Optimization for Forth CEPC Tracker

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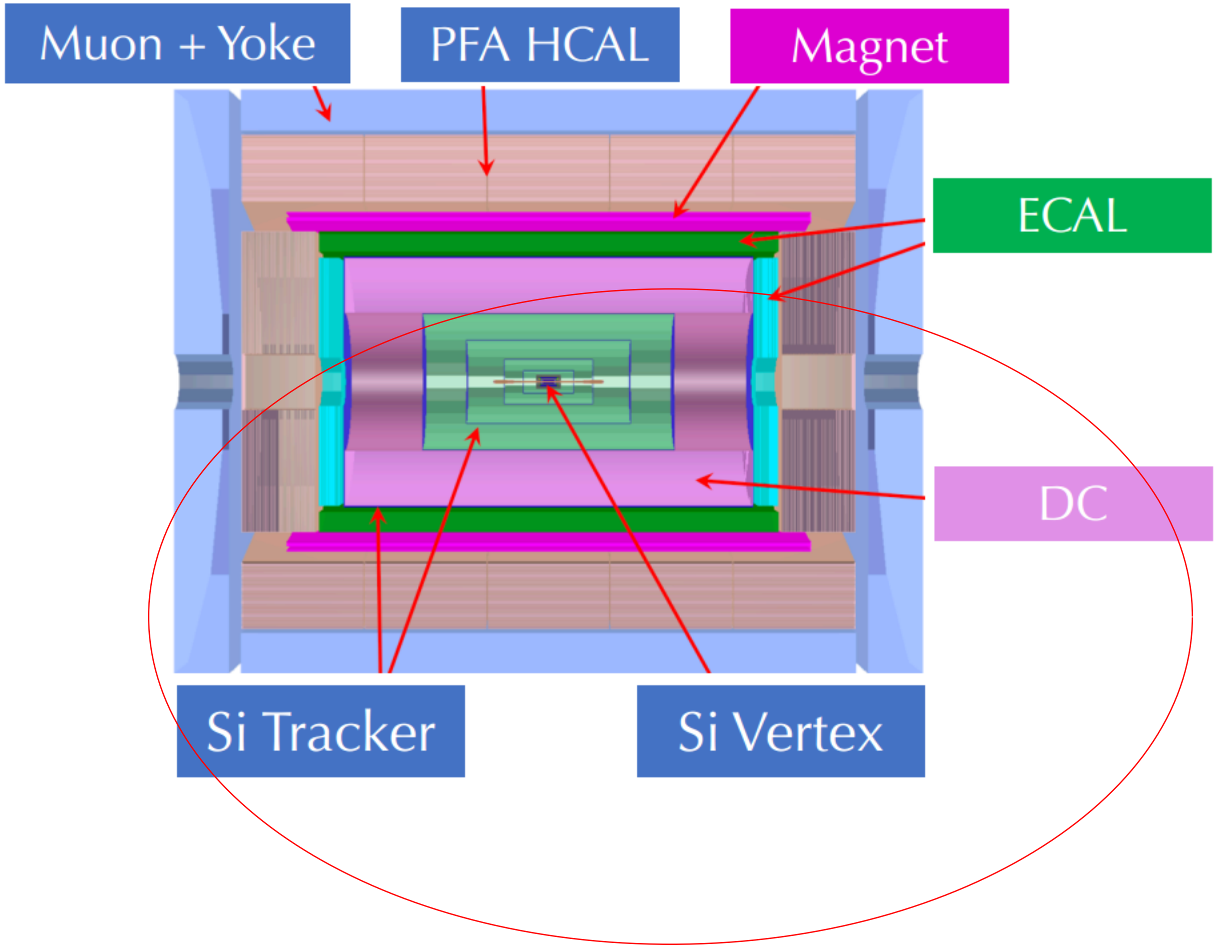
1.1 Motivation



determine the preliminary layout of the tracker with fast method to get smallest resolution of helix parameters (d_0, z_0, ϕ, θ, P_t)

1.2 Software

fast mathematic calculation

based on least square method

by Python

$$(\boldsymbol{C_y})_{mn} = \sigma_n^2 \delta_{mn} + \sum_{j=0}^{Min[m,n]-1} \sigma_{\alpha_j}^2 (x_m - x_j)(x_n - x_j)$$

$$\boldsymbol{C_a} = \left(\boldsymbol{G^T C_y^{-1} G}\right)^{-1}$$

$$\Delta a_i = \sqrt{(C_a)_{ii}}$$

$\boldsymbol{C_y}$, $\boldsymbol{C_a}$: covariance matrix for y and a

y : measurement quantity

a : helix parameter

G : function relation matrix of parameters

σ_n : position resolution

σ_{α_j} : error by multiple scattering

Reference : Nuclear Inst. and Methods in Physics Research, A 910 (2018) 127–132

1.3 Comparison with LDT software

result plots
running time

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Appendix

$$\chi^2 = \sum_{i=1}^{N} \left(\frac{y_{meas}^i - y_{fit}^i}{\sigma_i} \right)^2$$

$$f(x) = \sum_{i=0}^{M} a_i g_i(x)$$

$$\chi^2 = (\boldsymbol{y} - \boldsymbol{Ga})^{\boldsymbol{T}} \boldsymbol{W} (\boldsymbol{y} - \boldsymbol{Ga})$$

$$y_n = f(x_n) + u_n + \sum_{m=0}^{n-1} a_m (x_n - x_m)$$

$$(\boldsymbol{C_y})_{mn} = \sigma_n^2 \delta_{mn} + \sum_{j=0}^{Min[m,n]-1} \sigma_{\alpha_j}^2 (x_m - x_j)(x_n - x_j)$$

$$\sigma_{\alpha_j} = -$$

$$\boldsymbol{C_a} = \left(\boldsymbol{G^T C_y^{-1} G} \right)^{-\boldsymbol{1}}$$

$$\Delta a_i = \sqrt{(C_a)_{ii}}$$

$$\boldsymbol{a} = (a_0, a_1, \dots, a_M)$$

$$\boldsymbol{y} = (y_0, y_1, \dots, y_N)$$

$$\boldsymbol{G_{nm}} = g_m(x_n)$$

$$\boldsymbol{W} = \boldsymbol{C_y^{-1}}$$