Comparision between Multifold and sequential histogram scaling

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Generalized angularities

$$\lambda_\beta^\kappa = \sum_{\text{const}\in\text{jet}} \overbrace{\left(\frac{p_{\mathrm{T,const}}}{p_{\mathrm{T,jet}}}\right)^\kappa}^{\text{soft/hard radiation}} \times \overbrace{r(\text{const},\text{jet})^\beta}^{\text{collinearity sensitive}}$$

$$r(\text{const},\text{jet}) = \sqrt{(\eta_{\text{jet}} - \eta_{\text{const}})^2 + (\phi_{\text{jet}} - \phi_{\text{const}})^2}$$

- **LHA angularity** $\lambda_{0.5}^1 = \frac{\sum_{\text{trk}\in\text{jet}} p_{\mathrm{T,trk}}\sqrt{\Delta R}}{p_{\mathrm{T,jet}}}$,
- **Jet girth:** $\mathbf{g} = \lambda_1^1 = \frac{\sum_{\text{trk}\in\text{jet}} p_{\mathrm{T,trk}}\Delta R}{p_{\mathrm{T,jet}}}$, measure of jet broadening
- **Thrust** $\lambda_2^1 = \frac{\sum_{\text{trk}\in\text{jet}} p_{\mathrm{T,trk}}\Delta R^2}{p_{\mathrm{T,jet}}}$, related to jet mass
- **Momentum dispersion :** $p_T^D = \lambda_0^2$
- Done for both inclusive jets and hard-core component of the inclusive jets
- Hard-core component calculated by vector summing constituents with $p_T > 2.0$ GeV/c

Dataset and Simulations

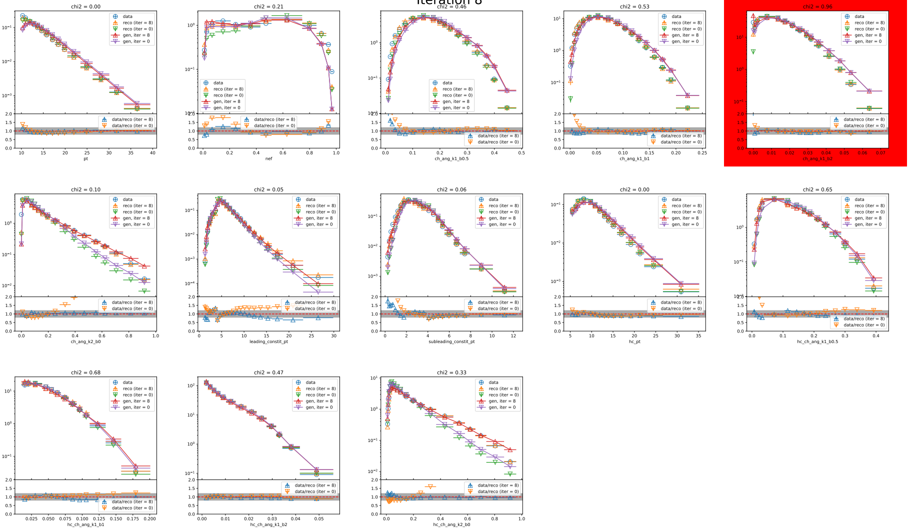
- **System:** Au+Au (2014), p+p (2012) @ $\sqrt{s_{\mathrm{NN}}} = 200\mathrm{GeV}$
- **High Tower (HT) triggered** events ($\exists$ tower with $E_{\mathrm{tower}} \geqslant 4$ GeV) to enhance jet signal
- **Embedding simulation:**
- GEN: PYTHIA-6 Perugia-STAR dijet events (J. K. Adkins, PhD thesis (Kentucky U., 2015))
- RECO: PYTHIA-6 Perugia-STAR + GEANT3 + STAR p+p Run12 ZeroBias (2023 version)

Unfolding by sequential scaling of histogram

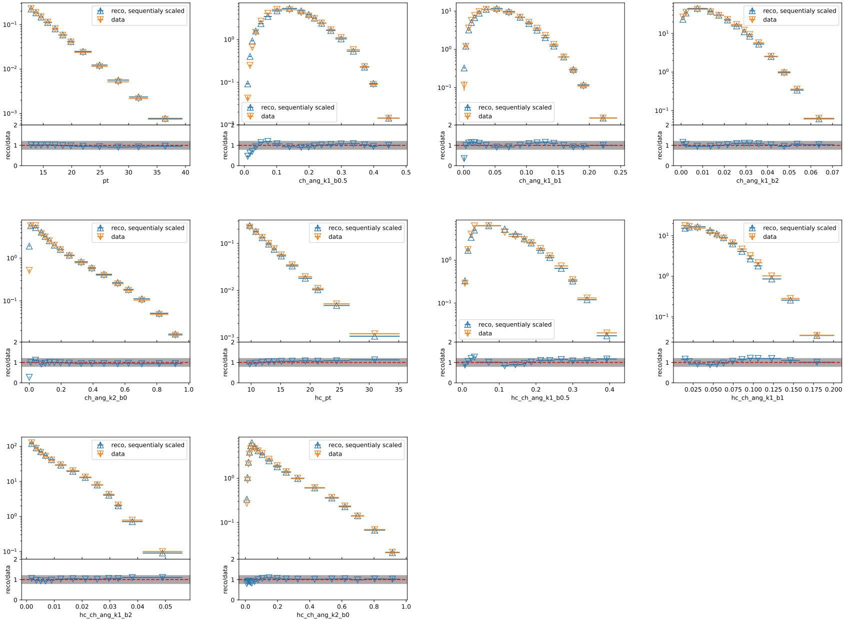
Youqi's slides:
https://drupal.star.bnl.gov/STAR/system/files/pwg$_{m}eeting_{0}12325.pdf$

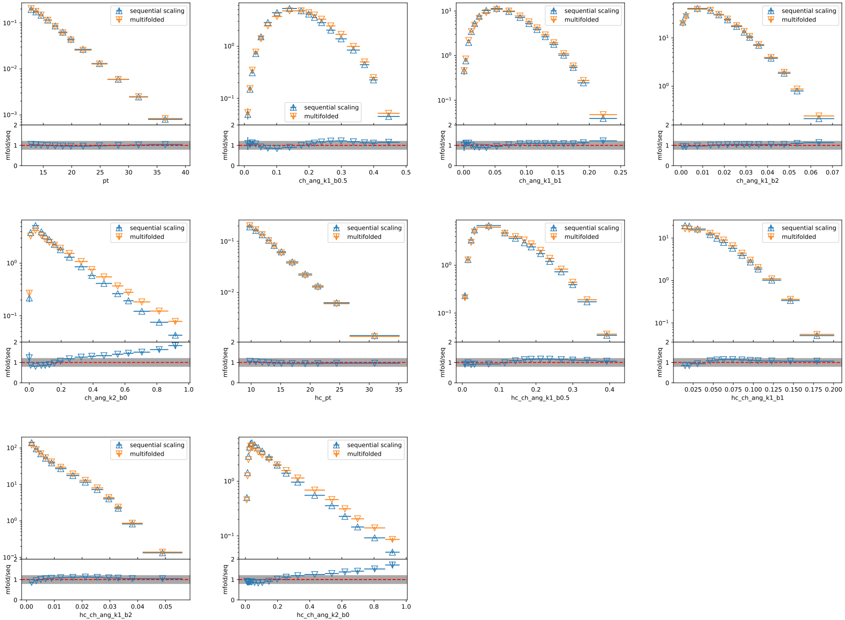
- Goal is to make reco distributions look like data, and propagate to gen level for a " pseudo-truth" level
- This is done by iteratively scaling the 1-d histograms of features
- Every iteration, find the feature with least agreement (based on χ^2), scale the reco level to recoilcile them
- Repeat till all χ^2 are below 1

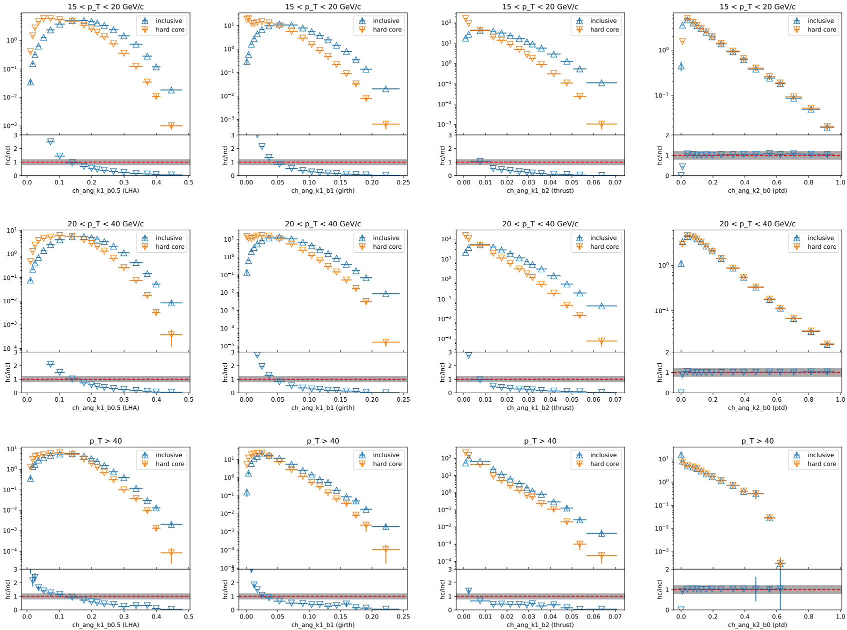
Iteration 8

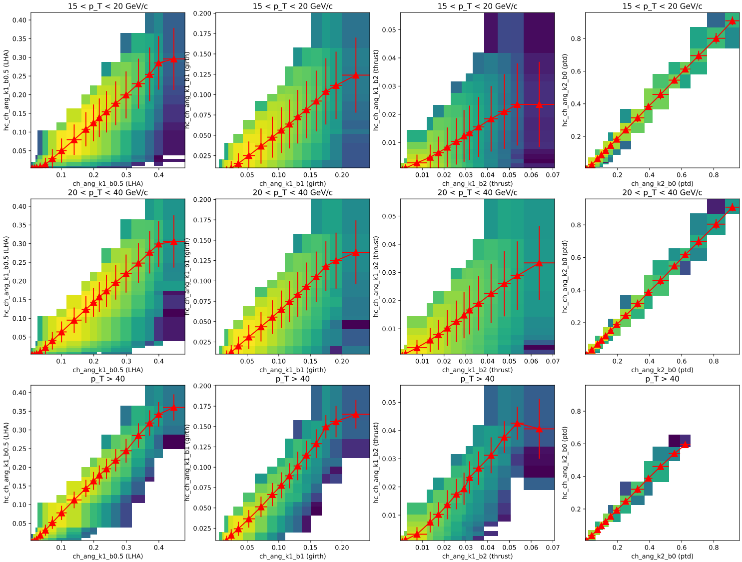


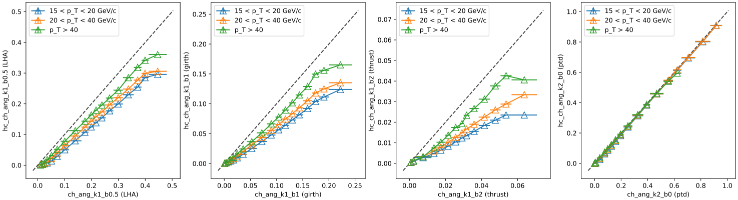
chi2 = 0.00
pt
chi2 = 0.21
nef
chi2 = 0.46
ch_ang_k1_b0.5
chi2 = 0.53
ch_ang_k1_b1
chi2 = 0.96
ch_ang_k1_b2
chi2 = 0.10
ch_ang_k2_b0
chi2 = 0.05
leading_constit_pt
chi2 = 0.06
subleading_constit_pt
chi2 = 0.00
hc_pt
chi2 = 0.65
hc_ch_ang_k1_b0.5
chi2 = 0.68
hc_ch_ang_k1_b1
chi2 = 0.47
hc_ch_ang_k1_b2
chi2 = 0.33
hc_ch_ang_k2_b0
data
reco (iter = 8)
reco (iter = 0)
gen, iter = 8
gen, iter = 0
data/reco (iter = 8)
data/reco (iter = 0)


reco, sequentialy scaled
data
reco/data
pt
ch_ang_k1_b0.5
ch_ang_k1_b1
ch_ang_k1_b2
ch_ang_k2_b0
hc_pt
hc_ch_ang_k1_b0.5
hc_ch_ang_k1_b1
hc_ch_ang_k1_b2
hc_ch_ang_k2_b0


sequential scaling
multifolded
mfold/seq
pt
ch_ang_k1_b0.5
ch_ang_k1_b1
ch_ang_k1_b2
ch_ang_k2_b0
hc_pt
hc_ch_ang_k1_b0.5
hc_ch_ang_k1_b1
hc_ch_ang_k1_b2
hc_ch_ang_k2_b0


15 < p_T < 20 GeV/c
20 < p_T < 40 GeV/c
p_T > 40
inclusive
hard core
hc/incl
ch_ang_k1_b0.5 (LHA)
ch_ang_k1_b1 (girth)
ch_ang_k1_b2 (thrust)
ch_ang_k2_b0 (ptd)


15 < p_T < 20 GeV/c
15 < p_T < 20 GeV/c
15 < p_T < 20 GeV/c
15 < p_T < 20 GeV/c
20 < p_T < 40 GeV/c
20 < p_T < 40 GeV/c
20 < p_T < 40 GeV/c
20 < p_T < 40 GeV/c
p_T > 40
p_T > 40
p_T > 40
p_T > 40
hc_ch_ang_k1_b0.5 (LHA)
ch_ang_k1_b0.5 (LHA)
hc_ch_ang_k1_b1 (girth)
ch_ang_k1_b1 (girth)
hc_ch_ang_k1_b2 (thrust)
ch_ang_k1_b2 (thrust)
hc_ch_ang_k2_b0 (ptd)
ch_ang_k2_b0 (ptd)


15 < p_T < 20 GeV/c
20 < p_T < 40 GeV/c
p_T > 40
hc_ch_ang_k1_b0.5 (LHA)
ch_ang_k1_b0.5 (LHA)
hc_ch_ang_k1_b1 (girth)
ch_ang_k1_b1 (girth)
hc_ch_ang_k1_b2 (thrust)
ch_ang_k1_b2 (thrust)
hc_ch_ang_k2_b0 (ptd)
ch_ang_k2_b0 (ptd)