Doubling of the Polarimeter in the GEP/SBS experiment

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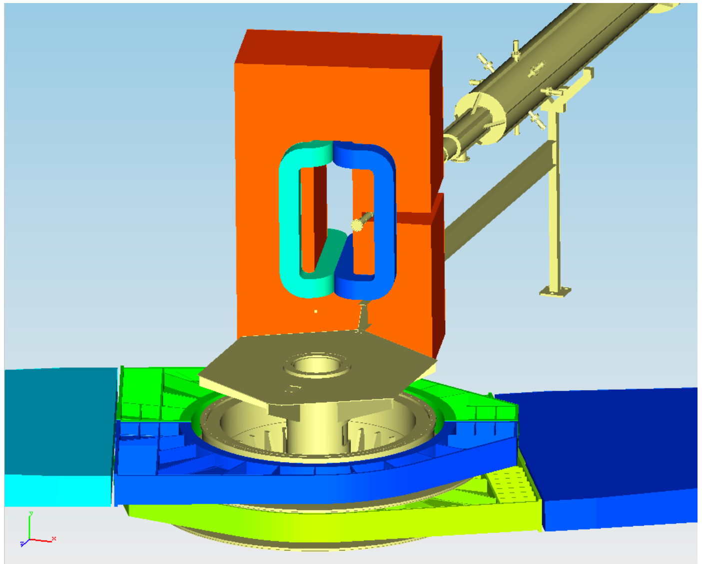
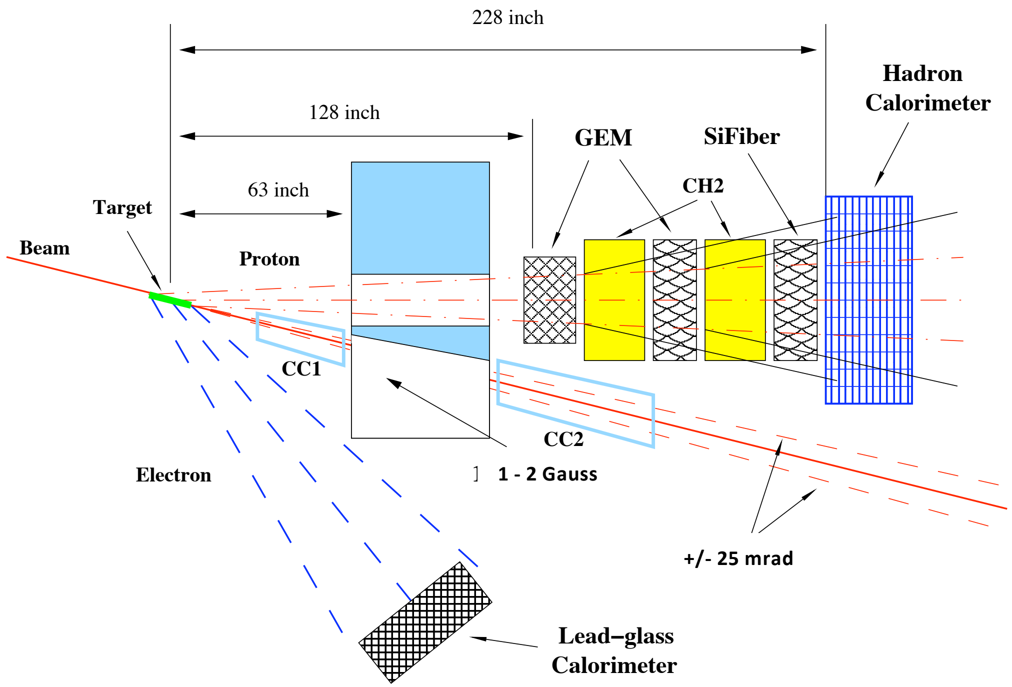
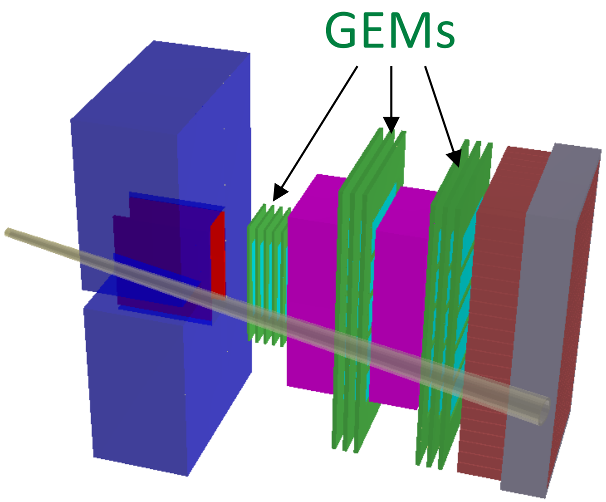
~~November 19, 2014~~

December 18, 2024

Super Bigbite "Poster"

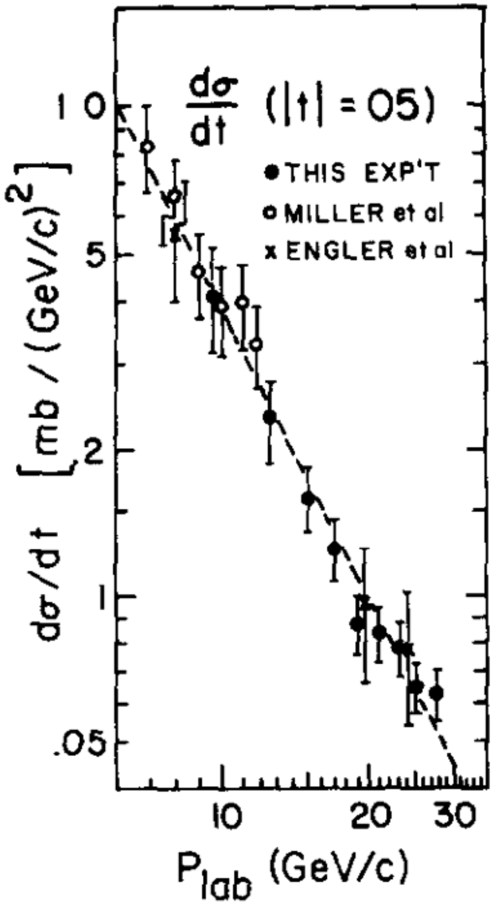






- Magnet: 48D48 - 46 cm gap, 2.5 Tesla*m
- Solid angle is 70 msr at angle 15 deg.
- GEM chambers with 70 μm resolution
- Momentum resolution is 0.5% for 8 GeV
- Angular resolution is 0.3 mrad

Elastic proton-proton scattering



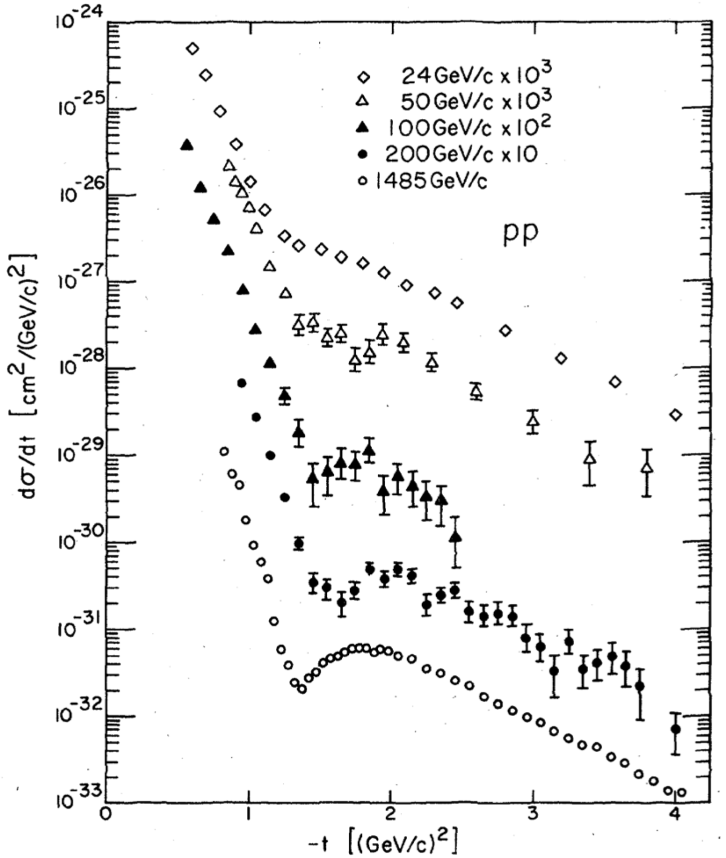


FIG. 21. Proton-proton elastic scattering between 24 and 1485 GeV/*c*. Data from this experiment and Refs. 14, 22, and

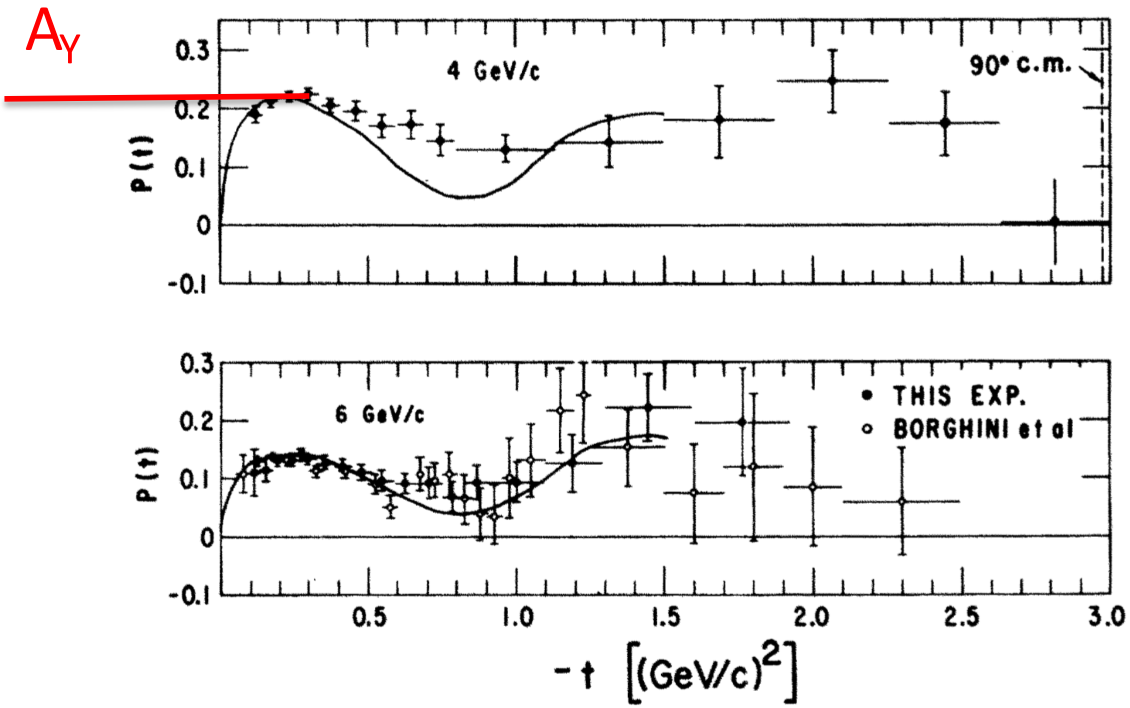
$$\frac{d\sigma}{dt} \propto 1/p_{lab}^{1.8}$$

$$\frac{d\sigma}{dt} \propto e^{-9 \cdot t}$$

at |t| < 1 GeV^2

A_Y in proton scattering

$$FoM = \int \frac{d\sigma}{dt} \cdot A_Y^2(t)dt$$



ANL (ZGS)
1970-1978

$$A_Y^{pp} \approx A_Y^{max} \cdot \frac{2}{\pi} \arctan(21|t|)$$

Proton elastic scattering

$$FoM = \int \frac{d\sigma}{dt} \cdot A_Y^2(t)dt$$

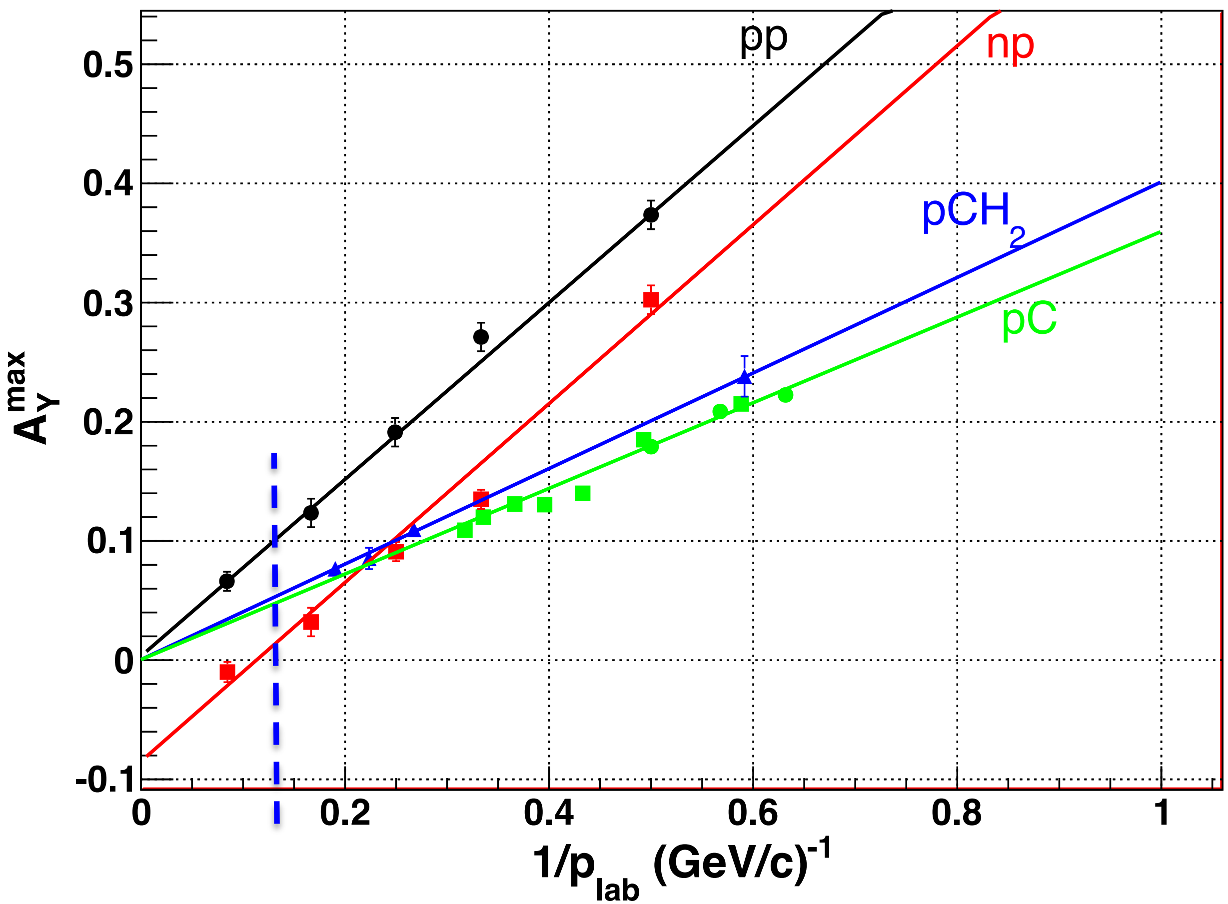
$$\frac{d\sigma}{dt} = 80[\frac{mb}{GeV^2}]e^{-9|t|}$$

$$A_Y^{pp} = 0.10 \cdot \frac{2}{\pi} \arctan(21|t|)$$

FoM = 0.0203 for |t| from 0 to 0.5 $(GeV/c)^2$

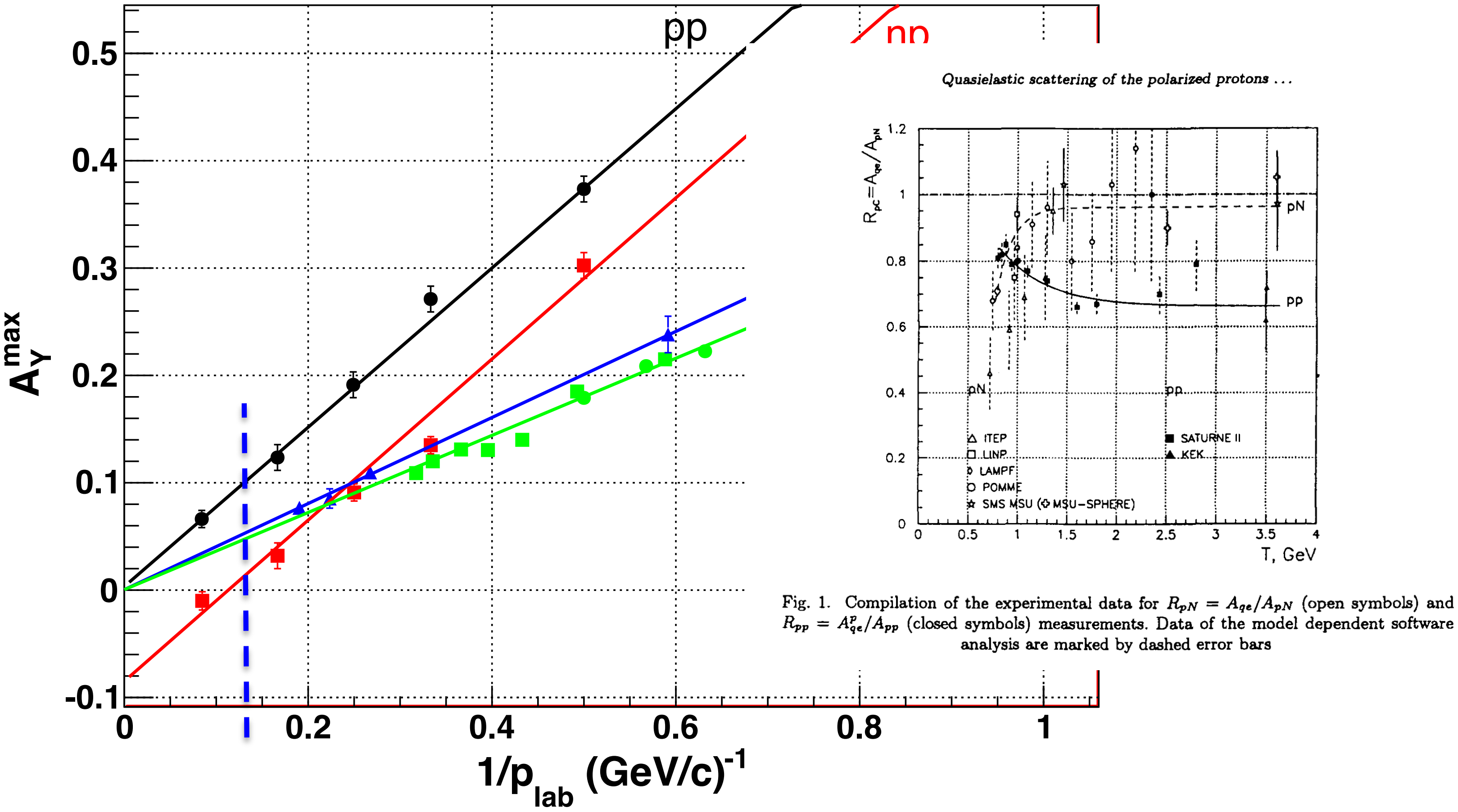
for 8 protons in CH_2 analyzer out of 14 nucleons

A_Y in proton scattering



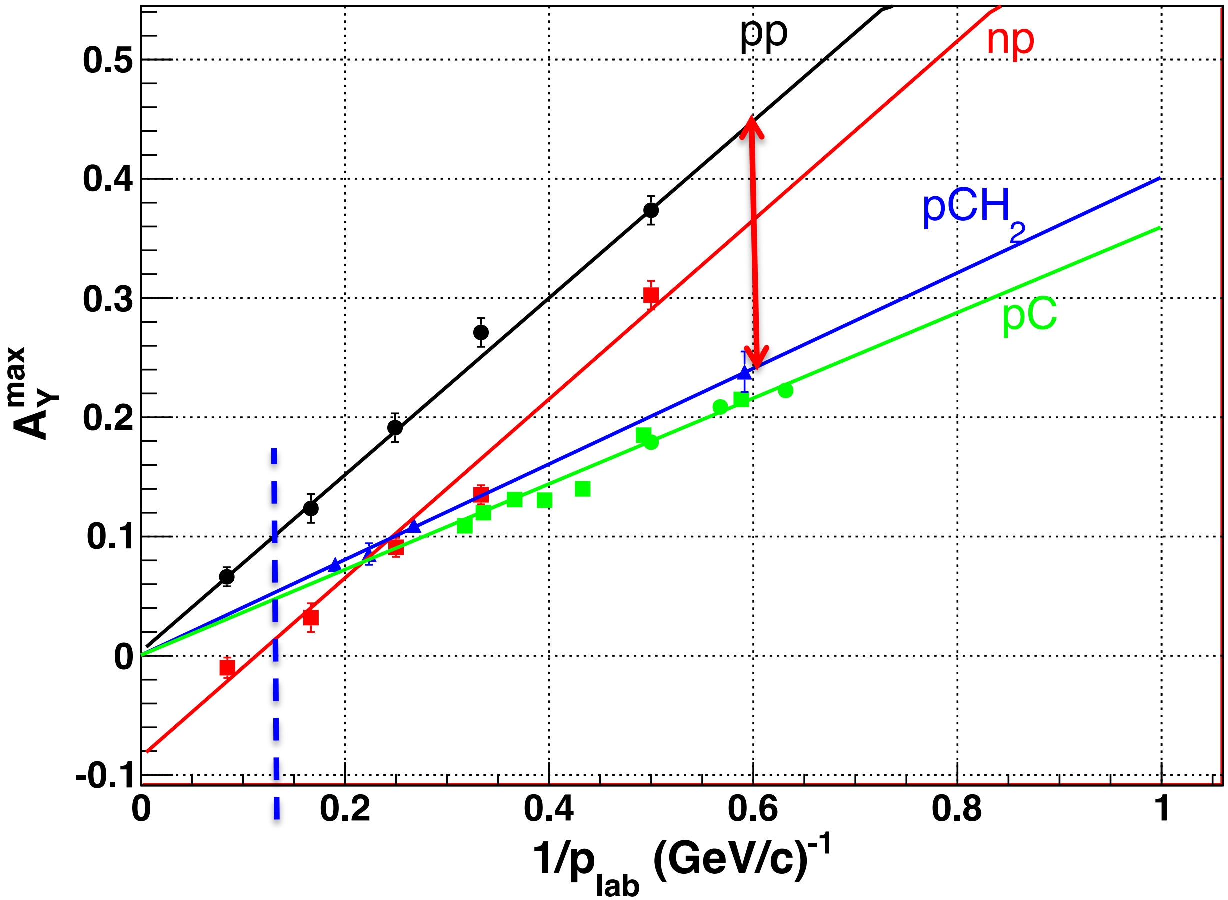
The reduction factor of the proton-Carbon A_Y due to Fermi/FSI is about 0.82 (at p_{lab}=7.3 GeV/c).

A_Y in proton scattering



The reduction factor of the proton-Carbon A_Y due to Fermi/FSI is about 0.82 (at p_{lab}=7.3 GeV/c).

A_Y in proton scattering



The proton-CH_2 A_Y is about half of A_Y for the proton-H from which ~ 0.8 is due to the loss of A_Y for p – bound p and a bigger loss due to p-n scattering

Proton elastic scattering

$$FoM = \int \frac{d\sigma}{dt} \cdot A_Y^2(t)dt$$

$$\frac{d\sigma}{dt} = 80[\frac{mb}{GeV^2}]e^{-9|t|}$$

$$A_Y^{pp} = 0.10 \cdot \frac{2}{\pi} \arctan(21|t|)$$

FoM = 0.0203 for |t| from 0 to 0.5 $(GeV/c)^2$

for 8 protons in CH_2 analyzer out of 14 nucleons

after correction for QE A_Y and all nucleons: FoM = 0.0086

Charge-Exchange scattering

Volume 31B number 9 PHYSICS LETTERS 27 April 1970

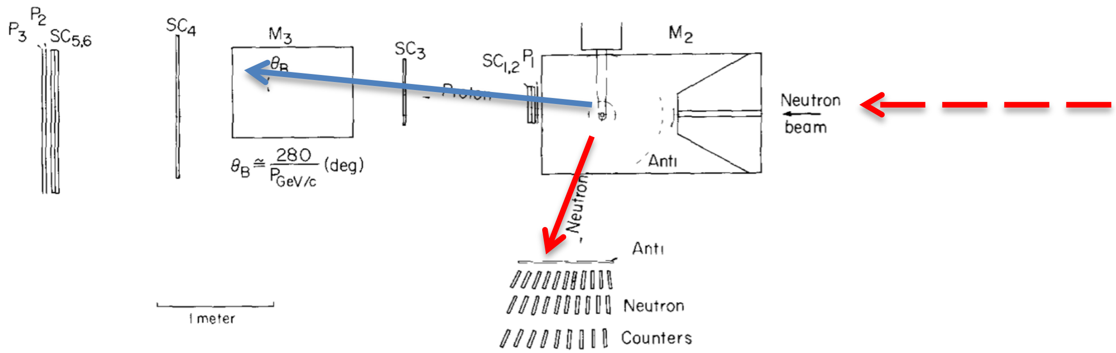


Fig 1 Side view of the experimental arrangement M2 is the polarized target magnet. The neutron bema entered through a hole in the return yoke of this magnet. M3 is the analyzing magnet in the proton spectrometer.

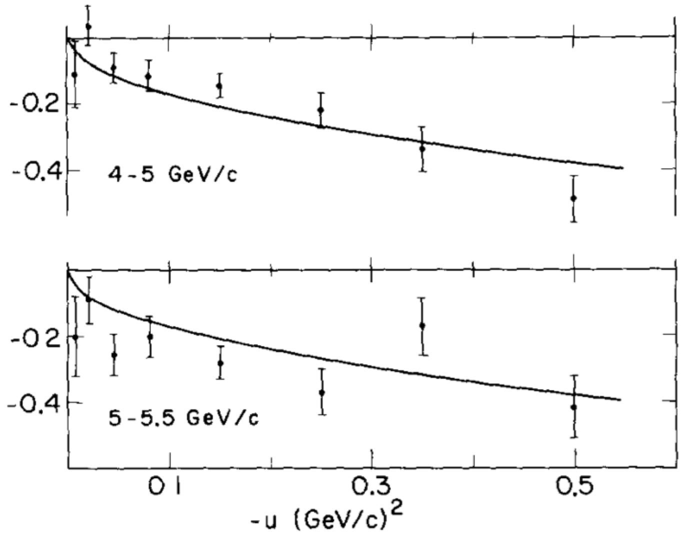
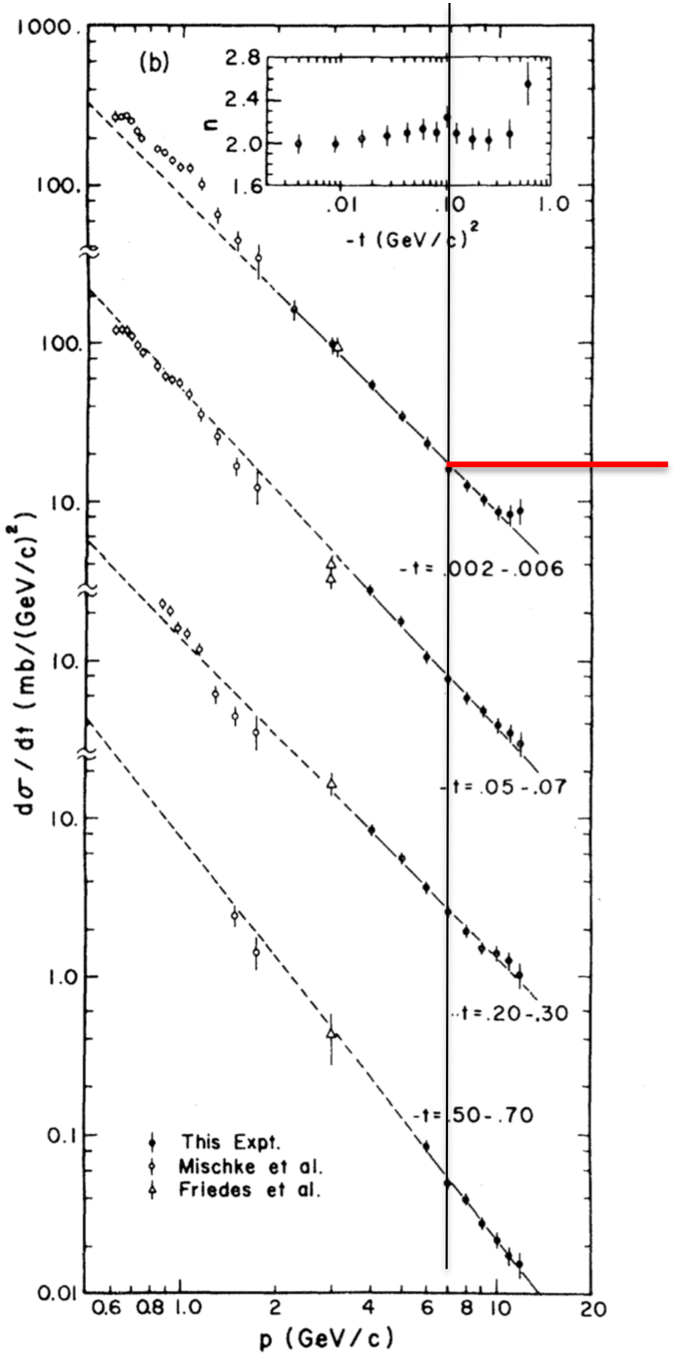


Fig. 2. Measured values of the polarization P in backward np scattering for the indicated values of incident

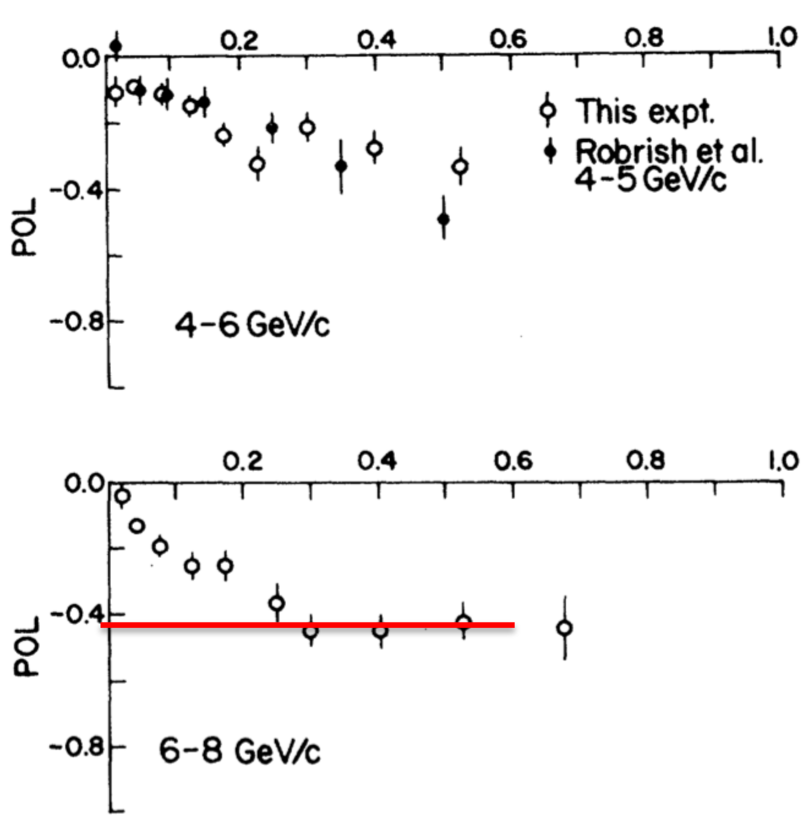
motivated by a recent suggestion for GEn-RP proposal: J.Annand/N.Piskunov

Proton to Neutron Ch-Ex scattering



Miller et al, PRL 1971

Abolins et al, PRL 1973



$$A_Y^{ch/ex} \approx A_Y^{max} \cdot \frac{2}{\pi} \arctan(7|t|)$$

Proton to Neutron Ch-Ex scattering

$$FoM = \int \frac{d\sigma}{dt} \cdot A_Y^2(t)dt$$

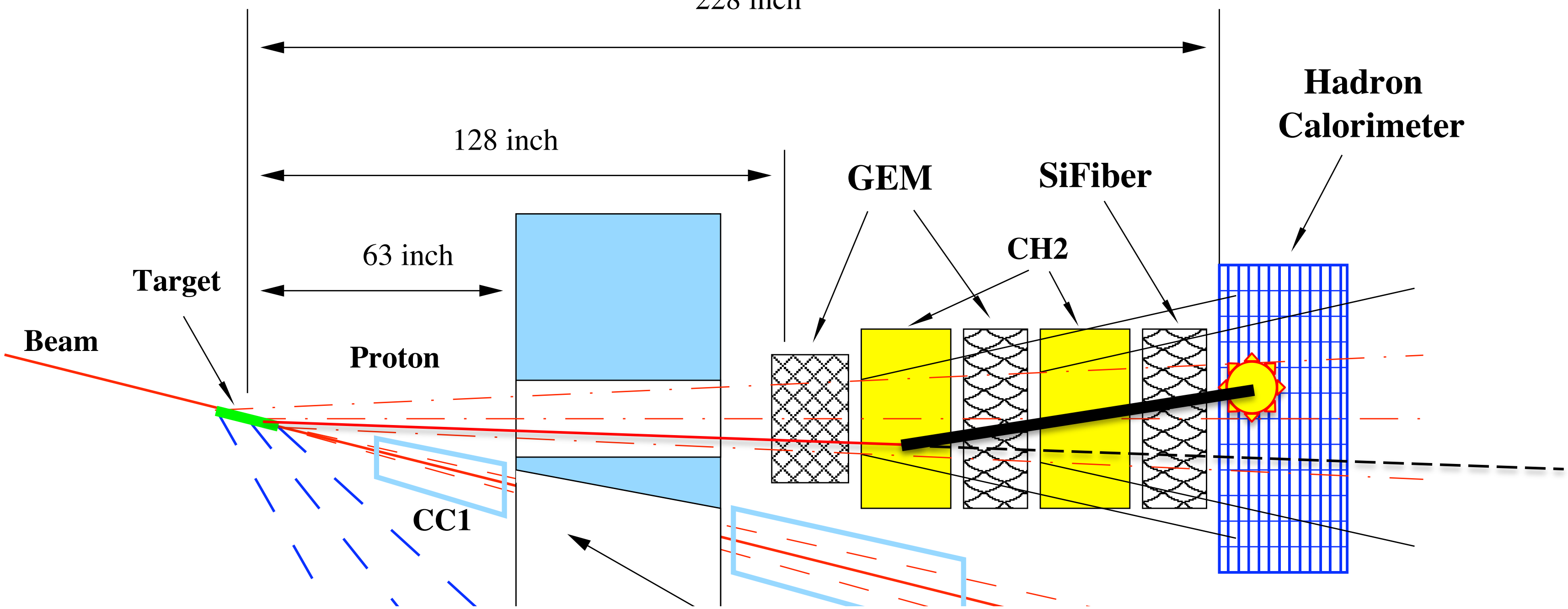
$$\frac{d\sigma}{dt} = 1.5[\frac{mb}{GeV^2}]e^{-5|t|}$$

$$A_Y^{ch/ex} = 0.45 \cdot \frac{2}{\pi} \arctan(9|t|)$$

FoM = 0.0098 for |t| from 0 to 0.5 $(GeV/c)^2$

for 6 neutrons in CH_2 analyzer out of 14 nucleons

Ch-Ex polarimeter



$P_{\perp}/P_{lab} =$ 0.5 GeV/c / 7.3 GeV/c ~ 4 deg -> 11-15 cm radius

.

$$\delta\phi \approx 15^{\circ}$$

Summary

- The FoM of the pCH_2->nX is estimated to be similar to the one for the pCH_2-> pX => double overall FoM!

- A MC study of the Ch-Ex polarimeter at GEP condition is needed

- An empirical test at JINR would be interesting to do - DONE

- The application for the GEn with the recoil polarimeter is being considered by John Annand – DONE

G(E(p)) / G(M(p)) ratio by polarization transfer in polarized e p ---> e polarized p

Jefferson Lab Hall A Collaboration • M.K. Jones et al. (Oct, 1999)

Published in: *Phys.Rev.Lett.* 84 (2000) 1398-1402 • e-Print: nucl-ex/9910005 [nucl-ex]

pdf links DOI cite claim reference search 1,000 citati

arXiv:2412.10598 [pdf, other] hep-ph hep-ex hep-lat nucl-ex

Likelihood of a zero in the proton elastic electric form factor

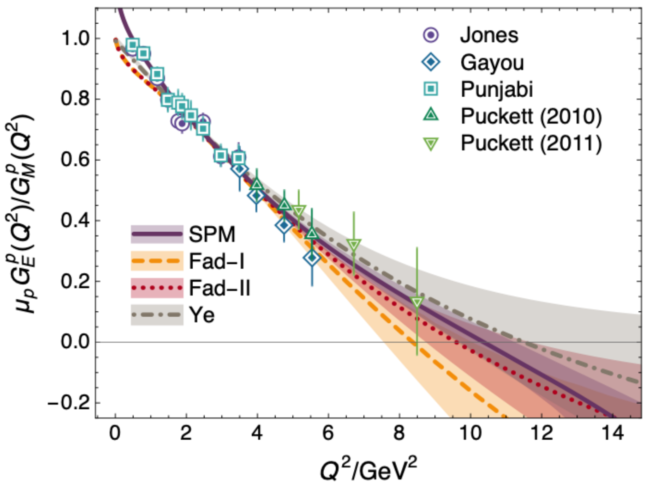


Figure 5: Final SPM prediction for the ratio $\mu_p G_E^p(Q^2)/G_M^p(Q^2)$. For comparison, the image also depicts the parameter-free Faddeev equation predictions [31, Fad-I, Fad-II] and the result obtained via a subjective phenomenological fit to the world's electron + nucleon scattering data [50, Ye]. The displayed data are from Refs. [21–25].

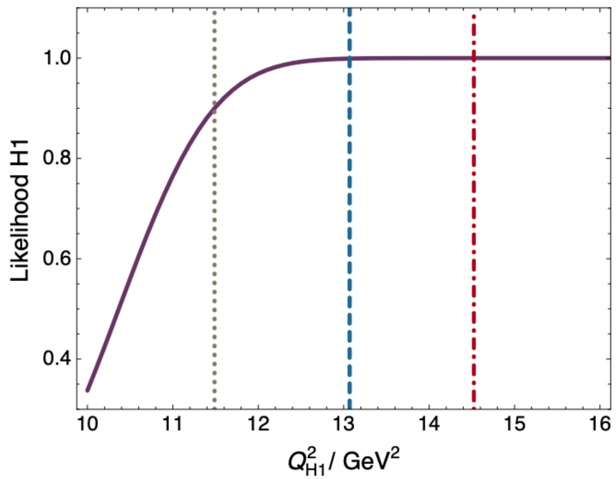


Figure 6: SPM prediction for likelihood that available data on $\mu_p G_E^p(Q^2)/G_M^p(Q^2)$ are consistent with a zero in the proton electric form factor on $Q^2 < Q^2_{H1}$. The 90% and 99.9% confidence limits are marked by vertical dotted and dashed lines, respectively. The boundary associated with H2 is marked by the red dot-dashed line; namely, the likelihood that available data are inconsistent with a zero to the left of this line is 1/1-million.