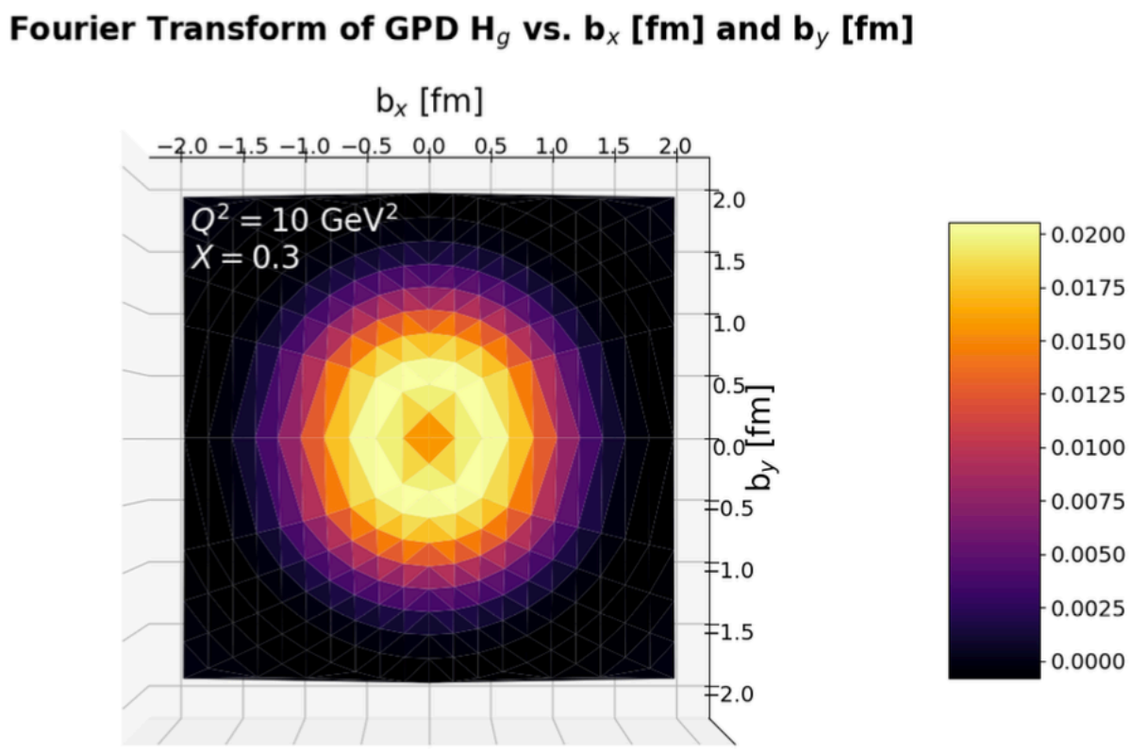
GPD round table discussion

- Deconvolution problem
- Evolution (conformal vs. direct, extension to NLO)
- Higher-order corrections
- Higher-twist corrections
- Global extractions
  - data availability
  - direct vs. conformal space (or hybrid)
  - modelling
  - dispersion relation beyond LO
  - compare GPD extractions *directly*
- Factorisation theorems
- GPD universality (DVCS vs. DVMP)
- Constraining GPDs by means of exclusive processes

- GPDs related to spatial distribution of **single** partons within hadrons:

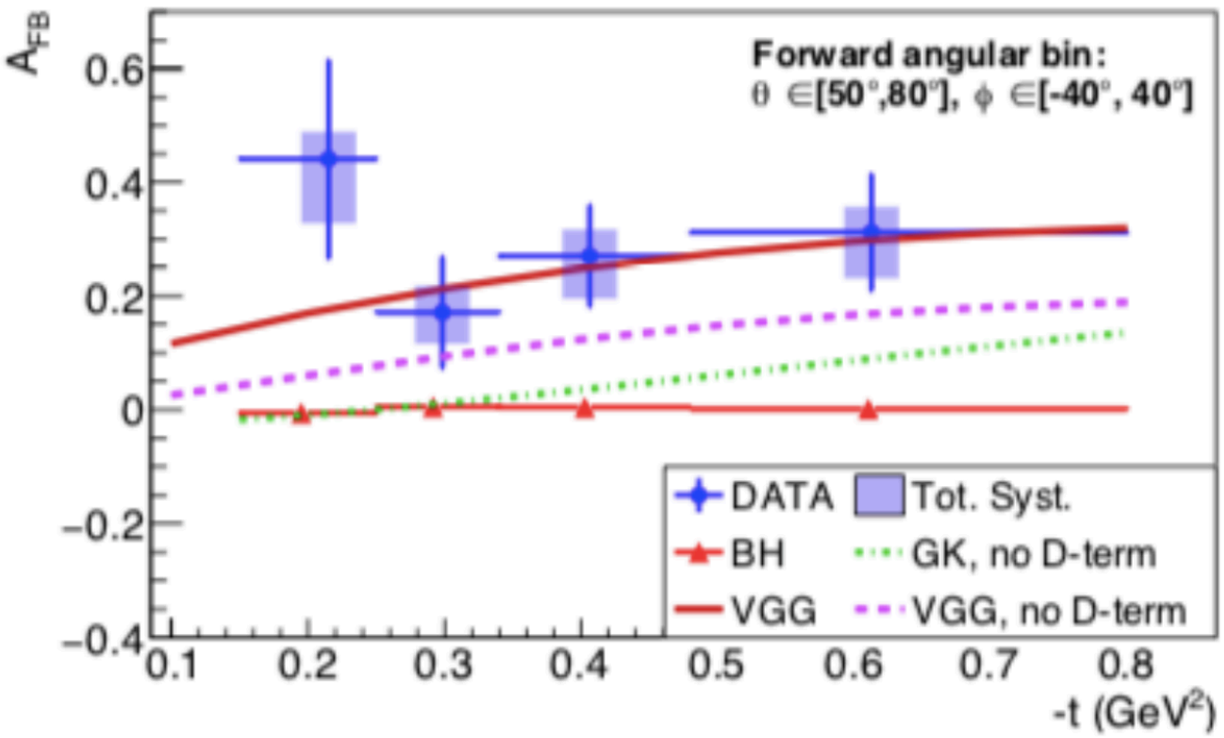
$$\mathcal{H}^q(X,0,b_T) = \int \frac{d^2\Delta_T}{(2\pi)^2} H^q(X,0,\Delta_T) e^{-i\Delta_T \cdot b_T}$$



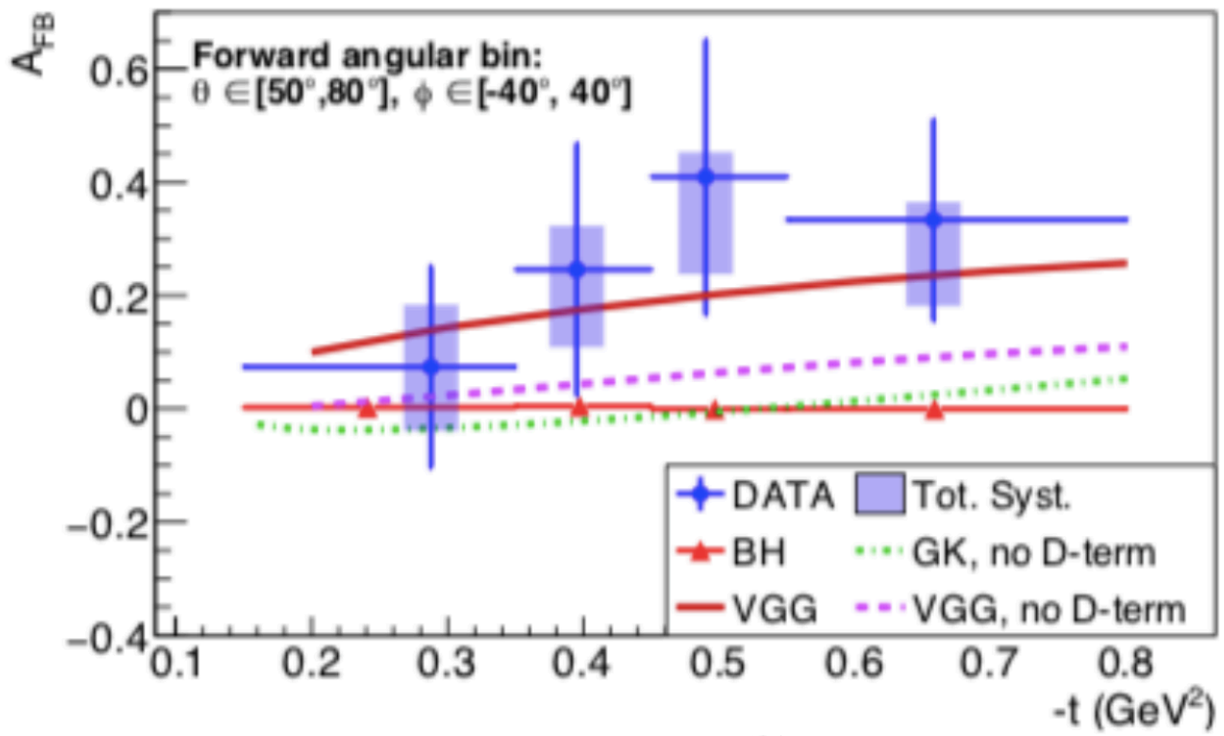
- Can they be used to access information on two-body distributions

$$\rho_2^{q,q}(x,\mathbf{b}_1,\mathbf{b}_2) = \frac{1}{2}\left[\rho(\mathbf{b}_1)\rho(\mathbf{b}_2) - \frac{1}{2}\rho(\mathbf{b}_1,\mathbf{b}_2)\right]$$

- First TCS measurement:



$E_\gamma = 7.23 \pm 1.61\ GeV$

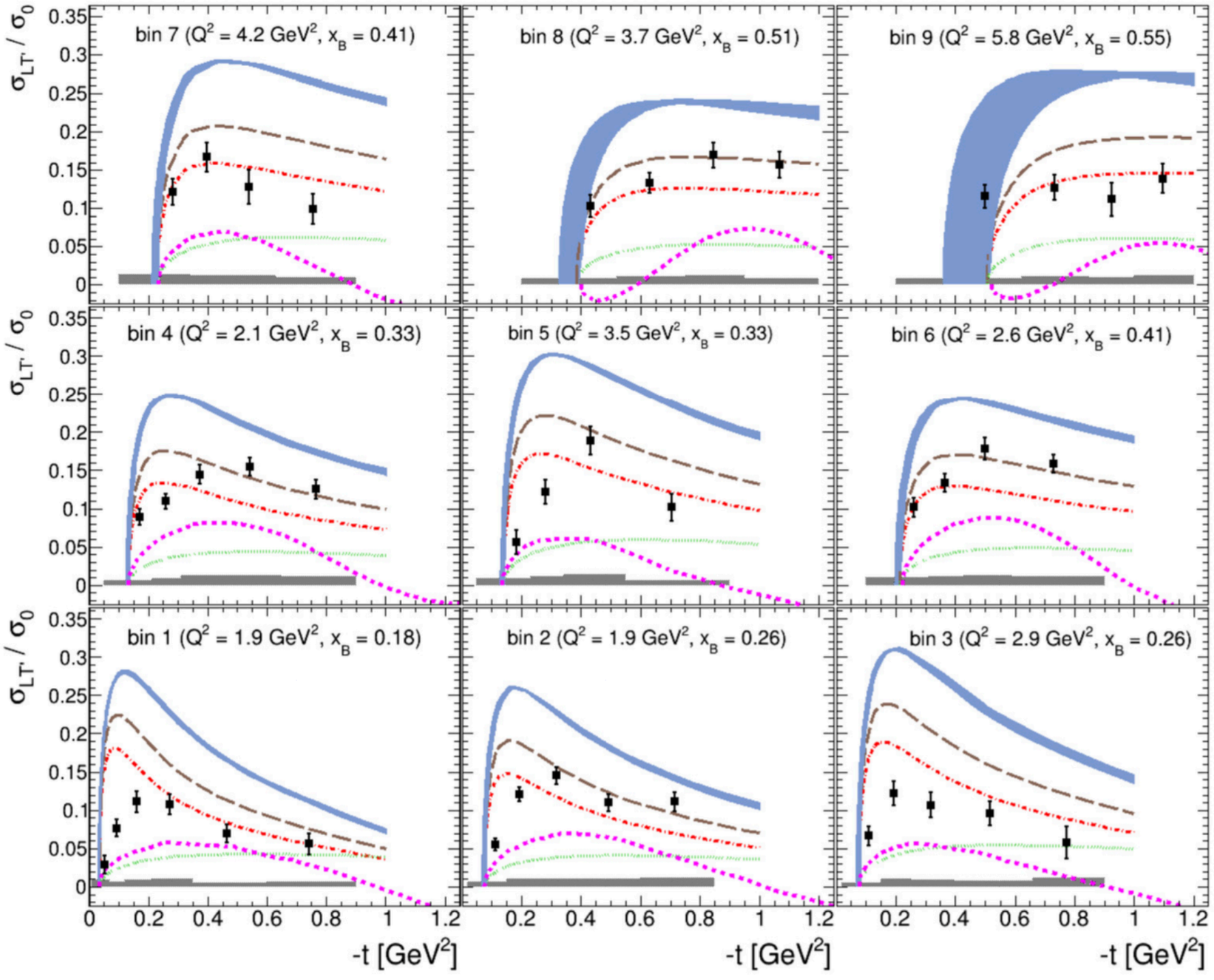


$E_\gamma = 8.13 \pm 1.23\ GeV$

P. Chatagnon et al. (CLAS), Phys. Rev. Lett. 127, 262501 (2021).

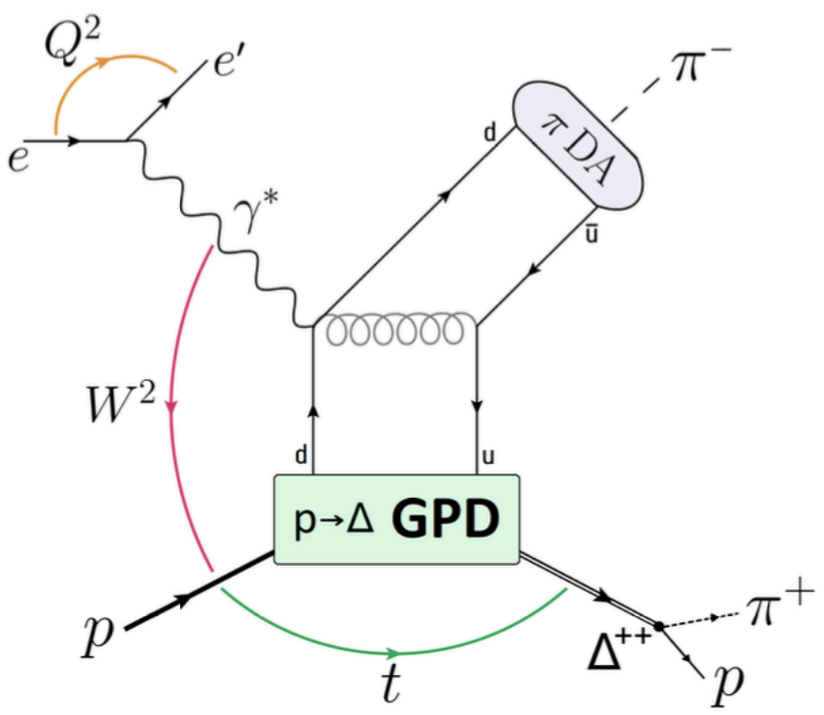
- How much information do can we extract from this data to better pin down GPDs?

- DVMP measurement:



- How do we model DAs? Can we reliably extract them from other processes?

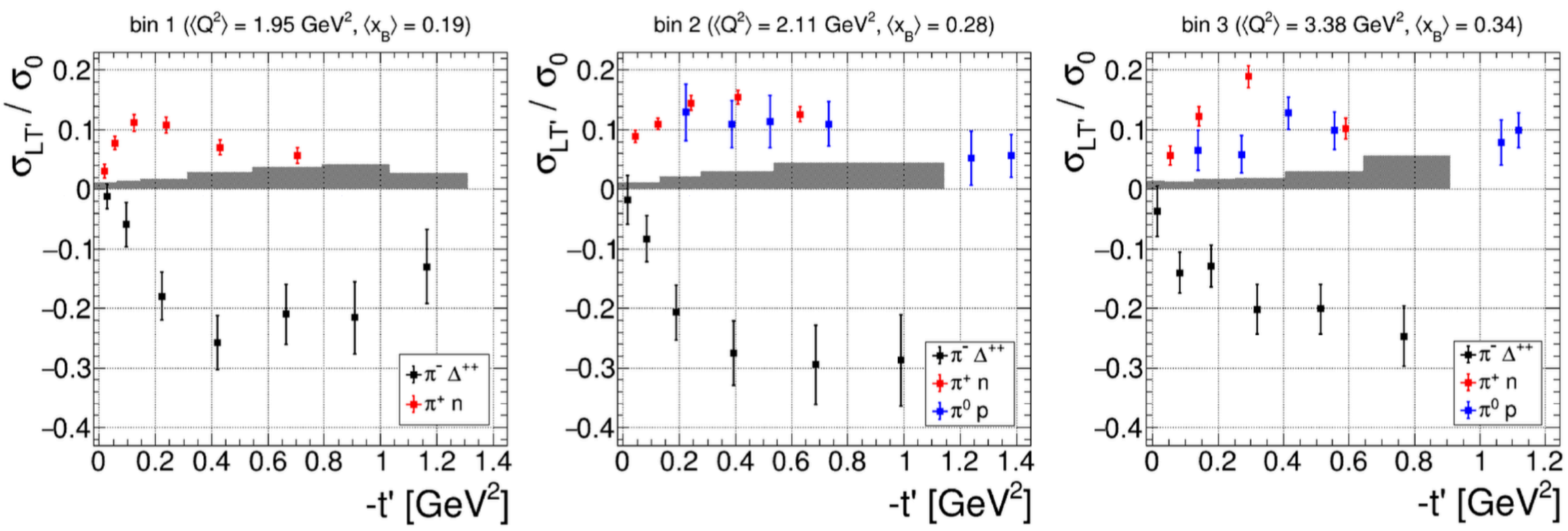
- Transition GPDs (Δ^{++} measurement):



First measurement.

Probes the $p \rightarrow \Delta^{++}$ transition GPDs

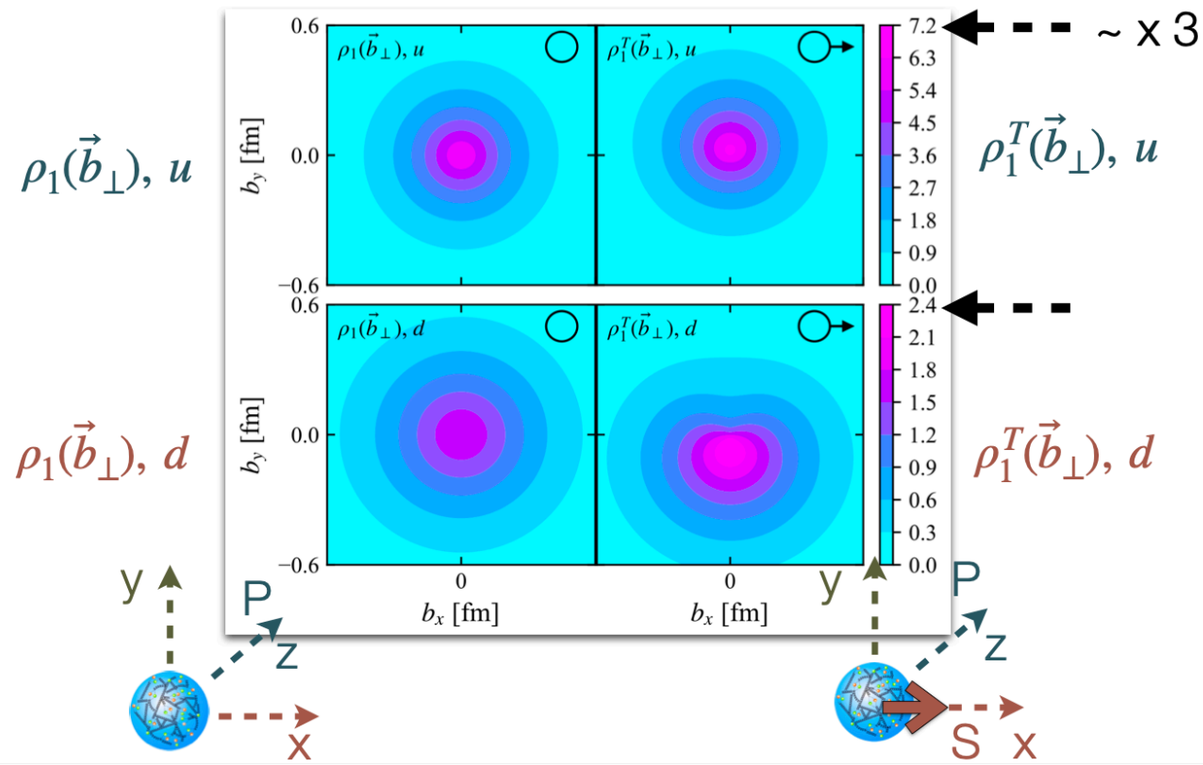
Access to d-quark content of the nucleon.

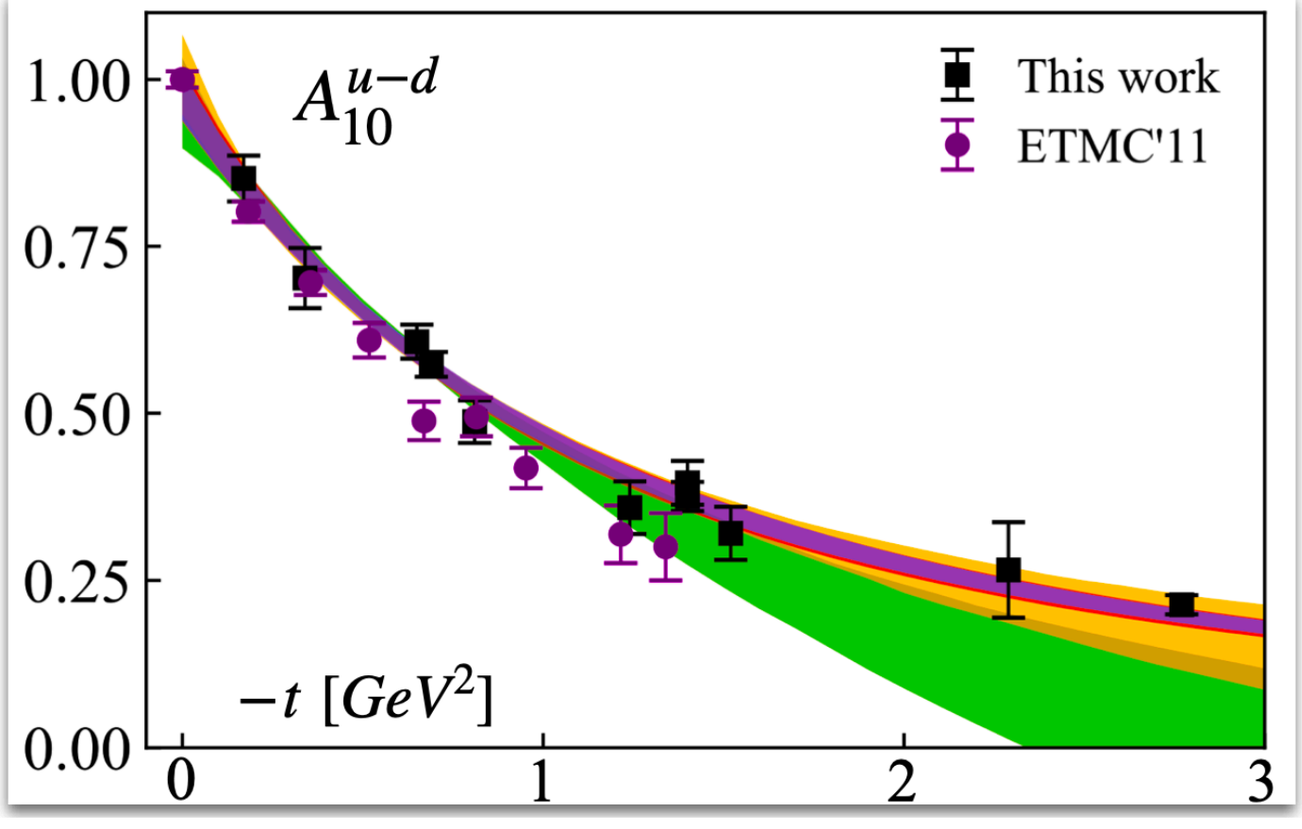


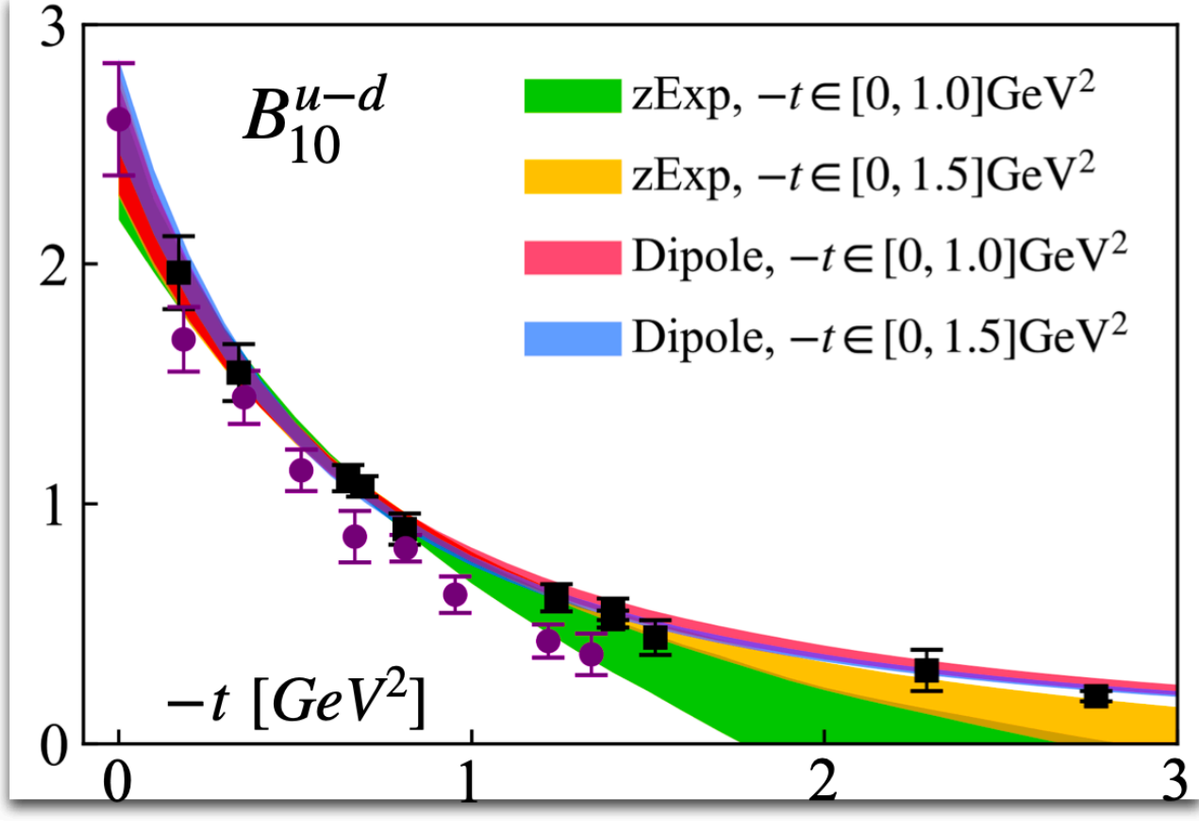
S. Diehl et al. (CLAS), arXiv:2303.11762, *submitted to PRL (2023)*

- GPD from lattice QCD:
  - lorentz invariant formalis
  - t dependence

charge distribution







- Reconstructing GPD evolution kernels from a finite number of moments:
  - using QCD at critica points and MSbar scheme allows to easily compute moments.

$$\gamma^{(3)} = \gamma^{(3,0)} + n_f \gamma^{(3,1)} + n_f^2 \gamma^{(3,2)}$$

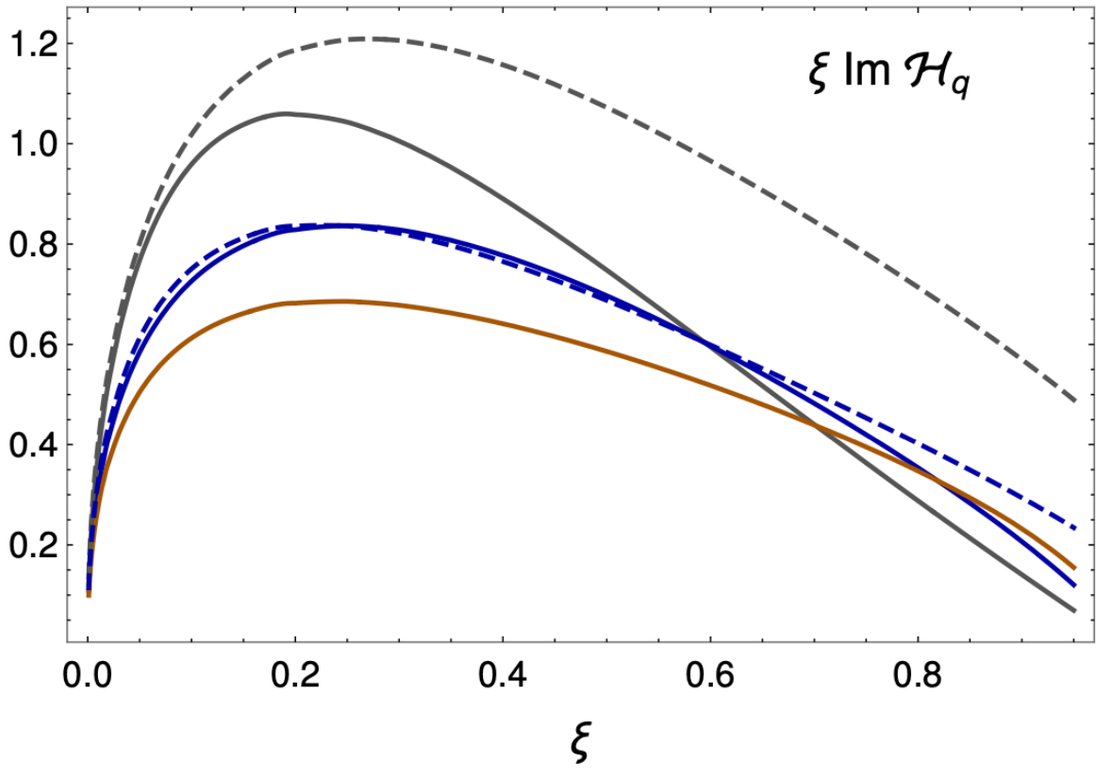
$$\gamma_{31}^{(3,0)} = \begin{pmatrix} \frac{36623912}{54675} & 0 \\ -\frac{2430374}{3645} & \frac{261063}{50} \end{pmatrix} \qquad \gamma_{51}^{(3,0)} = \begin{pmatrix} \frac{8049304723}{31255875} & 0 \\ -\frac{26632998209}{112521150} & \frac{2829671009}{329280} \end{pmatrix},$$

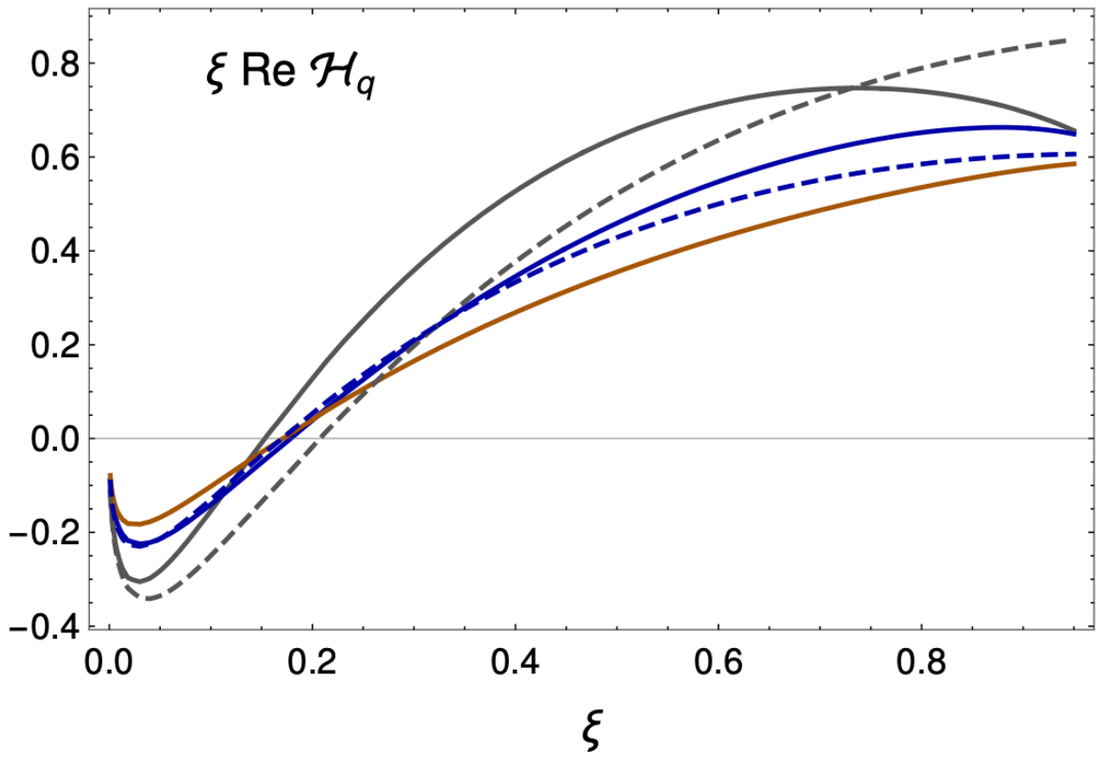
$$\gamma_{53}^{(3,0)} = \begin{pmatrix} \frac{320657981731}{520931250} & 0 \\ -\frac{29333397389}{20837250} & \frac{14378664569}{6860000} \end{pmatrix} \qquad \gamma_{71}^{(3,0)} = \begin{pmatrix} \frac{7192640196053}{56710659600} & 0 \\ \frac{52031947546}{506345175} & \frac{49155659027}{3969000} \end{pmatrix},$$

$$\gamma_{73}^{(3,0)} = \begin{pmatrix} \frac{159898280729473}{525098700000} & 0 \\ -\frac{5108698450661}{3750705000} & \frac{832037077}{441000} \end{pmatrix} \qquad \gamma_{75}^{(3,0)} = \begin{pmatrix} \frac{220023775251709}{396974617200} & 0 \\ -\frac{10780083012803}{7088832450} & \frac{16149051685793}{9724050000} \end{pmatrix}$$

- Resumming large threshold logarithms:

  - Preliminary numerical study. Simple model for non-singlet quark GPD



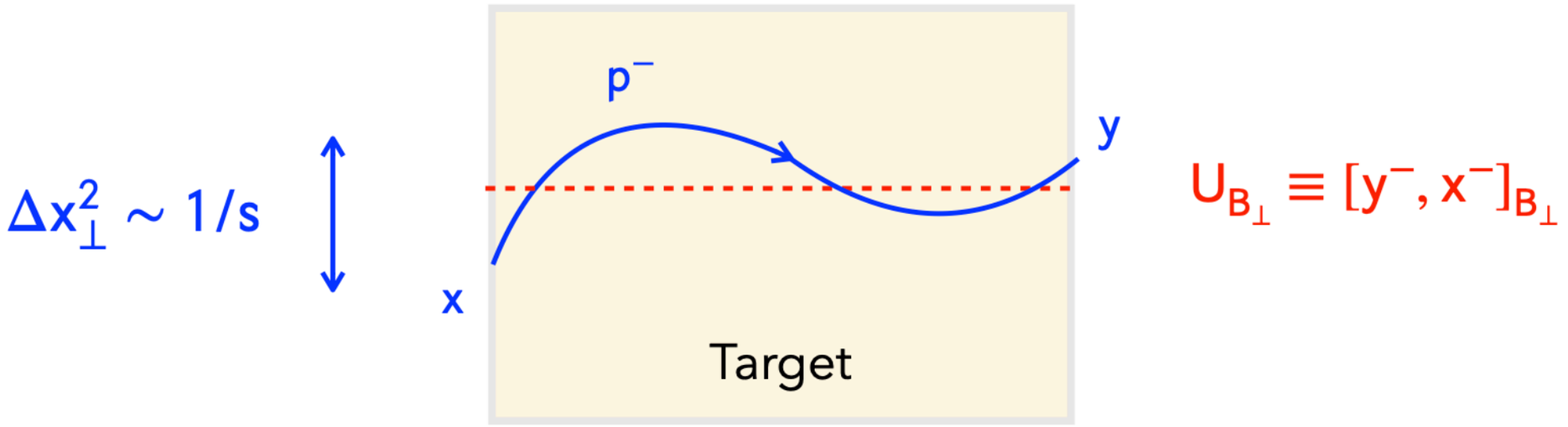


Gray: LO/NLL, Blue: NLO/NNLL, Brown: NNLO
Straight lines: Fixed order, Dashed lines: with resummation.

- Small impact of resummation (Jacob privately explained to me why)

- The gluon GPD
  - interpolating between small and moderate x

Propagator in the target background field



- Shock wave approximation: projectile $p^- \to \infty$

$$D(x-y) \sim \delta(x_\perp - y_\perp)\; U_x(x^-, y^-)$$

- Partial Twist Expansion: $\Delta x_\perp = x_\perp - y_\perp \ll B_\perp = (u x_\perp + (1-u) y_\perp)/2$

$$D(x-y) \sim \frac{p^-}{2i\pi\Delta x^-}\; e^{i\frac{(x-y)_\perp^2}{\Delta x^-}p^-}\; U_B(x^-, y^-) \;+\; O(|\Delta x_\perp|/|B_\perp|)$$

- Generalised GPDs
  - connection to Wigner distributions
  - orbital angular momentum

Some questions about GTMDs

- Do they actually map onto GPDs and TMDs?
- Can we measure them in observables? Do these observables factorize?
- Are they universal?

- Higher-twist corrections to DVMP
  - factorisation of twist-3 photon transverse polarisation?
  - Wide-angle meson production (large t) factorisation?
- Photon-meson pair production
  - access to chiral-odd GPDs
  - need to go to higher twist

- Constraining PDFs (and GPDs) by means of exclusive J/ψ production