$$\chi^2 = \sum_{i=0}^{N} \left(\frac{y_{meas}^i - y_{fit}^i}{\sigma_i} \right)^2$$

$$f(x) = F(a_i, x) \; i = 0,1, \dots, M$$

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

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

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

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

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

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

$$\sigma_{\alpha_j} = \frac{0.0136 GeV/c}{\beta P_t} \sqrt{\frac{d_j}{X_0}} \left(1 + 0.038 \ln \frac{d_j}{X_0} \right)$$

$$\boldsymbol{G_{mn}} = \frac{\partial F(a_i, x_n)}{\partial a_m}$$

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

$\boldsymbol{x} = (x_0, x_1, \dots, x_N)$

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

detector layers : 0, 1, …, N

track fitting parameters : 0, 1, …, M

y : measurement quantity

a : helix parameter

G : parameter function relation matrix

$\boldsymbol{C_y}$: covariance matrix for y

$\boldsymbol{C_a}$: covariance matrix for a

σ_n : spatial resolution

σ_{α_j} : error by multiple scattering

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

$$\lambda = \frac{\pi}{2} - \theta$$

$$\alpha = \frac{1(m)}{0.299792458 \cdot B}$$

$$\beta = \frac{P_t}{\sqrt{P_t^2 + m^2}}$$

$$R = \alpha \cdot P_t$$

$$\varphi = \cos^{-1}\left[\frac{(d_0 + R)^2 + R^2 - r^2}{2 \cdot R(d_0 + R)}\right]$$

$$\varphi_{e^-} = -\varphi_{e^+}$$

$$\omega = \frac{\varphi}{2} = \sin^{-1}\frac{\frac{r}{2}}{R}$$

$$s_{xy} = R \cdot \varphi$$

$$s = \sqrt{(R \cdot \varphi)^2 + z^2}$$

helix parameters $(d_0, z_0, \theta, \phi, P_t)$

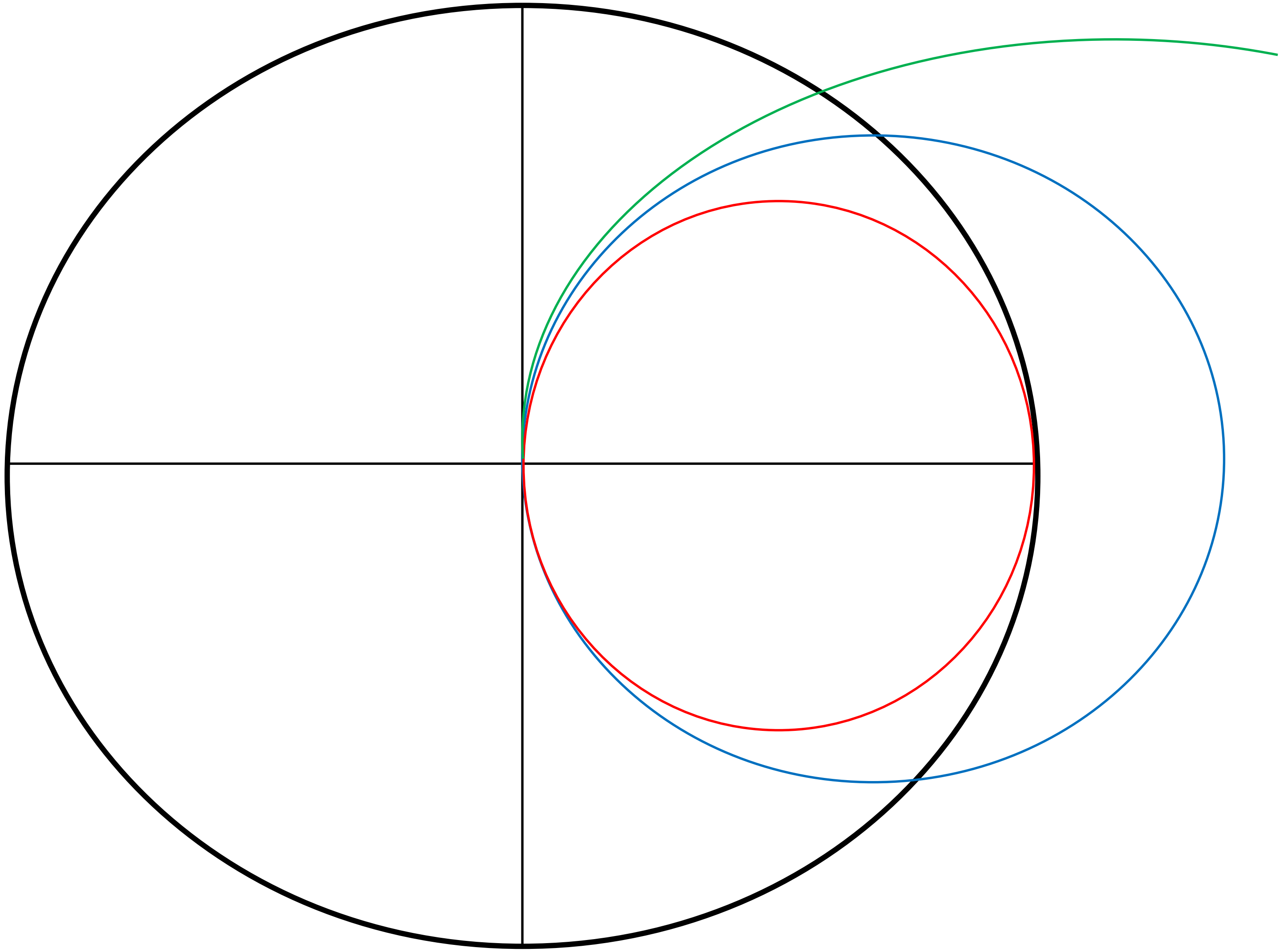
$$x = d_0 \cos\phi + R[\cos\phi - \cos(\phi + \varphi)]$$

$$y = d_0 \sin\phi + R[\sin\phi - \sin(\phi + \varphi)]$$

$$z = z_0 - R \tan\lambda \cdot \varphi$$

$$xy_{meas} = r \cdot \tan^{-1}\frac{y}{x}$$

$$z_{meas} = z$$



x-y plane track

For RES only :

$$\frac{\Delta P_t}{P_t} \propto aP_t$$

$$\Delta d_0 \propto a$$

$$\Delta z_0 \propto a$$

$$\Delta \theta \propto a$$

$$\Delta \phi \propto a$$

For M.S. only :

$$\frac{\Delta P_t}{P_t} \propto b$$

$$\Delta d_0 \propto \frac{b}{P_t}$$

$$\Delta z_0 \propto \frac{b}{P_t}$$

$$\Delta \theta \propto \frac{b}{P_t}$$

$$\Delta \phi \propto \frac{b}{P_t}$$