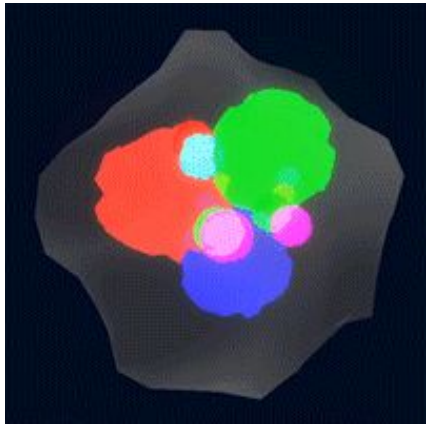
New Methodologies for DVES Data Analyses

B. Kriesten



February 10, 2021

Extraction Techniques

Novel Rosenbluth Extraction Framework for Compton Form Factors from Deeply Virtual Exclusive Experiments

Brandon Kriesten,* Simonetta Liuti,† and Andrew Meyer‡

arXiv: 2011.04484

Theory of Deeply Virtual Compton Scattering off the Unpolarized Proton

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Department of Physics, University of Virginia, Charlottesville, VA 22904, USA.

arXiv: 2004.08890

PHYSICAL REVIEW D **101,** 054021 (2020)

Extraction of generalized parton distribution observables from deeply virtual electron proton scattering experiments

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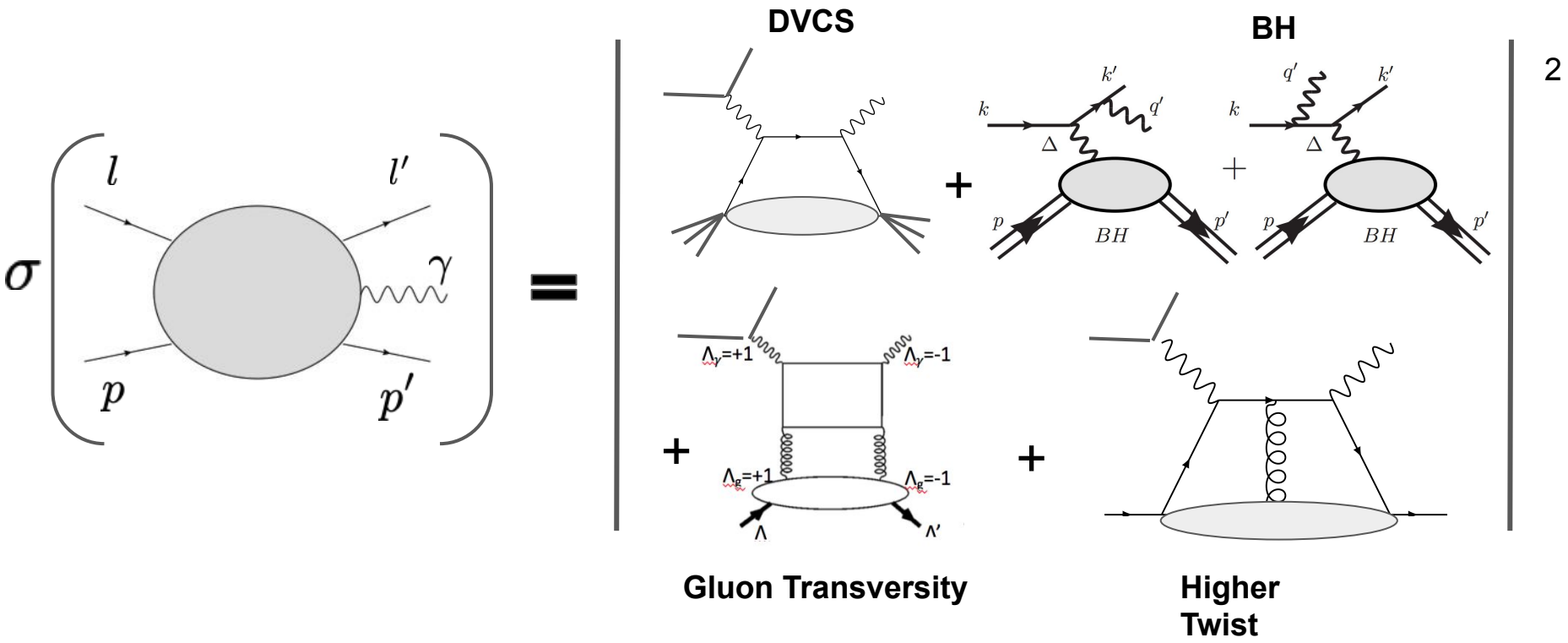
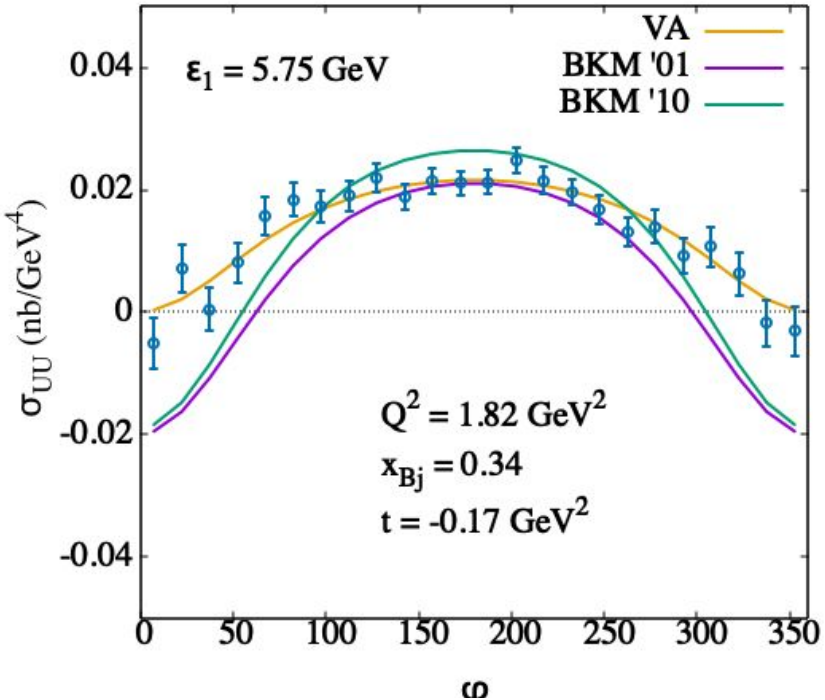
Deeply Virtual Compton Scattering

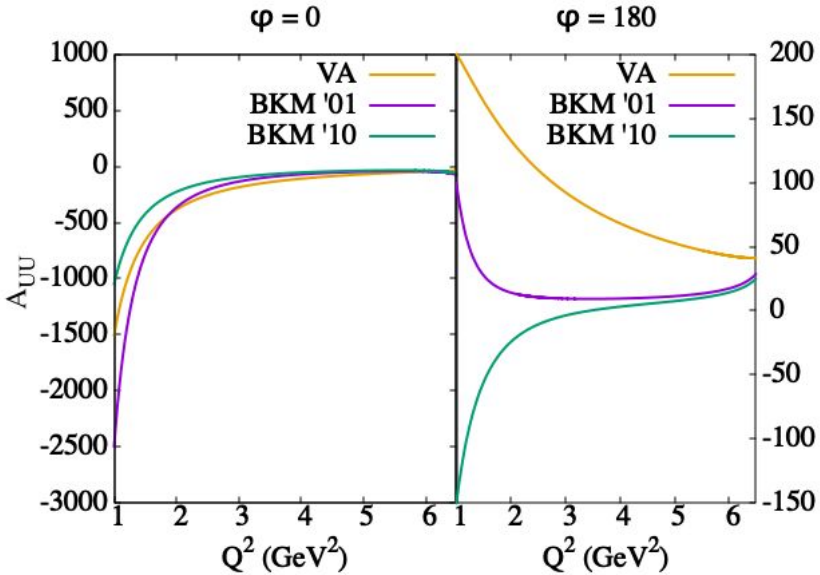


B.K., S.L., et. al. **PRD. 101, 054021 (2020)**

Cross Section Formalism

$$F_{UU}^{\mathcal{I},tw2} = A_{UU}^{\mathcal{I}} \Re e\Big(F_1\mathcal{H} + \tau F_2\mathcal{E}\Big) + B_{UU}^{\mathcal{I}} G_M \Re e(\mathcal{H}+\mathcal{E}) + C_{UU}^{\mathcal{I}} G_M \Re e\widetilde{\mathcal{H}}$$

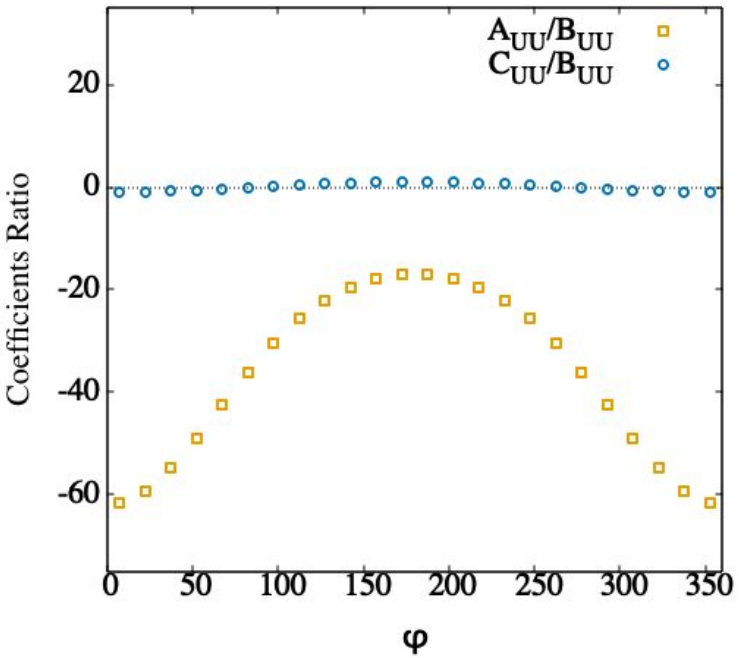


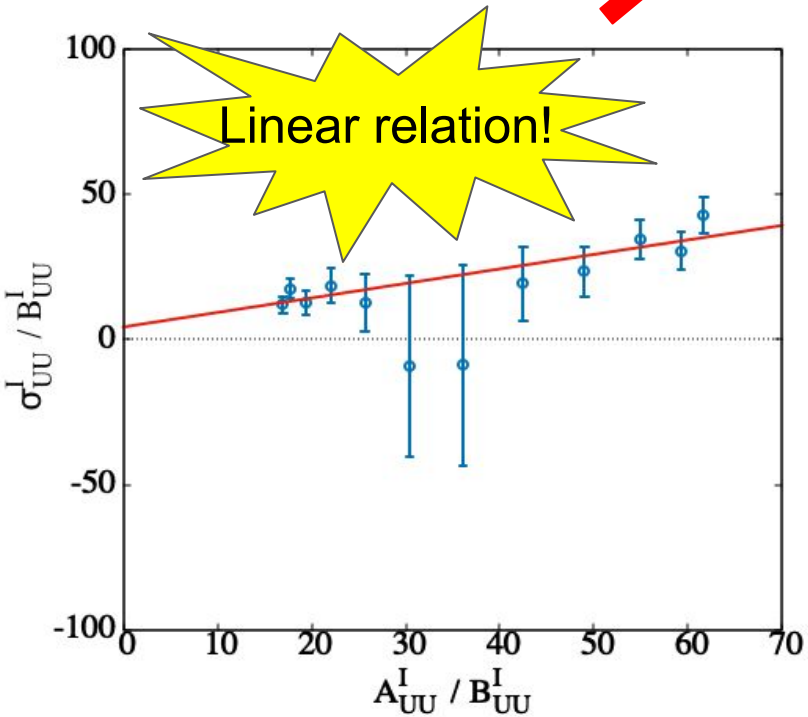


B.K., and S.Liuti, arXiv: 2004.08890

Rosenbluth Separation and Linear Relations

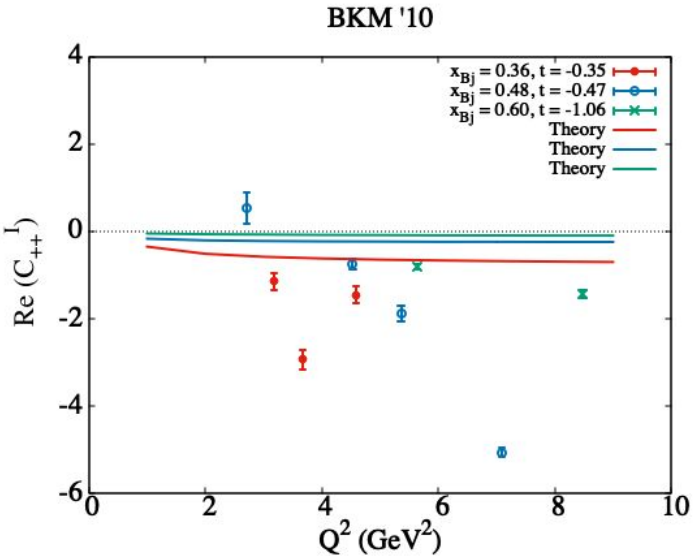
$$\frac{F_{UU}^{\mathcal{I},tw2}}{B_{UU}^{\mathcal{I}}} = \frac{A_{UU}^{\mathcal{I}}}{B_{UU}^{\mathcal{I}}}\Re e\Big(F_1\mathcal{H} + \tau F_2\mathcal{E}\Big) + G_M\Re e\Big(\mathcal{H}+\mathcal{E}\Big) + \frac{C_{UU}^{\mathcal{I}}}{B_{UU}^{\mathcal{I}}}G_M\Re e\tilde{\mathcal{H}}$$

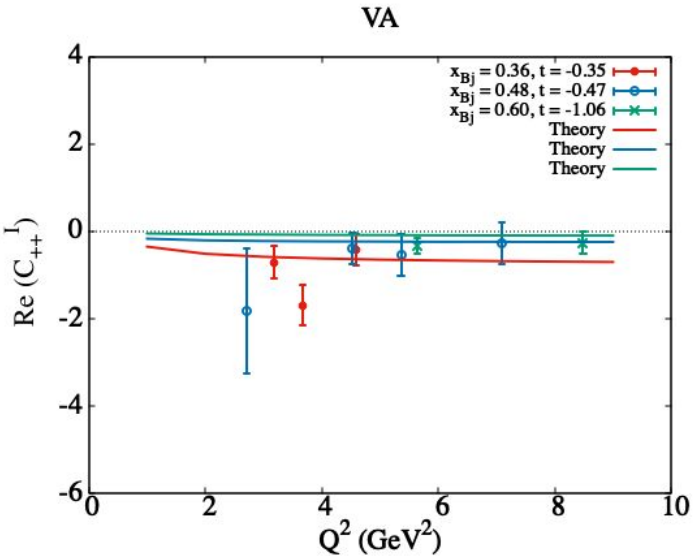




Rosenbluth Separation Results: Q2 dependence

$$\frac{F_{UU}^{\mathcal{I},tw2}}{B_{UU}^{\mathcal{I}}} \approx \frac{A_{UU}^{\mathcal{I}}}{B_{UU}^{\mathcal{I}}} \Re e\Big(F_1\mathcal{H} + \tau F_2\mathcal{E}\Big) + G_M \Re e\Big(\mathcal{H} + \mathcal{E}\Big)$$

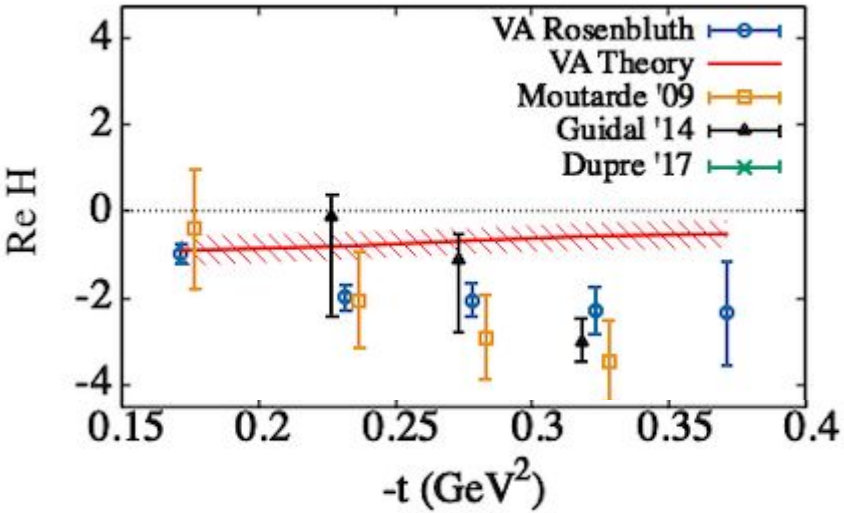


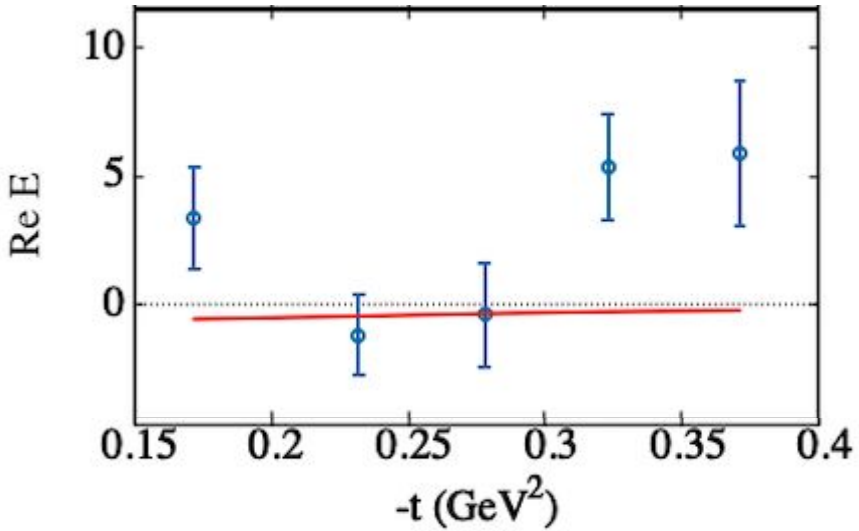


B.K., S.L. arXiv: 2011.04484

Separation of H and E

$$\frac{F_{UU}^{\mathcal{I},tw2}}{B_{UU}^{\mathcal{I}}} \approx \frac{A_{UU}^{\mathcal{I}}}{B_{UU}^{\mathcal{I}}} \Re e\Big(F_1\mathcal{H} + \tau F_2\mathcal{E}\Big) + G_M \Re e\Big(\mathcal{H} + \mathcal{E}\Big)$$

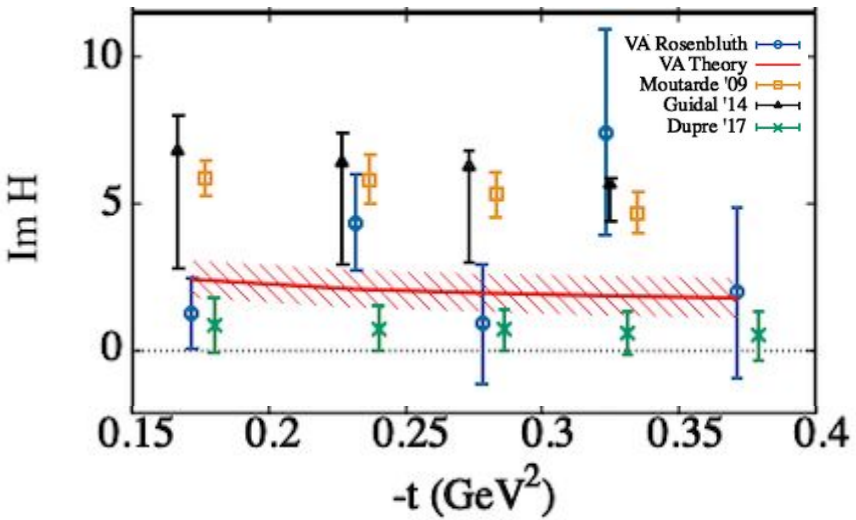


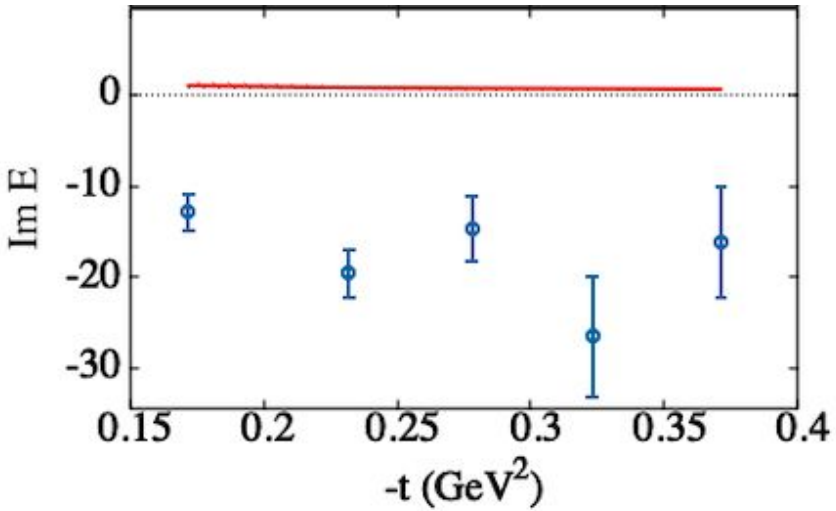


B.K., S.L. arXiv: 2011.04484

Separation of H and E

$$\frac{F_{LU}^{\mathcal{I},tw2}}{B_{LU}^{\mathcal{I}}} \approx \frac{A_{LU}^{\mathcal{I}}}{B_{LU}^{\mathcal{I}}} \Im m\Big(\mathrm{F}_1\mathcal{H} + \tau \mathrm{F}_2\mathcal{E}\Big) + \mathrm{G}_\mathrm{M}\Im m\Big(\mathcal{H} + \mathcal{E}\Big)$$





B.K., S.L. arXiv: 2011.04484

B.K., S.L., et. al. **PRD. 101, 054021 (2020)**

Higher Twist Observables

$$F_{UU}^{\mathcal{I}} = F_{UU}^{\mathcal{I},tw2} + \frac{K}{\sqrt{Q^2}} F_{UU}^{\mathcal{I},tw3}$$

Orbital Angular Momentum

GTMD GPD

$$\frac{d}{dx}\int d^2k_T \frac{k_T^2}{M^2} F_{1,4} = H + E + \widetilde{E}_{2T} + \mathcal{A}_{F_{14}}$$

Twist-2 **Twist-3** **LIR breaking**

Can we disentangle the Twist-3 GPDs from data?

$$F_{UU}^{\mathcal{I},tw3} = \Re e\Big\{ A_{UU}^{(3)\mathcal{I}}\Big[F_1(2\widetilde{\mathcal{H}}_{2T} + \mathcal{E}_{2T}) + F_2(\mathcal{H}_{2T} + \tau\widetilde{\mathcal{H}}_{2T})\Big]$$

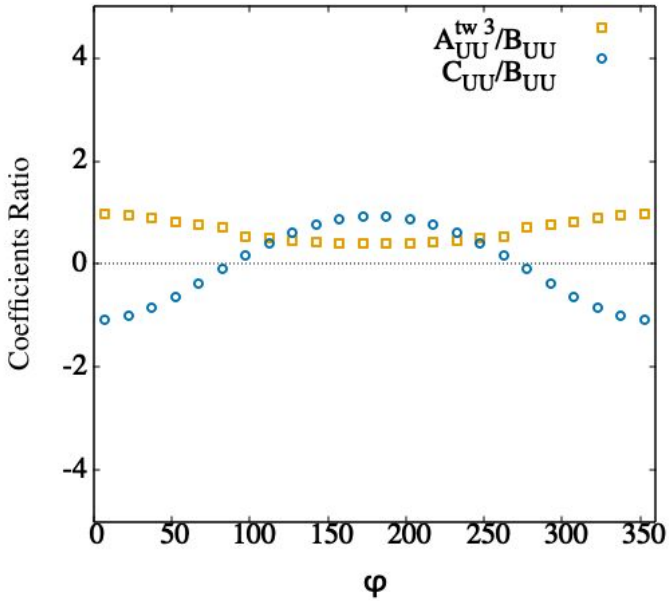
$$+ B_{UU}^{(3)\mathcal{I}} G_M \widetilde{E}_{2T} + C_{UU}^{(3)\mathcal{I}} G_M \Big[2\xi H_{2T} - \tau(\widetilde{E}_{2T} - \xi E_{2T})\Big]\Big\}$$

Rajan, Englehardt, Liuti arXiv:1709.05770 Rajan, Courtoy, Englehardt, Liuti arXiv:1601.06117

Higher Twist Observables

$$F_{UU}^{\mathcal{I},tw3} = \Re e\Big\{ A_{UU}^{(3)\mathcal{I}}\Big[F_1(2\widetilde{\mathcal{H}}_{2T} + \mathcal{E}_{2T}) + F_2(\mathcal{H}_{2T} + \tau\widetilde{\mathcal{H}}_{2T})\Big]$$

$$+B_{UU}^{(3)\mathcal{I}} G_M\, \widetilde{E}_{2T} + C_{UU}^{(3)\mathcal{I}} G_M\Big[2\xi H_{2T} - \tau(\widetilde{E}_{2T} - \xi E_{2T})\Big]\Big\}$$



Polarized observables for higher twist extractions?

Moving Forward

- Moving on from a harmonics description of the cross section is essential for transitioning into a new era of high precision deeply virtual exclusive scattering experiments.
- Can we access leading twist properties such as angular momentum? What about Twist-3 objects such as orbital angular momentum? Gluon observables?
    - Intersection between theory and data analysis.
- Exploring new paradigms of data analysis
    - Exploiting linear relations i.e. in the unpolarized cross section linear relations give us access to not just the CFF ReH but also ReE.
    - Sophisticated machine learning algorithms to simultaneously extract CFFs from all polarization configurations.

Backup

DVCS Extraction