the momentum projection perpendicular to the beam axis. Why is the resolution degrading when θ goes down?



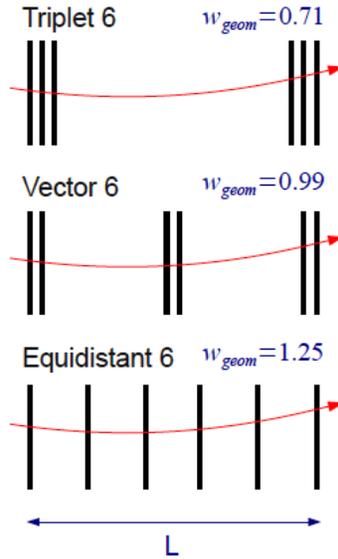
2

In collider experiment, we usually find first a small vertex detector at low radii and then a large tracking detector. While the tracking volume is used to measure the particle momentum, the vertex layers allow to extrapolate the trajectory around the collision point.

- 2.1 Why is the vertex detector small and the tracking one large ?
- 2.2 Which detection technologies are most suited for these two different task and why ?
- 2.3 Assuming the vertex detector is made of several individual layers and the tracking detector of an quasi-continuous measuring device, which track reconstruction algorithm will be most suited for each of them ?

3

We consider a tracker made of six equivalent layers with same spatial resolution and same material budget b . The system covers a length L . A uniform magnetic field of strength B bends particle trajectories in order to measure particle momenta through the track curvature R . Three different geometries are considered, as depicted below.



When multiple scattering is a dominant effect, the relative resolution on the curvature can be parametrized with:

$$\frac{\sigma_R}{R} = w_{geom} \frac{2b}{BL}.$$

The values of the parameter w_{geom} are given in the previous figure.

- 3.1 Reminds the expression of b , in function of parameters that characterise a single detection layer? What happens if one layer is made of several material?
- 3.2 Explain why the factor b appears at the numerator and the factor BL appears at the denominator.
- 3.3 Explain why w_{geom} is worst for the arrangement where layers are equidistant. You can use a drawing for your discussion.
- 3.4 In the case of events with many particles crossing the tracer, which geometry will have the higher track reconstruction efficiency?