Momentum estimate

The momentum of a T seed can be estimated assuming that the particle originated from the interaction point. This method, known as the p-kick method, is based on the idea that the effect of the field can be described by an instant kick of the momentum vector in the centre of the magnet. In general, the actual momentum kick, $\Delta\vec{p}$, depends on the integrated magnetic field along the particle's trajectory:

$$\Delta\vec{p} = q \int \mathrm{d}\vec{l} \times \vec{B} \quad . \tag{6.48}$$

The main component, Δp_x, provides the highest precision on the momentum. In terms of the track parameters this relation becomes:

$$\Delta p_x = p_{x,f} - p_{x,i} = p \left(\frac{t_{x,f}}{\sqrt{1 + t_{x,f}^2 + t_{y,f}^2}} - \frac{t_{x,i}}{\sqrt{1 + t_{x,i}^2 + t_{y,i}^2}} \right) = q \int \left| \mathrm{d}\vec{l} \times \vec{B} \right|_x \quad , \tag{6.49}$$

where the subscript $t_{x,f}$ and $t_{y,f}$ are the slopes of the T seeds. They are known from the parabolic fit of the T seeds, and are evaluated at station T3. The slopes before the magnet, $t_{x,i}$ and $t_{y,i}$, as well as the integrated magnetic field need to be estimated. Note that the charge of the particle, q, is determined from the sign of curvature and the field polarisation.

The total integrated magnetic field along the z axis equals 4.2 T m. The centre of the magnet is defined by a plane at $z = z_{\mathrm{magnet}}$ where the integrated field equals half the total value. This plane at $z_{\mathrm{magnet}} = 5150\,\mathrm{mm}$ serves as an initial focal plane for all T seeds. The particle's trajectory can be approximated by two lines intersecting at this focal plane, as illustrated in Fig. 6.9. This path starts from the T seed and is extrapolated up to z_{magnet}. At this point the path makes a kink towards the nominal interaction point $(0, 0, 0)$, giving a first estimate for the slopes before the magnet. Then, along this path, the integrated field is calculated and a second focal plane at $z = z_{\mathrm{c}}$ is determined. The new values for $t_{x,i}$, $t_{y,i}$ and the integrated magnetic field are substituted in (6.49), resulting an estimate for p. However, a small systematic effect is observed in the momentum resolution, which depends on the slope $t_{x,f}$ as

$$\langle \delta p/p \rangle = -0.0092 - 0.112\, t_{x,f}^2 \quad . \tag{6.50}$$

After correcting for this effect, the final momentum from the p-kick method has a resolution of $\delta p/p = (0.6964 \pm 0.005)\%$, as illustrated in Fig. 6.10(a). The dependence of the resolution on the momentum of the particle is shown in Fig. 6.10(b).

Matching criteria

After applying the p-kick method, the T seeds are fitted with the Kalman filter, thereby accounting for multiple scattering and energy loss. The VELO seeds are also fitted, but without correcting for these effects, as the momentum of the VELO seeds is unknown. A good precision on the track parameters from these fits is required for an optimal track