$$E^{\text{kin}}_{\text{Front Face}} = \sqrt{p^2_{Beam} + m^2_{Beam}} - m^2_{Beam} - E_{Loss} \tag{1}$$

$$E^{\text{kin}}_{j} = E^{\text{kin}}_{\text{Front Face}} - \sum_{j<i} E_{\text{dep i}} \tag{2}$$

$$E_i = \sqrt{p^2_{Beam} + m^2_{Beam}} - m^2_{Beam} - E_{Loss} - E_{\text{dep FF-i}} \tag{3}$$

$$\delta E_i = \sqrt{\delta p^2_{Beam} + \delta E^2_{Loss} + \delta E^2_{\text{dep FF-i}}} \tag{4}$$

$$E_{\text{dep FF-i}} = \sum_{j<i} E_{\text{dep i}} \Rightarrow \delta E_{\text{dep FF-i}} = (i-1)\delta E_{\text{dep i}} \tag{5}$$

$$\sigma^{\pi^-}_{TOT}(E_i) = \frac{1}{n\ \delta X} \frac{\epsilon^{\text{Inc}}(E_i)\ \ C^{\pi MC}_{\text{Int}}(E_i)\ \ N^{\text{TOT}}_{\text{Int}}(E_i)}{\epsilon^{\text{Int}}(E_i)\ \ C^{\pi MC}_{\text{Inc}}(E_i)\ \ N^{\text{TOT}}_{\text{Inc}}(E_i)}. \tag{6}$$

$$\sigma^{K^+}_{TOT}(E_i) = \frac{1}{n\ \delta X} \frac{\epsilon^{\text{Inc}}(E_i)\ \ C^{KMC}_{\text{Int}}(E_i)\ \ N^{\text{TOT}}_{\text{Int}}(E_i)}{\epsilon^{\text{Int}}(E_i)\ \ C^{KMC}_{\text{Inc}}(E_i)\ \ N^{\text{TOT}}_{\text{Inc}}(E_i)}. \tag{7}$$

$$\mathcal{L}(\mu_0; \sigma^2_0; \Delta\theta_0, \Delta\theta_1) = \prod_{i=0}^{1} f_X(\Delta\theta_i, \mu_0, \sigma^2_0) \Rightarrow \tag{8}$$

$$\log \mathcal{L} = -\frac{1}{2}\log(2\pi) - \log\sigma_0 - \frac{1}{2}\frac{(\Delta\theta_0 - \mu_0)^2}{\sigma^2_0} + \text{same for } \Delta\theta_1 \tag{9}$$