ρ^0 Transverse Target Spin Asymmetry at HERMES

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Outline

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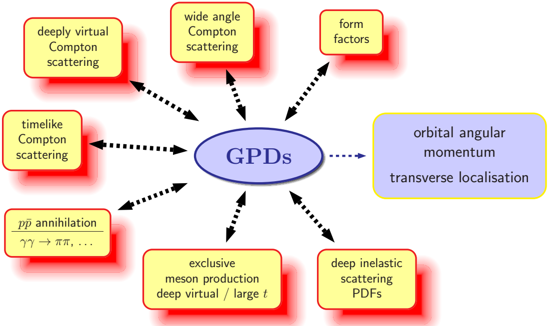
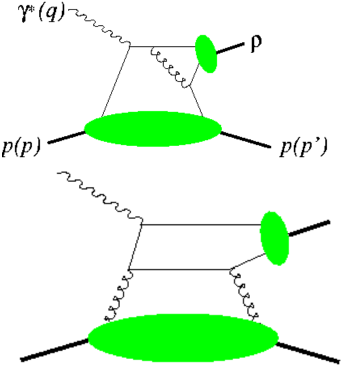
Generalized Parton Distribution Functions and Ji sum rule

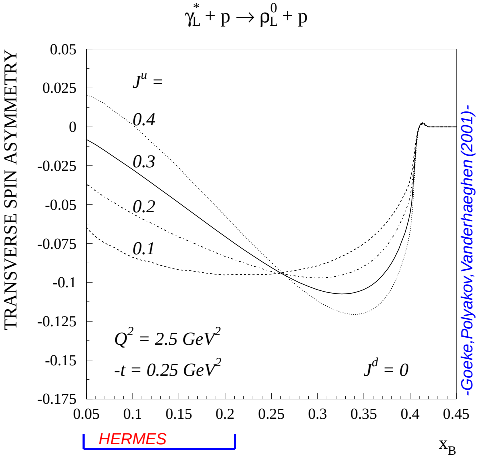


- Vector mesons (..ρ, ϕ..): unpolarized GPDs: H E (AUT sensitive)
- Ji sum rule:(Ji,PRL 78(1997) 610)

$$\frac{1}{2}\int_{-1}^{1} dx\, x\, [H(x,\zeta,t)+E(x,\zeta,t)] \overset{t\to 0}{=} J_q$$

Why ρ^0, production mechanism and sensitivity





- Sensitive to quark and gluon exchange

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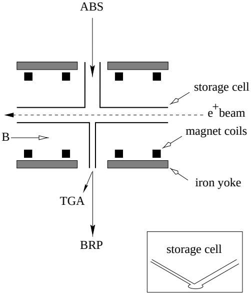
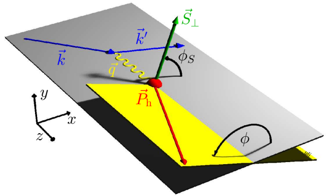
THE POLARISED TARGET



- Dataset 2002, 2003, 2004, 2005 Data, Integrated Luminosity $171.6pb^{-1}$
- Pure Gaseous Polarised Target, with high Polarisation $\approx$ 75
- Flip of helicity every 90 sec in 0.5 sec, very small systematics

Production Kinematics,angles



- Angles define according to Trento convention

$$A_{UT} = -\frac{\pi}{2}\mathcal{A}_{GPV}$$

- ϕ is angle between lepton and hadron planes
- $\vec{S}_\perp$ is spin vector transverse to photon momentum
- ϕ_S is angle between lepton plane and $\vec{S}_\perp$

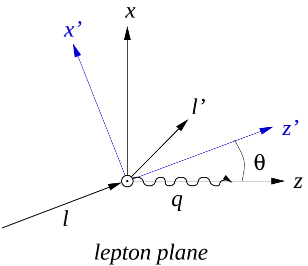
Transverse Target Spin Asymmetry

- Transverse target polarization relative to lepton beam direction (measured):

$$A^{l}_{UT}(\phi,\phi_S) = \frac{1}{P_T}\frac{d\sigma(\phi,\phi_S)-d\sigma(\phi,\phi_S+\pi)}{d\sigma(\phi,\phi_S)+d\sigma(\phi,\phi_S+\pi)}$$

- Transverse target polarization relative to virtual photon direction:

$$A^{\gamma^*}_{UT}(\phi,\phi_S) = \frac{1}{S_\perp}\frac{d\sigma(\phi,\phi_S)-d\sigma(\phi,\phi_S+\pi)}{d\sigma(\phi,\phi_S)+d\sigma(\phi,\phi_S+\pi)}$$



$$P_T A^{l}_{UT}(\phi_S) = S_T(\theta_\gamma,\phi_S)A^{\gamma^*}_{UT}(\phi_S) + S_L(\theta_\gamma,\phi_S)A^{\gamma^*}_{UL}$$

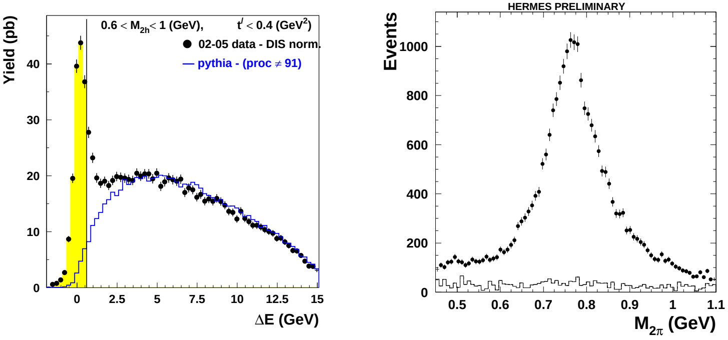
$$\left|\frac{S_L}{S_T}\right| < 0.15$$

Outline

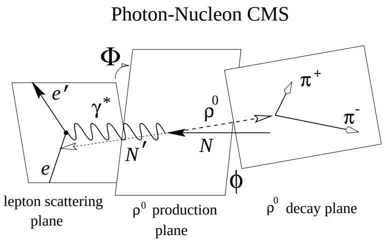
- Kinematic cuts:
  $W^2 > 4GeV^2,\ Q^2 > 1GeV^2,\ y < 0.85$
- Exclusive cuts:
  $0.6 < M_{2\pi} < 1.0GeV,\ \Delta E < 0.6GeV,\ -t' < 0.4GeV^2$
- Take into account beam polarization related terms in fit procedure
- Monte Carlo studies
  - Determine background contamination
  - Acceptance effects
  - Cross Contamination between asymmetry moments
  - Check L-T separation
  - Kinematic dependencies of Acceptance/Asymmetry

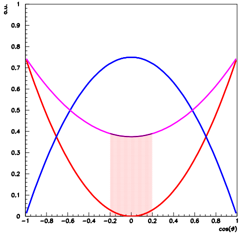
Exclusive Production

- $ep \to e'p\rho^0$, $\rho^0 \to \pi^+\pi^-$
- Exclusive ρ^0 through Energy and Momentum transfer
- $\Delta E = \frac{M_x^2 - M_p^2}{2M_p}$, $t' = t - t_0$



ρ^0_L, ρ^0_T Separation





- Each ρ^0 polarization state has a characteristic decay angular distribution
- Can use ρ^0 CM angle $\Theta_{\pi\pi}$ of π-meson to separate ρ^0_L, ρ^0_T

- (Diehl, Sapeta: hep-ph/0503023)

$$W(P_T, \cos\theta_{\pi\pi}, \phi, \phi_S) \propto$$
$$\Big[\cos^2\theta_{\pi\pi} \; r^{04}_{00} \left(1 + P_T A^{l}_{UT,\rho_L}(\phi,\phi_S) + A_{UU,\rho_L}(\phi)\right) +$$
$$\frac{1}{2}\sin^2\theta_{\pi\pi} \; (1 - r^{04}_{00})\left(1 + P_T A^{l}_{UT,\rho_T}(\phi,\phi_S) + A_{UU,\rho_T}(\phi)\right) \Big]$$

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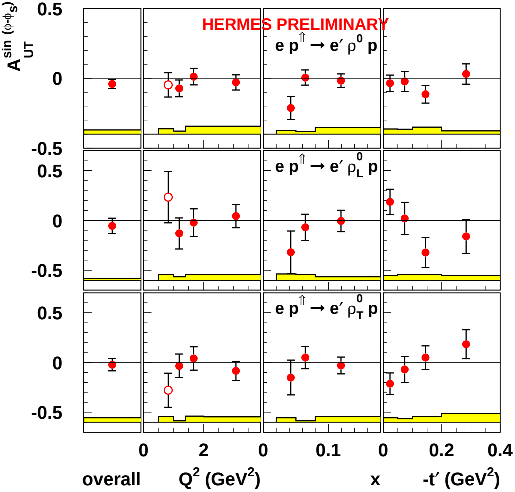
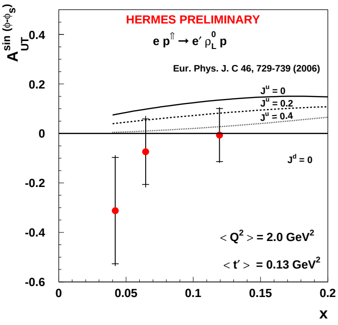
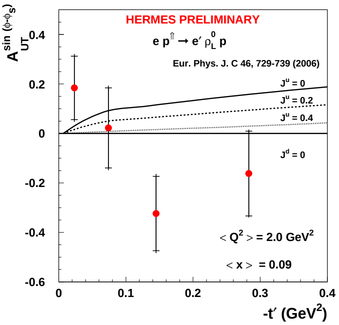


- assuming SCHC holds we can compare with Theory

Comparison with GPD prediction





- Data hints positive J^u
- In agreement with HERMES DVCS result

- First extraction of $A_{UT}^{\sin(\phi-\phi_S)}$
- In SCHC separately for ρ_L^0 and ρ_T^0 by using a fit on the $\phi, \phi_S, \cos\theta_{\pi\pi}$ distributions
- ϕ-meson A_{UT} results coming soon