First look at KaonLT experiment data

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anyone else??

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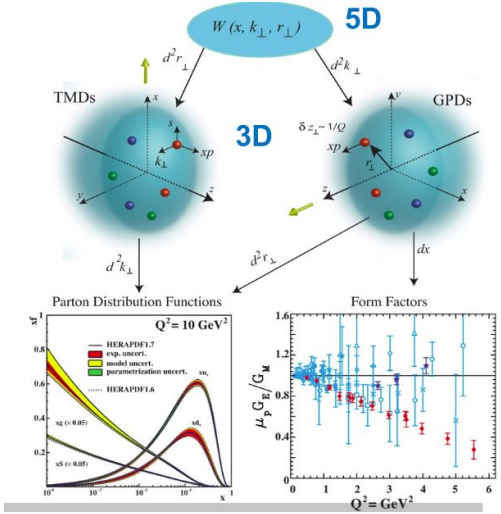
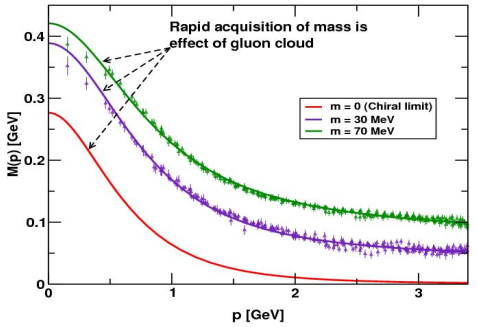
Hadron Structure, Keep or toss??

- Generalized Parton Distributions (GPDs)
- Form factors are vital in understanding internal hadronic structure and dynamics
- Kaon and pion form factors are of particular interest
  - Pion is the lightest QCD quark system and is a critical component of dynamically generating mass
  - Kaon replaces the lightest quark with a heavier strange, expanding the understanding of quark interactions





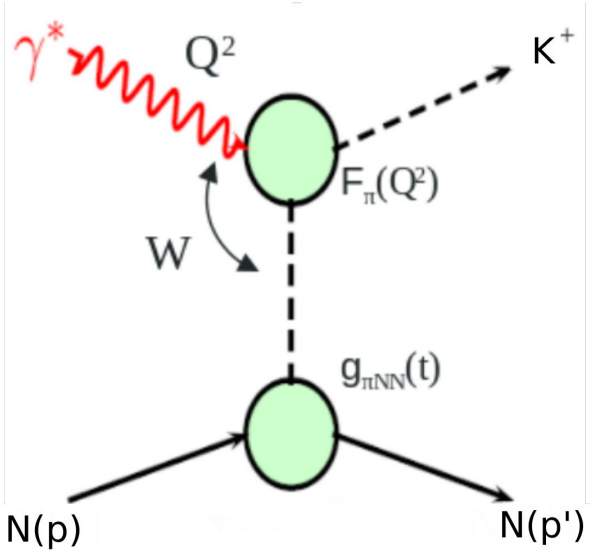
Measurements of the Form Factor

⇒ **At low to moderate Q^2:** Form factor can be directly measured through elastic scattering

⇒ **At high Q^2:** Form factor must be indirectly measured using the meson cloud of the proton

To extract the form factor from meson electroproduction data requires:

- ➢ Full L/T separation of cross section - isolation of σ_L
- ➢ Selection of the pion pole process
- ➢ Extraction of the form factor using a model
- ➢ Validation of technique - model dependence checks



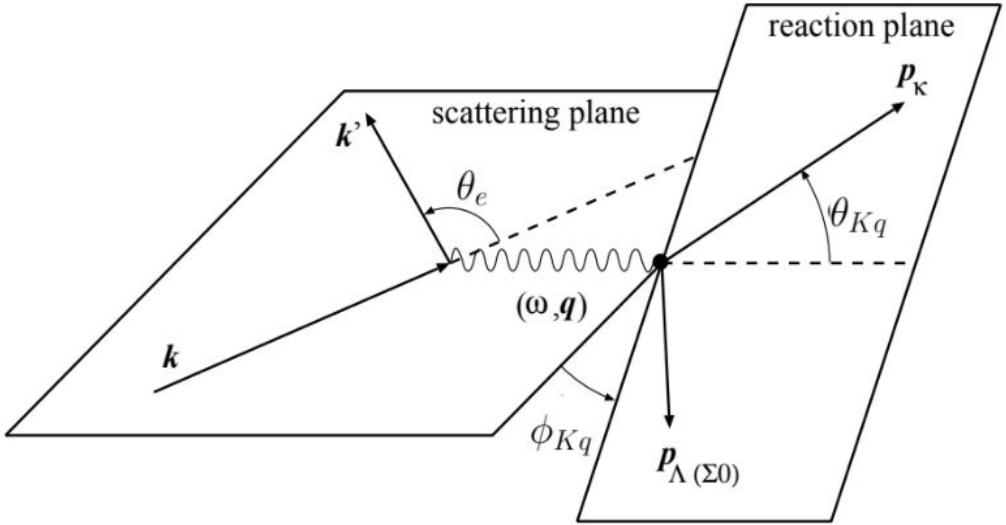
Separating the Cross Section

- Since the photon is virtual and therefore not measured the polarization can be decomposed into the polarized components (L/T and the interference terms LT and TT)
- It is crucial that full azimuthal coverage is achieved to allow further simplification using the Rosenbluth separation technique.
  - Rosenbluth separation involves measuring the terms over full 2π azimuthal coverage and integrating over the experimental acceptance to eliminate any interference terms.

$$2\pi\frac{d^2\sigma}{dtd\phi} = \varepsilon\frac{d\sigma_L}{dt} + \frac{d\sigma_T}{dt} + \sqrt{2\varepsilon(\varepsilon+1)}\frac{d\sigma_{LT}}{dt}\cos\phi + \varepsilon\frac{d\sigma_{TT}}{dt}\cos 2\phi$$

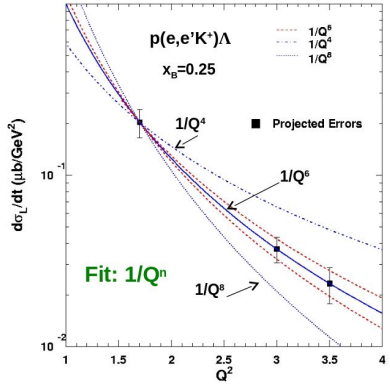
Exclusive K^+ Electroproduction

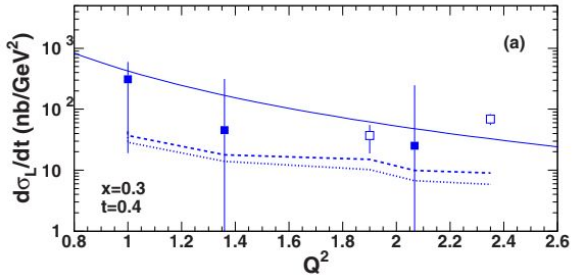
- $p(e, e'K^+)\Lambda(\Sigma^0)$
- The exclusive products detected are the scattered electron and Kaon, while the missing hyperon mass is calculated explicitly

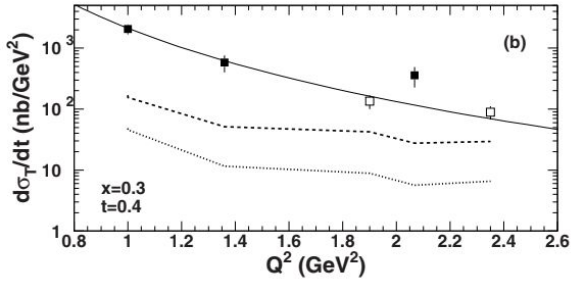


Recent kaon data

- The K^+ electroproduction cross section has a Q^2 dependence at fixed x and -t
  - Factorization of σ_L scales to leading order Q^{-6}
  - In that regime expect σ_T to go as Q^{-8} and consequently $\sigma_L >> \sigma_T$
- Data of 6 GeV Jlab cross section appear to be consistent with this expected scaling but with relatively large uncertainties
- *M. Carmignotto et al., PhysRevC **97**(2018)025204*

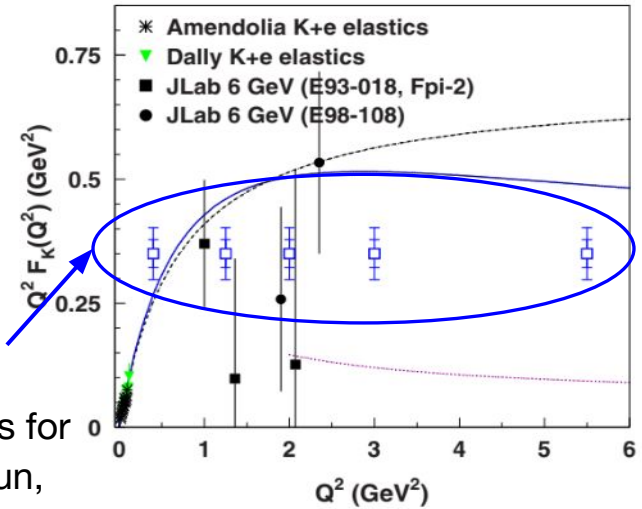




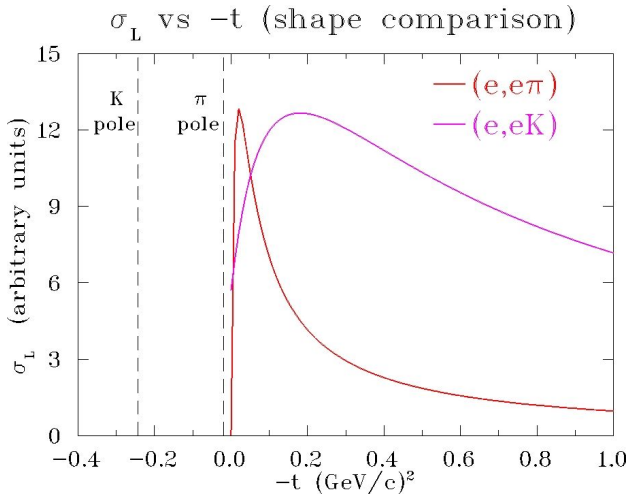


Recent kaon data (con't)

- Extraction like in the pion case by studying the model dependence at small t
- Comparative extractions of F_π at small and larger t show only modest model dependence
  - larger t data lie at a similar distance from pole as kaon data
- *M. Carmignotto et al., PhysRevC* ***97****(2018)025204*

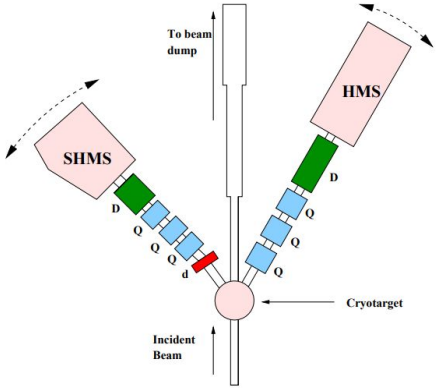


Possible extractions for 2018/19 run, need updated version!



Kaon LT - All Data Collected

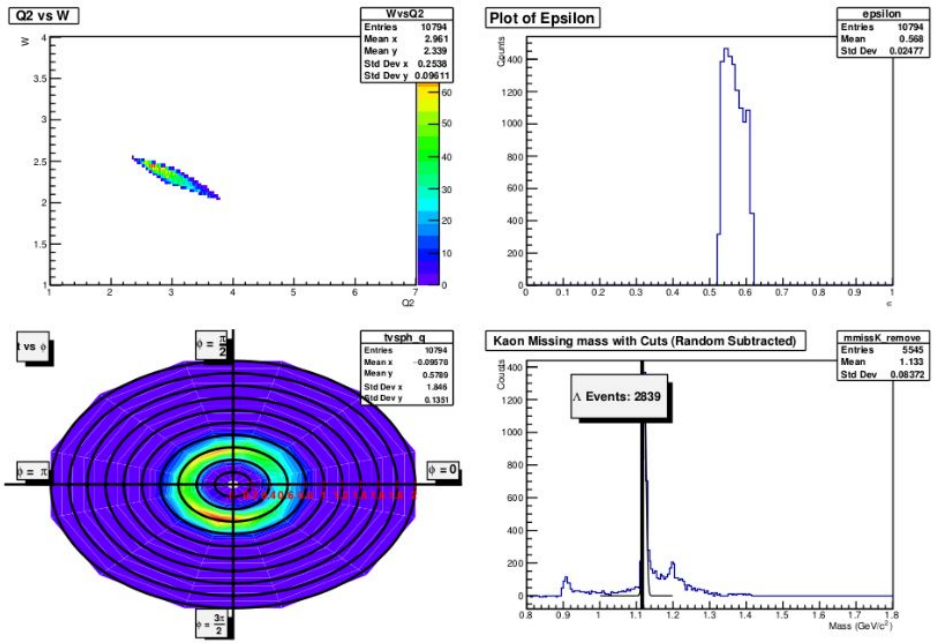
- The p(e, e′K^+)Λ, Σ^0 experiment ran in Hall C at Jefferson Lab over the fall and spring.
- An unpolarized continuous electron beam was incident on a liquid hydrogen (LH_2) target. The SHMS detected the electroproduced kaon, in coincidence with the HMS which detected the scattered electron.



E (GeV)	Q^2 (GeV^2)	W (GeV)	x
10.6/6.2	3.0	2.32	0.40
10.6/6.2	2.115	2.95	0.21
10.6/8.2	4.4	2.74	0.40
10.6/8.2	3.0	3.14	0.25
10.6/8.2	5.5	3.02	0.40
4.9/3.8	0.5	2.40	0.09

Kaon LT - All Data Collected

- E12-09-011: Separated L/T/LT/TT cross section over a wide range of Q^2 and t
- Jlab 12 GeV Kaon program features:
  - First cross section data for Q^2 scaling tests with kaons
  - Highest Q^2 for L/T separated kaon electroproduction cross section
  - First separated kaon cross section measurement above W=2.2 GeV



Fall run specifics and online plots

- Setup
- Physics Settings
- Issues that arose
- Online plots

December run specifics and online plots

- Setup
- Physics Settings
- Issues that arose
- Online plots

Spring run specifics and online plots

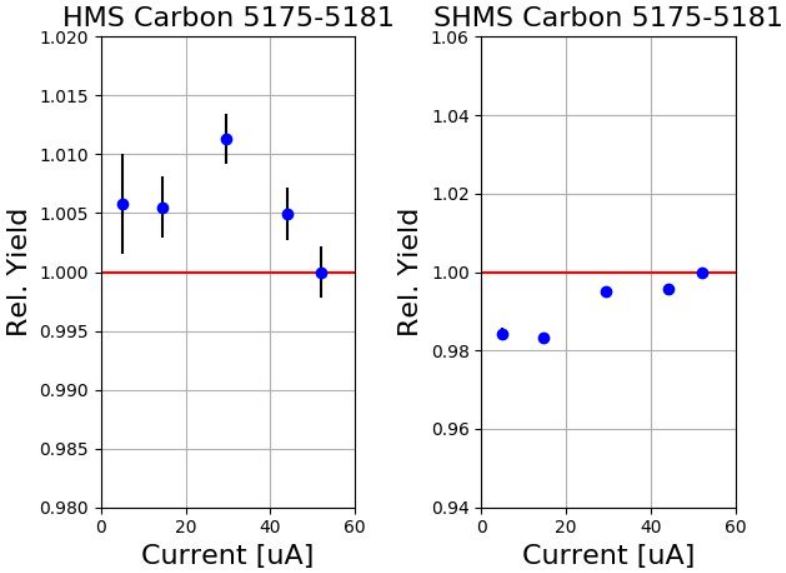
- Setup
- Physics Settings
- Issues that arose
- Online plots

Analysis Phases

1. Calibrations
    - Calorimeter, aerogel, HC cer, HMS cer, DC, Quartz plan of hodo
    - Assure we are replaying to optimize our physics settings
2. Efficiencies and offsets
    - Luminosity and elastics
3. First iteration of cross section
    - Bring everything together
4. Fine tune
    - Fine tune values to minimize systematics
5. Repeat previous step
    - Repeat until acceptable cross sections are reached
6. Possible attempt at form factor extraction
    - Fit the data to a model and iterate

Current Phase

- Understanding efficiencies from luminosity scans has been ongoing with only one run having been looked at
- In the process of calibrations
- Once calibrations are complete, I will concentrate on elastics studies along with continued studied of luminosity
- Should finish phase one by middle of summer



Conclusion

- Kaon can provide an interesting way to expand previous data of charged pion form factor data with access to the production mechanism involving strangeness
- E12-09-011 has completed its 2018-19 run
- Potential to extract the Kaon form factor from the L/T separated cross sections to the highest Q^2 achievable at Jlab
    - Full azimuthal coverage, good phase space matching and favorable rates to allow Kaon cross section separation
- Provide much needed data for Q^2 scaling at fixed x and -t in Kaon electroproduction to validate QCD factorization for hadron imaging studies
- Currently in the first phase of analysis with hopes of finishing by the middle of this summer