Status of MFT tracking

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MFT WP9 Meeting
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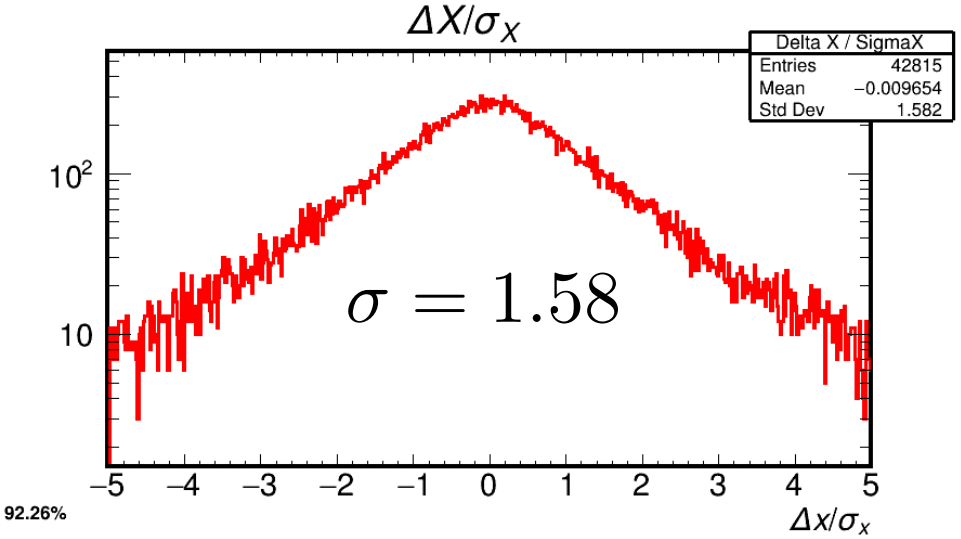
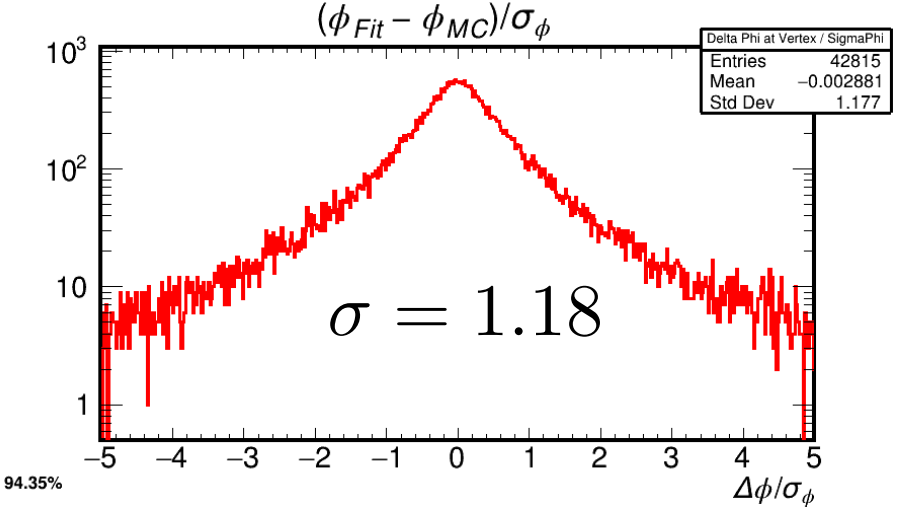
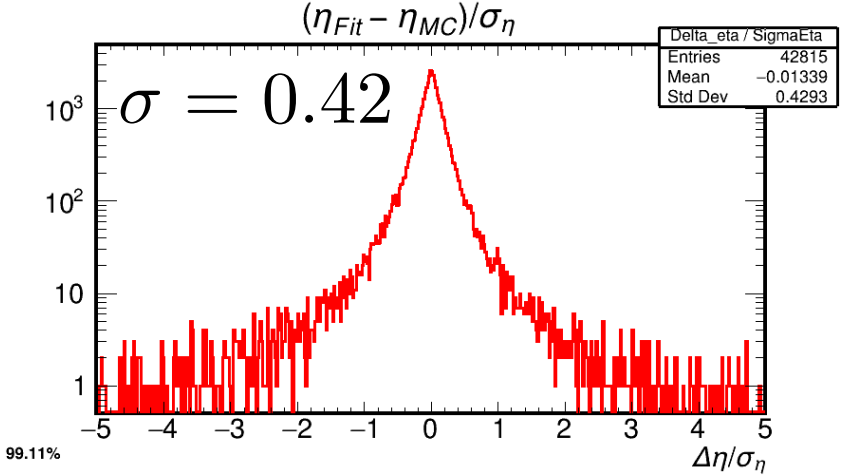
Outline

- New MFT standalone tracking seed
  - Corrections for low momentum tracks
- Evaluation of fitting covariances matrices

Previous episode: MFT Standalone Tracks covariances







- Standard normal distributions (σ = 1) are expected
- Current efforts to clarify effects of MCS & cluster uncertainties (cluster dictionary)

What changed?

- MFT Cluster topology dictionary
  - MFT Cluster Dictionary: https://github.com/AliceO2Group/AliceO2/pull/4247
  - Using dictionary obtained from 50000 pythia events
- Seed parameters and covariances matrix: corrections for low p_t tracks
  - https://github.com/AliceO2Group/AliceO2/pull/4487
- Suppression of log term from MCS effects calculation
  - Same PR #4487

MFT tracking seed: Corrections for low Pt tracks

$$\phi_0 = \mathrm{atan2}(\Delta y, \Delta x) - \frac{H_z(q/p_{t0})\Delta z k}{2tanl_0} \qquad (\text{was } \phi_0 = \mathrm{atan2}(\Delta y, \Delta x))$$

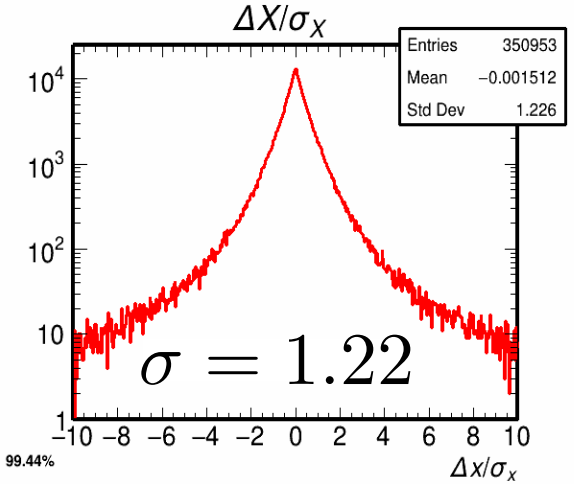
$$\tan\lambda_0 = \frac{\Delta z}{\Delta r}\frac{1}{\sqrt{2}}\sqrt{1+\sqrt{(q/p_{t0})^2\Delta r^2 k^2 + 1}} \qquad (\text{was } \tan\lambda_0 = \frac{\Delta z}{\Delta r})$$

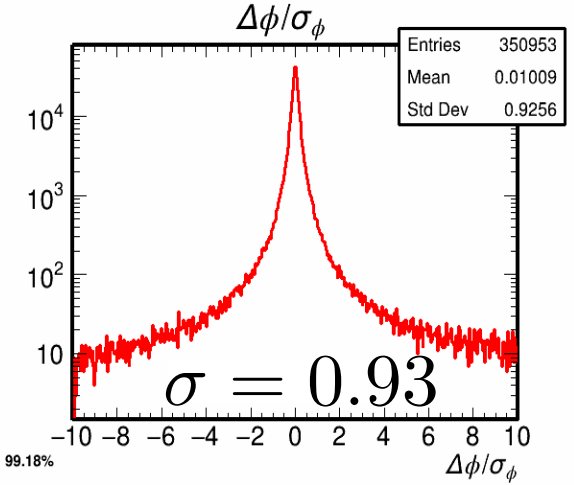
- q/pt0 → Fast Circle Fit by Bogdan + adaptations by Lucas
- Seed covariance matrix
  - see backup slides (attached notebook for full calculations)
- MFT tracking seed free of *gourmet* parameters (boost = cooking)
  - Minimal improvement with respect to what we had before, but now we understand what is going on

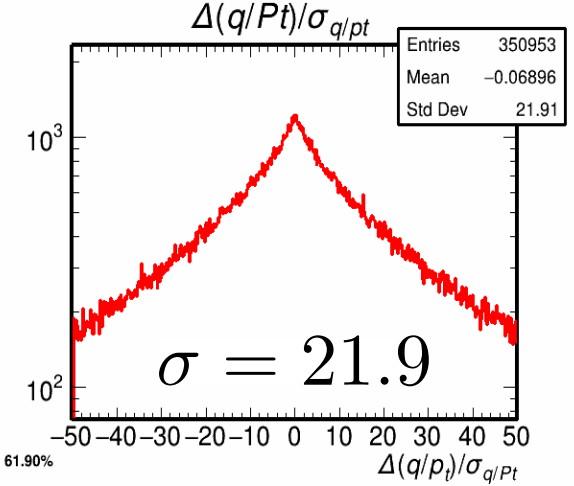
Covariances

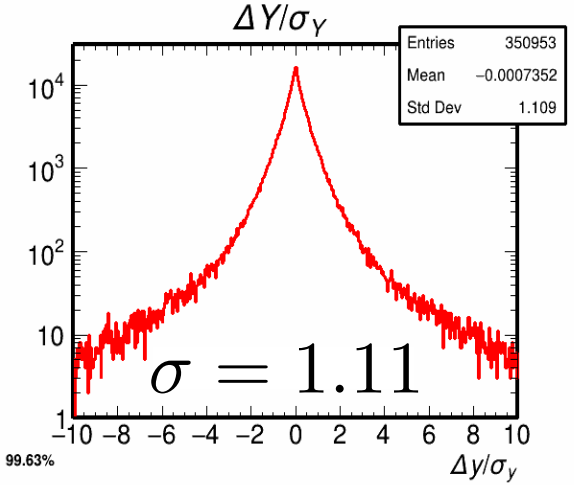
$\left(\frac{x}{X_0}\right)_{\mathrm{MFT}} = 0.041$

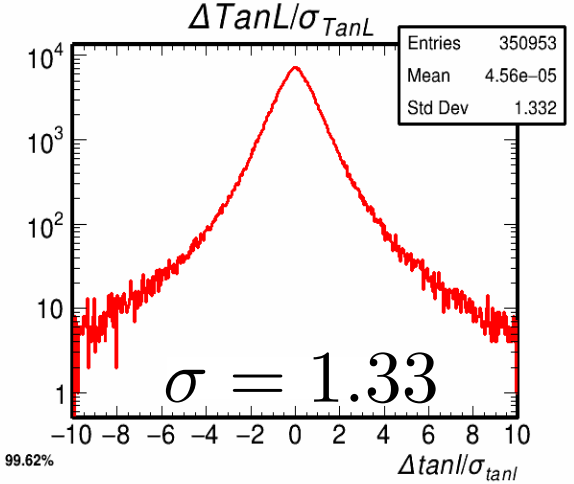
Helix_xbudget0.041

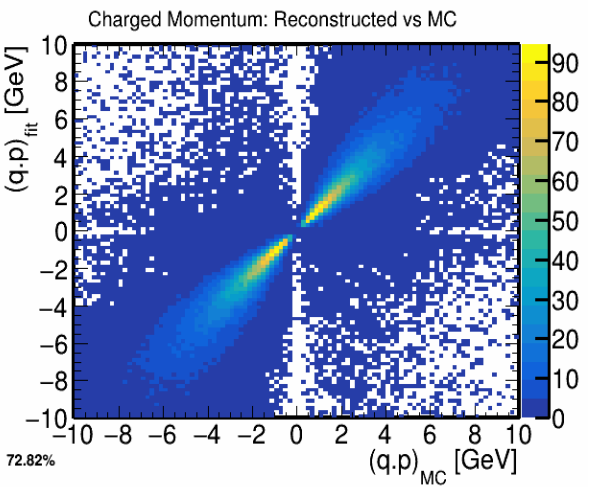






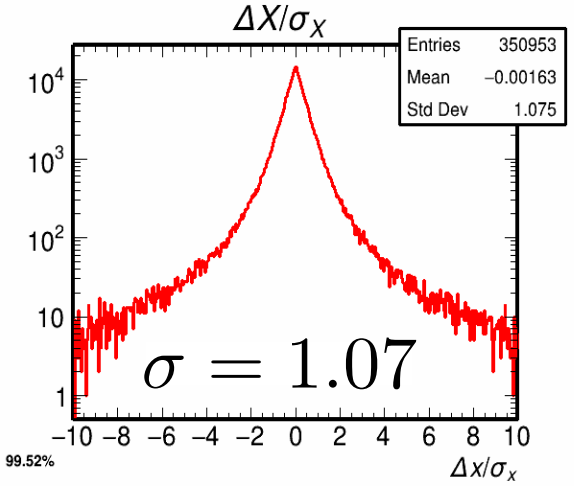


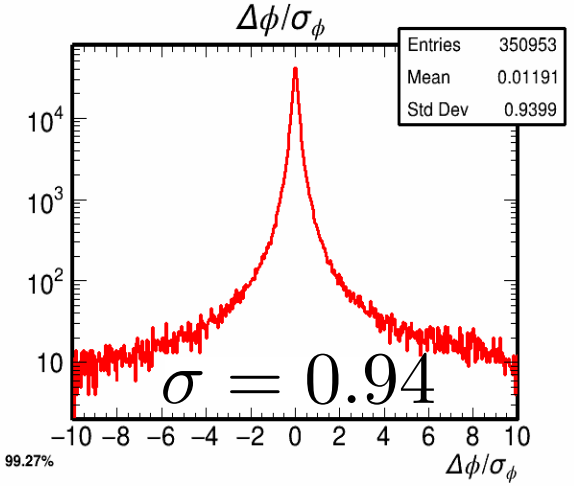


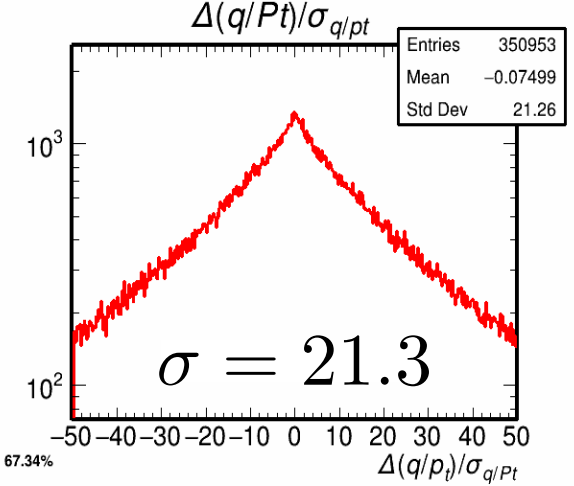


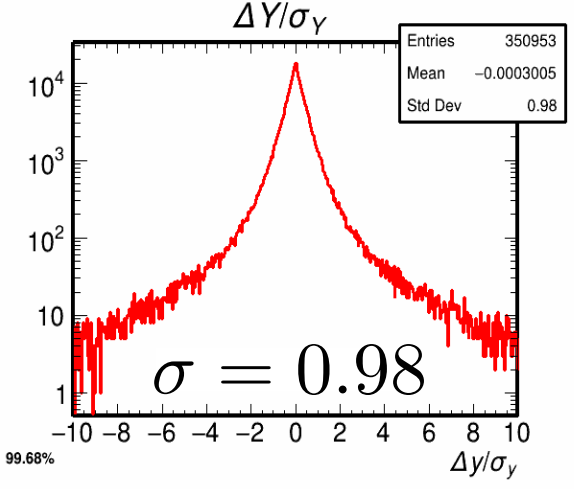
Covariances $\left(\frac{x}{X_0}\right)_{\mathrm{MFT}} = 0.1$

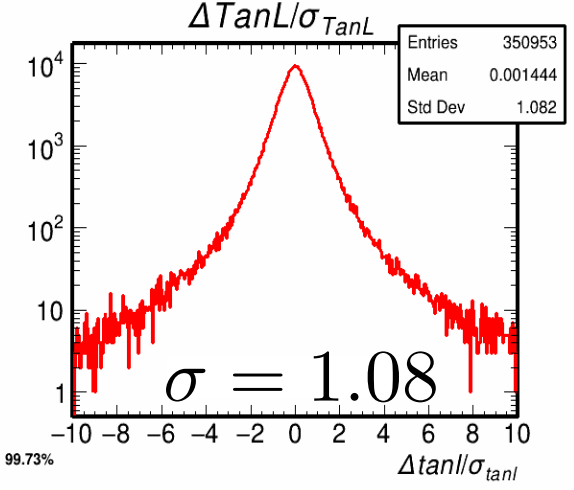
Helix_xbudget0.1

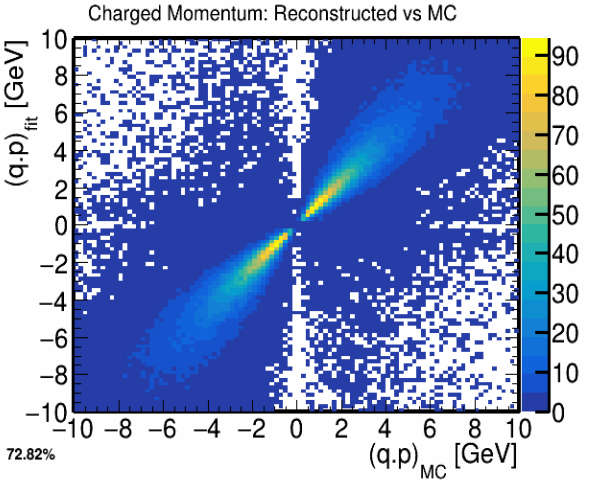








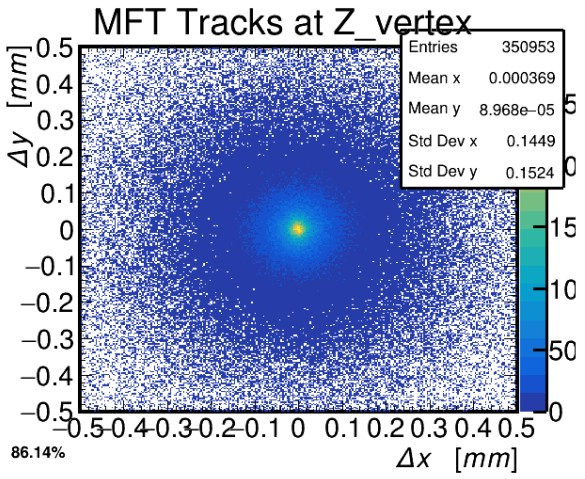


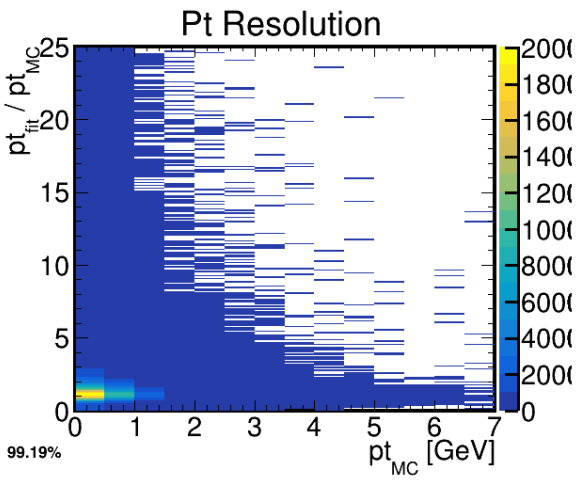


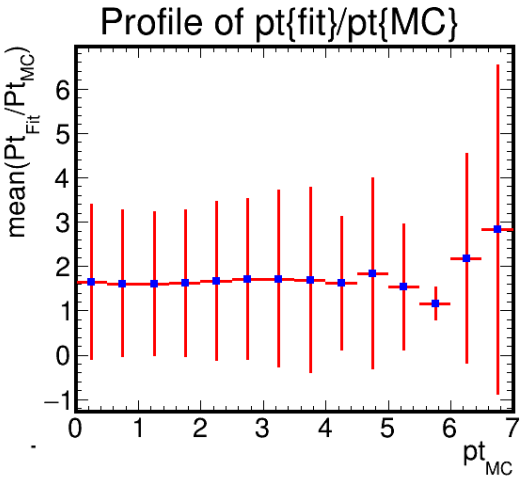
Parameters

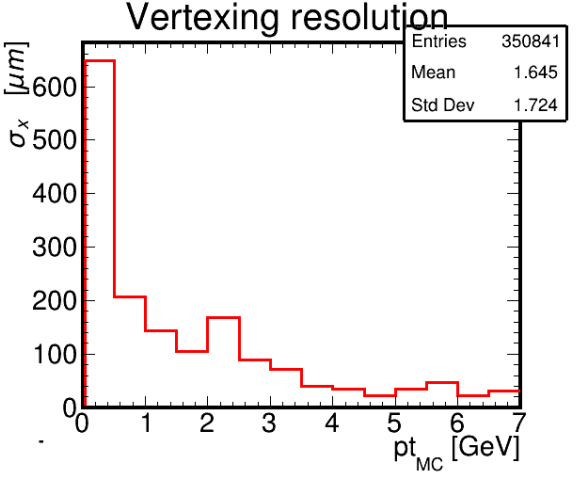
$$\left(\frac{x}{X_0}\right)_{\mathrm{MFT}} = 0.1$$

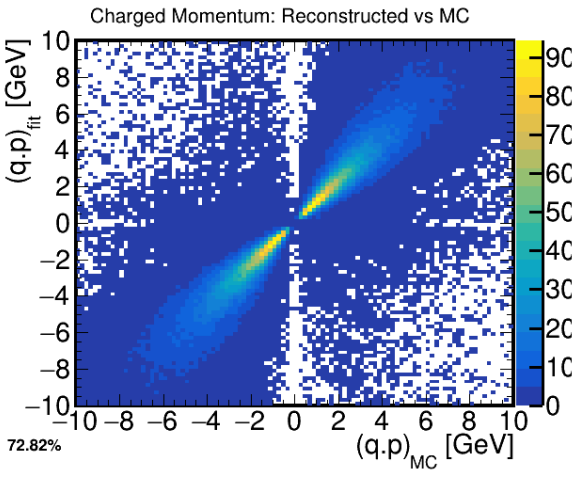
Helix_xbudget0.1

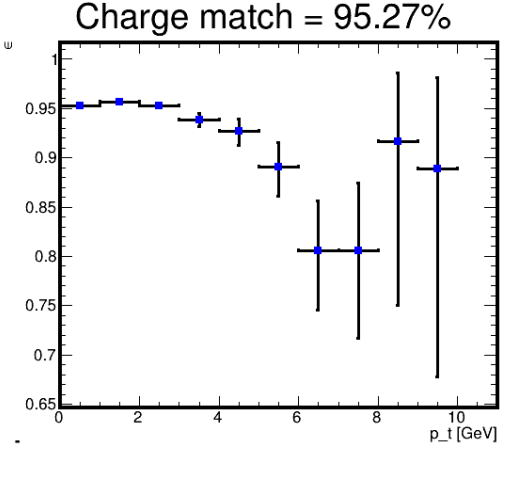












Summary

- MFT track seed corrected for low momentum tracks
  - Fit is not affected by vertex displacement
- MCS effects: agreement between simulation and fitting requires a factor 2.4 for x/X_0: 0.041 → 0.1
  - Good for tracking parameters only
- Further investigations needed for q/pt:
  - q/pt value: Remove q/pt from Kalman filter (stick to FCF)
  - q/pt covariance: add MCS effects after fitting

Backup slides

MFT Track seed parameters

$$\begin{bmatrix} x_0 \\ y_0 \\ \phi_0 \\ \tan\lambda_0 \\ (q/p_{t0}) \end{bmatrix} = \begin{bmatrix} x_0 \\ y_0 \\ -\frac{0.5\sqrt{2}(q/p_{t0})H_z k\sqrt{\Delta x^2+\Delta y^2}}{\sqrt{\sqrt{(q/p_{t0})^2k^2(\Delta x^2+\Delta y^2)+1}+1}} + \mathrm{atan}_2\left(\Delta y, \Delta x\right) \\ \frac{0.5\sqrt{2}\Delta z}{\sqrt{\Delta x^2+\Delta y^2}}\sqrt{\sqrt{(q/p_{t0})^2k^2\left(\Delta x^2+\Delta y^2\right)+1}+1} \\ (q/p_{t0}) \end{bmatrix}$$

MFT track seed covariances matrix

$$\begin{bmatrix} \sigma_{x_0}^2 & 0 & 0 & 0 & 0 & 0 \\ 0 & \sigma_{y_0}^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & D\left(JK^2\sigma_{q/p_{t0}}^2 + L_0^2\sigma_{\Delta x}^2 + M_0^2\sigma_{\Delta y}^2\right) & EK\left(\sqrt{2}B^{\frac{5}{2}}\left(L_0\Delta x\sigma_{\Delta x}^2 - \Delta y\sigma_{\Delta y}^2\left(-1.0G_y - H_y + I_x\right)\right) + 1.0N\sigma_{q/p_{t0}}^2\right) & \frac{P\sigma_{q/p_{t0}}^2}{B^{\frac{3}{2}}}\sqrt{2} \\ 0 & 0 & EK\left(\sqrt{2}B^{\frac{5}{2}}\left(L_0\Delta x\sigma_{\Delta x}^2 - \Delta y\sigma_{\Delta y}^2\left(-1.0G_y - H_y + I_x\right)\right) + 1.0N\sigma_{q/p_{t0}}^2\right) & Q\left(K^2\left(2\Delta x^2\sigma_{\Delta x}^2 + 2\Delta y^2\sigma_{\Delta y}^2\right) + O\sigma_{q/p_{t0}}^2\right) & R\sigma_{q/p_{t0}}^2 \\ 0 & 0 & \frac{P\sigma_{q/p_{t0}}^2}{B^{\frac{3}{2}}}\sqrt{2} & R\sigma_{q/p_{t0}}^2 & \sigma_{q/p_{t0}}^2 \end{bmatrix}$$

- $A = \sqrt{(q/p_{t0})^2\Delta r^2k^2 + 1}$
- $B = A + 1$
- $C = (q/p_{t0})k$
- $D = \frac{1}{A^2B^4\Delta r^4}$
- $E = \frac{D\Delta z}{B\Delta r}$
- $F = \frac{\Delta r\Delta x}{AB^{\frac{3}{2}}}C^3H_z$
- $G = \sqrt{2}AB^{\frac{3}{2}}CH_z\Delta r$
- $G_x = 0.5G\Delta x$
- $G_y = 0.5G\Delta y$
- $H = \sqrt{2}\sqrt{B}C^3H_z\Delta r^3$
- $H_x = -0.25H\Delta x$
- $H_y = -0.25H\Delta y$
- $I = AB^2$
- $I_x = I\Delta x$
- $I_y = I\Delta y$
- $J = 2B\Delta r^6k^2$
- $K = 0.5AB - 0.25C^2\Delta r^2$
- $L_0 = I_y + L$
- $L = G_x + H_x$
- $M = -G_y - H_y$
- $M_0 = I_x + M$
- $2N = -B^3CH_z\Delta r^7k^2$
- $O = 0.125C^2\Delta r^8k^2$
- $P = -\frac{Kk}{A}H_z\Delta r$
- $Q = \frac{\Delta z^2}{A^2B\Delta r^6}$
- $R = \frac{0.25C\Delta z}{A\sqrt{B}}\sqrt{2}\Delta rk$