

EIC Impact Study on the Tensor Charge from a QCD Global Analysis of SSAs



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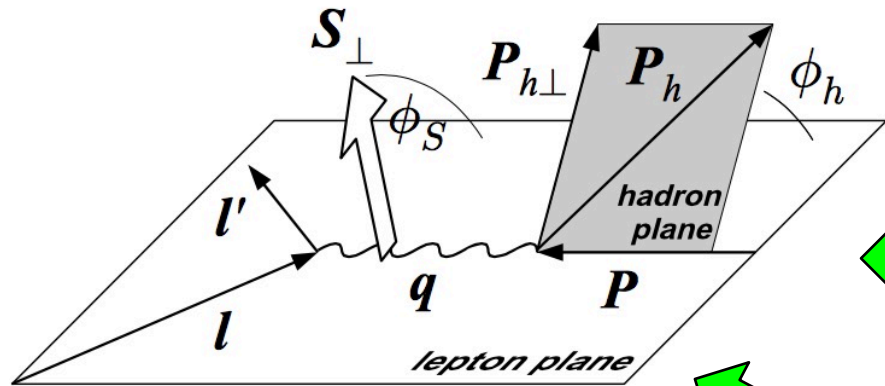
Lebanon Valley College, Annville, PA, USA



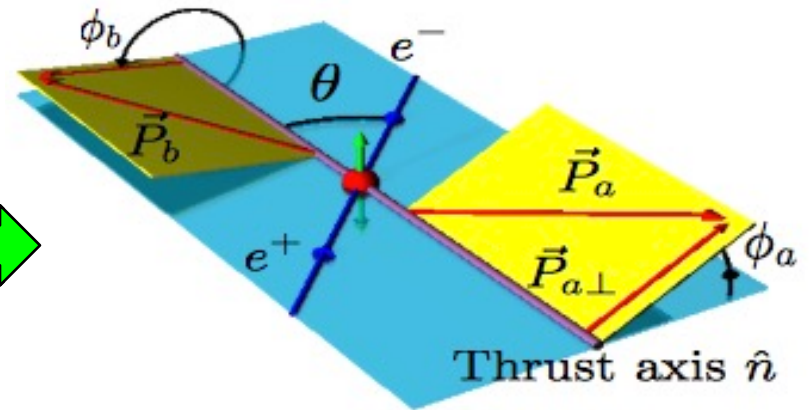
Based on J. Cammarota, L. Gamberg, Z.B. Kang, J.A. Miller,
D. Pitonyak, A. Prokudin, T. Rogers, N. Sato,
Phys. Rev. D 102 (2020), 054002 [arXiv:2002.08384 [hep-ph]]

EIC SIDIS WG Meeting

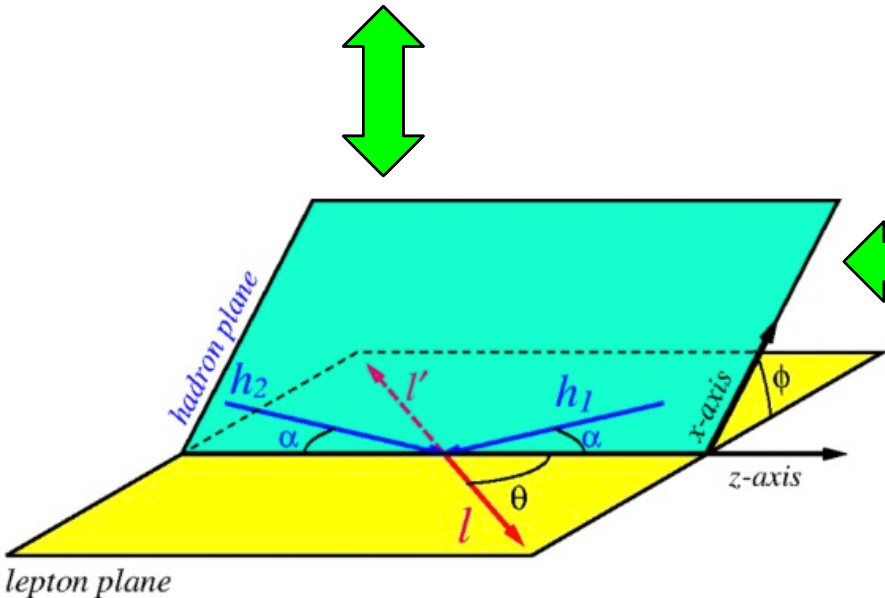
October 12, 2020



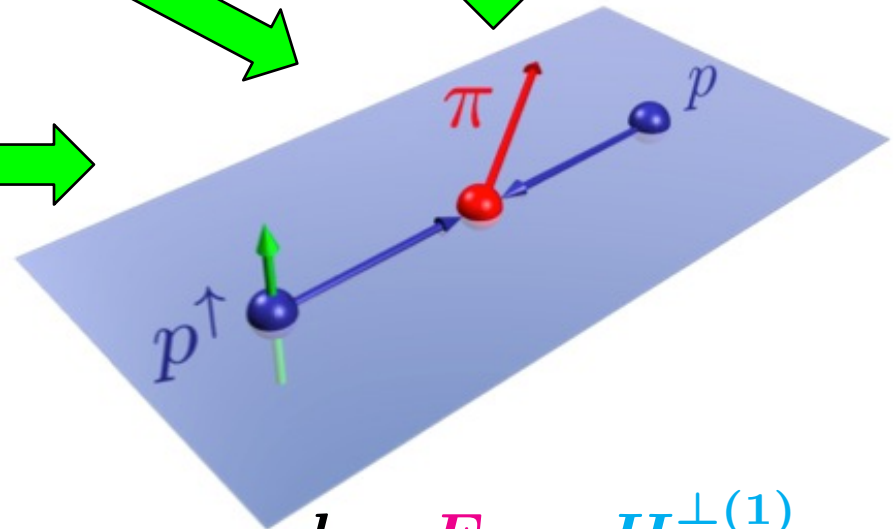
$h_1, F_{FT}, H_1^{\perp(1)}$



$H_1^{\perp(1)}$



F_{FT}



$h_1, F_{FT}, H_1^{\perp(1)}$

- We performed the first QCD global analysis of SSAs in SIDIS, Drell-Yan, e^+e^- annihilation, and proton-proton collisions and extracted a universal set of non-perturbative functions (JAM20)

$$h_1(x), F_{FT}(x, x), H_1^{\perp(1)}(z)$$

along with the relevant transverse momentum widths for the Sivers, transversity, and Collins functions: $\langle k_T^2 \rangle_{f_{1T}^\perp}, \langle k_T^2 \rangle_{h_1}, \langle P_\perp^2 \rangle_{H_1^\perp}^{fav}, \langle P_\perp^2 \rangle_{H_1^\perp}^{unf}$

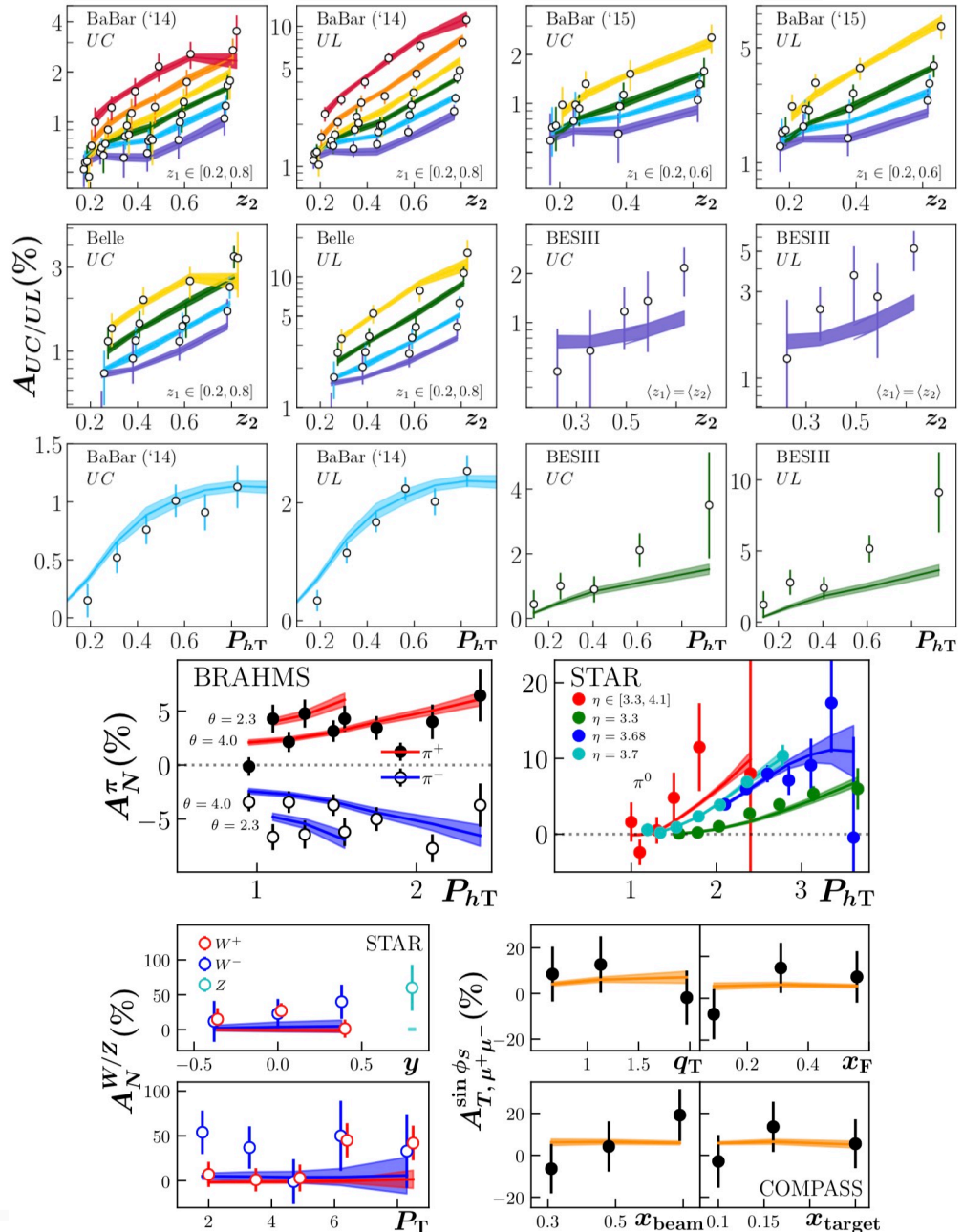
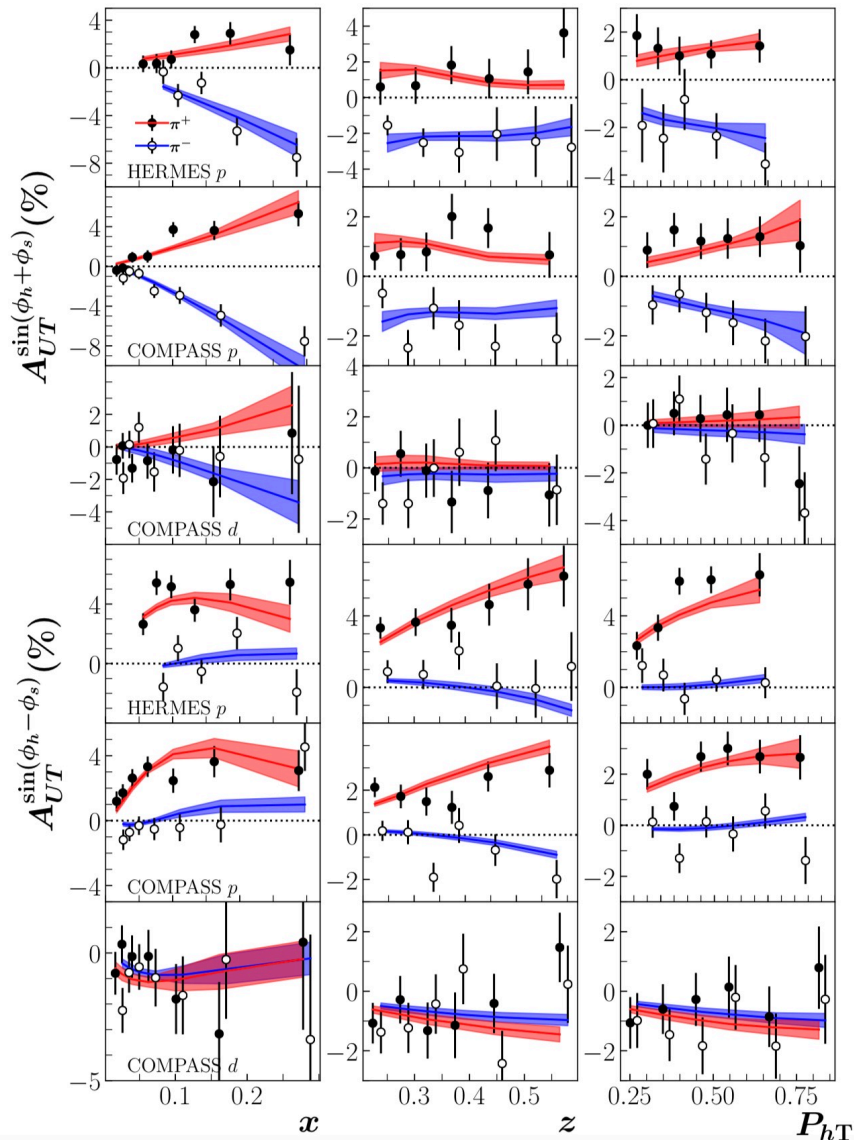
- We used a Gaussian ansatz: $F(x, k_T^2) \sim F(x)e^{-k_T^2/\langle k_T^2 \rangle}$ where

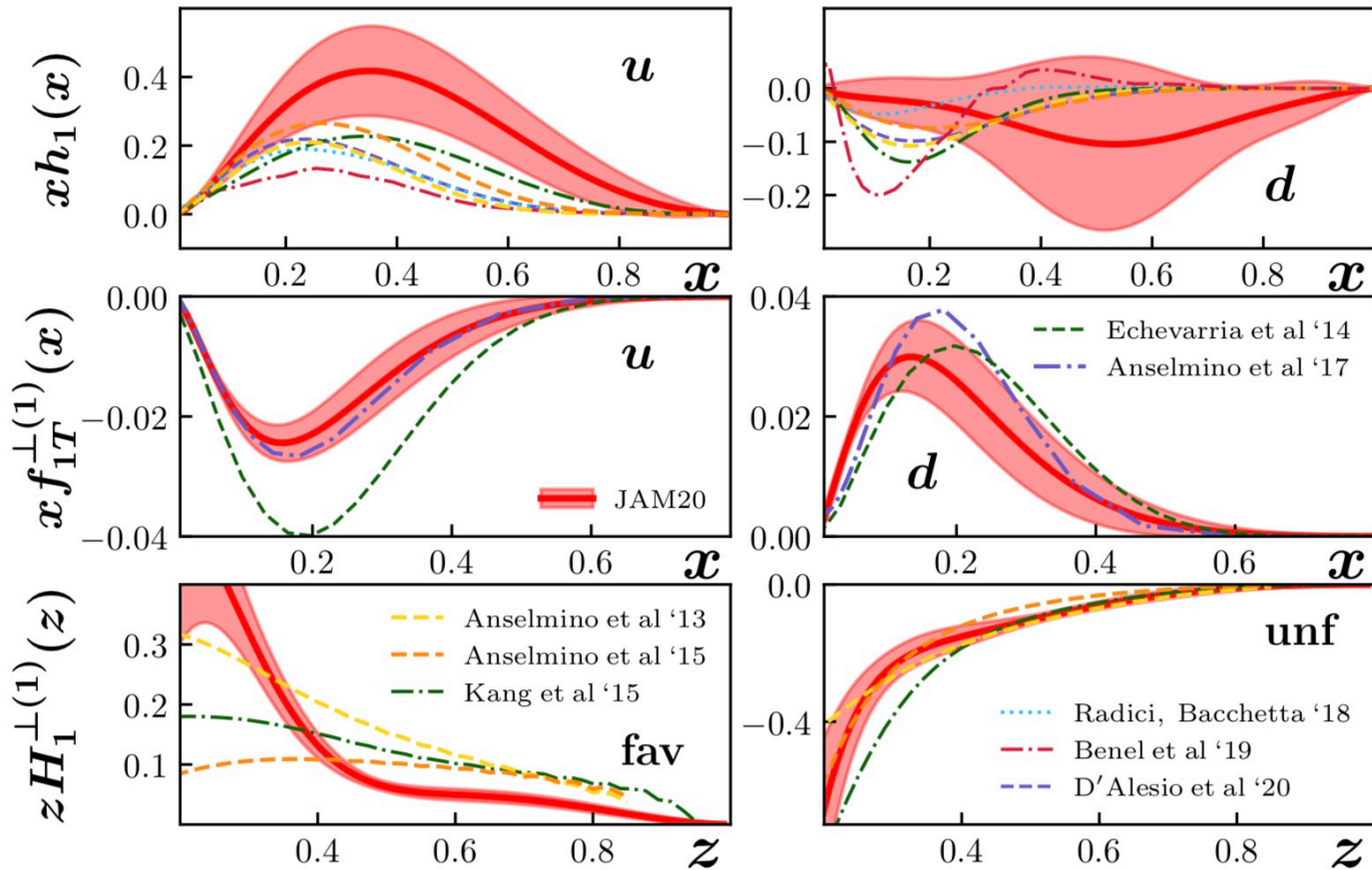
$$F^q(x) = \frac{N_q x^{a_q} (1-x)^{b_q} (1 + \gamma_q x^{\alpha_q} (1-x)^{\beta_q})}{B[a_q + 2, b_q + 1] + \gamma_q B[a_q + \alpha_q + 2, b_q + \beta_q + 1]}$$

NB: $\{\gamma, \alpha, \beta\}$ only used for Collins function

- DGLAP-type evolution for the collinear functions analogous to Duke & Owens (1984): double-log Q^2 -dependent term explicitly added to the parameters

$$\chi^2 / N_{\text{pts.}} = 520 / 517 = 1.01$$

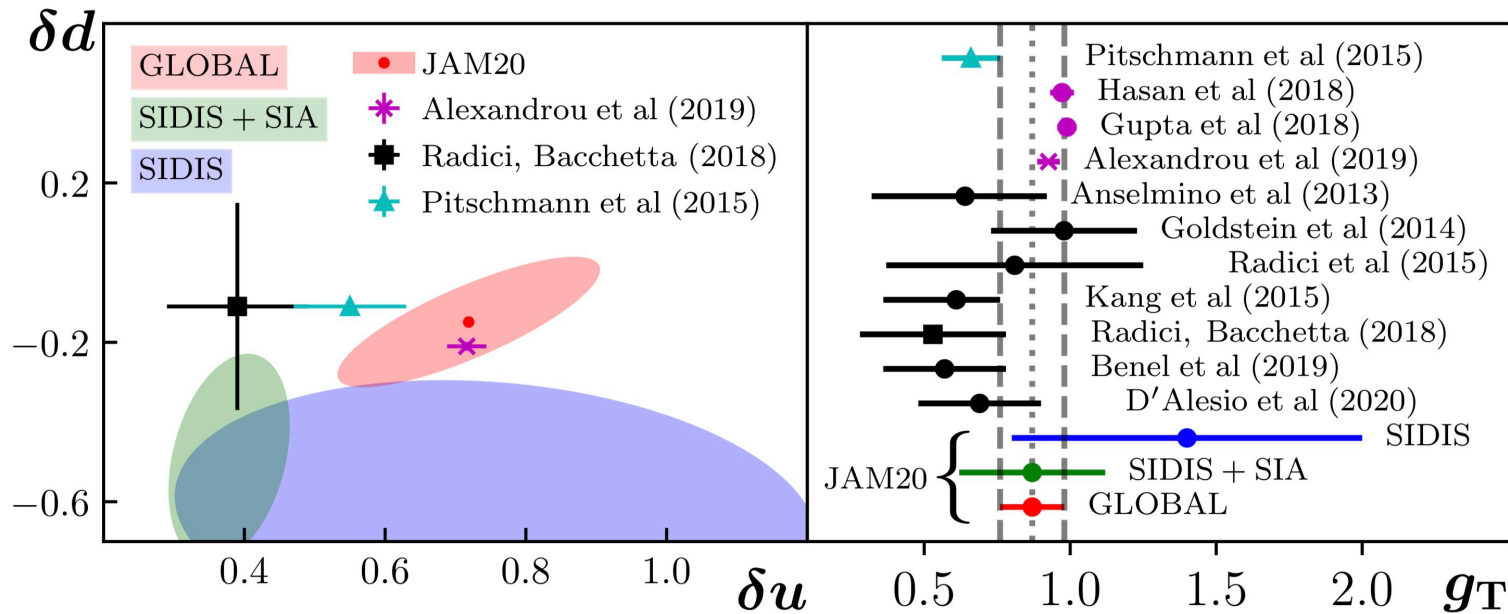




Transversity

Sivers first moment (QS function)

Collins first moment



SIDIS \rightarrow (SIDIS + SIA) \rightarrow GLOBAL : $g_T = 1.4(6) \rightarrow 0.87(25) \rightarrow \mathbf{0.87(11)}$

- This is the most precise phenomenological determination of g_T to date
- Our tensor charges, especially δu , show excellent agreement with lattice: $\delta u = 0.72(19)$, $\delta d = -0.15(16)$

- We generated SIDIS Collins EIC pseudo-data (based on the files provided by Ralf Seidl) with PID+smearing systematics. The number of points listed is after our cuts of $0.2 < z < 0.6$, $Q^2 > 1.63 \text{ GeV}^2$, $0.2 < P_{hT} < 0.9 \text{ GeV}$ are made on the data

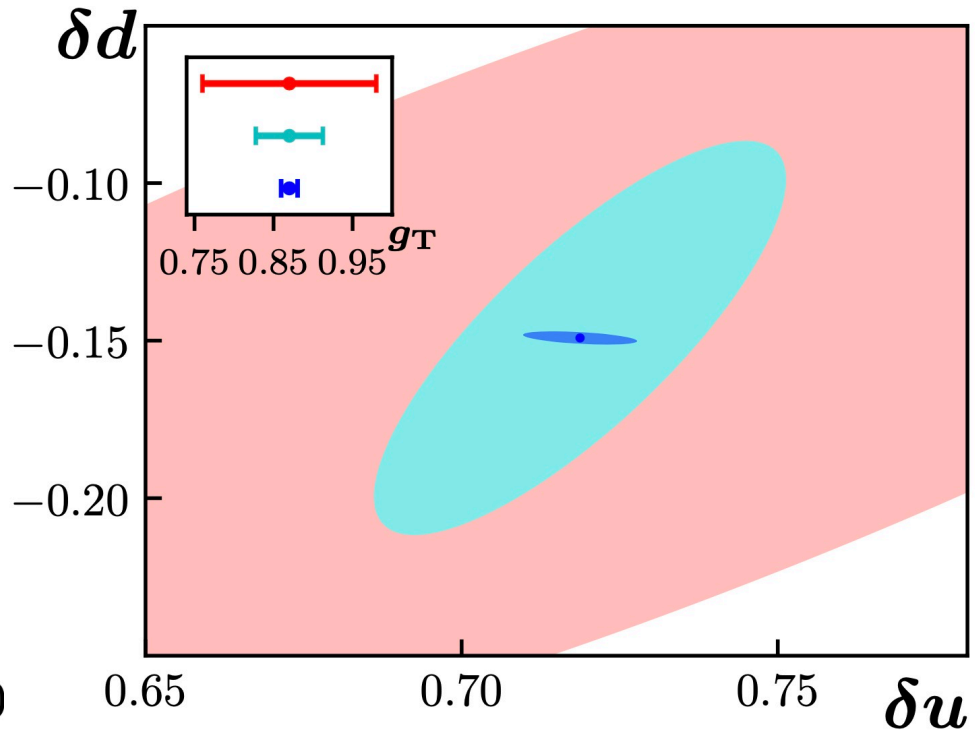
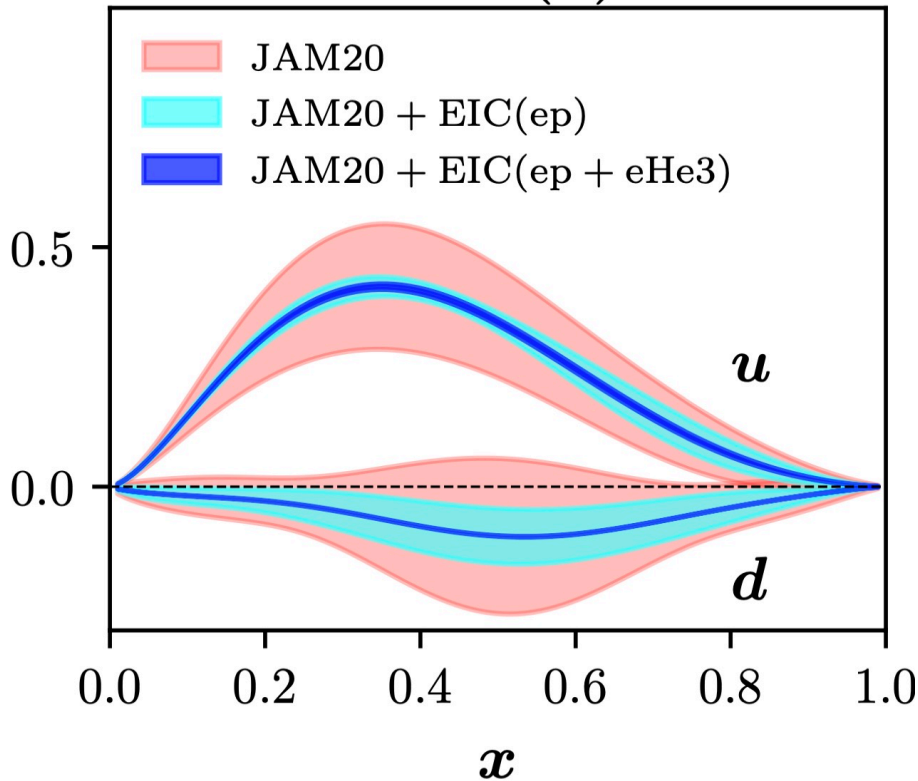
$e p^\uparrow \rightarrow e \pi^+ X$	$e p^\uparrow \rightarrow e \pi^- X$	$e n^\uparrow \rightarrow e \pi^+ X$	$e n^\uparrow \rightarrow e \pi^- X$
18x275 (756 pts.)	18x275 (744 pts.)	18x100 (665 pts.)	18x100 (661 pts.)
10x100 (634 pts.)	10x100 (619 pts.)	10x100 (650 pts.)	10x100 (645 pts.)
5x100 (537 pts.)	5x100 (556 pts.)	5x41 (475 pts.)	5x41 (571 pts.)
5x41 (464 pts.)	5x41 (453 pts.)		

Total EIC points = 8430

JAM20 original fit (SSA points) = 517 (362 sensitive to Collins and/or transversity, i.e., SIDIS Collins, e^+e^- , and A_N)

- We re-fit the $8430 + 517 = 8947$ data points with ~ 200 replicas using priors from the JAM20 global analysis

$xh_1(x)$



<u>JAM20</u>	<u>JAM20+EIC(ep)</u>	<u>JAM20+EIC(ep+eHe3)</u>
$\delta u = 0.72 \pm 0.19$	$\delta u = 0.72 \pm 0.03$	$\delta u = 0.719 \pm 0.009$
$\delta d = -0.15 \pm 0.16$	$\delta d = -0.15 \pm 0.06$	$\delta d = -0.149 \pm 0.002$
$g_T = 0.87 \pm 0.11$	$g_T = 0.87 \pm 0.04$	$g_T = 0.87 \pm 0.01$