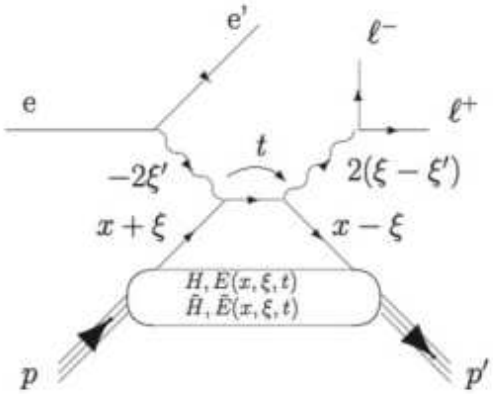
HIGHLIGHTS:

Spatial Structure, Mechanical Properties and Emergent Hadron Mass

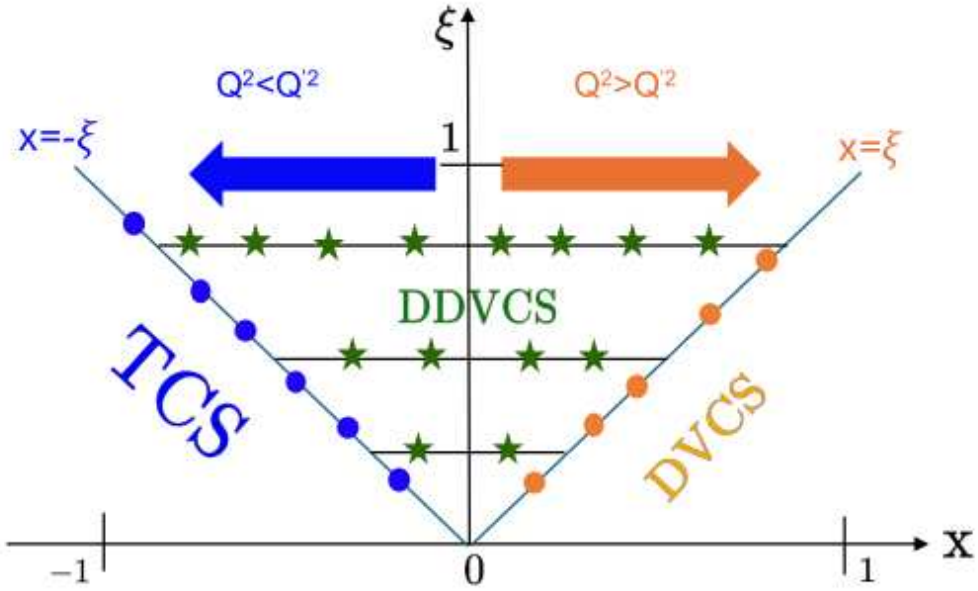
Compiled by Garth Huber (Regina)

My apologies for any errors or omissions!

GPDs via Double DVCS



Kinematics of two photons are described by ξ and ξ'.



$$\xi' = \frac{x_B}{2 - x_B}$$

$$\xi = \xi' \frac{Q^2}{Q^2 + Q'^2}$$

$$x = 2\xi' - \xi$$

Quark propagators between two photons now reads as:

$$\frac{1}{x - (2\xi' - \xi) + i\epsilon} + \frac{1}{x + (2\xi' - \xi) - i\epsilon}$$

Observables (e.g. BSA) proportional to the Im part of the amplitude, allow direct measurement of GPDs at (x=2ξ' - ξ, ξ, t) points.

Here one can get away from the x=ξ line by varying virtualities of incoming and outgoing photons

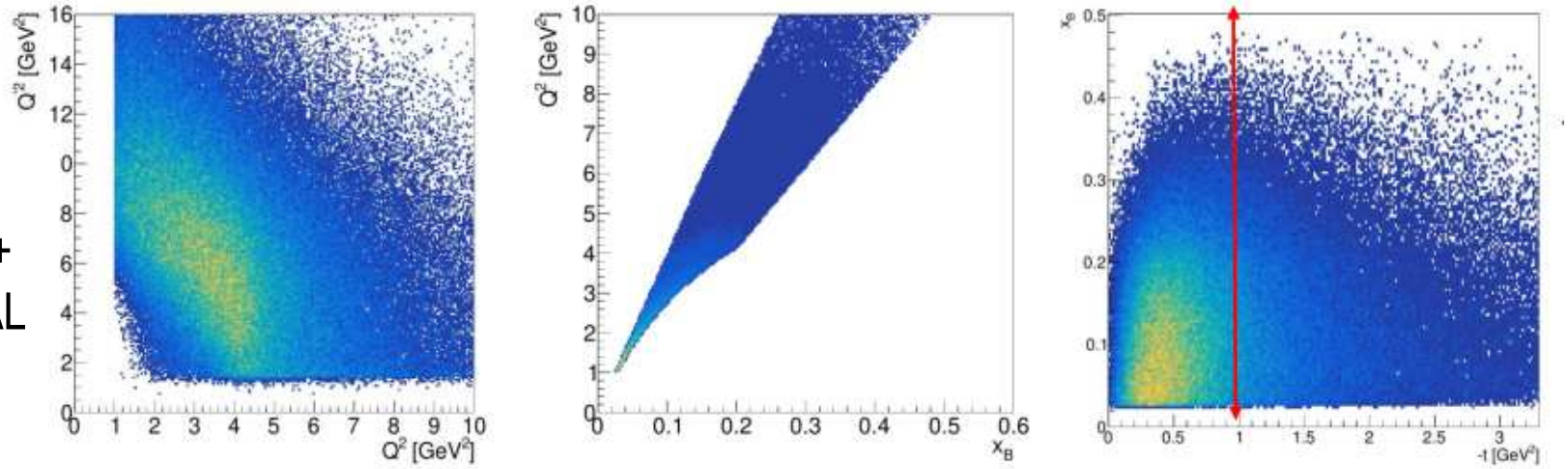
RafayelParemuzyan (JLab)

GPDs via Double DVCS

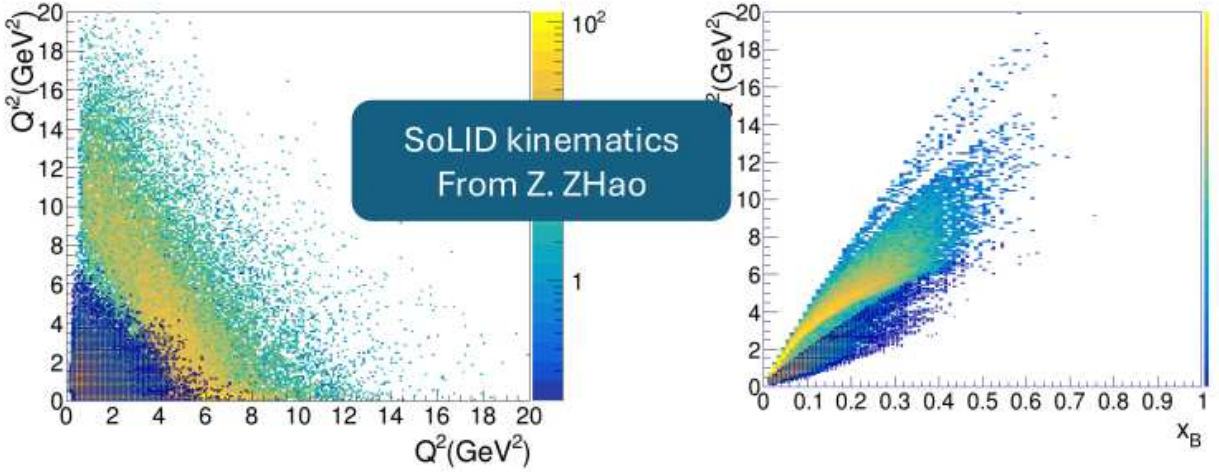
22 GeV advantages:

- Resonance free [2-3 GeV] region is more accessible
- Larger Q^2-Q'^2 coverage allows to test scaling, GPD evolution, study higher twist effects

CLAS + μEMCAL

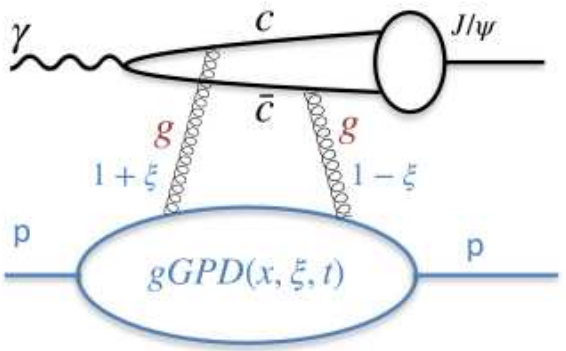


SoLID + μDet
Dark region is 11 GeV



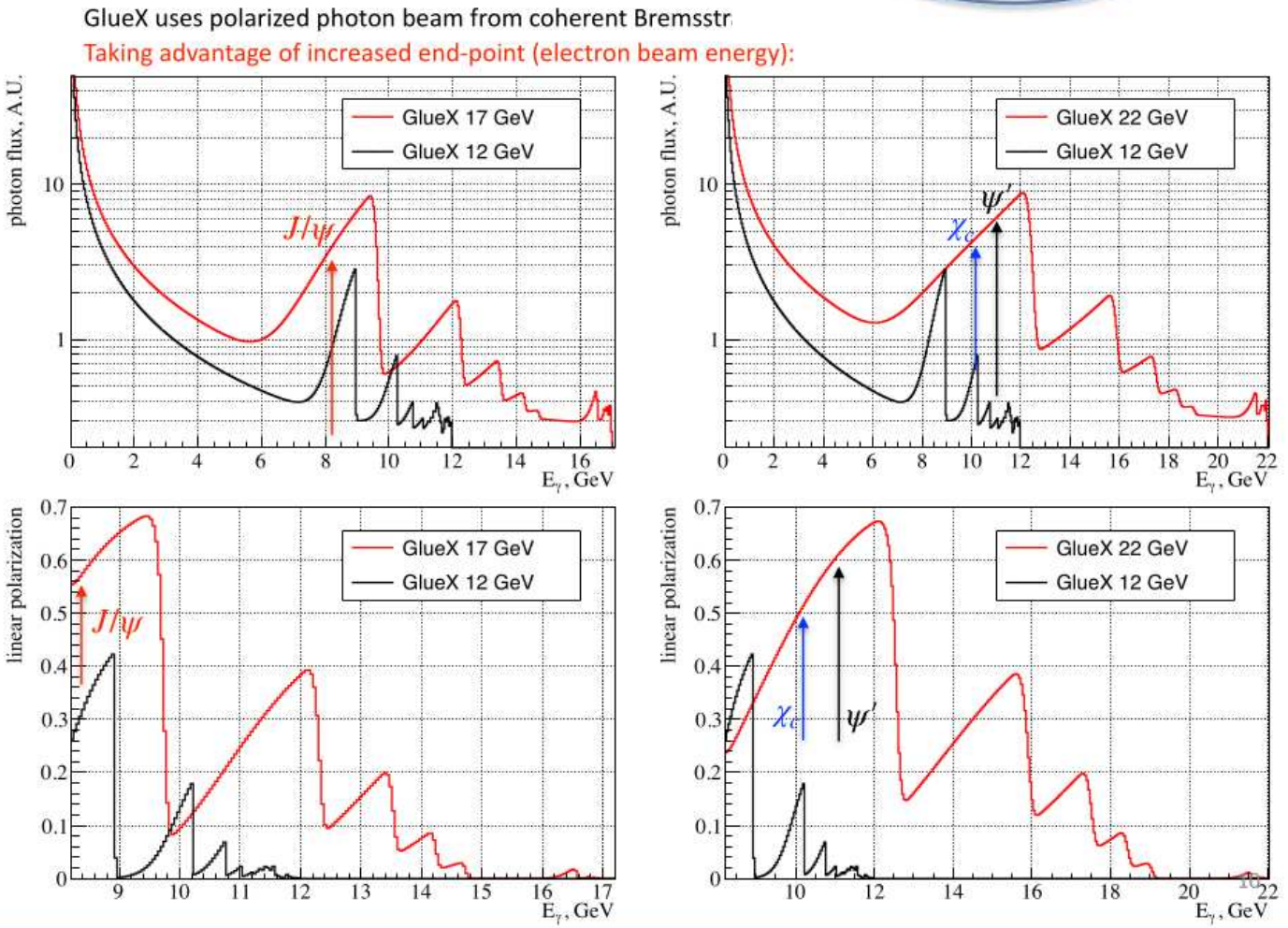
Threshold Charmonium Production: Access to Gluon Structure of the Proton

- **Exclusive charmonium production probes the QCD trace anomaly contributions to hadronic mass and gluon Gravitational FFs**



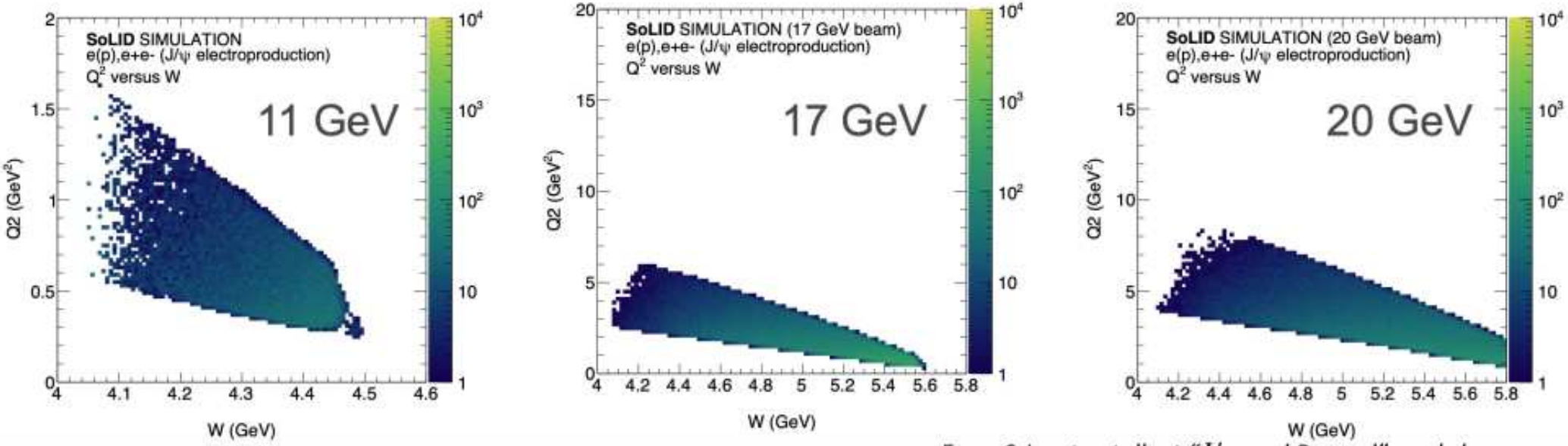
22 GeV GlueX:

- Significantly increased FOM for linear polarization
- Unique in polarization measurements and χ_c states



Lubomir Pentchev (JLab)

Threshold Charmonium Production: Access to Gluon Structure of the Proton



From S.Joosten talk at "J/ψ and Beyond" workshop

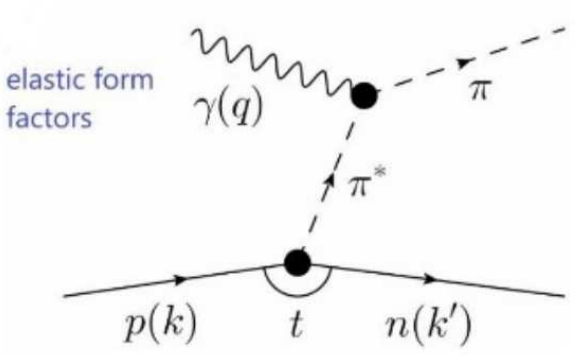
22 GeV SoLID:

- Unique J/ψ electroproduction measurements up to Q^2=8 GeV^2
- Unique $\psi(2S)$ electroproduction up to Q^2=1.5 GeV^2
- Opens up possibility of Charmonium measurements with polarized ammonia target

Lubomir Pentchev (JLab)

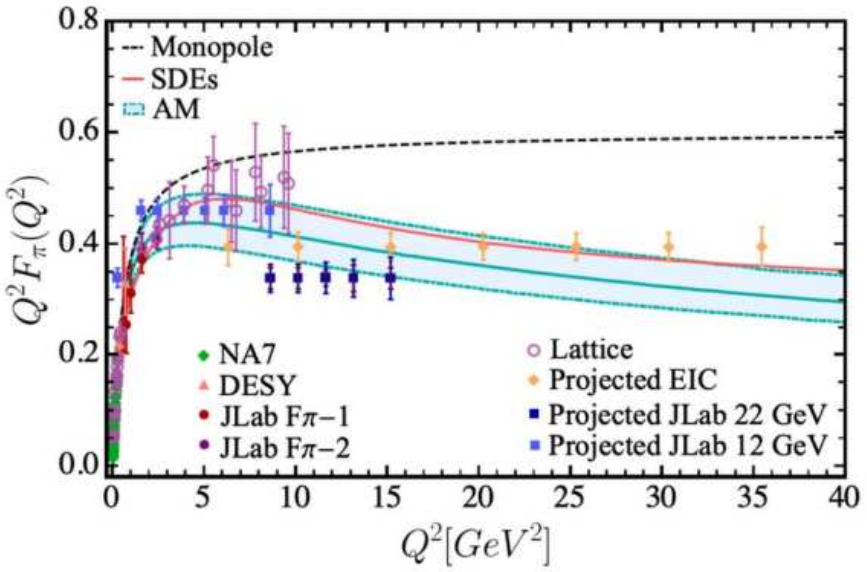
π^+/K^+ Structure

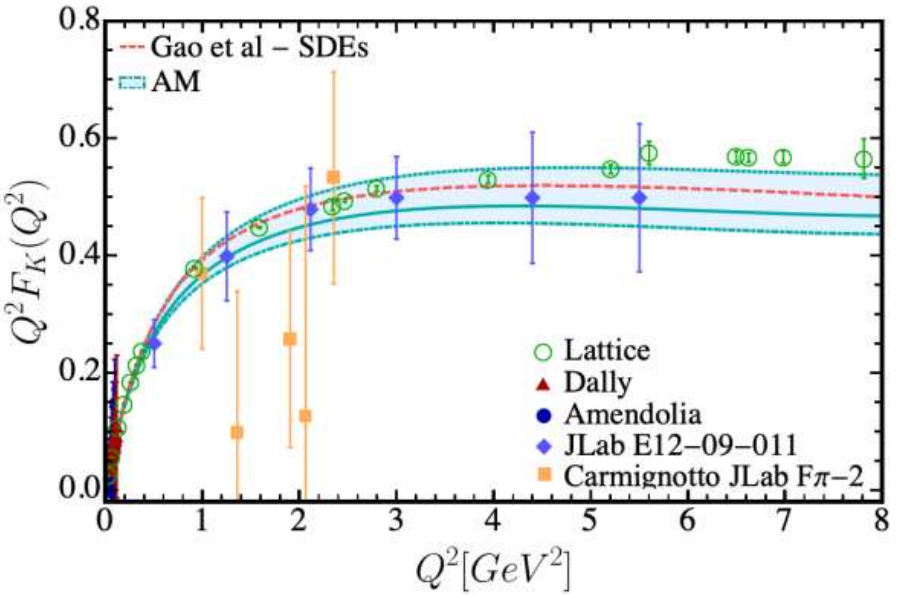
- **Studies of π and K structure over a broad Q^2 range will probe the quark and gluon energy contributions to hadronic mass**



The Q^2-dependence of the **pion** and **kaon electromagnetic form factors** to larger Q^2 rang of photon virtualities accessible to the **JLab12**, **JLab22** and the **EIC programs**.

I. M. Higuera, R. J. Hernández, K. Raya, AB, Phys. Rev. D 110, 034013, (2024)



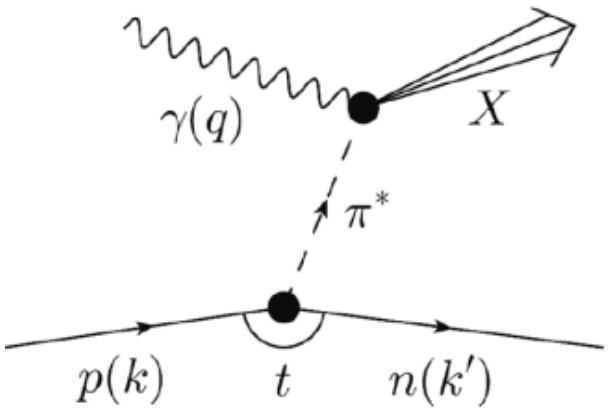


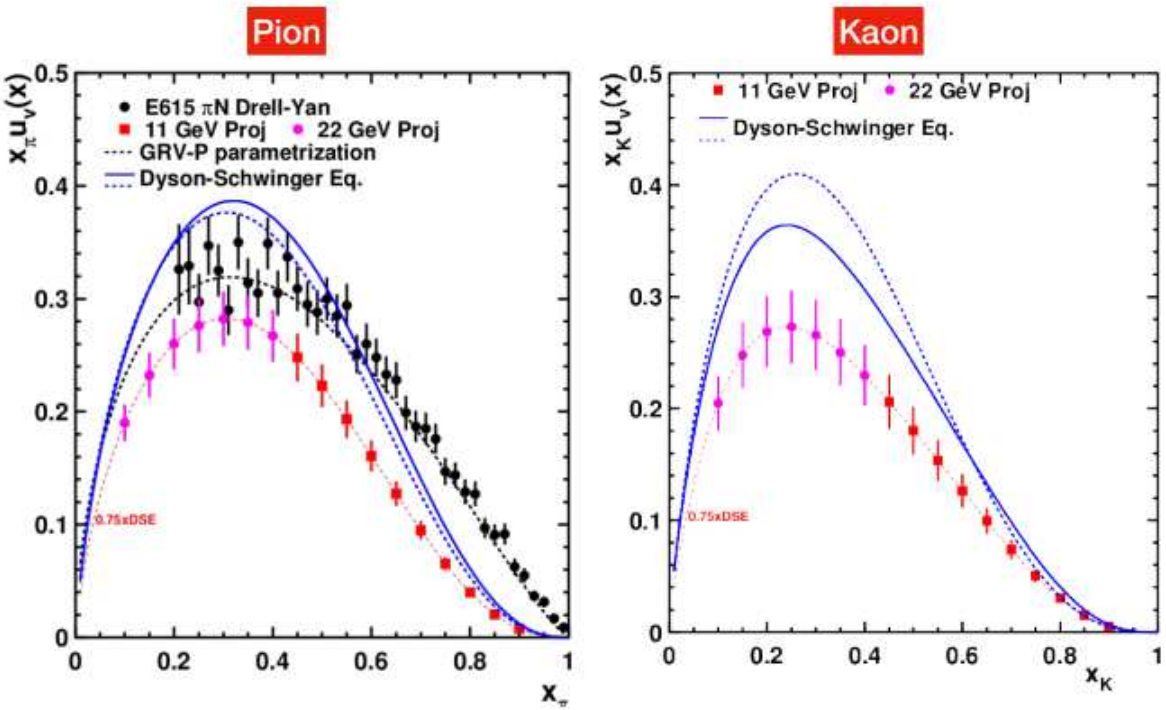
Z-Q. Yao, D. Binosi, C.D. Roberts, Phys.Lett.B 855 (2024) 138823

K. Raya, AB, D. Binosi, C. D. Roberts, J. Rodríguez-Quintero, Few Body Syst. 65 (2024) 2, 60

π^+/K^+ Structure

- **22 GeV Pion TDIS:**
  - Significantly extends available phase space and count rate for Meson Structure Function extractions
  - Drastically expands x-range
  - Adds to sparse K^+ world data
- SIDIS on virtual meson becomes possible
  - Would need to add pion detector to TDIS





- 22GeV Projections:
  - 50 days' beam time
  - Time to keep error bars same as 11GeV proposals
- 22GeV drastically expands x-range!
- Adds to sparse world data
- Especially kaon!

π^+ DVCS

- **22 GeV Pion DVCS:**
  - Would provide world unique x>0.1 data complementary to EIC pion DVCS at x<0.1
  - Beam spin asymmetry would be a clear observable for mapping gluon superiority in pion, crucial info for EHM
  - Opens up possibility for multidimensional imaging of pion
  - To Do:
    - How to measure final state π^+ and γ
    - How to isolate Sullivan process in p(e,e'$\pi^+\gamma$)n

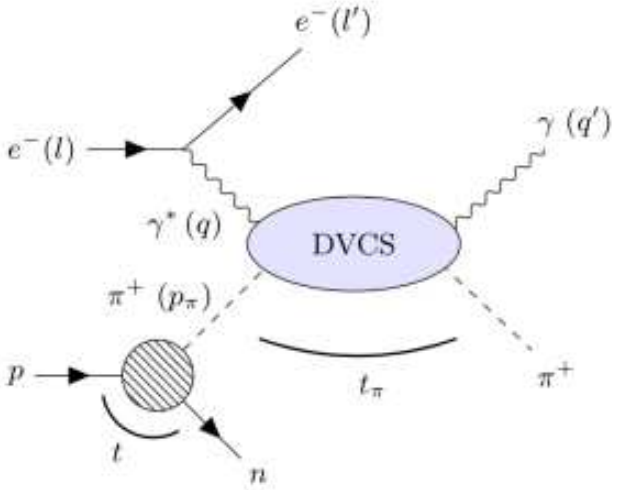
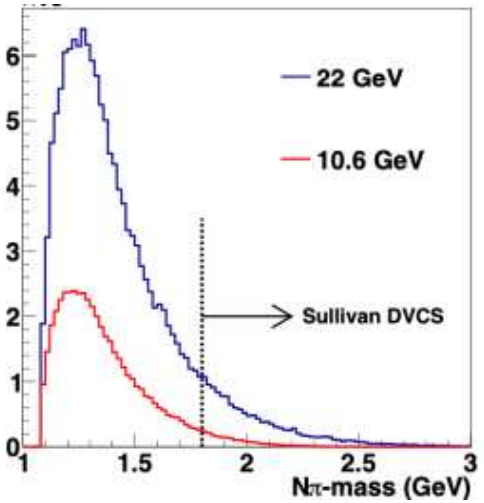
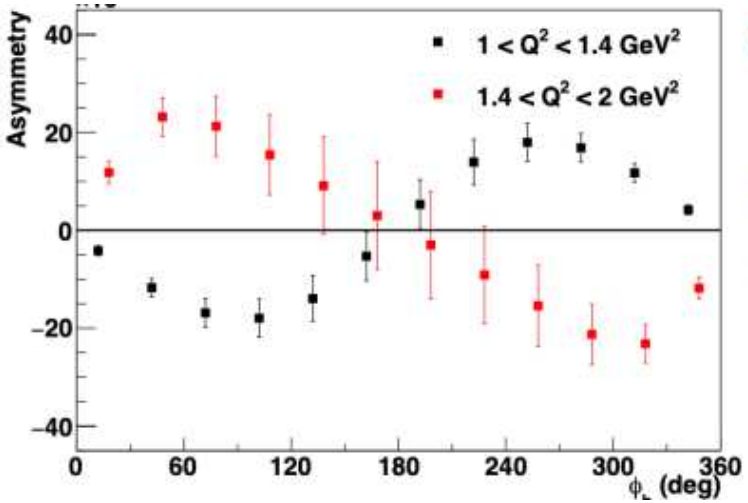


Image and more info on Sullivan DVCS:
J. Chavez et al, PRL 128, 202501 (2022)

More stats above nucleon resonances cut

Assumed luminosity 3000fb^{-1}





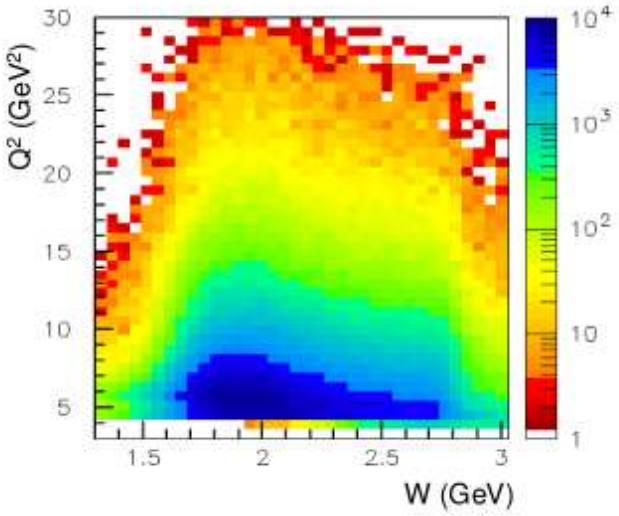
Plots M. Defurne

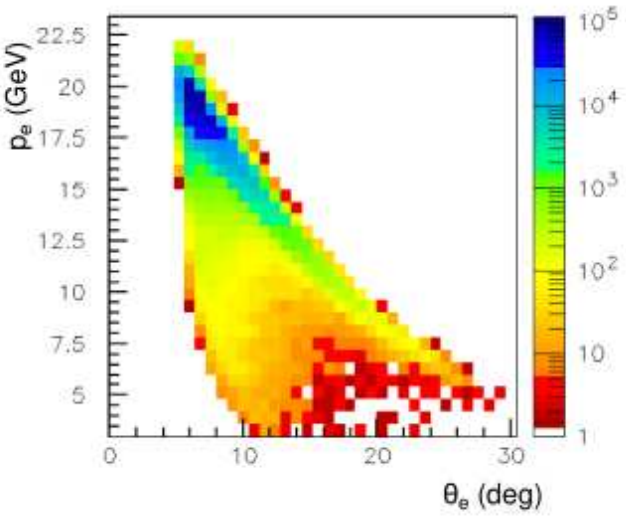
Only accessible for TIDS with 22GeV electron beam

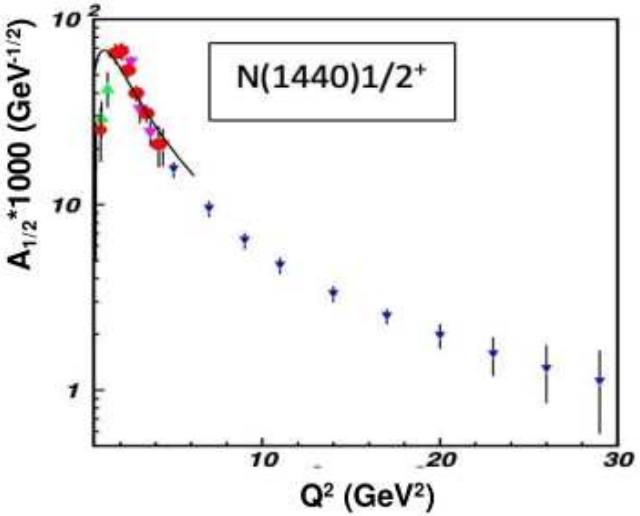
Resonance Electroexcitations

N* masses and Electroexcitation Amplitudes

- Important evidence for the different internal structures of N* resonances
- Provide insights into strong interaction dynamics underlying EHM







22 GeV CLAS:

- Simulation studies in progress for:
  - $\pi^+ n$, $\pi^0 p$, $\pi^+ \pi^- p$, $K^+ \Lambda$, $K^+ \Sigma^0$, (e,e'X)
- Q^2 range extension to 30 GeV^2 opens opportunity to explore how dominant part of hadronic mass and N* structure emerge from QCD

Patrick Achenbach (JLab)