

# SIDIS Projection

— Sivers analysis

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# Sivers Function — Global Fit

## Observables

- Sivers asymmetry
- Multiplicity

## Parametrization

- Gaussian ansatz times a collinear distribution

$$f_{1T}^{\perp q}(x, \mathbf{k}_{\perp}) = N_q \frac{x^{a_q} (1-x)^{b_q} (1+c_q x)}{B(a_q+1, b_q+1) + c_q B(a_q+2, b_q+1)} \frac{1}{\pi \Omega_q} \exp\left(-\frac{\mathbf{k}_{\perp}^2}{\Omega_q}\right)$$

## Monte Carlo sampling

$$E[O] = \int d^n a \mathcal{P}(\mathbf{a} | D) O(\mathbf{a})$$

$$\mathcal{P}(\mathbf{a} | D) \sim \mathcal{L}(D | \mathbf{a}) \pi(\mathbf{a})$$

$$V[O] = \int d^n a \mathcal{P}(\mathbf{a} | D) [O(\mathbf{a}) - E[O]]^2$$

# Nested Sampling

## Goal

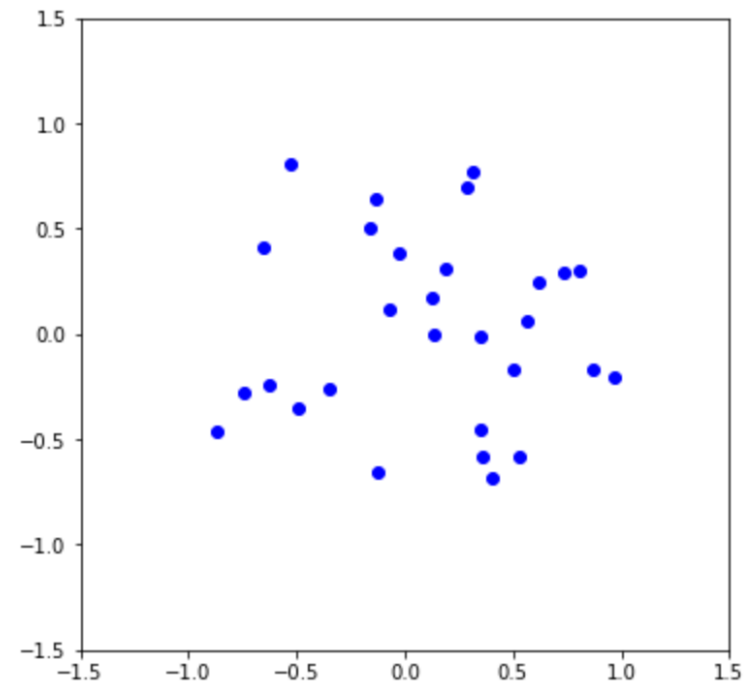
- Monte Carlo sampling of the likelihood  $\mathcal{L}(a)$  (or  $\chi^2$ ) distribution in the parameter space

## Mapping

- $\mathcal{L}(a) \rightarrow \mathcal{L}(X)$ :  $N$  samples  $[a_N, a_{N-1}, \dots, a_1]$  ordered with decreasing  $\mathcal{L}$

## Iteration

- A set of active points: with greatest  $\mathcal{L}$
- Flat sampling until find a point with  $\mathcal{L}$  greater than one of the active points
- Update the active points set and collect the removed point
- When iteration stops, collect all active points



# Nested Sampling

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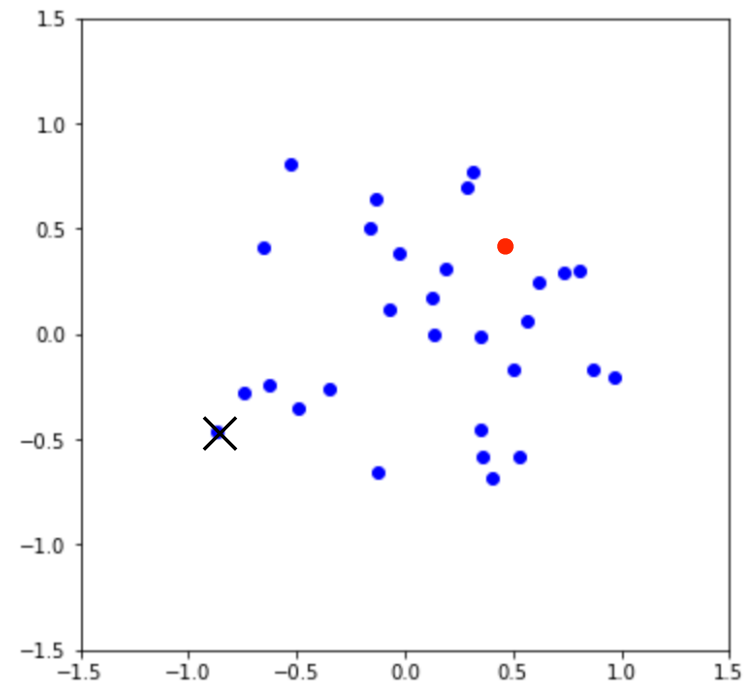
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# Nested Sampling

## Burning

- Flat sampling the parameter space until  $\sim 500$  points are collected

## Shrink the sampling range

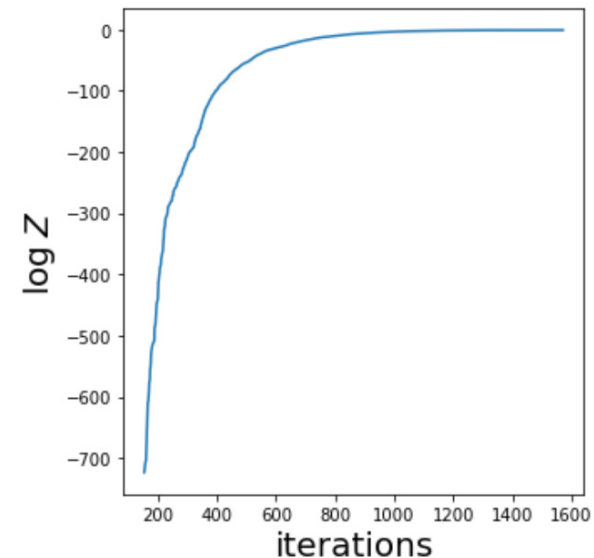
- At the beginning of each iteration: construct an ellipsoid covering all active points and enlarged by a factor, and do flat sampling in the ellipsoid

## Stop criteria

- The relative std of the  $\chi^2$  of the active points is smaller than a required value  $\sim 1e-4$

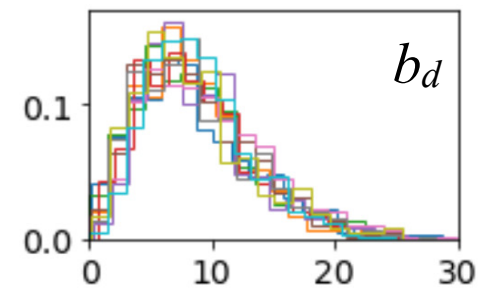
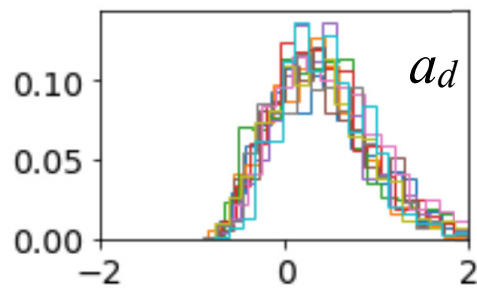
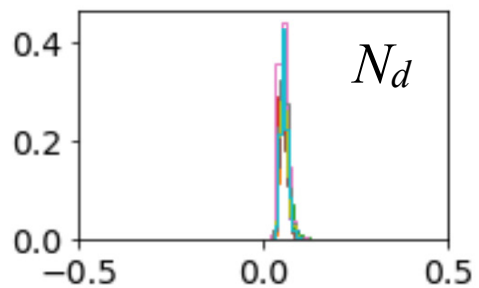
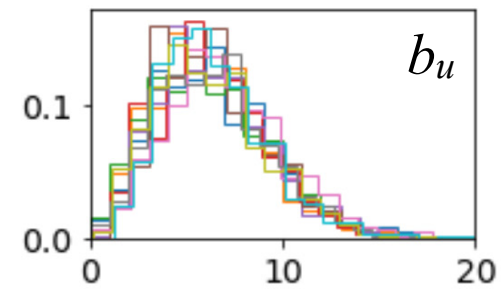
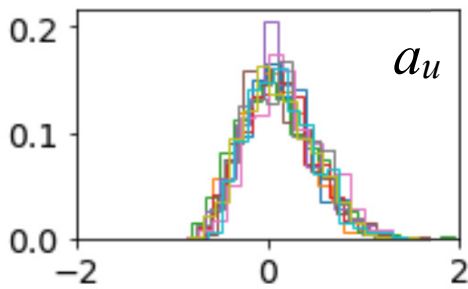
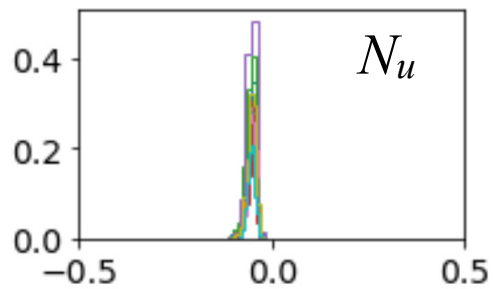
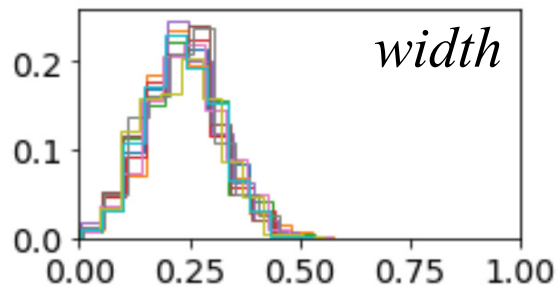
## Validate results

- The likelihood becomes stable
- Parameter distributions from independent runs are consistent



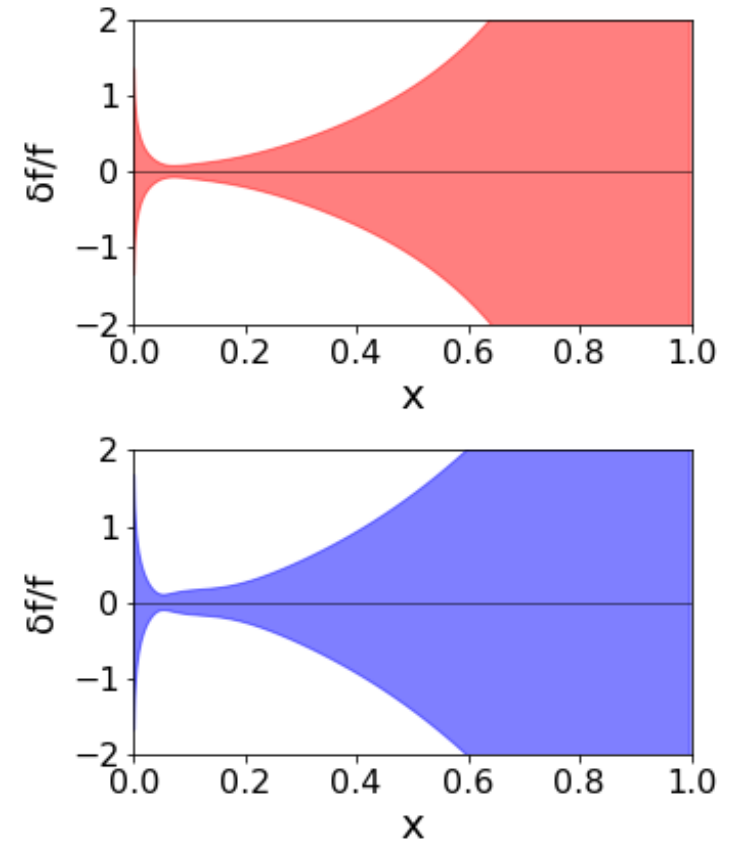
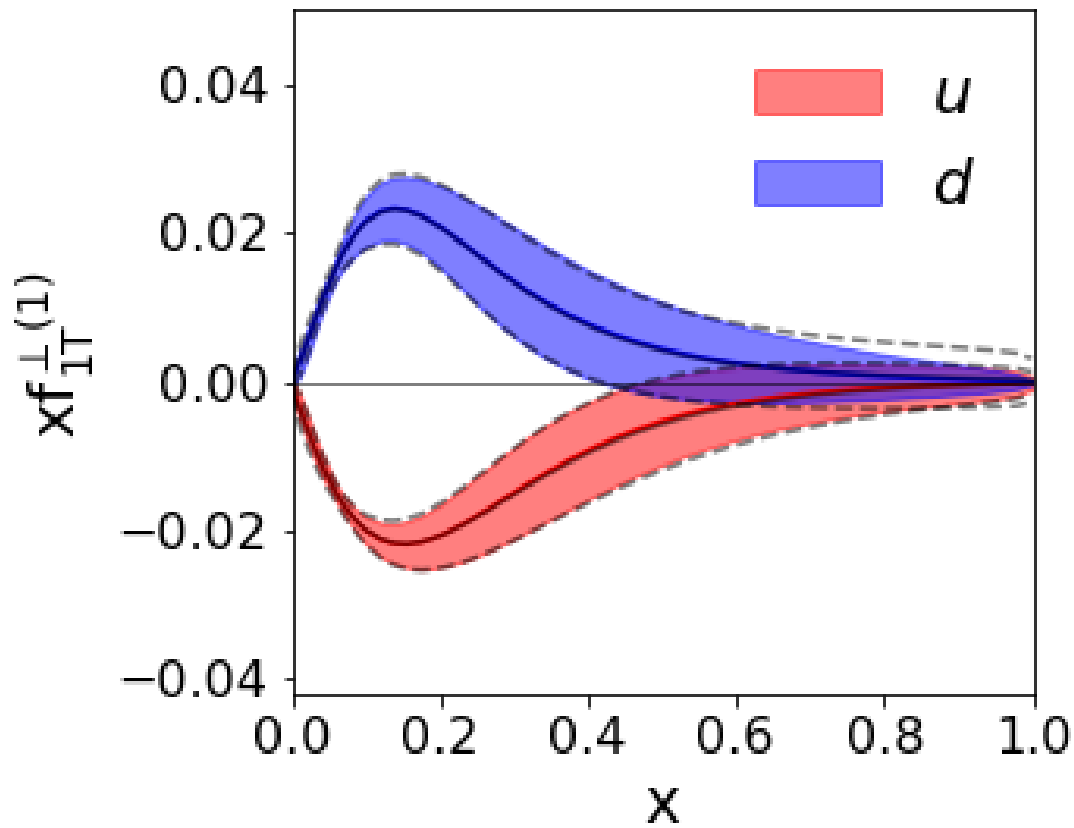
# Parameter distributions

Analysis of the world data (10 independent runs)

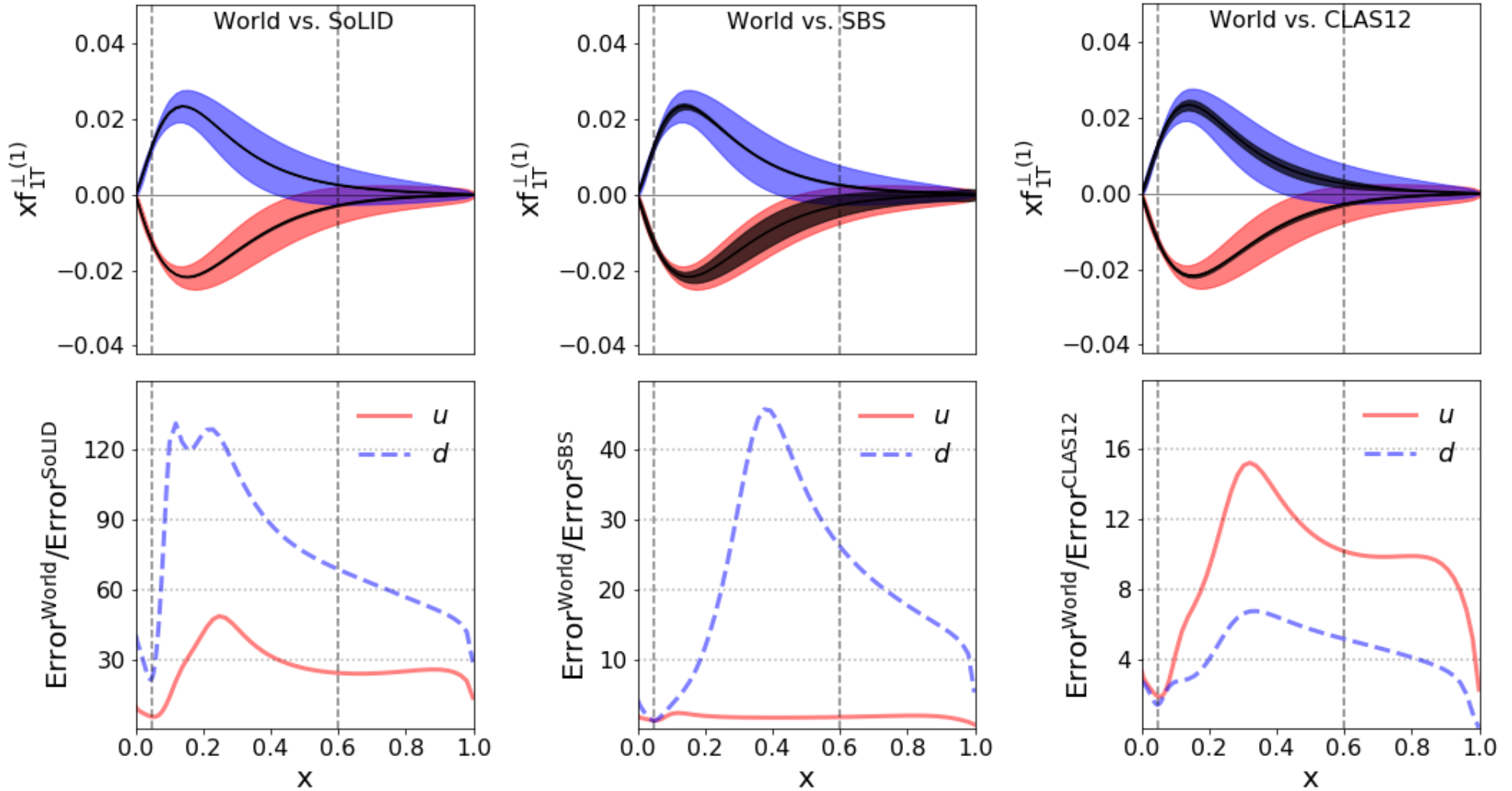


# Sivers distributions

Analysis of the world data

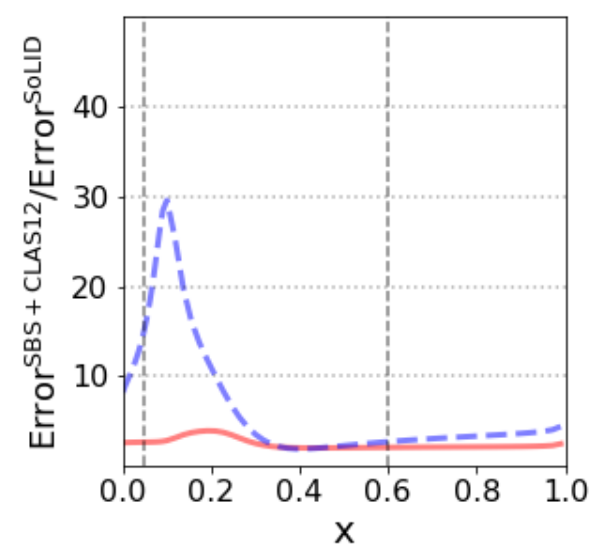
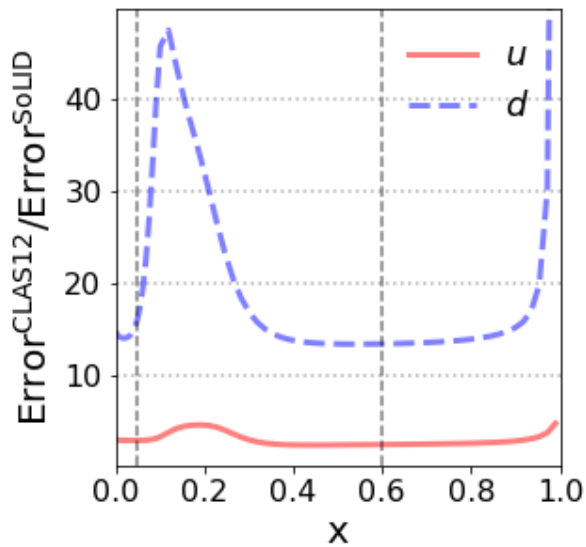
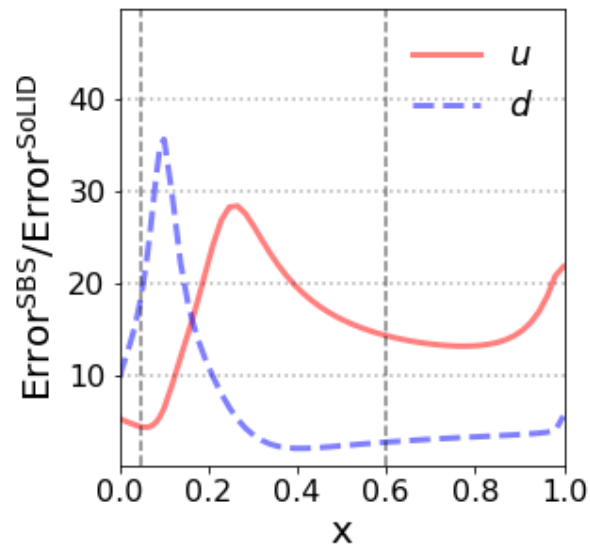
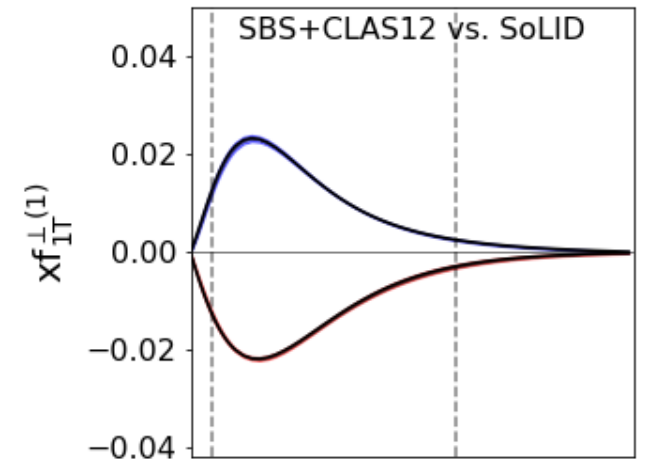
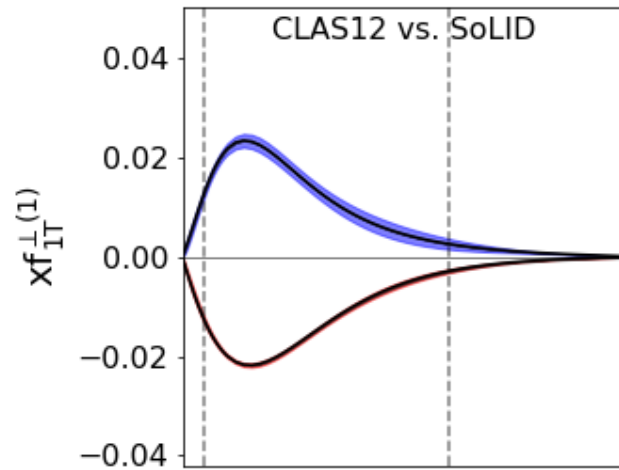
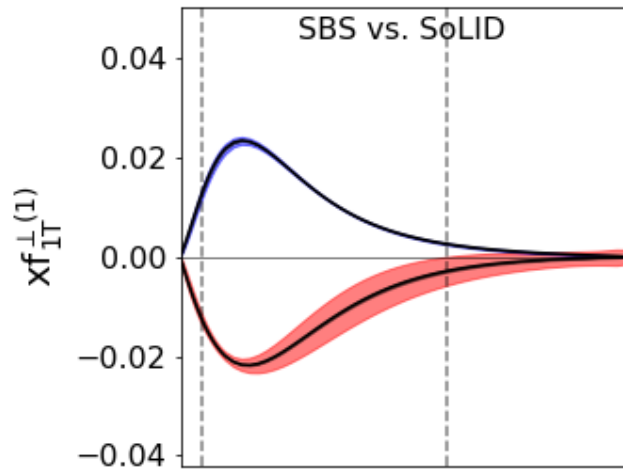


# Impact On Sivers





# Comparisons

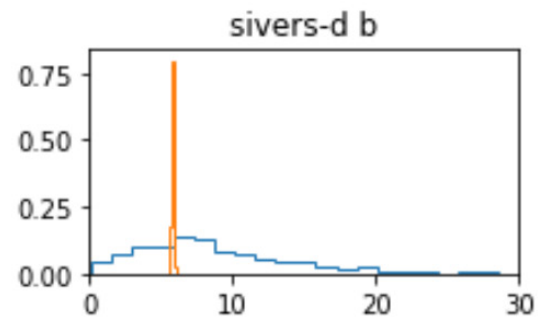
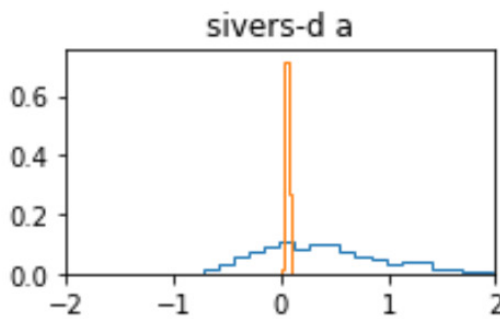
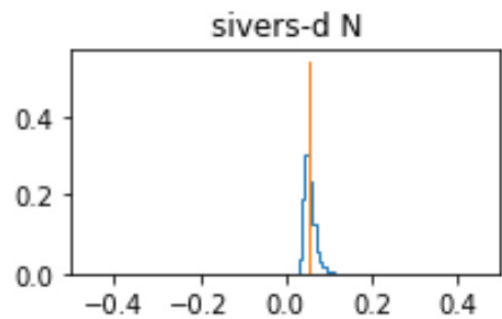
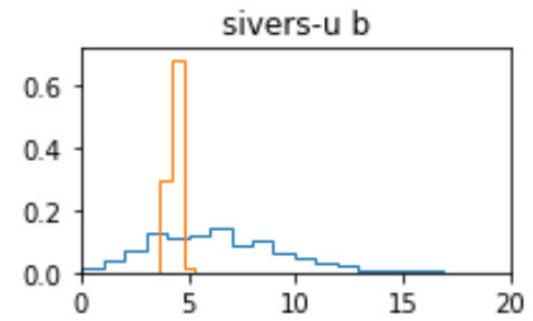
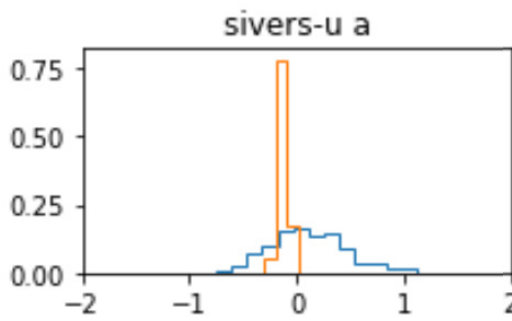
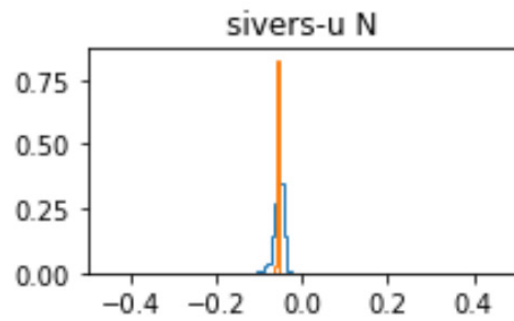
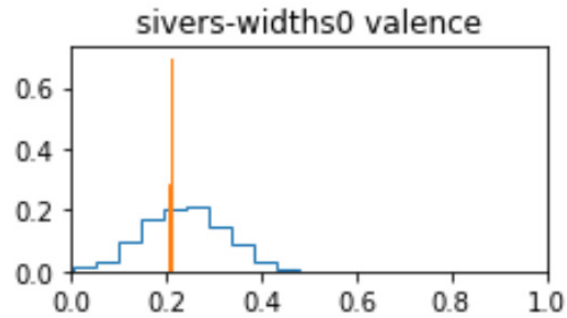


# To do

- Include multiplicity data
    - have done for world data, on-going for projected data
  - More parameters
  - More flavors
  - Kaon data
- 
- Apply the new method on the transversity analysis (Nobuo Sato)

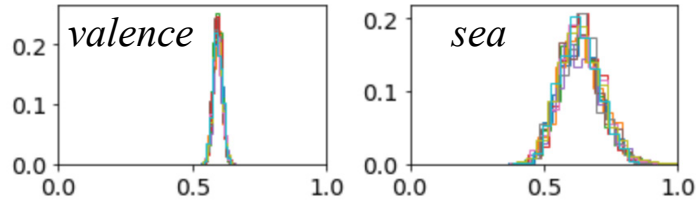
Backup

# Parameter distributions before/after SoLID

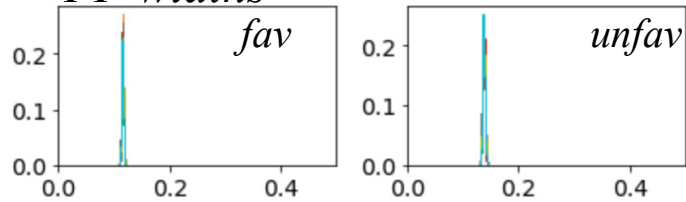


# Fit Asym. & Multiplicity data together

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*Sivers widths*

