Track reconstruction optimization

for Triplet Track Trigger.

Pre-Selection Cuts

Barrel cuts

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

Endcap cuts

1. Transverse endcap cut : $|\phi_{13}| < \phi^{disc}_{13,cut}$
2. Longitudinal endcap cut : $|\eta_{13}| < \eta^{disc}_{13,cut}$
3. Transverse residual cut : $|d\phi_2| < d\phi^{disc}_{2,cut}$
4. Longitudinal residual cut : $|d\eta_2| < d\eta^{disc}_{2,cut}$

Final - Selection Cuts

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

   $|\kappa_{123} - \kappa_{013}|/\sigma_\kappa < 5 * \sigma \quad \rightarrow$ loose cut
   $|\kappa_{123} - \kappa_{013}|/\sigma_\kappa < 4 * \sigma \quad \rightarrow$ medium cut
   $|\kappa_{123} - \kappa_{013}|/\sigma_\kappa < 3 * \sigma \quad \rightarrow$ tight cut
   where, $\sigma \sim 1$ and σ_κ is defined below.

Pull distribution

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

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

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

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

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

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

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

$$= MS_{const} * \frac{\kappa_{013}^2}{sin(\theta_{013})}$$

Cuts \ gap size	20mm	25mm	30mm	35mm	40mm
$\phi_{13,cut}^{barrel}$	0.014	0.018	0.021	0.025	0.028
$z_{13,cut}^{barrel}$	250	320	380	430	480
$d\phi_{2,cut}^{barrel}$	3.0e-4	3.0e-4	3.0e-4	3.0e-4	3.0e-4
dz_{2_exp}	-0.9	-1.1	-1.13	-1.18	-1.3
dz_{2_const}	0.1	0.12	0.13	0.15	0.16
hit_{const}	5e-09	2.048e-09	9.87654e-10	5.33111e-10	3.125e-10
MS_{const}	0.00482438	0.0030876	0.00214417	0.00157531	0.00120609

Cuts \ $z_{gapsize}$	53mm	67mm	80mm	93mm	106mm
$\phi_{13,cut}^{disc}$	0.014	0.018	0.021	0.025	0.028
$\eta_{13,cut}^{disc}$	5e-3	6e-3	7e-3	8e-3	9e-3
$d\phi_{2,cut}^{disc}$	5.0e-4	5.0e-4	5.0e-4	5.0e-4	5.0e-4
$d\eta_{2,cut}^{disc}$	2e-3	2e-3	2e-3	2e-3	2e-3