

To do



1) For acc systematics (done trigger seperated)

redefine acceptance systematics by pull in 3D

- ⇒ integrate 3D, 2D, 1D xsection
- ⇒ Check pull in 3D, 2D, and 1D

2) For purity systematics (done trigger seperated)

implement new cross section = mean of cocktail fit and simple fit

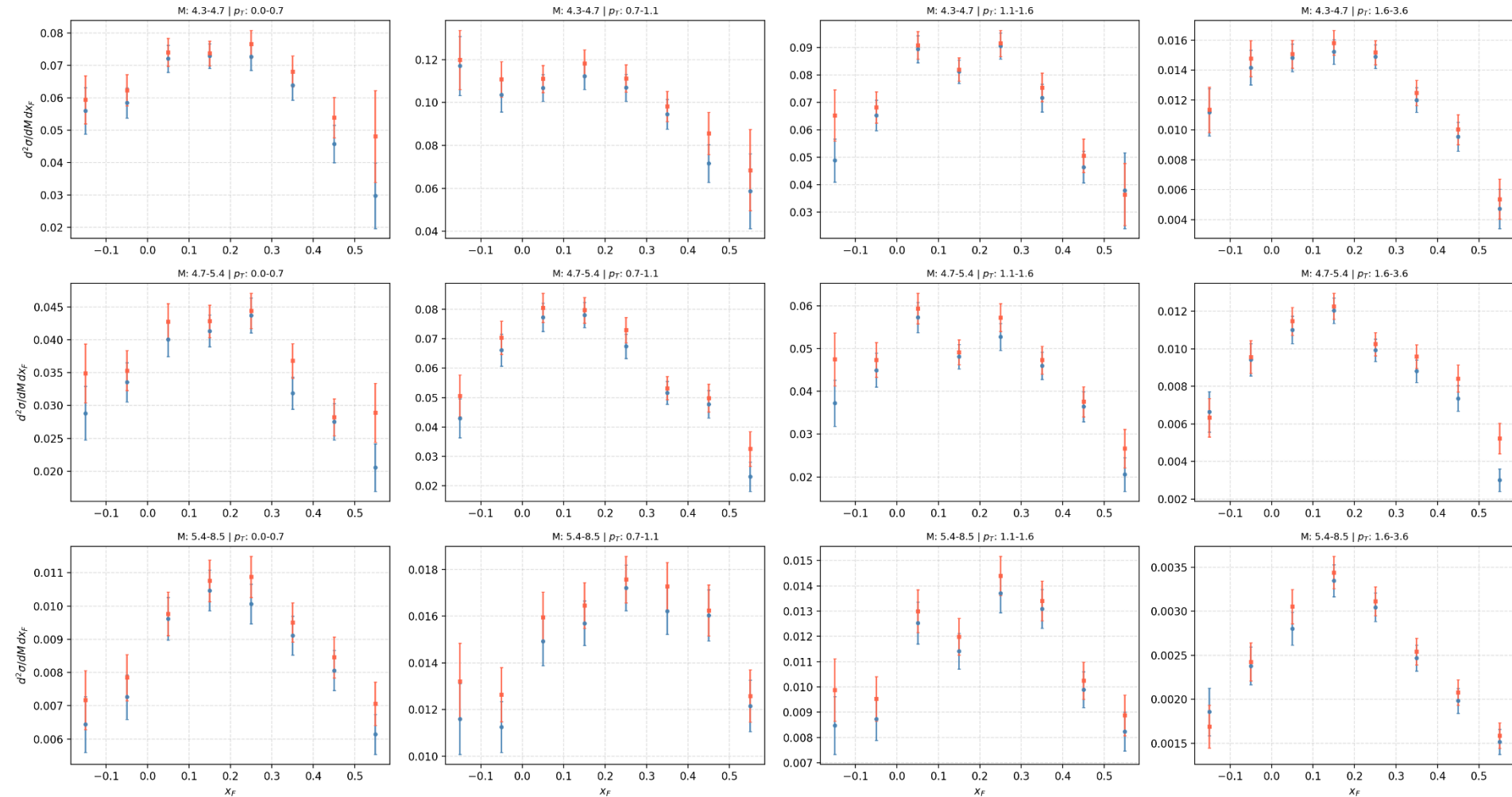
new purity systematics = $(xsc_cocktail - xsc_simple) / \sqrt{12}$

Correlation between kinematics is high, 0.8 to 1.

3) For trigger systematics and trigger combine, we did not reach agreement yet.

P09 VS Xsc_wAvg

1. Cross Sections: Computed Mean (blue) vs Reference (red)

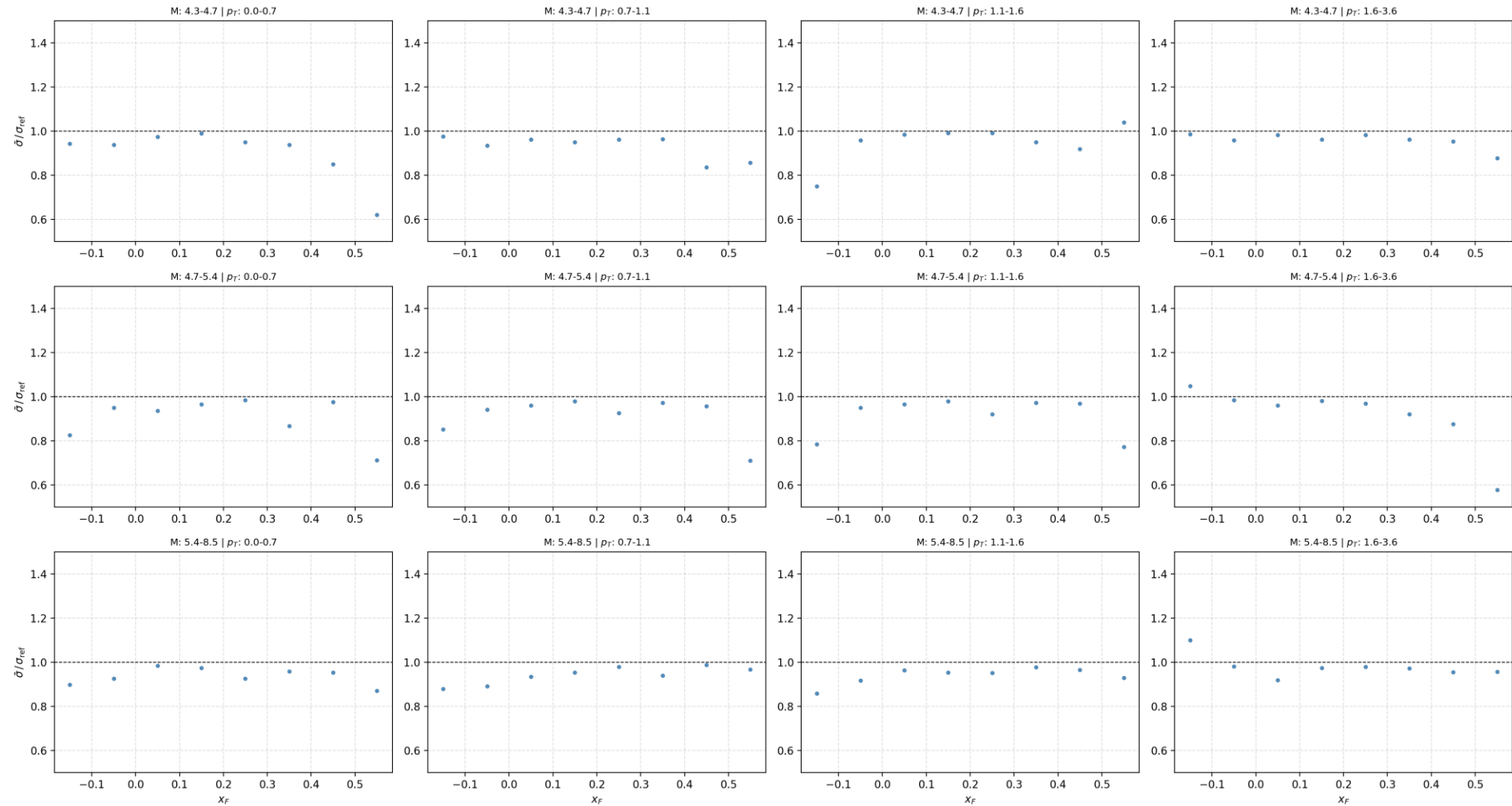


wAvg is consistently lower than P09?

Computed mean P09

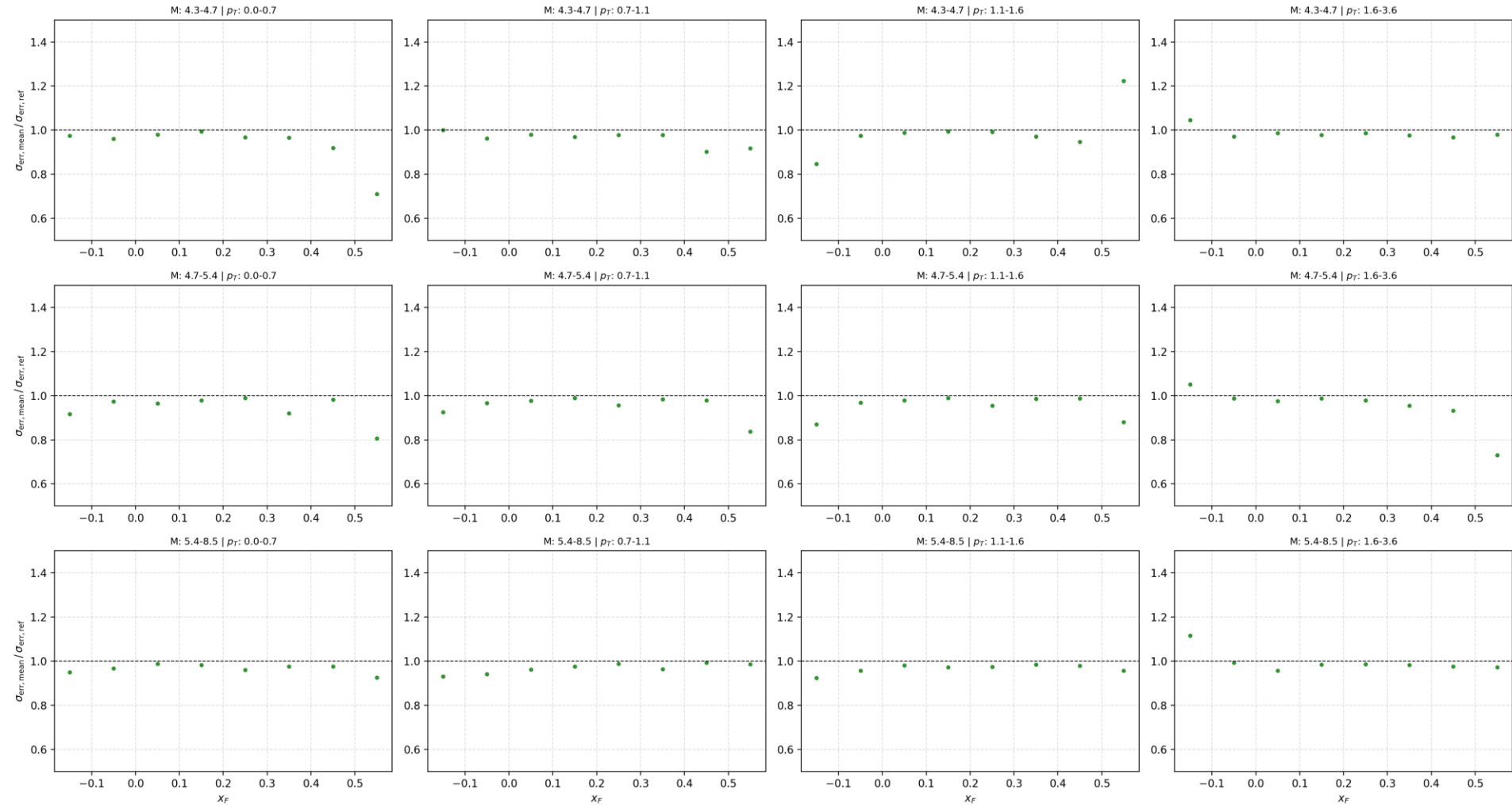


2. Ratio of Cross Sections: Mean / P09





3. Ratio of Error Sizes: $\text{err_mean} / \text{err_P09}$



Pull

- https://drive.google.com/open?id=1O9jDCQlk9Yo71ge92LPYM33TPvumvoKW&usp=drive_fs
- Pull for two independent measurement.

$$p = \frac{\sigma_A - \sigma_B}{\sqrt{(\sigma_A^{\text{stat}})^2 + (\sigma_B^{\text{stat}})^2}}$$

- Pull for our case : reference is average of all the periods which means reference is not independent from data sample.

$$p_i = \frac{\sigma_i - \bar{\sigma}}{\sqrt{(\sigma_i^{\text{stat}})^2 - (\bar{\sigma}^{\text{stat}})^2}}$$

- Add systematics to have good period compatibility

$$\sigma_i^{\text{total}} = \sqrt{(\sigma_i^{\text{stat}})^2 + (\sigma_i^{\text{sys}})^2} = \sqrt{1 + f_{\text{total}}^2} \cdot \sigma_i^{\text{stat}}, \quad f_{\text{total}} = \sqrt{f_{\text{scale}}^2 + f_{\text{bias}}^2}$$

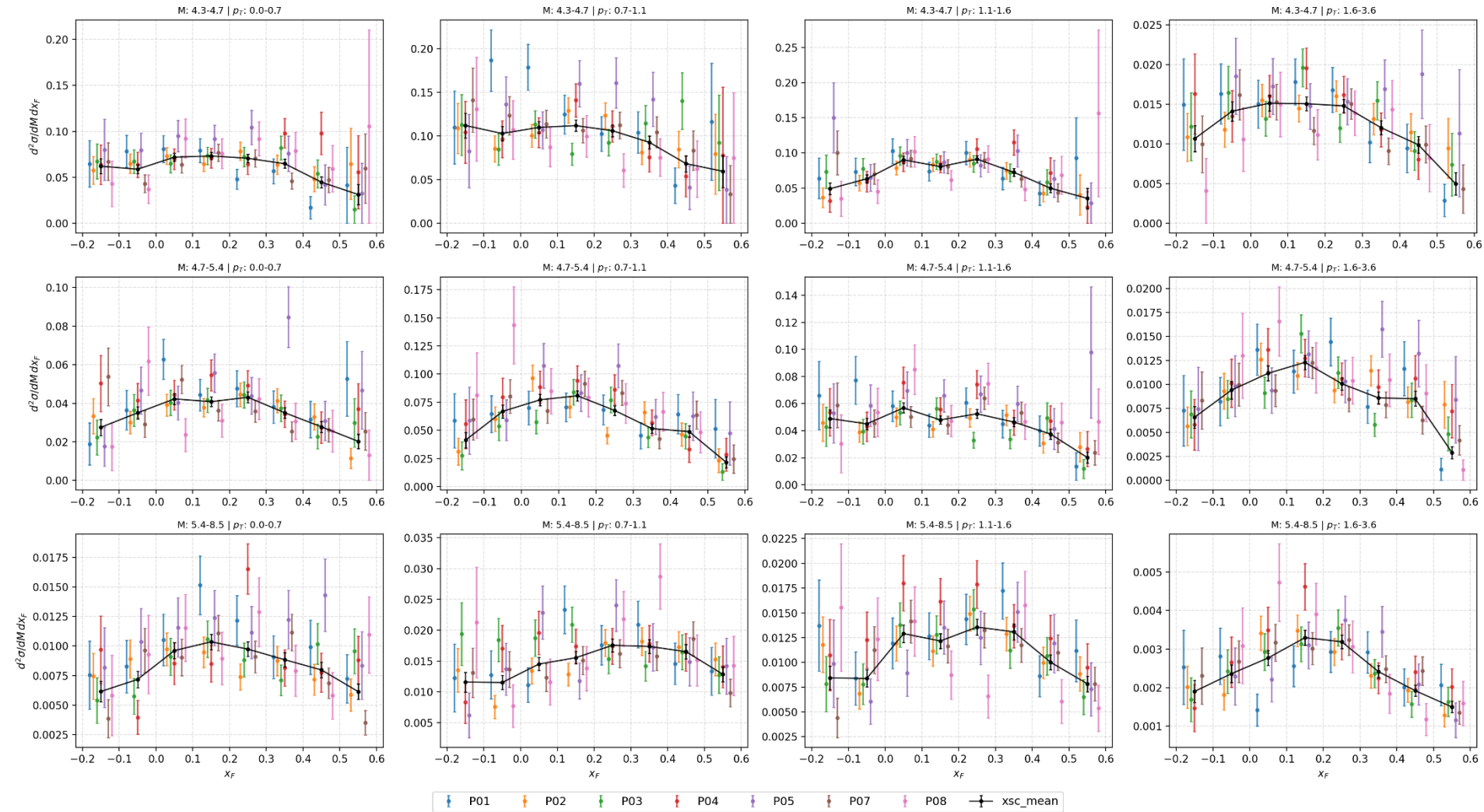
$$f_{\text{scale}} = \sqrt{\max(0, \hat{\sigma}^2 - 1)}$$

$$f_{\text{bias}} = |\hat{\mu}|$$

- Our goal is to have acc sys in 3D and have good period compatibility in all dimensions.

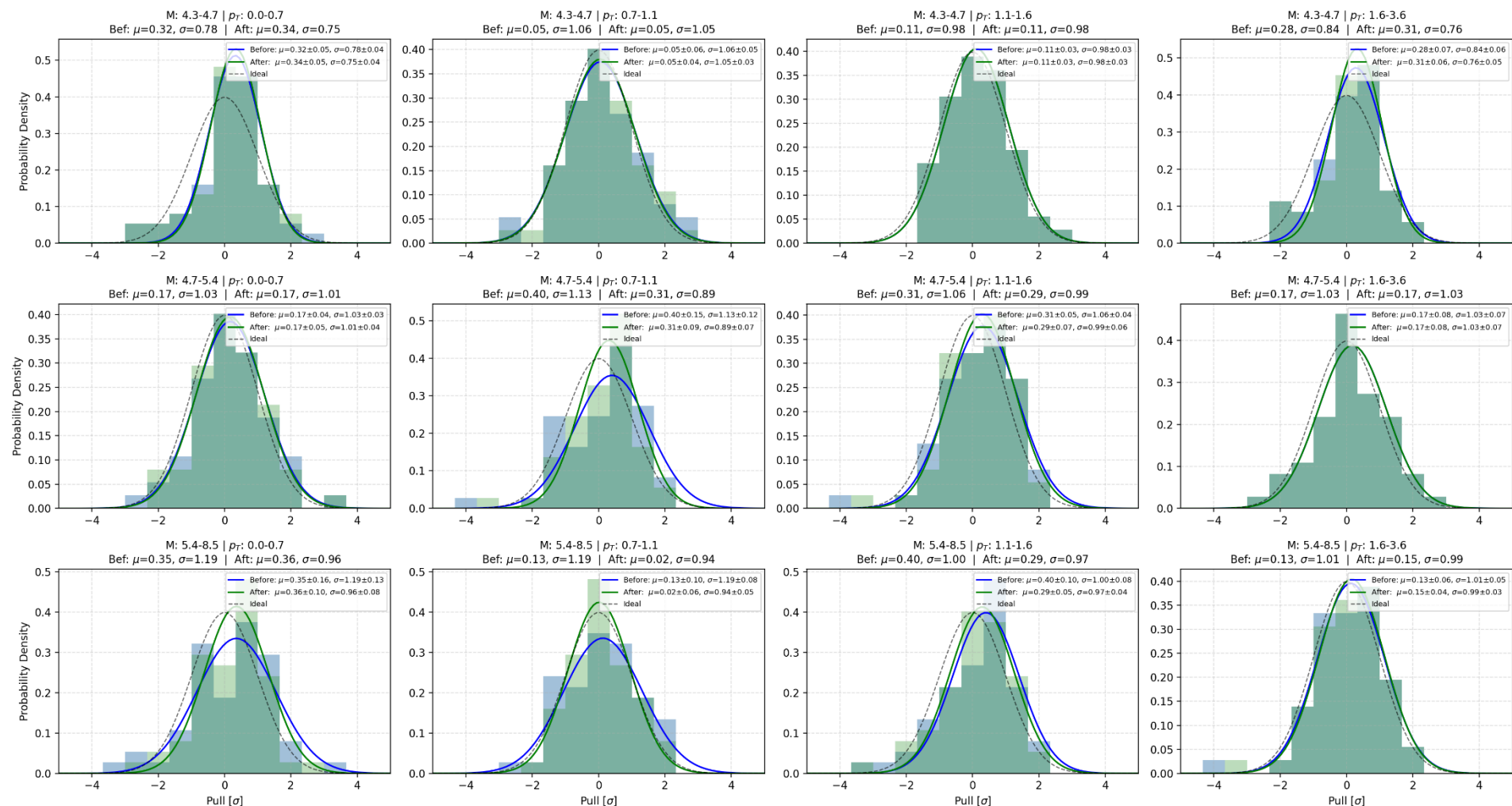
3D Xsc

1. Cross Sections (Stat Errors) + xsc_mean



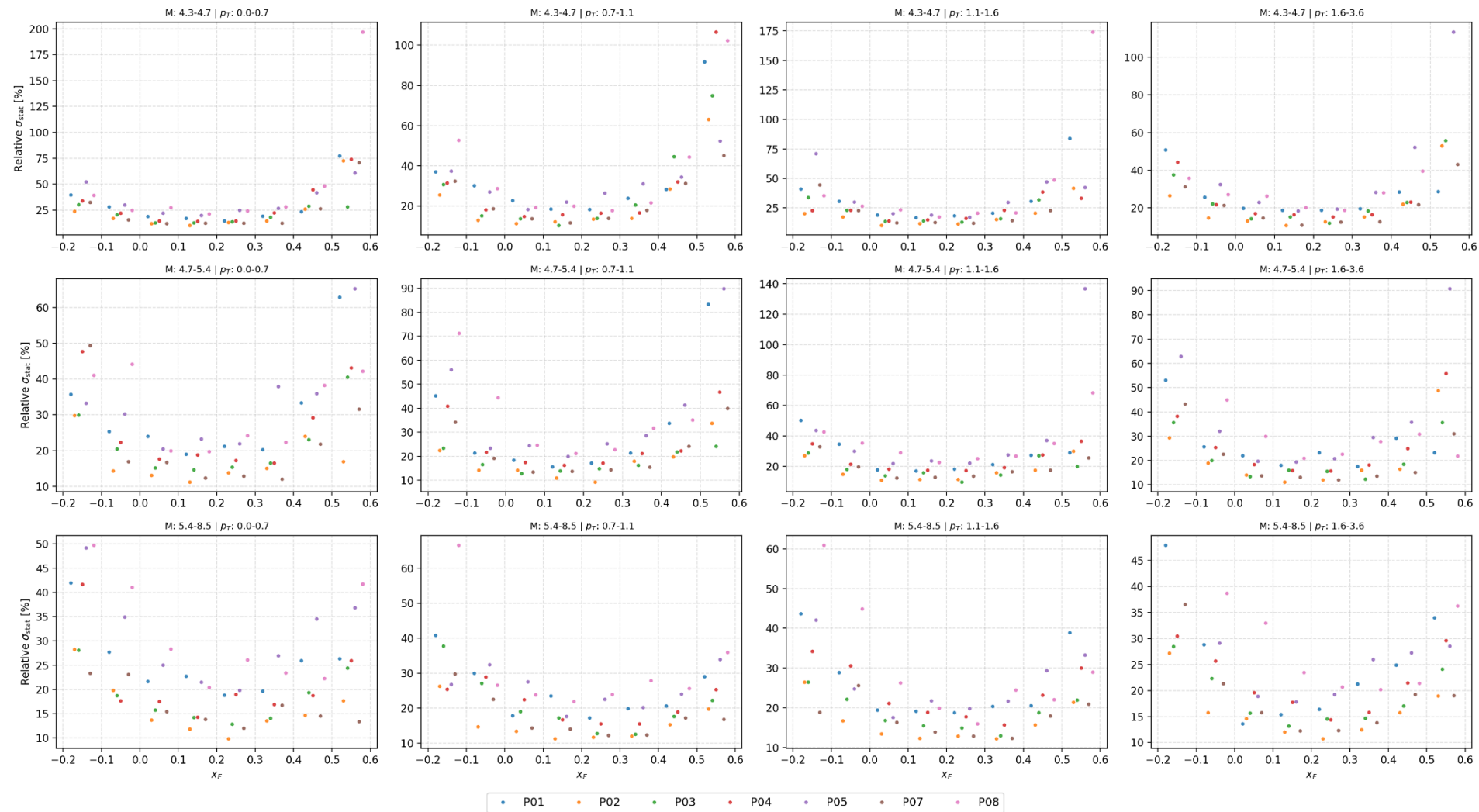
Pull : Before(stat) VS After ($\sqrt{\text{stat}^2 + \text{sys}^2}$)

7. Pull Distributions: Before (blue) vs After (green)



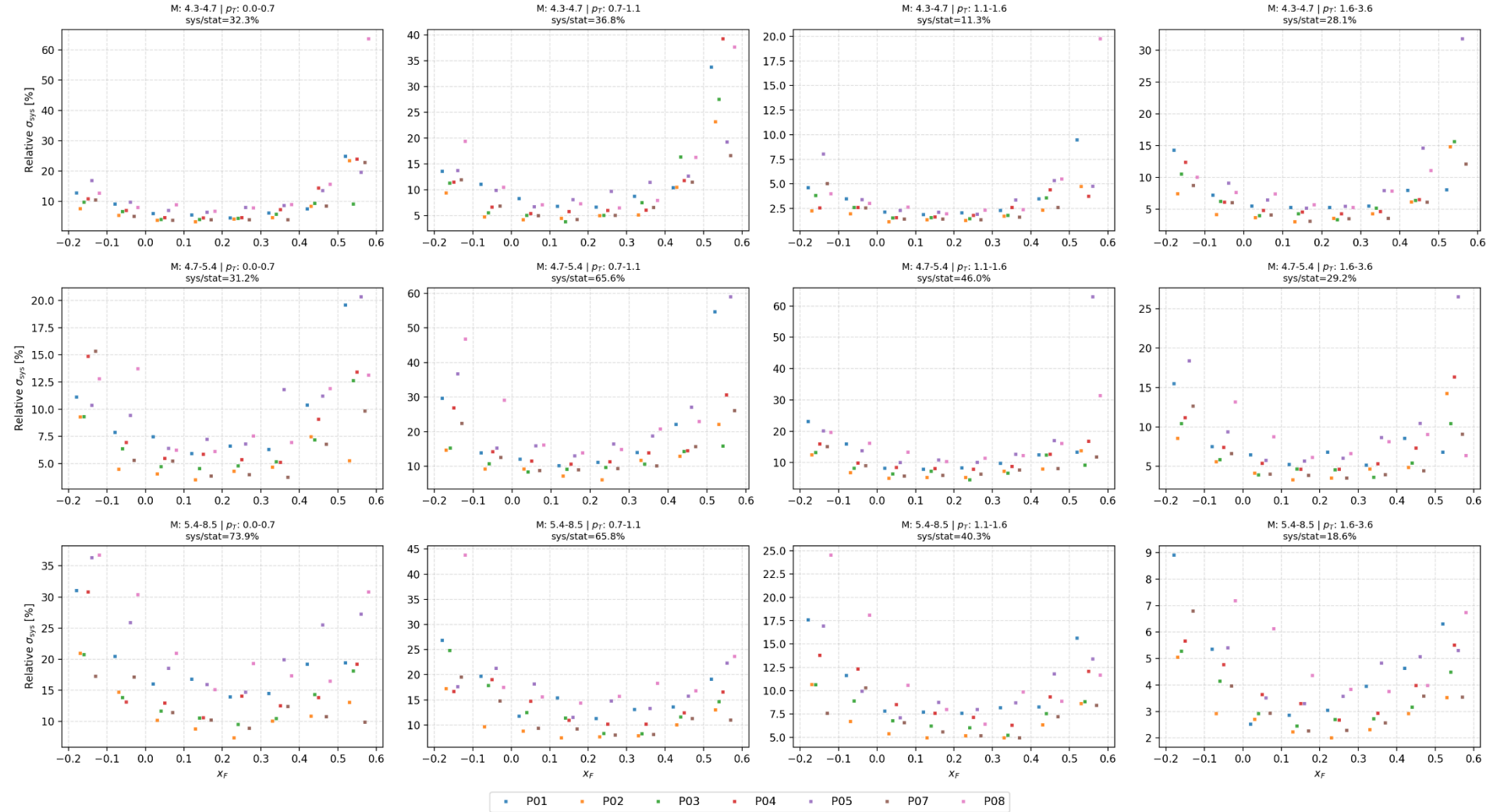
3D Xsc : Size of Sat

4. Fractional Statistical Uncertainties [%]



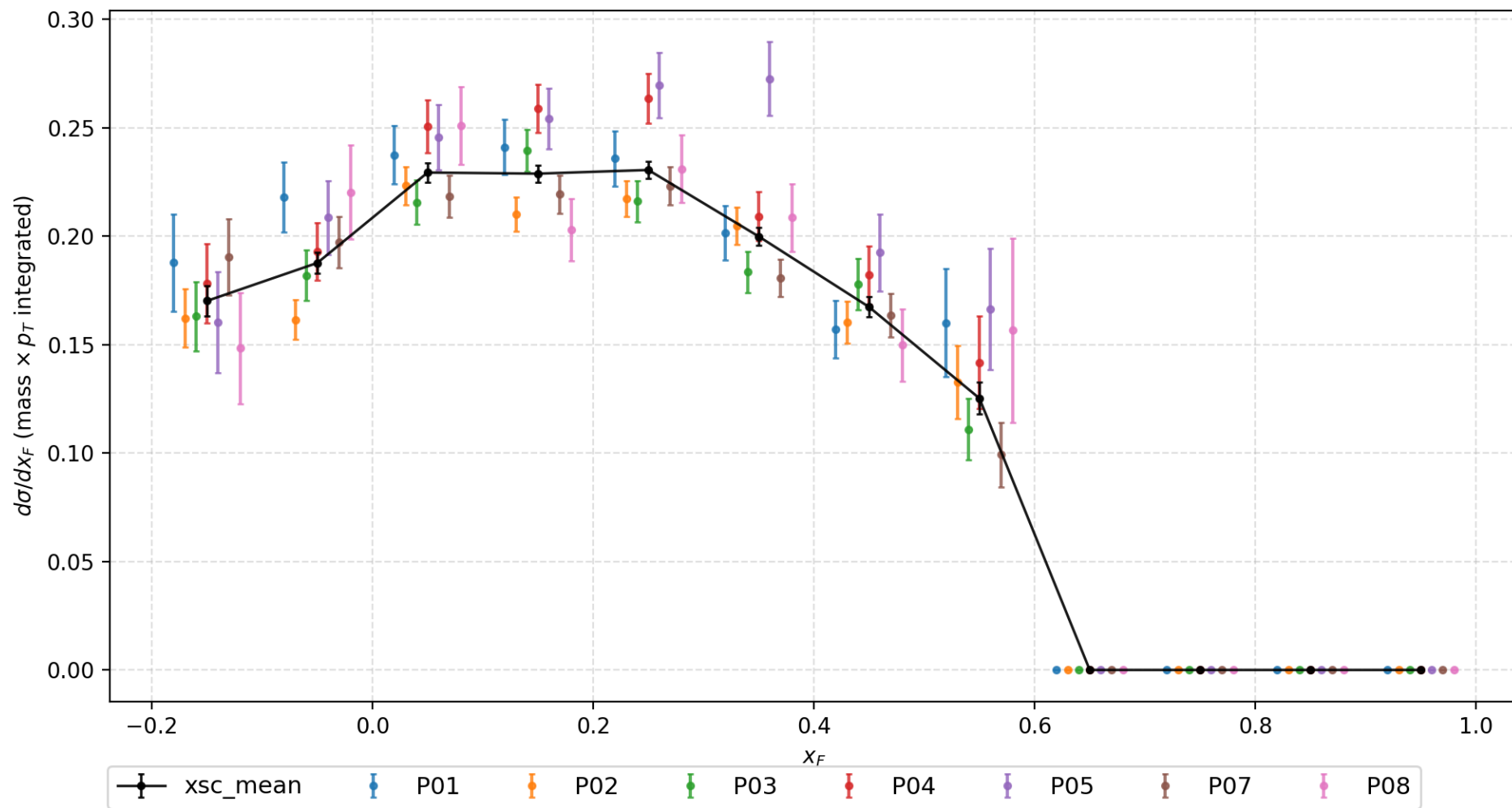
3D Xsc : Size of Sys

5. Fractional Systematic Uncertainties [%]



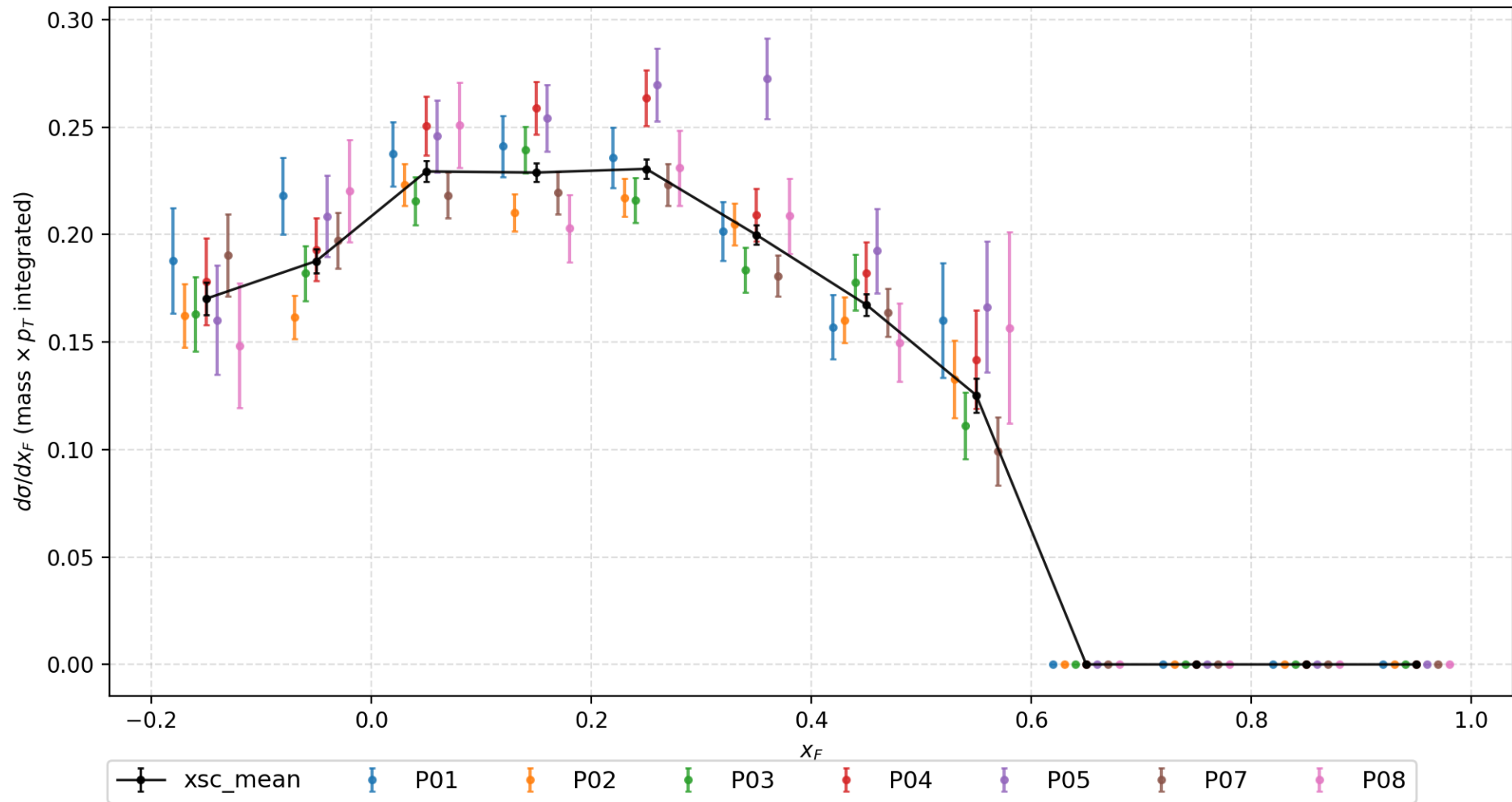
Integration : 1D Xsc(stat)

1. 1D xF Cross Sections — Stat Errors Only



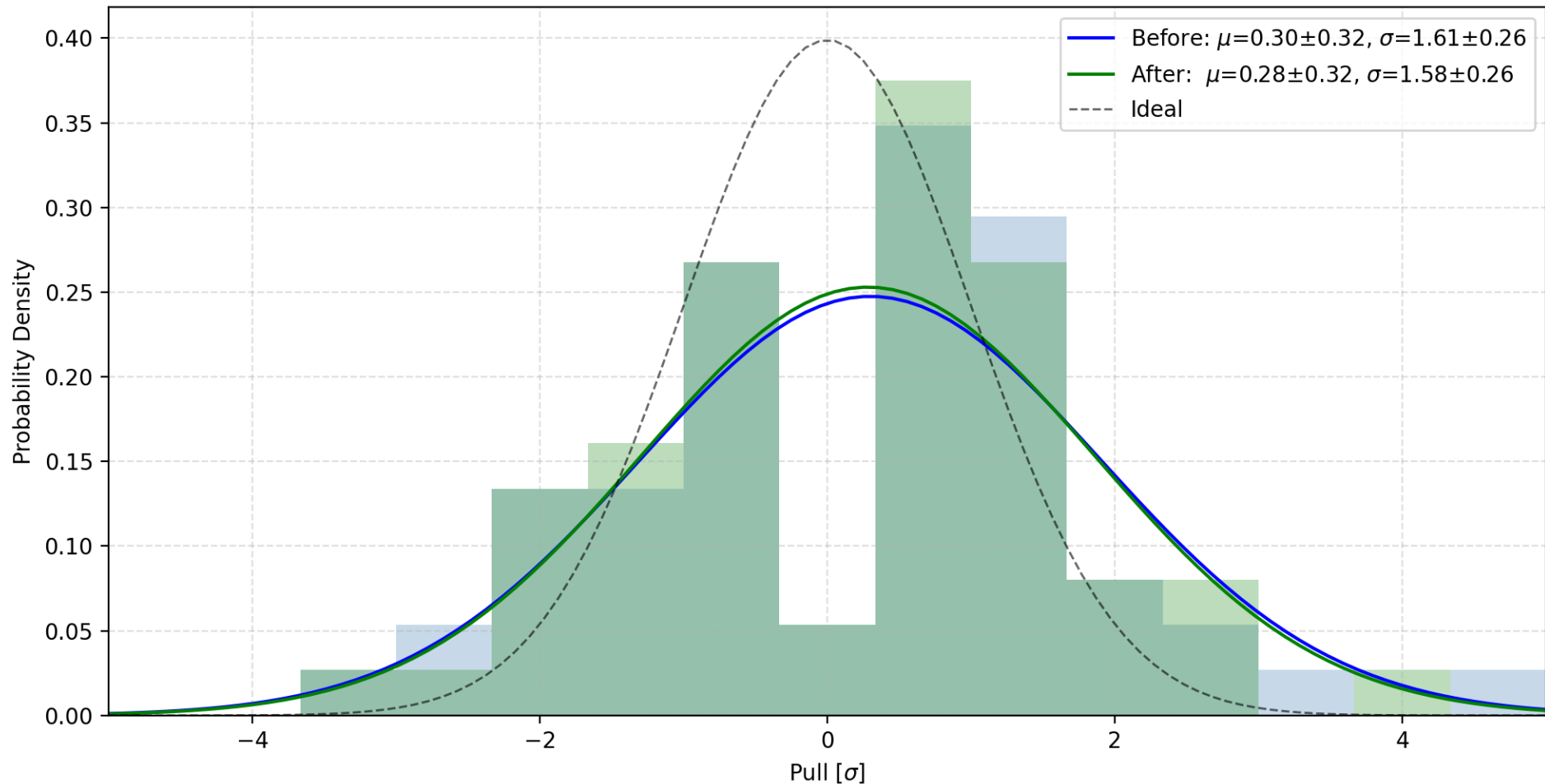
Integration : 1D Xsc (sqrt(stat^2+sys^2))

2. 1D xF Cross Sections — Total Errors (Stat+Sys)



1D Xsc : Pull Before VS After

3. 1D Pull: Before (Stat, blue) vs After (Stat+Sys, green)



Pull Integration (only Stat.)

- https://drive.google.com/file/d/1-JT__N_IfMRxxKecJcVHepgKrzbaKKOM/view?usp=sharing
- Definition of pull

$$p_i(m, p_T, x_F) = \frac{\mu_i(m, p_T, x_F) - \bar{\mu}(m, p_T, x_F)}{\sqrt{(\delta_i^{\text{stat}})^2 - (\delta_{\bar{\mu}}^{\text{stat}})^2}}$$

- Pull after integration to 1D

$$\mu_i^{\text{1D}}(x_F) - \bar{\mu}^{\text{1D}}(x_F) = \sum_{m, p_T} \left[\mu_i(m, p_T, x_F) - \bar{\mu}(m, p_T, x_F) \right] \cdot \Delta m \Delta p_T \quad \text{Numerator (linear sum)}$$

$$\delta_i^{\text{stat, 1D}}(x_F) = \sqrt{\sum_{m, p_T} \left(\delta_i^{\text{stat}}(m, p_T, x_F) \cdot \Delta m \Delta p_T \right)^2} \quad \text{Denominator (quadratic sum)}$$

$$p_i^{\text{1D}} \sim \frac{N \Delta}{\sqrt{N} \delta} = \sqrt{N} \cdot \frac{\Delta}{\delta} = \sqrt{N} \cdot p_i^{\text{3D}}$$

Numerator is growing faster than denominator

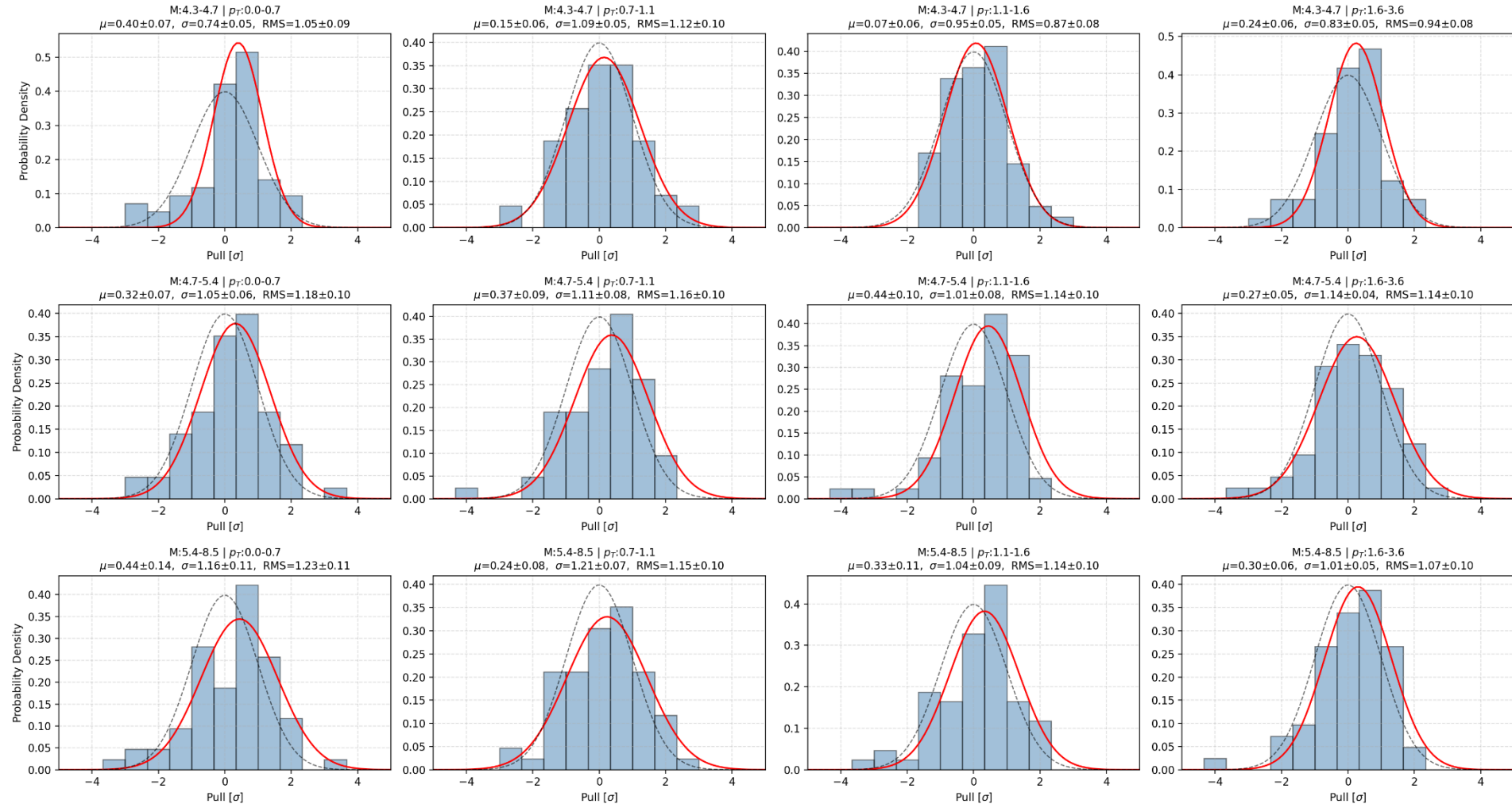
Pull in 1D is mathematically larger than pull in 3D

Access systematics in 3D and apply to 1D, idea-wise doesn't work.

We also see the prove through our excise.

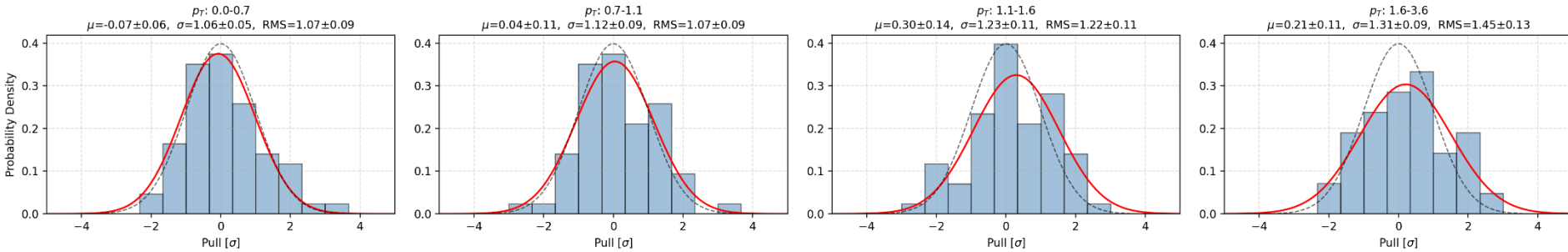
Pull per bin in 3D (only stat)

3D Pull Distributions — Per (mass, pT) Bin

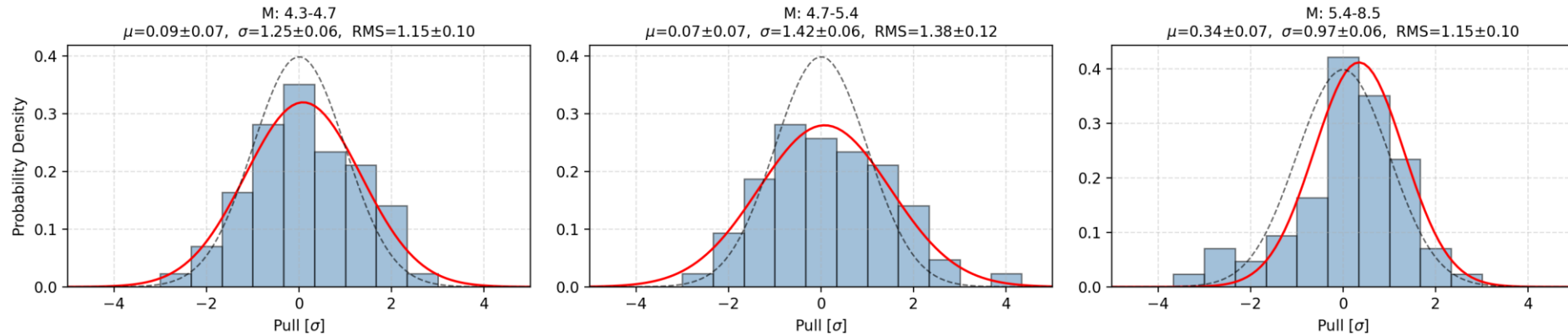


Pull per bin in 2D (only stat)

2D(pT, xF) Pull Distributions — Per pT Bin

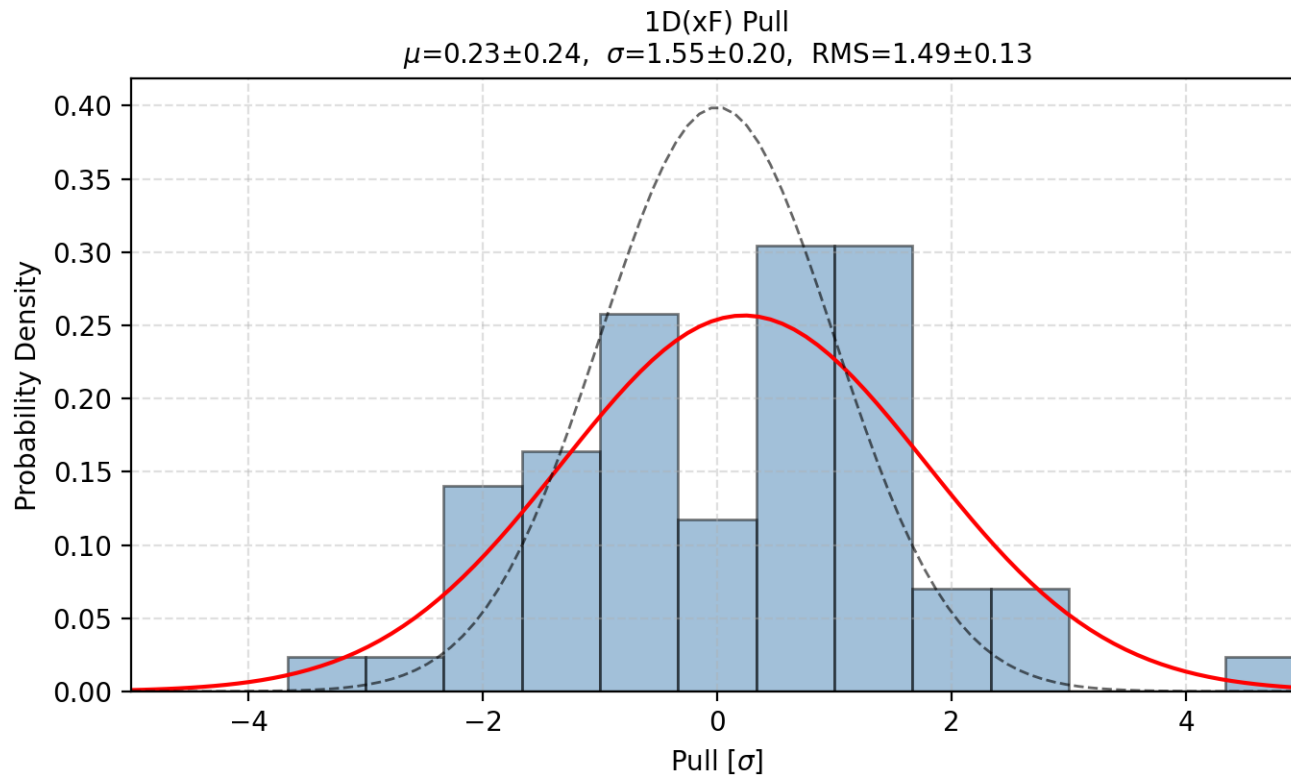


2D(m, xF) Pull Distributions — Per Mass Bin



Pull per bin in 1D (only stat)

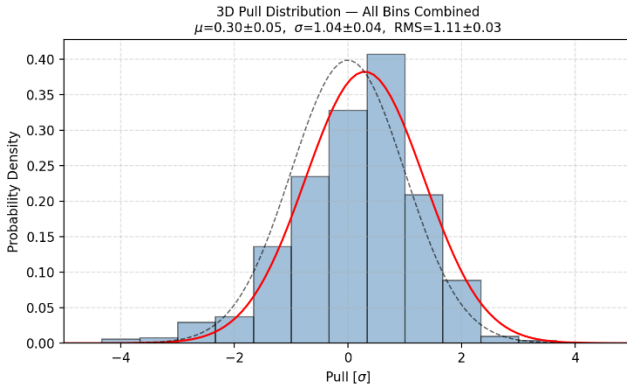
1D(xF) Pull Distribution (Stat Only)



Pull combined in 3/2/1/0D

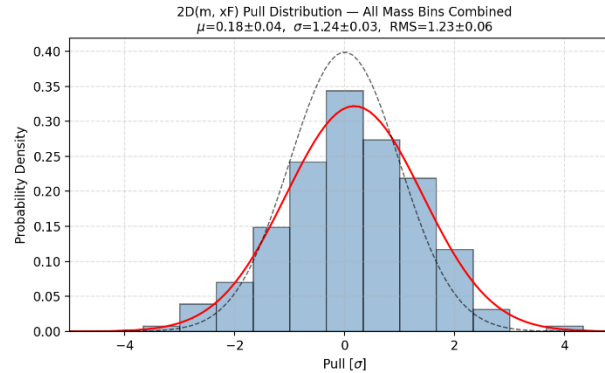
3D (m, xf, pt)

3D Pull Distribution — All Bins Combined



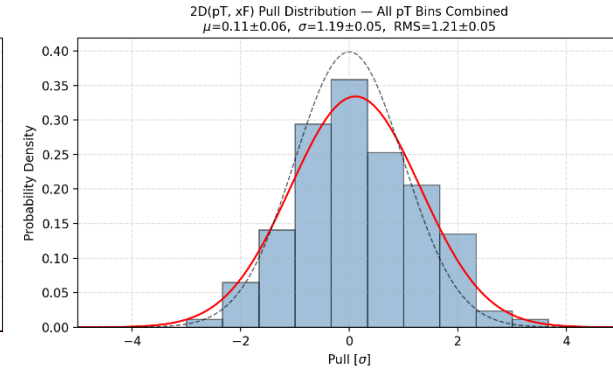
2D (m, xf)

2D(m, xF) Pull Distribution — All Mass Bins Combined



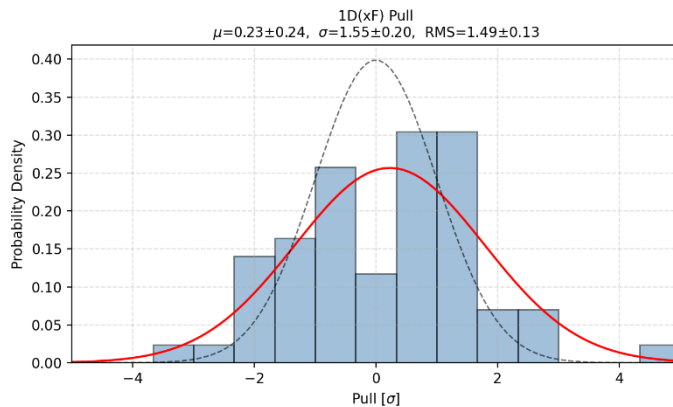
2D (m, pt)

2D(pt, xF) Pull Distribution — All pT Bins Combined

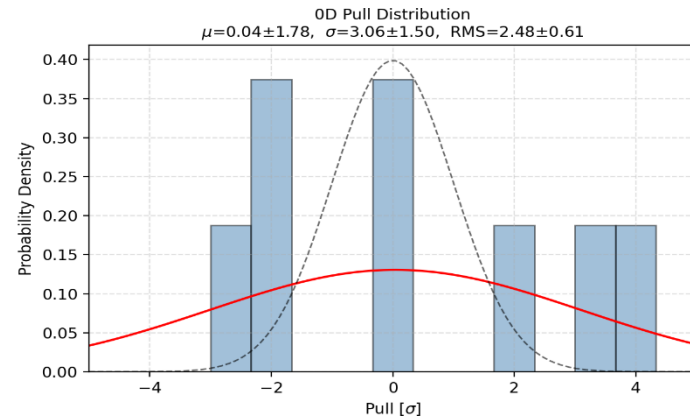


1D (xf)

1D(xF) Pull Distribution (Stat Only)



0D



Pull sigma is growing larger and large after the integration