E12-09-011: Role of Strangeness in GPD studies and the Kaon form factor

***Spokespersons: Tanja Horn, Garth Huber, Pete Markowitz***

Potential of kaons for 3D structure studies of the proton

❑ Separated cross sections over a large range in Q^2 are essential for:

- ➤ testing hard-soft factorization required for studies of the proton's transverse spatial structure

- ➤ understanding dynamical effects in both Q^2 and $-t$ and interpretation of non-perturbative contributions in experimentally accessible kinematics

- ➤ could open a new domain for GPD study since virtually nothing is known concerning these quantities when strangeness is in play (PAC34)

PAC34: "This Hall C proposal to measure L-T separated kaon production and so test the expected approach to scaling of σ_L is critical to the GPD program. "

Potential in mapping the spatial extension of kaons

❑ Separated kaon cross sections at low values of t essential for:

- ➤ quantifying the role of the kaon pole required for extraction of the kaon form factor via $p(e,e'K^+)$
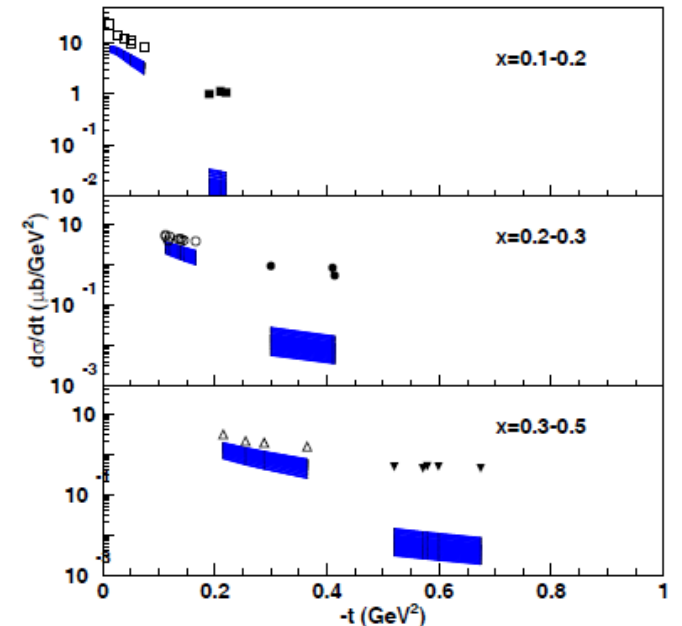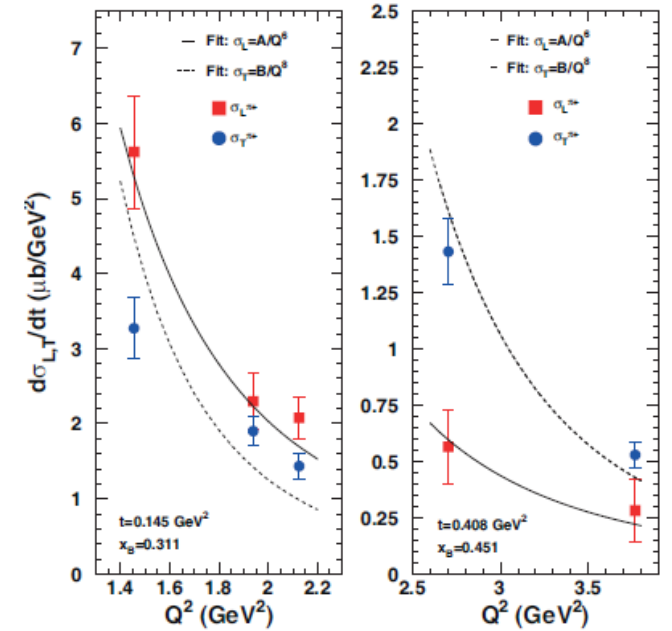
E12-09-011 Goals

PAC34: "…it is compulsory to first test that the regime of validity has been reached and this can be done by comparing the Q^2 variation of the cross section against the prediction of QCD. This is a solid physics case…."

**E12-09-011: Measure the separated cross section of K$^+$ production above the resonance region**

➢ *Separated cross sections: L, T, LT, TT over a wide range of Q^2, t-dependence*

❑ *The Q^2 dependence* will allow studying the scaling behavior of the separated cross sections

➢ 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 the resonace region

❑ *The t-dependence* allows for detailed studies of the reaction mechanism

➢ Contributes to understanding of the non-pole contributions, which should reduce the model dependence in interpreting the data

➢ Bonus: if warranted by data, extract the kaon form factor

T. Horn, C.D. Roberts, J. Phys. G43 (2016) no7, 073001
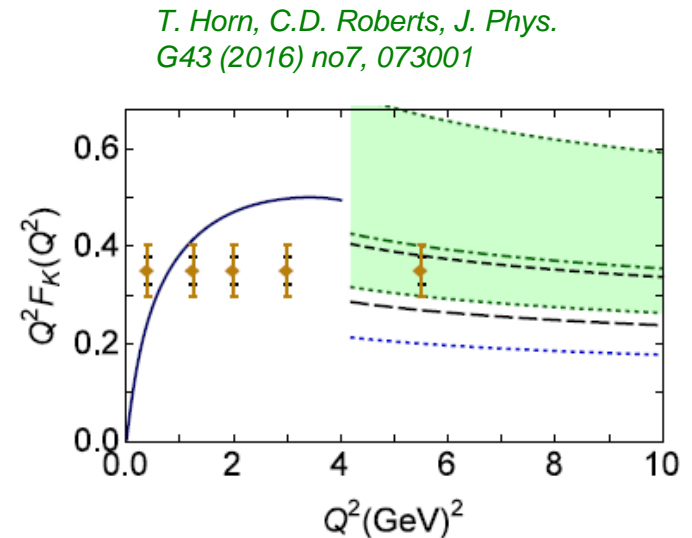
E12-09-011: Experimental Requirements

❑ Beam characteristics

  ➢ Energies: 3.8, 5.0, 5.6, 6.6, 7.4, 8.2, 8.8, 9.3, 10.9 GeV
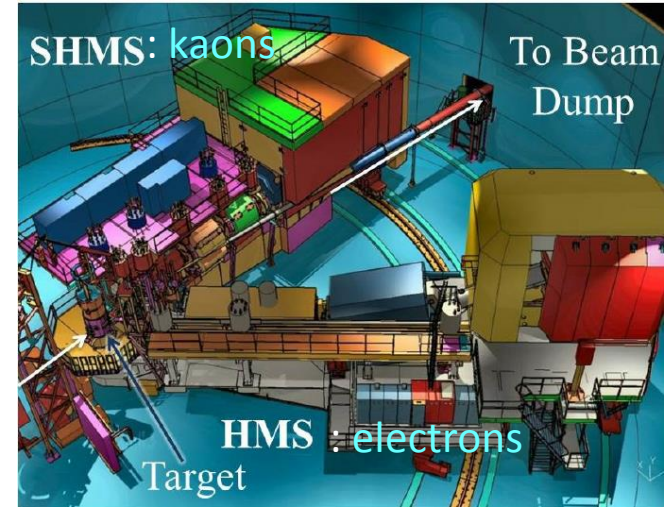
    (some flexibility on exact values)

  ➢ Currents: 70μA

❑ Targets: 10-cm LH2, LD2, Al dummy, carbon optics

❑ Spectrometers

  ➢ SHMS angles down to 5.6 deg while p_{SHMS}=5.2 GeV/c and E=7.4 GeV

  ➢ SHMS angles down to 6 deg while p_{SHMS}=7.1 GeV/c and E=9.3 GeV

❑ Detectors

  ➢ Standard SHMS&HMS package (e.g. tracking, calorimetry, PID) and aerogel Cherenkov detector in SHMS

Heavy gas Cherenkov (C_4F_{10} @ 1atm) for π^+/K^+ separation

Aerogel Cherenkov (n=1.011-1.03) for p/K^+ separation
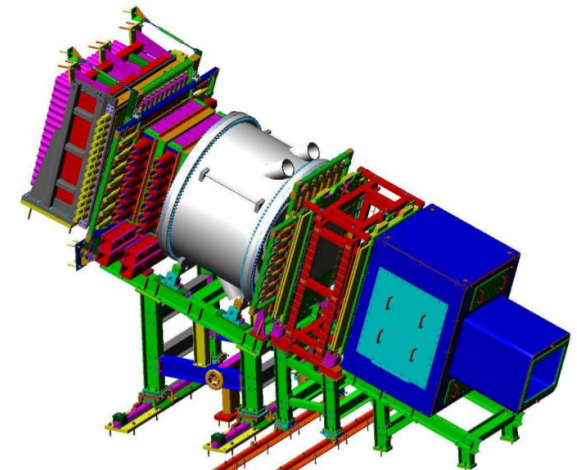
E12-09-011: collaboration

CUA, Regina, FIU, ANSL/Yerevan, MSU, Hampton, Jlab, Mount Allison, Saint Mary's, Umd, JMU, CalStateLA, CNU, Norfolk, USC, INFN, Ohio, WM

Extensive experience as this is the third generation of precision L/T separated meson production in Hall C

❑ Executed *kaon* production experiments in Hall A/C, e.g., E98-108 (Hall A), E93-018 (Hall C)

  M. Coman et al., *Cross sections and Rosenbluth separations in H-1(e,e' K+)L up to Q^2=2.35 GeV^2*, Phys. Rev. C**81** (2010) 052201

  R. Mohring et al., *Separation of longitudinal cross-sections in the p(e,e'K$^+$)Λ and p(e,e' K$^+$)Σ^0 reactions*, Phys. Rev. C**67** (2003) 055205

❑ Very similar to *pion* precision L/T separations in Hall A/C, executed successfully by the collaboration

  *J. Volmer, et al., Phys. Rev. Lett. **86** (2001) 1713*   *V. Tadevosyan, et al., Phys. Rev. C**75** (2007) 055205*

  *T. Horn, et al., Phys. Rev. Lett. **97** (2006) 192001*   *G. Huber, et al., Phys. Rev. C**78** (2008) 045203*

  *H. Blok, et al., Phys. Rev. C**78** (2008) 045202*   *T. Horn, et al., Phys. Rev. C**78** (2008) 058201*

  *G. Huber, et al., Phys. Rev. C**91** (2015) 015202*   *G. Huber, et al., Phys. Rev. Lett. **112** (2014) 182501*

  ❑ Expertise with *kaon detection* with aerogel Cherenkov detectors:

  *R. Asaturyan, et al., Nucl. Inst. Meth. A **458** (2005) 364*   *S. Marrone, et al., Nuevo Cim. B **124** (2009) 99*

  T. Horn, et al., arXiv:1607:05264 (2016)   *L. Lagamba, et al., Nucl. Inst. Meth. A **471** (2001) 325*

E12-09-011: resources and readiness

❑ Part of early running group in Hall C consisting of three experiments with common feature of tagging the active quark: E12-09-017, E12-09-002, E12-09-011

  ➢ Global Run Plan with phases ordered in priorities

❑ Resources:

  ➢ About 40 senior collaborators (not counting students/postdocs)

    o Approved for 40 PAC days (80 calendar days), or 240 shifts – project ~10 shifts/person

  ➢ Students: Salina Ali, Andres Vargas (CUA), Samip Basnet, Ryan Ambrose, Rory Evans (U. of Regina), Jonathan Castellanos (FIU)

  ➢ Postdocs: Arthur Mkrtchyan (CUA)

❑ Kaon particle identification detectors are ready (see relevant talk in detector readiness session)