

Kaon LT Meeting

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contributions to x'_{tar}

- using old hms matrices from Tanja
- HMS recon : RECON_COSY.DAT.HMS100
- HMS forward : FORWARD_COSY.DAT.HMS100

forward : HMS100 matrix

$$x_{\text{fp}} = -3.0782 x_{\text{tar},0} + 0.2188 x'_{\text{tar},0}$$
$$x'_{\text{fp}} = 0.0184 x_{\text{tar},0} - 0.3262 x'_{\text{tar},0}$$

backward : HMS100 matrix

$$x'_{\text{tar}} = 0.3174 x_{\text{fp}} - 2.8530 x'_{\text{fp}}$$
$$\delta = 0.2512 x_{\text{fp}} + 0.1685 x'_{\text{fp}}$$

HMS out-of-plane angle vs. y_{beam}

$$x'_{\text{tar}} = -1.0295 x_{\text{tar},0} + 1.0000 x'_{\text{tar},0}$$
$$\delta = -0.7702 x_{\text{tar},0} - 0.0000 x'_{\text{tar},0}$$

- using $x'_{\text{tar},0} = -x_{\text{tar},0}/D_{\text{HMS}}$, $D_{\text{HMS}} = 1.68\text{m}$, we get $x'_{\text{tar}} \approx -1.624725 \text{ rad/m}$.

contributions to x'_{tar}

- SHMS default recon in SIMC :
`shms-2017-26cm-monte_q1_1018_q2_1027_q3_1018_hb80_recon_fit.dat`
- SHMS forward from Dave : `shms_forward_cosy_dipole26cm_dm1.2_nonseq.dat`

forward : SHMS matrix

$$x_{\text{fp}} = -1.3860 x_{\text{tar},0} - 9.7907 \times 10^{-12} x'_{\text{tar},0}$$
$$x'_{\text{fp}} = -0.6029 x_{\text{tar},0} - 0.7215 x'_{\text{tar},0}$$

backward : SHMS matrix

$$x'_{\text{tar}} = 0.2987 x_{\text{fp}} - 1.5500 x'_{\text{fp}}$$
$$\delta = 0.6435 x_{\text{fp}} - 0.2205 x'_{\text{fp}}$$

SHMS out-of-plane angle vs. y_{beam}

$$x'_{\text{tar}} = 0.5205 x_{\text{tar},0} + 1.1183 x'_{\text{tar},0}$$
$$\delta = -0.7589 x_{\text{tar},0} + 0.1591 x'_{\text{tar},0}$$

- not the same pair of forward/backward matrices

Using the Sequential Forward Matrix

- For the α -th resulting variable, the reconstruction equations can be written as

$$x^{(\alpha)} = \sum_{i,j,k,l,m} C_{ijklm}^{(\alpha)} (x_{\text{fp}})^i (x'_{\text{fp}})^j (y_{\text{fp}})^k (y'_{\text{fp}})^l (x_{\text{tar}})^m .$$

- To first order, the equation reduces to matrix multiplication (the same holds for the forward matrix):

$$x'_{\text{tar}} = C_{10000}^{(x'_{\text{tar}})} (x_{\text{fp}}) + C_{01000}^{(x'_{\text{tar}})} (x'_{\text{fp}}) + C_{00100}^{(x'_{\text{tar}})} (y_{\text{fp}}) + C_{00010}^{(x'_{\text{tar}})} (y'_{\text{fp}}) + C_{00001}^{(x'_{\text{tar}})} (x_{\text{tar}})$$

$$y_{\text{tar}} = C_{10000}^{(y_{\text{tar}})} (x_{\text{fp}}) + C_{01000}^{(y_{\text{tar}})} (x'_{\text{fp}}) + C_{00100}^{(y_{\text{tar}})} (y_{\text{fp}}) + C_{00010}^{(y_{\text{tar}})} (y'_{\text{fp}}) + C_{00001}^{(y_{\text{tar}})} (x_{\text{tar}})$$

$$\vdots$$

$$\implies \begin{cases} \mathbf{x}_{\text{recon}} = \mathbf{C}_{\text{recon}} \cdot \mathbf{x}_{\text{fp}} \\ \mathbf{x}_{\text{fp}} = \mathbf{C}_{\text{forward}} \cdot \mathbf{x}_{\text{tar},0} \end{cases}$$

$$\implies \mathbf{x}_{\text{recon}} = \mathbf{C}_{\text{recon}} \cdot \mathbf{C}_{\text{forward}} \cdot \mathbf{x}_{\text{tar},0}$$

- note the matrix files are formatted column-wise so it represents \mathbf{C}^T .

contributions to x'_{tar}

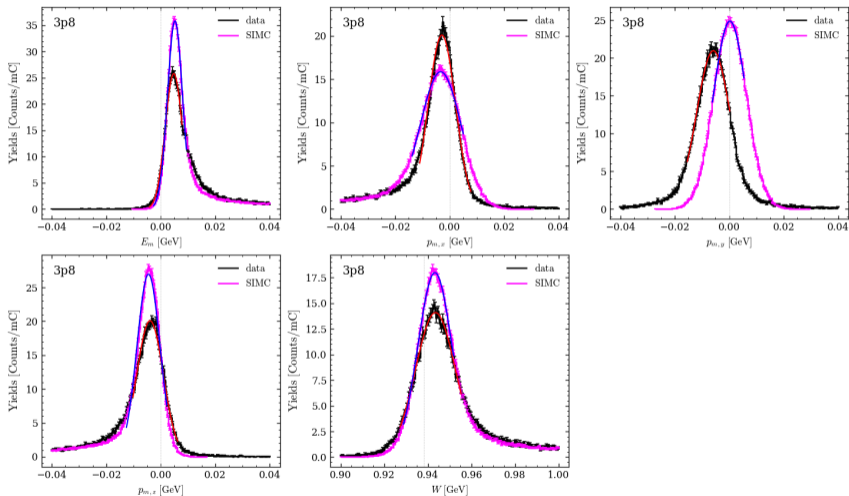
- assume independent of other offsets
- take SIMC values as truth instead of pdg values

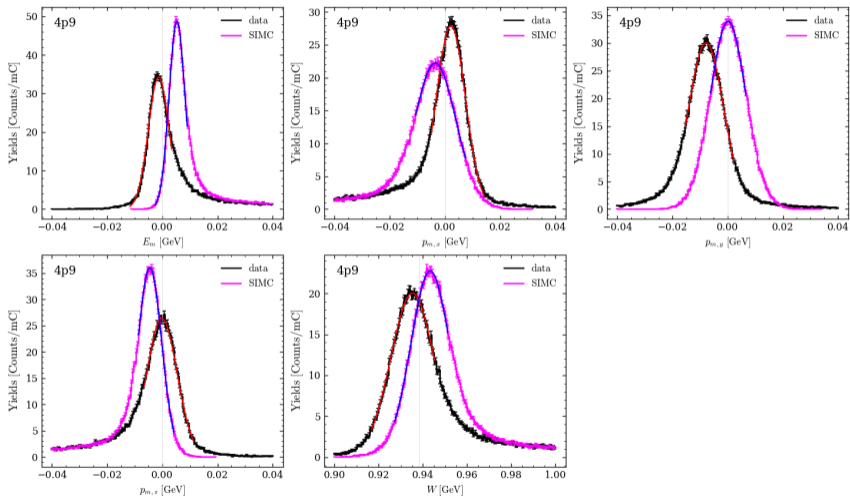
peak fitting

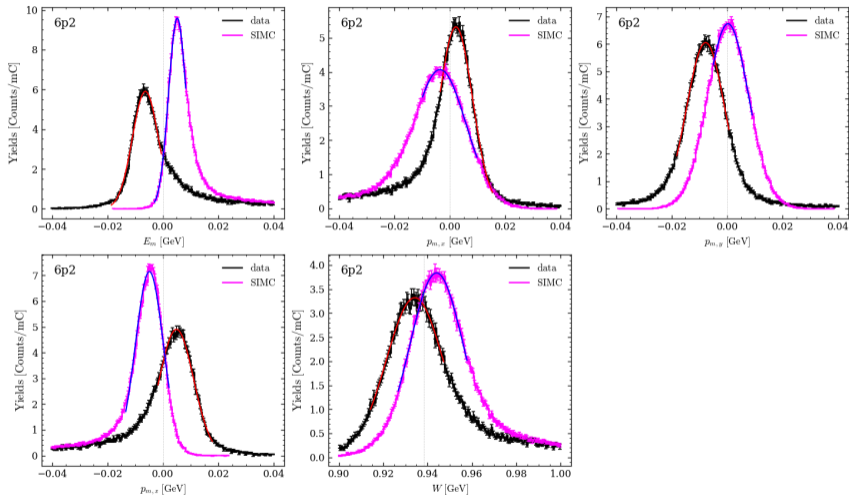
- fit gaussian around the peak, range selected by requiring same integral on both sides
- uncertainty includes systematics from varying fitting range and model (e.g. gaussian + constant, gaussian + linear, crystal ball, etc...)

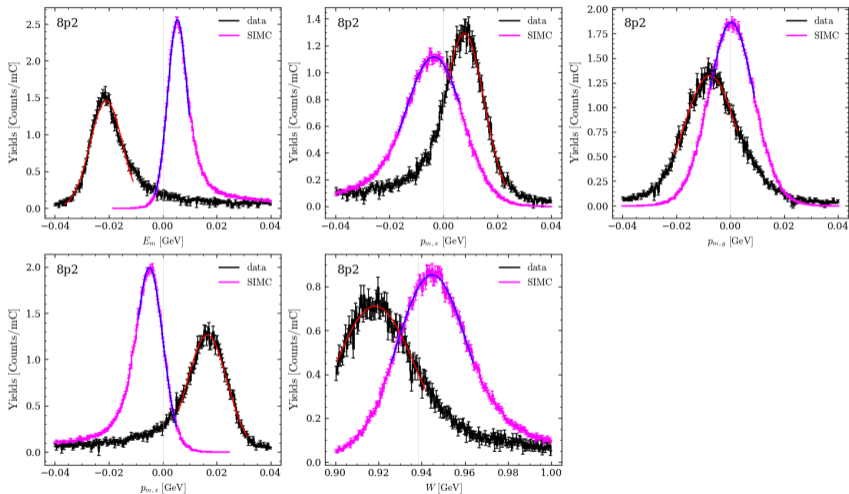
data

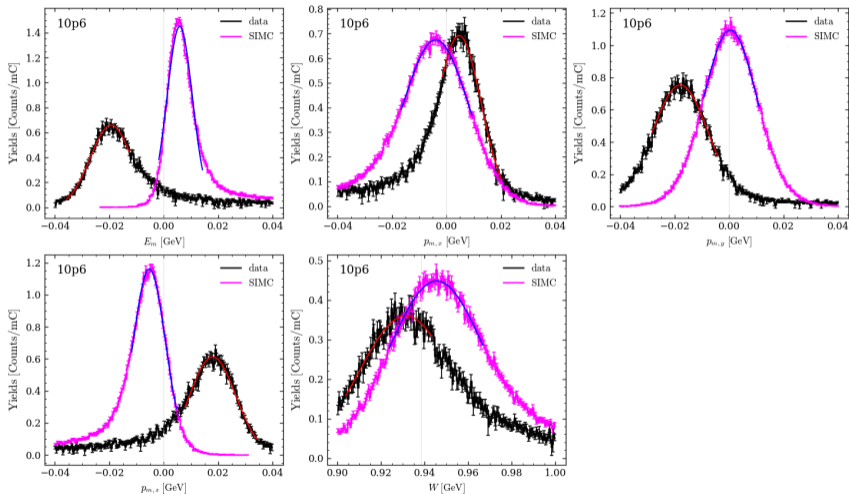
- coincidence runs
- usual proton pid and acceptance cuts
- with dummy subtraction applied







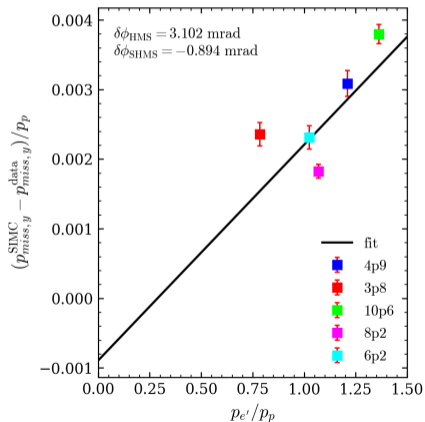




Out-of-plane angle offset

contributions to x'_{tar}

- assume independent of other offsets
- take SIMC values as truth instead of pdg values



Some notes about applying offsets

SIMC

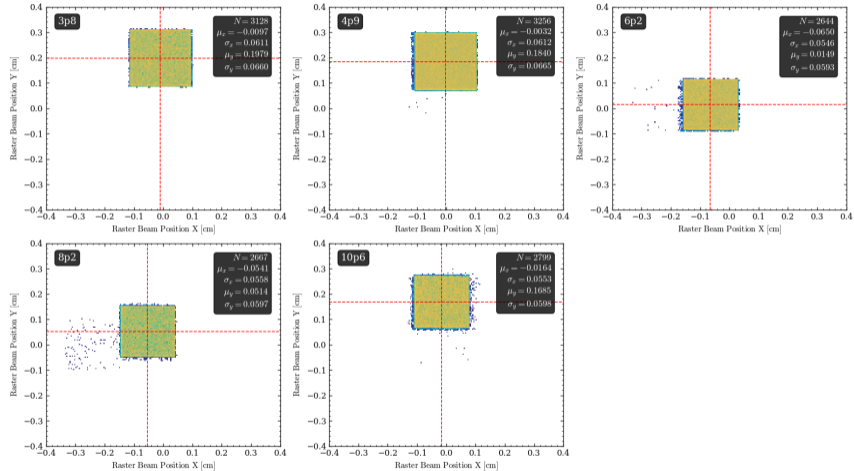
- All offsets are applied in event generation stage
- In forward step, offsets are subtracted from MC samples and added back in the reconstruction step.
- report raw reconstructed variables (e.g. `ssdelta`)

Hcana

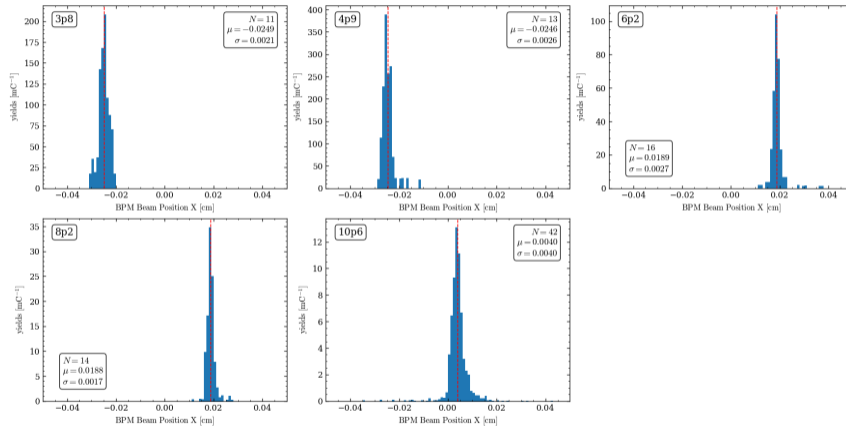
- offsets are baked into the data
- offsets are added in the reconstruction step.
- `fOpOffset` is only applied in kinematics so `gtr` branches only includes correction from matrix element offsets.
- However, for some mysterious reason, the ϕ matrix element offset is added to the central ϕ . This does not affect KaonLT since we set it to zero.

- remove `PhiOffset` from central ϕ in `Hcana` ?
- SIMC settings:
 - manually calculate the corrected ebeam, central angles and momenta and directly set them in the input file
 - set target xy offsets using `H.rb.raster.fr.xbpm.tar` (same unit : cm)
 - set `xptar` offset for both arms in input file (no need to change sign but unit is mrad)
 - **DO** apply `xptar` offsets in `Recon_hcana.C` for both arms
 - written a version which reads from the `.hist` file.

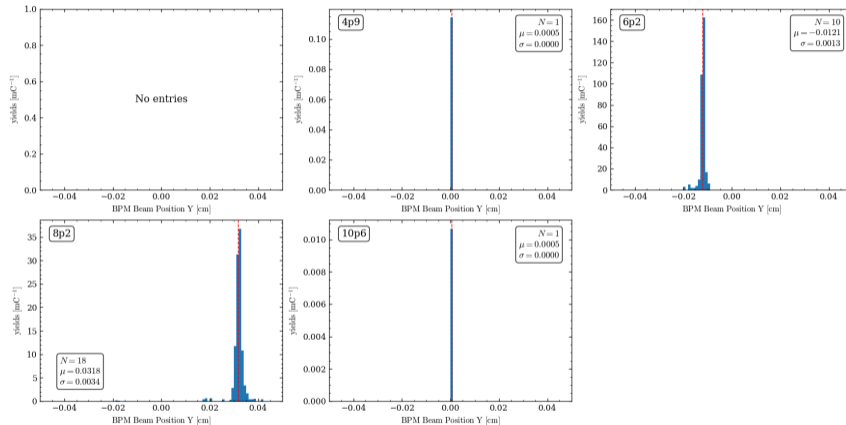
HeeP beam position Raster XY



HeeP beam position BPM X



HeeP beam position BPM Y



- get beam pos in production data and rerun simc to check MM shift