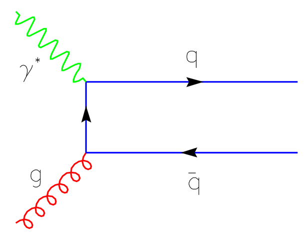
Recent Results at HERMES

Spin Asymmetry of Pairs of High p_T Hadrons

High p_T Hadron Pairs

$\frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L_z$

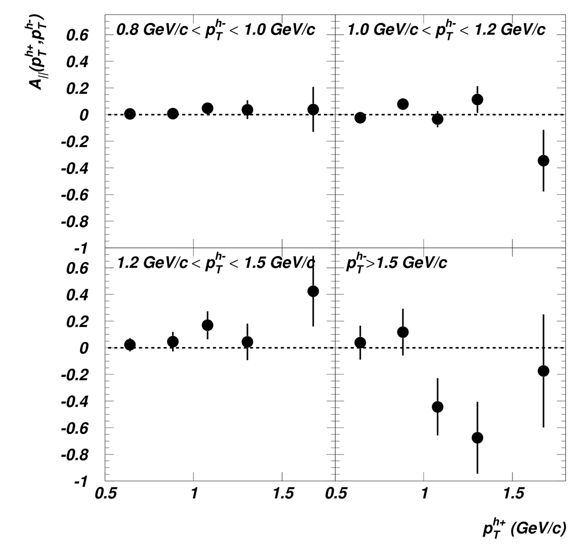
- Isolation of photon gluon fusion process
  $\rightarrow$ sensitivity to **gluon distribution**
- Spin asymmetry in photon gluon fusion
  $\rightarrow$ sensitivity to **gluon polarization** $\Delta G/G$



HERMES: measure asym of pairs of hadrons at high p_T

- require at least **two hadrons of opposite charge**
- require $M(2\pi) > 1.0$ GeV/c^2 to remove ρ and ϕ resonances
- do not require scattered e^+ in spectrometer
  $\Rightarrow$ **photoproduction** ($Q^2 \simeq 0$)

Measured Asymmetry

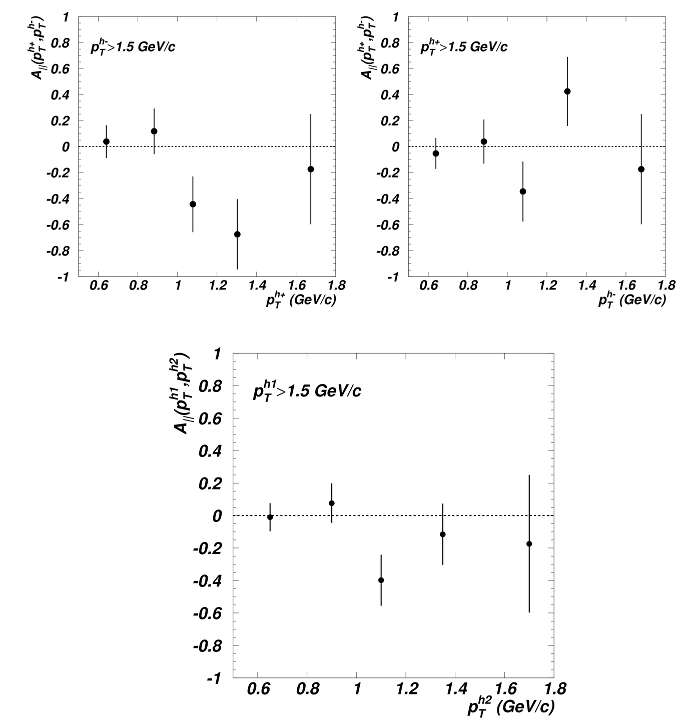


Systematic error $\simeq$ 6% of measurement

Checks that have been performed on the data:

- $e^+ - h^+$ misidentification
- particle identification cut variation
- momentum ($\sim z$) cut variation
- consistent result obtained using identified pions only

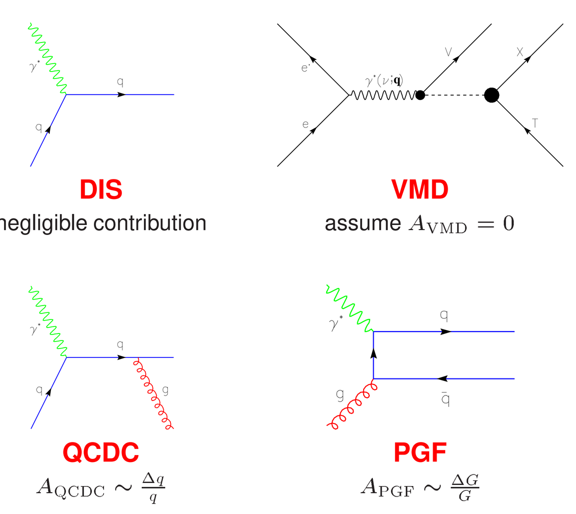
Region of Interest



systematic error $\simeq$ 6% of measurement

Interpretation

Assume four different processes may contribute:



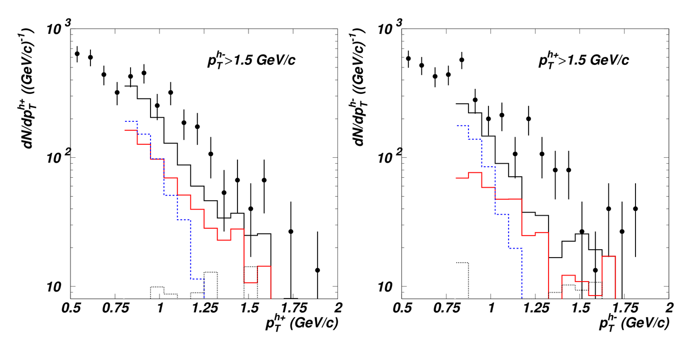
... estimate their relative contributions using PYTHIA

$\rightarrow$ extract $\Delta G/G$

NOTE: Possible contribution from anomalous photon neglected, expected to be small at these energies.

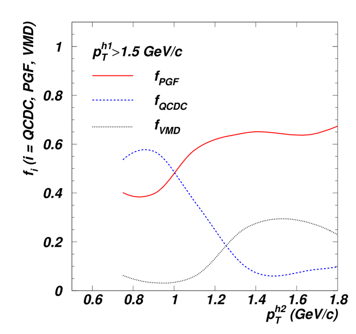
MC-Data Comparisons

Comparisons of measured yields with predictions of model implemented in PYTHIA.



solid black = total yield
solid red = PGF
dashed blue = QCDC
dotted black = VMD

Data are interpreted in terms of $\Delta G/G$ only in region where PYTHIA model is independent of $p_T^{\min}$ cutoff parameter.

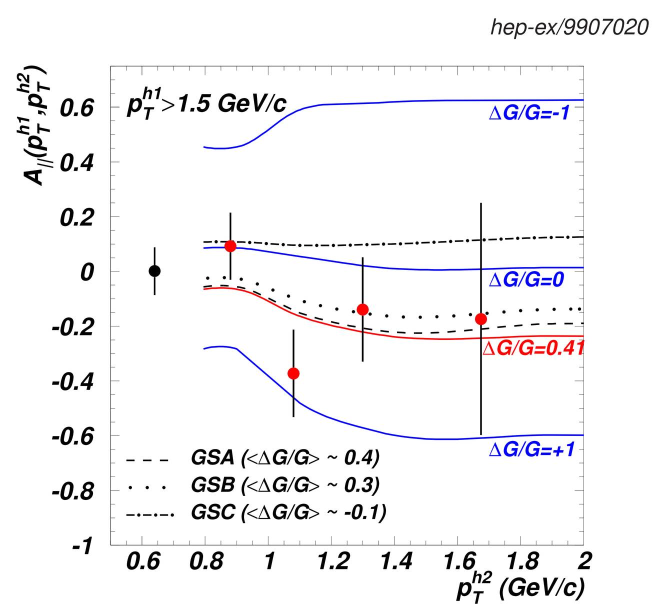


Result Using PYTHIA Model

$\Delta G/G = 0.41 \pm 0.18$(stat) ± 0.03 (exp. syst)

at $\langle x_G \rangle = 0.17$ and $\langle \hat{p}_T^2 \rangle = 2.1$ GeV/c^2

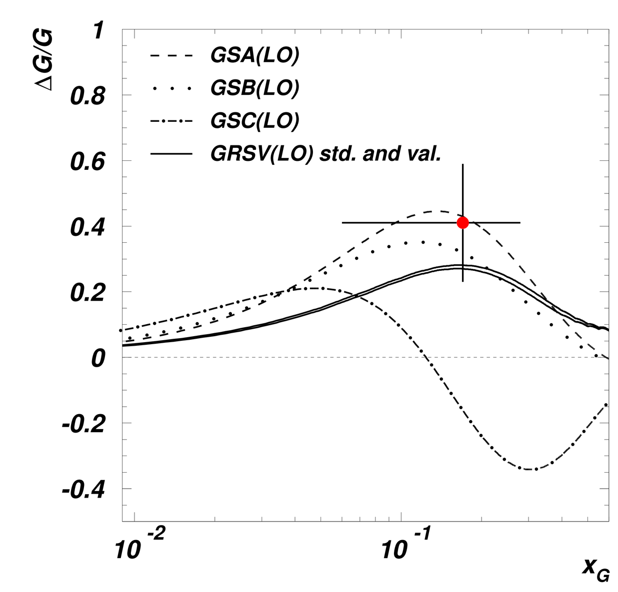
hep-ex/9907020



Unknown theoretical uncertainty from contribution and spin asymmetry of anomalous photon and NLO QCD corrections. If only a dilution, value of $\Delta G/G$ will increase but significance of deviation from zero will not change.

Gluon Polarization

HERMES has measured the spin asymmetry of pairs of hadrons at high p_T: Only known source of observed negative polarization is photon-gluon fusion process and **positive gluon polarization**

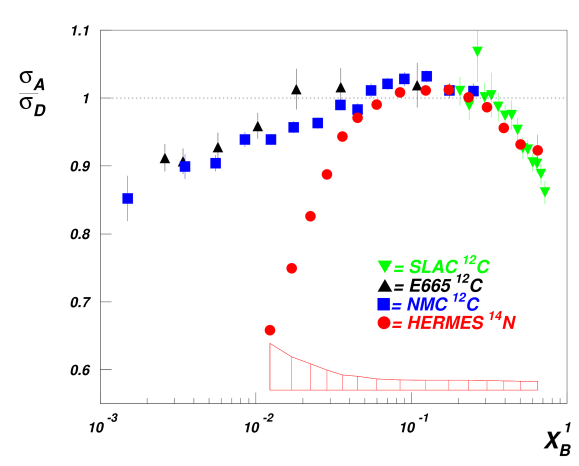


HERMES will also study ΔG via polarized charm production, assisted by the RICH and muon detection upgrades

A-Dependence or $R = \sigma_L/\sigma_T$

Cross section ratio ^{14}N/D

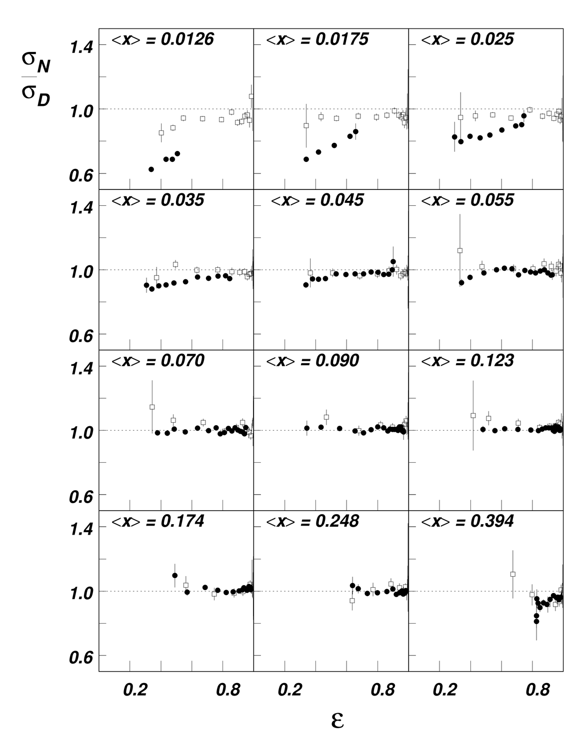
$$\frac{\sigma_A}{\sigma_D} = \frac{F_2^A}{F_2^D} \frac{(1+\epsilon R_A)(1+R_D)}{(1+R_A)(1+\epsilon R_D)}$$



HERMES and NMC data points overlap in x and Q^2, but cover different ranges in ϵ (γ polarization parameter)

$\rightarrow$ possible sensitivity to A-dependence of $R = \sigma_L/\sigma_T$

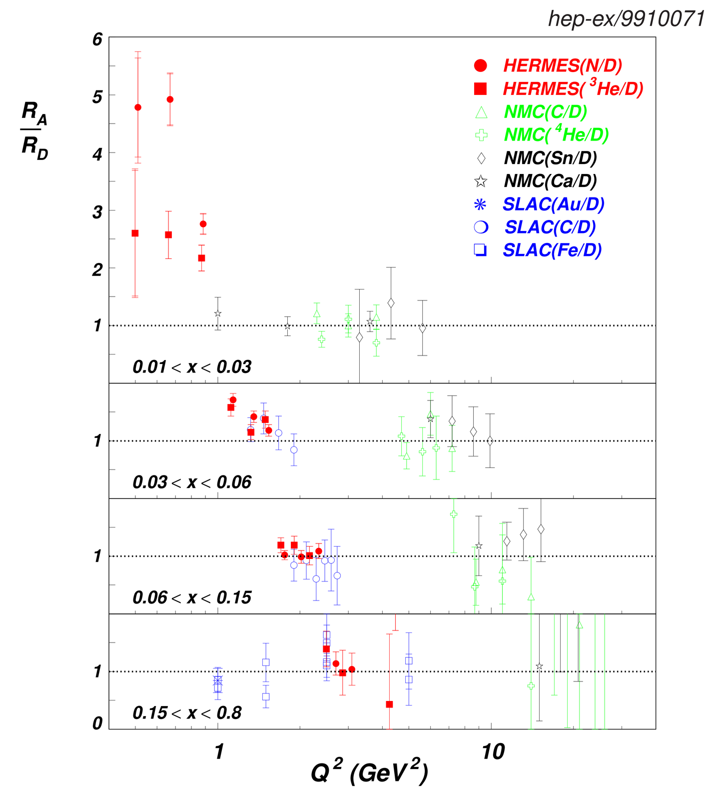
Cross section ratio vs ϵ



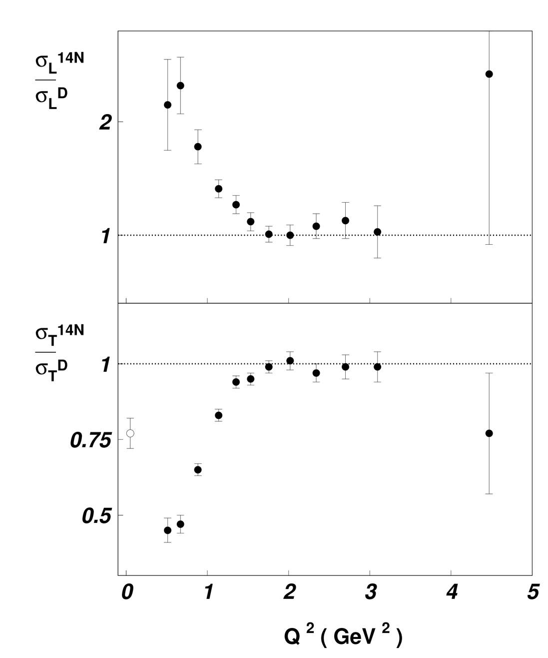
HERMES (solid) and NMC (open) points are at different Q^2 values

A-Dependence of $R = \sigma_L/\sigma_T$

hep-ex/9910071



A-Dependence of σ_L and σ_T



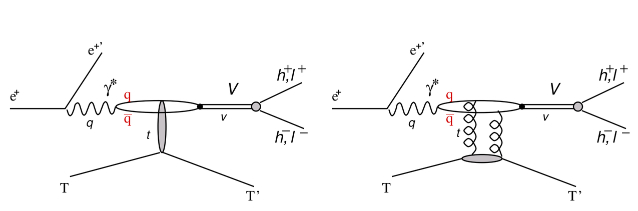
Possible Interpretation

- Twist-4 effect in nuclei (scales as $1/Q^2$)?
- Nuclear gluon fields?
- Shadowing differences for σ_L and σ_T?

Double Spin Asymmetry in Diffractive ρ Production

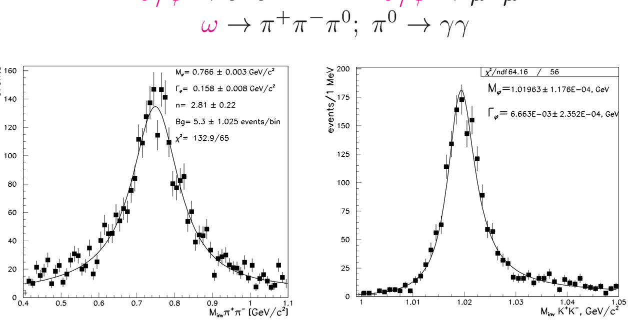
Spin Asymmetry in Diffractive Vector Meson Production

Naive expectation: **no spin dependence**
(e.g. exchange of 0^{++} Pomeron)

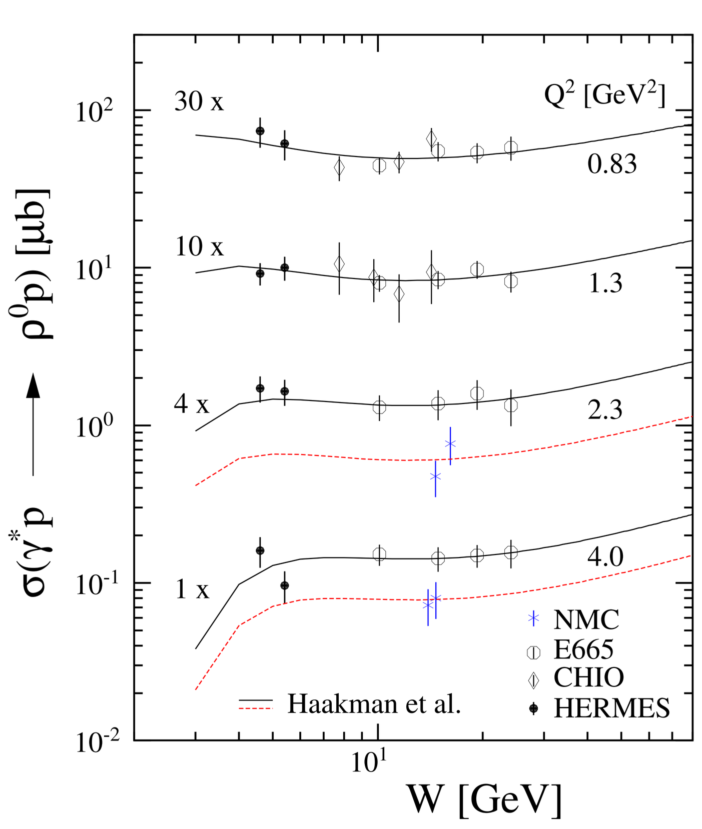


Channels reconstructed at HERMES

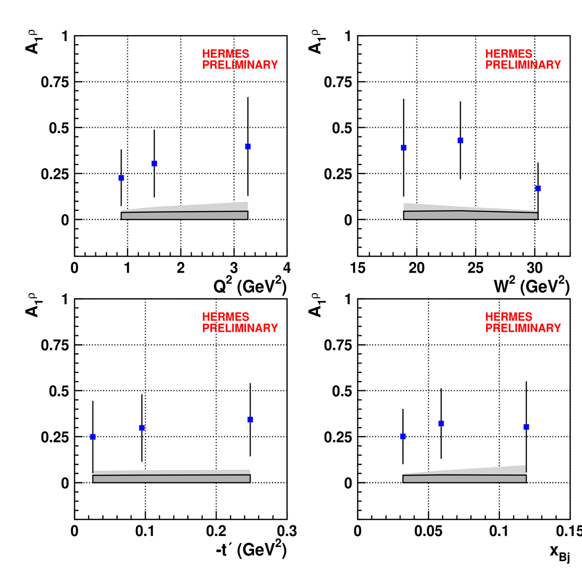
$\rho^0 \rightarrow \pi^+\pi^-$ $\quad$ $\phi \rightarrow K^+K^-$
$J/\psi \rightarrow e^+e^-$ $\quad$ $J/\psi \rightarrow \mu^+\mu^-$
$\omega \rightarrow \pi^+\pi^-\pi^0$; $\pi^0 \rightarrow \gamma\gamma$



Diffractive ρ Cross-Section



Photon Absorption Asymmetry



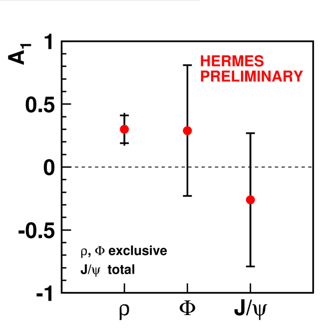
Maximum possible contribution of unknown A_2^ρ added in quadrature to experimental systematic uncertainty $\Rightarrow$ light gray error band

$A_1^\rho = 0.30 \pm 0.11(\mathrm{stat}) \pm 0.04(\mathrm{sys}) \pm 0.05(\mathrm{theor})$

$\Rightarrow$ Evidence of non-trivial spin structure in diffractive vector meson production

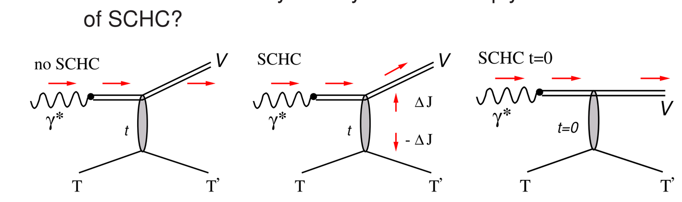
Possible Interpretations

Diffractive VM production related to ΔG?
already at the low mass of the ρ?
(M. Ryskin, hep-ph/9706505)



Spin density matrix elements

measured via angular distributions in VM production
$\rightarrow$ extraction of $R = \sigma_L/\sigma_T$ assuming SCHC.
Does a non-zero asymmetry at small t imply a violation of SCHC?



Off-forward parton distributions

Asymmetry in diffractive pair production of charged mesons and exclusive ρ production may give access to OFPD's? (A. Schaefer et al. hep-ph/9901283)

A significant non-zero asymmetry in diffractive ρ production is an unexpected and exciting result, which is presently without theoretical explanation.