KaonLT u-Channel Analysis: $u - \phi$ Binning

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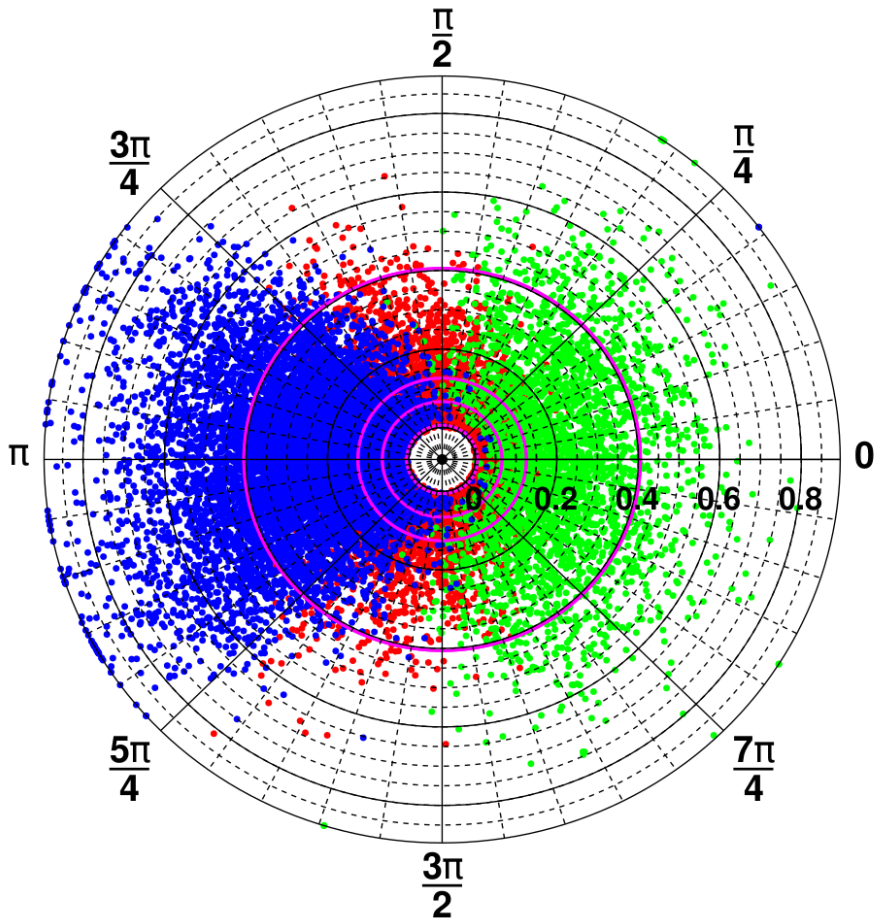
Input From Bill

- Met with Bill for analysis discussion, who made several suggestions:
- AGC efficiency study with Heep data
- Keep $\omega : \rho$ ratio somewhat consistent between bins
- Time better spent constraining background fit instead of adjusting bin borders
- Add exclusion criterion about number of events around $m_X = m_\omega$
- Determine actual u_{min} per setting and remake $u - \phi$ plot with real u'
- Pythia looks like it should be shifted to the right – control with modified kinematics?

Modified $u - \phi$ Plot



- Plotting $-u' = -u + u_{min}$
- Can not get rid of offset in the plot
- Also showing (current version of) bin borders
- Still see ϕ coverage fail around $-u = 0.3$

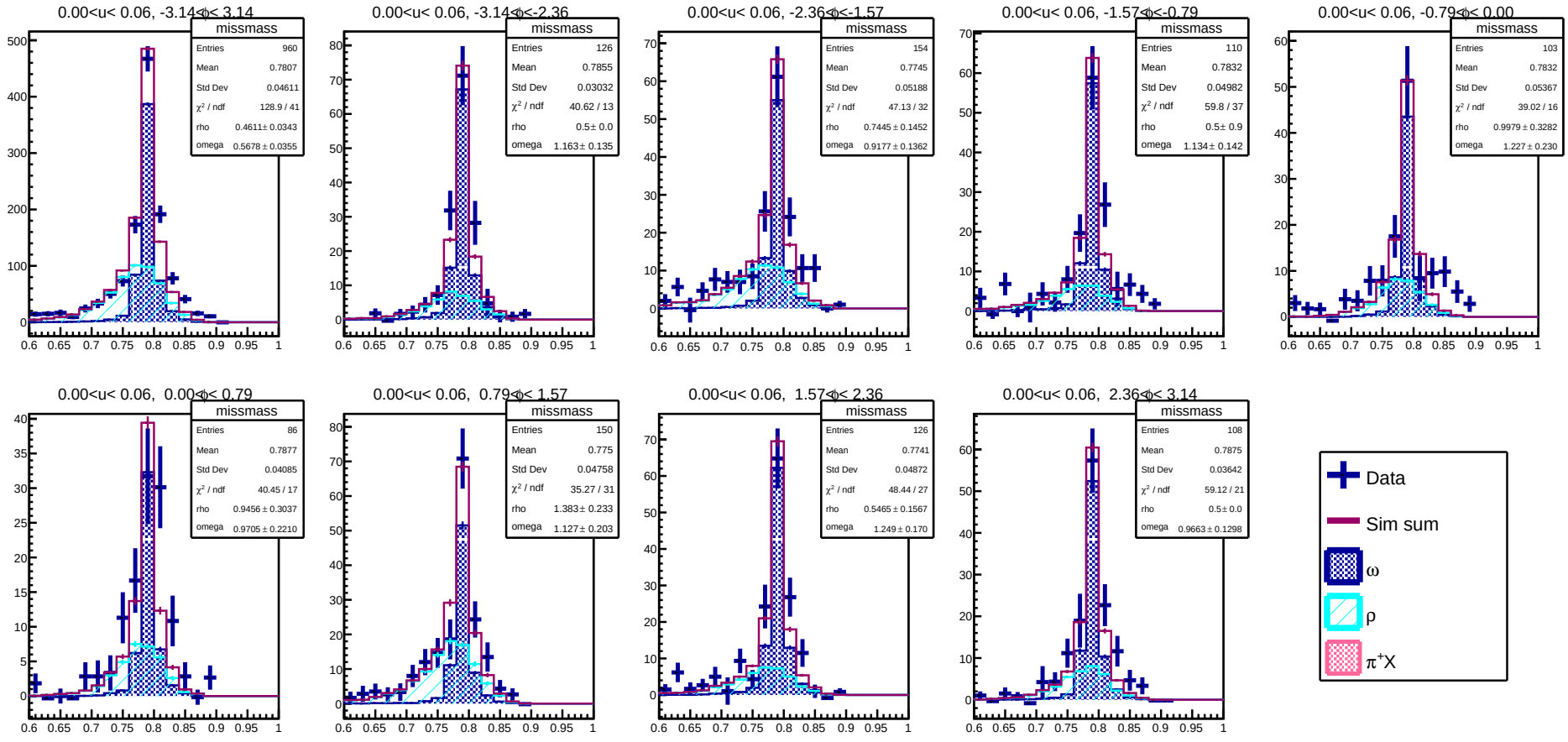
Modified Fitting Algorithm

When binning in u and ϕ, statistics are low, and running each fit independently causes binning artifacts. Therefore, the fit is constrained to not vary too drastically across bins in ϕ

1. For each u-bin, with data integrated in ϕ:
   - 1.1 Manually normalize each simulation to data in a region of m_X where that contribution is expected to dominate
   - 1.2 Create ROOT function for sim sum and fit with χ^2 minimization
     - 1.2.1 Constrain fit parameters only so that no contribution can be negative
   - 1.3 Save the outputs of the fit as starting parameters
2. For each ϕ-bin:
   - 2.1 Create ROOT function for sim sum and fit with χ^2 minimization
     - 2.1.1 Use results from ϕ-integrated data as starting parameters
     - 2.1.2 Constrain fit parameters to control variation between bins (within a factor of 2 from nominal)

Modified Fits

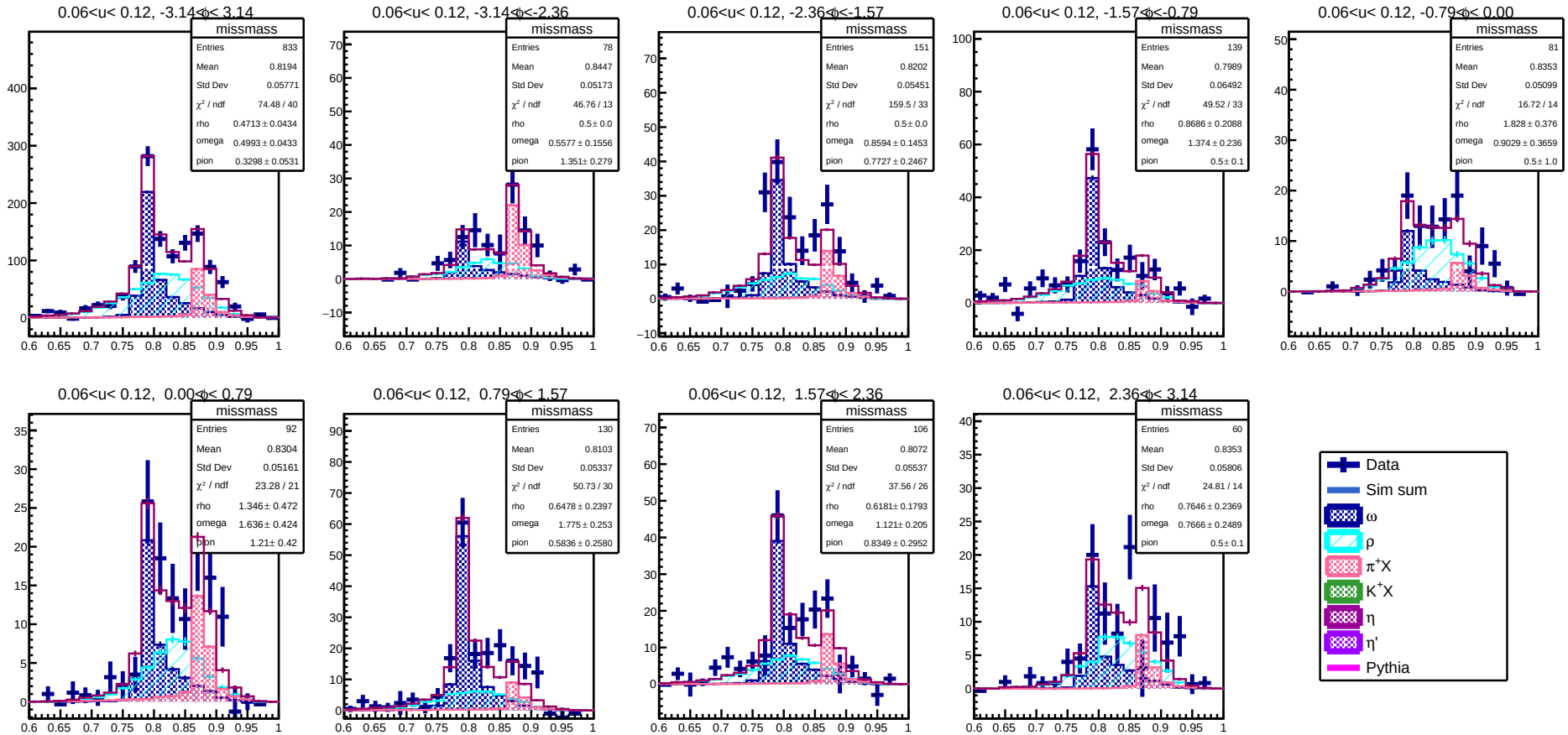
Bin 1: Considering only ρ, ω (below minimum $-u$ for π^+ production in SIMC)



SHMS Center, high ϵ, $0.00< -u <0.06$

Modified Fits

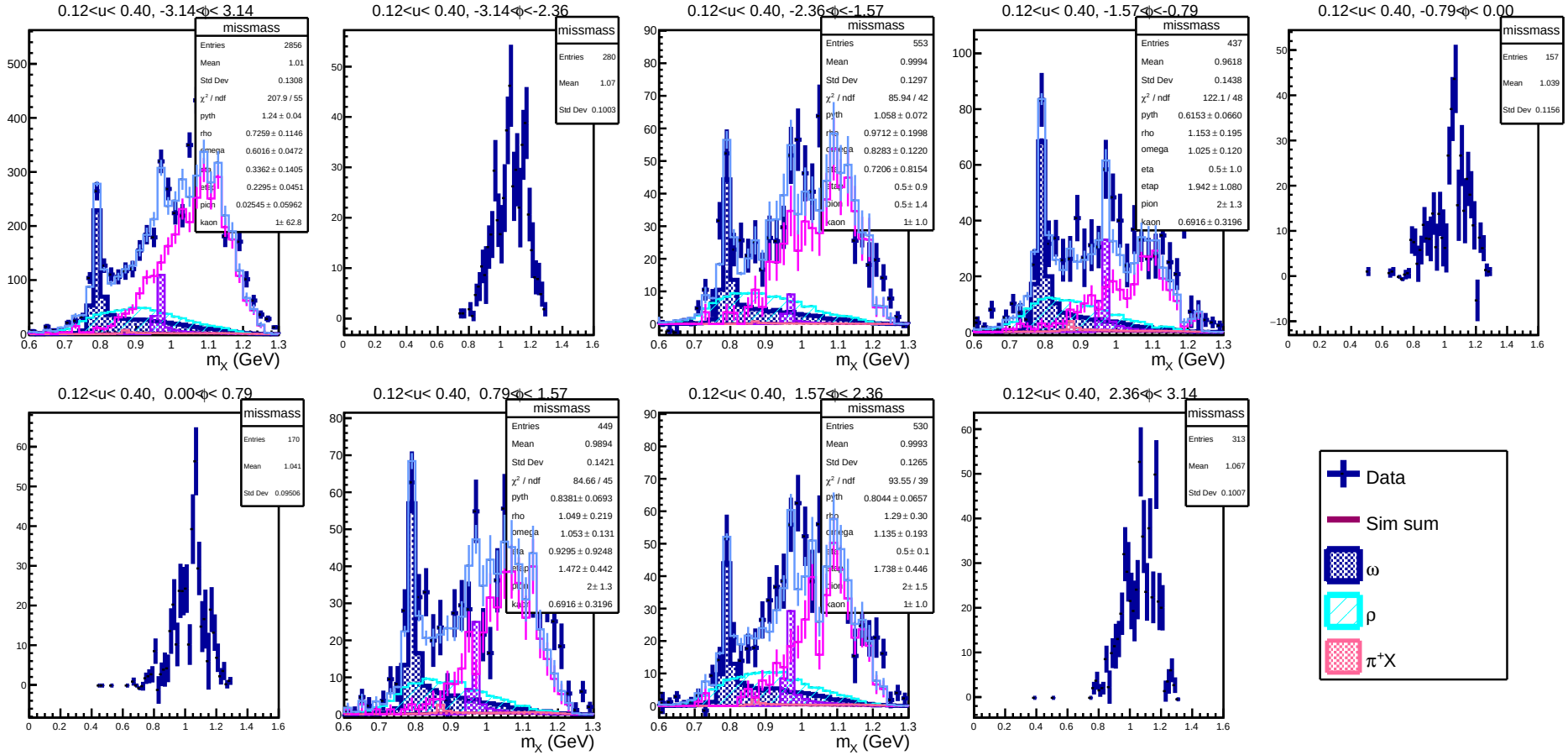
Bin 2: Considering ρ, ω, and π^+ leakthrough



SHMS Center, high ϵ, 0.06< $-u$ <0.12

Modified Fits

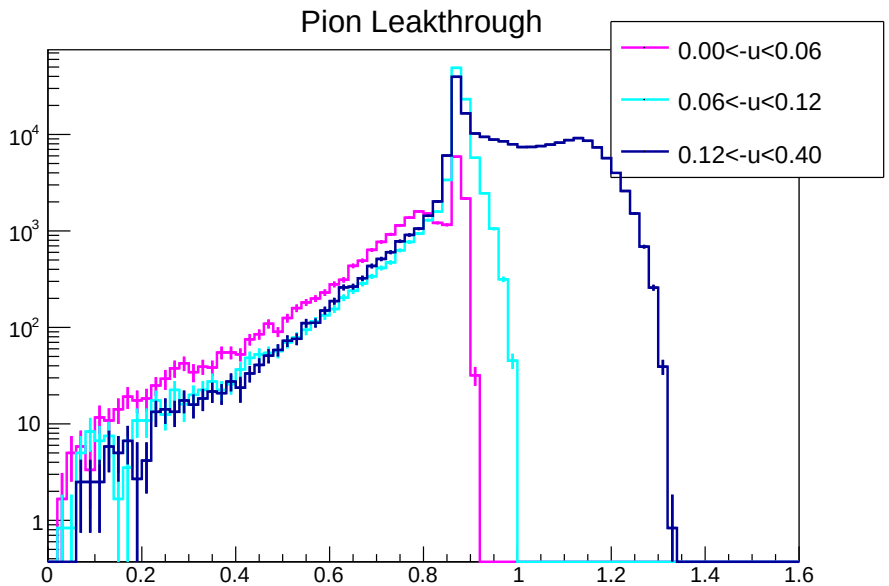
Bin 3: considering all processes, skipping bins with under 30 counts in $0.75 < m_X < 0.85$

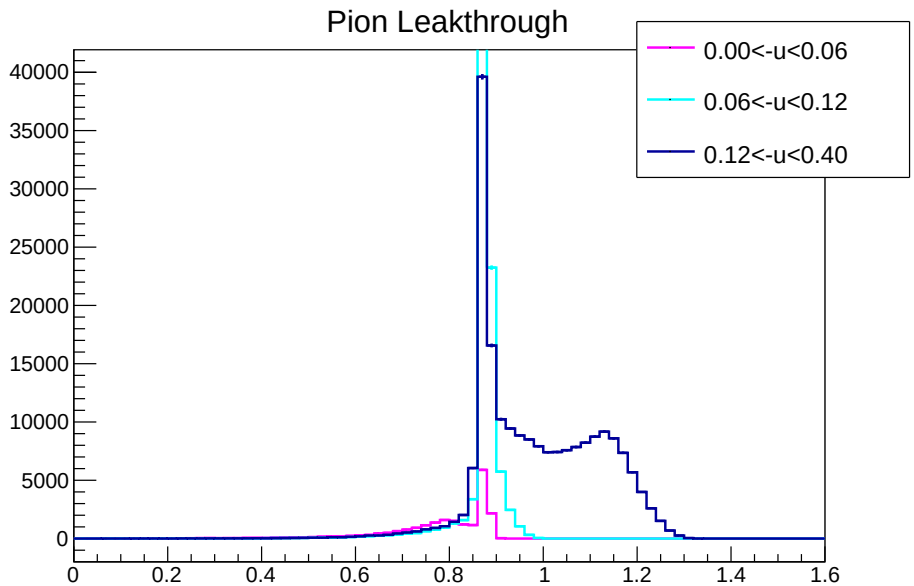


SHMS Center, high ϵ, $0.12 < -u < 0.40$

Pion & Kaon Leakthrough

- In the last set of shape study plots, the data samples with π^+ and K^+ PID seemed unrealistic
- Switch to using SIMC for K^+ channels
- Would like to use real data for π^+, but the sample appears impure despite aggressive PID cuts





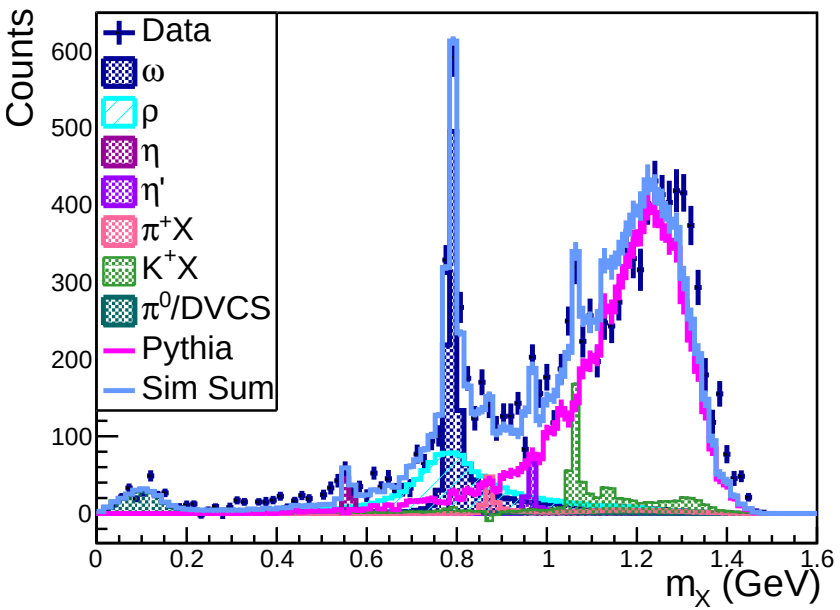
TCut pion = "P.aero.npeSum>4 && P.hgcer.npeSum>4 && RFTime.SHMS_RFtimeDist>1.7 && !hgc_hole";

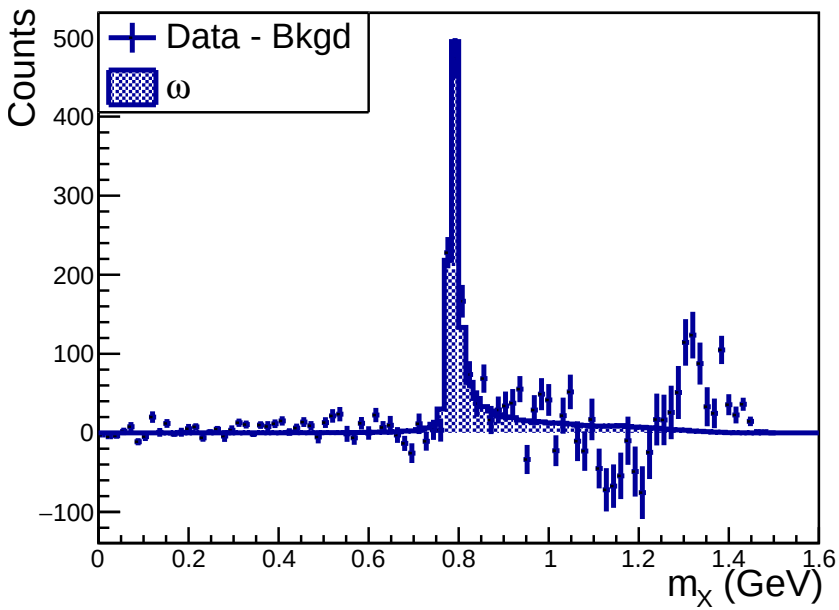
Shift Pythia?

- Visually, it seems Pythia m_X should extend farther right
- Bill: shifting Pythia to the right would result in more ρ contribution. It's difficult to justify a manual shift, but is there a kinematic correlation that can be exploited?
- Could be the t-shift

→ Greater Pythia discrepancy at settings with a larger m_X offset

→ Large $t : m_X$ correlation in Pythia





Outlook

$u - \phi$ coverage (by shape study fit feasibility)

0<(-u)<0.06

	phi	1	2	3	4	5	6	7	8
High epsilon	Left	0	0	0	0	0	0	0	0
	Right	0	0	0	1	1	0	0	0
	Center	1	1	1	1	1	1	1	1
Low epsilon	Left	0	0	0	0	0	0	0	0
	Center	1	1	1	1	1	1	1	1

0.06<(-u)<0.12

	phi	1	2	3	4	5	6	7	8
High epsilon	Left	1	0	0	0	0	0	0	1
	Right	0	0	0	1	1	0	0	0
	Center	1	1	1	1	1	1	1	1
Low epsilon	Left	1	0	0	0	0	0	0	1
	Center	1	1	1	1	1	1	1	1

0.12<(-u)<0.40

	phi	1	2	3	4	5	6	7	8
High epsilon	Left	1	1	0	0	0	0	1	1
	Right	0	0	1	1	1	1	0	0
	Center	0	1	1	0	0	1	1	0
Low epsilon	Left	1	1	0	0	0	0	1	1
	Center	0	1	1	0	0	1	1	0

TO DO

- Attempt Richard's event-by-event MM weighting for the kinematic comparison plots
- New replay w/ Sameer's coin blocking corrections
- Compute t-shift and incorporate into shape study
- AGC efficiency study with Heep data
- Modify SIMC collimator routine for proton punchthrough