

Track reconstruction optimization

for Triplet Track Trigger.

Pre-Selection Cuts

1. Transverse barrel cut : $|\phi_{13}| < \phi_{13_cut} \text{ rad}$
2. Longitudinal barrel cut : $|z_{13}| < z_{13_cut} \text{ mm}$
3. Transverse residual cut : $|d\phi_2| < d\phi_{2_cut} \text{ rad}$
4. Longitudinal residual cut : $|dz_2| < dz_{2_const} * \sin(\theta_{013})^{dz_{2_exp}} \text{ mm}$

Final - Selection Cuts

1. Minimum momentum : $pt_{013} > 2GeV/c$
2. Longitudinal acceptance : $|\eta_{013}| < 2.5$
3. Luminous region : $|Z_{013}| < 100mm$
4. Momentum consistency :

$$\begin{aligned} |\kappa_{123} - \kappa_{013}|/\sigma_\kappa &< 5 * \sigma \quad \rightarrow \text{loose cut} \\ |\kappa_{123} - \kappa_{013}|/\sigma_\kappa &< 4 * \sigma \quad \rightarrow \text{medium cut} \\ |\kappa_{123} - \kappa_{013}|/\sigma_\kappa &< 3 * \sigma \quad \rightarrow \text{tight cut} \end{aligned}$$

where, $\sigma \sim 1$ and σ_κ is defined below.

Pull distribution

$$Pull = \frac{\kappa_{123} - \kappa_{013}}{\sigma_\kappa} \tag{1}$$

$$\sigma_\kappa^2 = \left(\frac{\sqrt{6} * \sigma_t}{d^2}\right)^2 + \frac{t}{X_0 * \sin(\theta_{013})} * \left(\frac{13.6MeV * \kappa_{013}}{0.3 * B * d}\right)^2 \tag{2}$$

substituting the uncertainty in the transverse direction, $\sigma_t = \frac{w}{\sqrt{12}}$

$$\sigma_\kappa^2 = 0.5 * \left(\frac{w}{d^2}\right)^2 + \frac{t}{X_0 * \sin(\theta_{013})} * \left(\frac{13.6MeV * \kappa_{013}}{0.3 * B * d}\right)^2 \tag{3}$$

where, κ_{013} & κ_{123} are in mm,

$w = 40 * 10^{-3}$ mm is the pixel width,

$d = 20/25/30/35/40$ mm is the spacing between the layers in the triplet,

$\frac{t}{X_0} = 0.015$ relative radiation length in the middle layer &

$B = 4T$ is the magnetic field

$$hit_{const} = 0.5 * (\frac{w}{d^2})^2$$

$$\begin{aligned} \sigma_{MS}^2 &= \frac{t}{X_0 * \sin(\theta_{013})} * (\frac{13.6 MeV * \kappa_{013}}{0.3 * B * d})^2 \\ &= MS_{const} * \frac{\kappa_{013}^2}{\sin(\theta_{013})} \end{aligned}$$

Cuts \ gap size	20mm	25mm	30mm	35mm	40mm
ϕ_{13_cut}	-	0.018	0.021	0.025	0.028
z_{13_cut}	-	320	380	430	480
$d\phi_{2_cut}$	-	3.0e-4	3.0e-4	3.0e-4	3.0e-4
dz_{2_exp}	-	-1.1	-1.15	-1.25	-1.3
dz_{2_const}	-	0.16	0.17	0.19	0.2
hit_{const}	-	2.048e-09	9.87654e-10	5.33111e-10	3.125e-10
MS_{const}	-	0.00308267	0.00214074	0.00157531	0.00120609