KL vertex fitter

Modifying Fitter

	Gamma Energy Calibration	KL vertex fit
# of parameters	17(x,y,E1~E5)	18 (x,y,E)
# of Unknown variables	4(vx,vy,vz,E6)	3(vx,vy,vz)
# of restrictions	6	6

Restrictions **h**

- Reconstructed π^0 mass

$$(E_{\gamma 1} + E_{\gamma 2})^2 - (\mathbf{p_1} + \mathbf{p_2})^2 - M_{\pi^0}^2 = 0$$
$$(E_{\gamma 3} + E_{\gamma 4})^2 - (\mathbf{p_3} + \mathbf{p_4})^2 - M_{\pi^0}^2 = 0$$
$$(E_{\gamma 5} + E_{\gamma 6})^2 - (\mathbf{p_5} + \mathbf{p_6})^2 - M_{\pi^0}^2 = 0$$

- Reconstructed K_L mass

$$(\sum_i E_{\gamma i})^2 - (\sum_i \mathbf{p}_i)^2 - M_{K_L}^2 = 0$$

- Center of energy

$$\sum x_i \cdot E_{\gamma i} - x_{K_L} \frac{z_{K_L} - z_T}{z_{CsI} - z_T} \cdot \sum E_{\gamma i} = 0$$
$$\sum y_i \cdot E_{\gamma i} - y_{K_L} \frac{z_{K_L} - z_T}{z_{CsI} - z_T} \cdot \sum E_{\gamma i} = 0$$

Parameters

- a = (x1,y1,E1,….x6,y6,E6) : xi,yi,Ei gamma position, Energy
  - size = 18
- v = (vx, vy, vz) : KL decay position
  - size = 3
- D and E matrix
  - D =d**h**/d**a**: 6x18
  - E =d**h**/d**v**: 6x3

Chi2

$$\mathbf{h}|_{\mathbf{a}=\mathbf{a}_0,\mathbf{v}=\mathbf{v}_0} + D(\mathbf{a}-\mathbf{a}_0) + E(\mathbf{v}-\mathbf{v}_0) \approx \mathbf{0}.$$

$$\chi^2 = (\mathbf{a}-\mathbf{a}_0)^t V_{\mathbf{a}_0}^{-1}(\mathbf{a}-\mathbf{a}_0) + 2\lambda^t(\mathbf{h} + D(\mathbf{a}-\mathbf{a}_0) + E(\mathbf{v}-\mathbf{v}_0))$$

$$V_{a_0} = \begin{pmatrix} \sigma_{x_1}^2 & 0 & 0 & \cdots \\ 0 & \sigma_{y_1}^2 & 0 & \\ 0 & 0 & \sigma_{E_1}^2 & \\ \vdots & & & \ddots \end{pmatrix}.$$

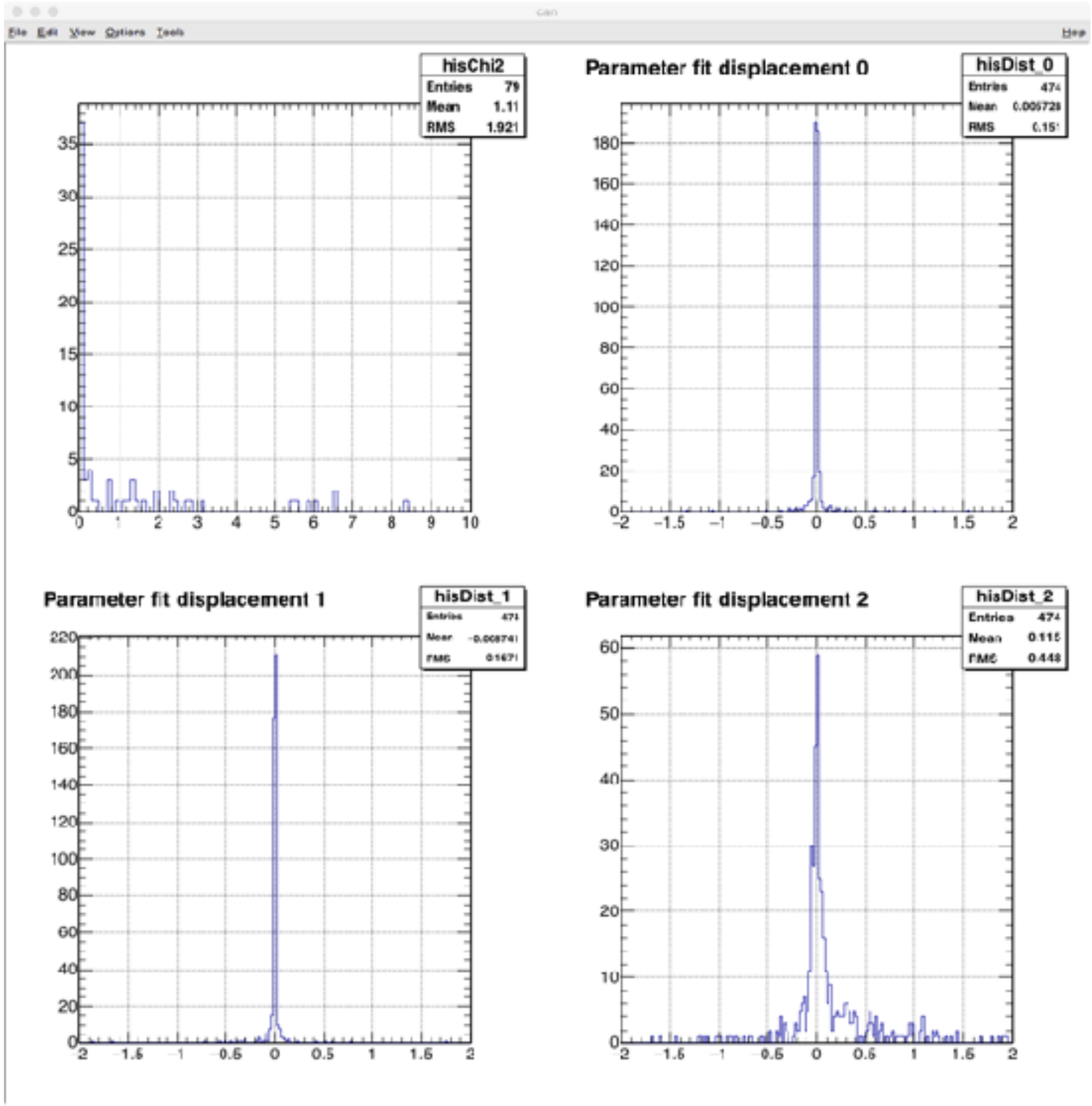
$$\lambda_0 = V_D(D(\mathbf{a}-\mathbf{a}_0) + \mathbf{h})$$
$$\mathbf{v} = \mathbf{v}_0 - V_E E^t \lambda_0$$
$$\lambda = \lambda_0 + V_D E(\mathbf{v}-\mathbf{v}_0)$$
$$\mathbf{a} = \mathbf{a}_0 - V_{\mathbf{a}_0} D^t \lambda$$

$V_D = DV_aD^t$,
$V_E = E^tV_DE$

http://www.phys.ufl.edu/~avery/fitting.html

Current status

program working: ok
chi2 distribution: ?
changes in fitting:?



About program

- Uses e14g6ana output
- make and execute
  - ./bin/TestKLPosCal [E14G6ANA output]
  - ~~~_fit.root will be generated.
- Environment
  - ROOTSYS, CLHEP_BASE_DIR, E14_TOP_DIR