Physics behind our measurement, why $ ho^0$	HERMES Experiment	Analysis	Results

# $ho^{0}$ Transverse Target Spin Asymmetry at HERMES

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#### 1 Physics behind our measurement, why $\rho^0$

- Generalized Parton Distribution Functions and Ji sum rule
- Why  $\rho^0$ , production mechanism and sensitivity

### 2 HERMES Experiment

- Transverse Target Spin Asymmetry
- 3 Analysis
  - Data Processing
  - Exclusive Production
  - $\rho_L^0$ ,  $\rho_T^0$  Separation

#### 4 Results

- Comparison with GPD prediction
- Summary and Outlook

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Generalized Parton Distribution Functions and Ji sum rule

#### Generalized Parton Distribution Functions and Ji sum rule



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

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Why  $\rho^0$ , 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<sup>-1</sup>
- Pure Gaseous Polarised Target, with high Polarisation pprox 75
- Flip of helicity every 90 sec in 0.5 sec, very small systematics



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Transverse Target Spin Asymmetry

#### Production Kinematics, angles



Angles define according to Trento convention

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



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HERMES Experiment ○●	Analysis o o o	Results o o
	HERMES Experiment ⊙●	HERMES Experiment Analysis ○● ○ ○

Transverse Target Spin Asymmetry

Transverse Target Spin Asymmetry Transverse target polarization relative to lepton beam direction (measured):

$$A_{UT}^{I}(\phi,\phi_{s}) = \frac{1}{P_{T}} \frac{d\sigma(\phi,\phi_{s}) - d\sigma(\phi,\phi_{s}+\pi)}{d\sigma(\phi,\phi_{s}) + d\sigma(\phi,\phi_{s}+\pi)}$$

Transverse target polarization relative to virtual photon direction:

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



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Data Processing			

- Kinematic cuts:  $W^2 > 4 GeV^2$ ,  $Q^2 > 1 GeV^2$ , y < 0.85
- Exclusive cuts:

 $0.6 < \textit{M}_{2\pi} < 1.0 \textit{GeV}, \ \Delta\textit{E} < 0.6 \textit{GeV}, \ -\textit{t}' < 0.4 \textit{GeV}^2$ 

- 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



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Exclusive Production			

$$e \rho \rightarrow e' \rho \rho^{0}, \rho^{0} \rightarrow \pi^{+} \pi^{-}$$

$$Exclusive \rho^{0} through Energy and Momentum transfer$$

$$= \Delta E = \frac{M_{x}^{2} - M_{p}^{2}}{2M_{p}}, t' = t - t_{0}$$

$$\int_{0}^{0} \int_{0}^{0.6 < M_{2n} < 1 (GeV), t' < 0.4 (GeV^{2}) \\ - 02.05 data - DIS norm - pythia - (proc + 91) \\ - 02.05 data - DIS norm - pythia - (proc + 91) \\ - 02.05 data - DIS norm - pythia - (proc + 91) \\ - 0.05 data - DIS norm - pythia - (proc + 91) \\ -$$

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#### $\rho_L^0, \rho_T^0$ Separation



 $W(P_T, \cos \theta_{\pi\pi}, \phi, \phi_s) \propto$ 

(Diehl, Sapeta: hep-ph/0503023)



- Each ρ<sup>0</sup> polarization state has a characteristic decay angular distribution
- Can use  $\rho^0$  CM angle  $\Theta_{\pi\pi}$  of  $\pi$ -meson to separate  $\rho_L^0$ ,  $\rho_T^0$

$$\begin{bmatrix} \cos^{2} \theta_{\pi\pi} & r_{00}^{04} & \left(1 + P_{T} A_{UT,\rho_{L}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{L}}(\phi)\right) + \\ \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s}) + A_{UU,\rho_{T}}(\phi)\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s})\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s})\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s})\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s})\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \left(1 + P_{T} A_{UT,\rho_{T}}^{\prime}(\phi,\phi_{s})\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{00}^{04}\right) \\ = \frac{1}{2} \sin^{2} \theta_{\pi\pi} & \left(1 - r_{$$

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assuming SCHC holds we can compare\_with Theory \_



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Comparison with CDD prodiction			

#### Comparison with GPD prediction



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Data hints positive J<sup>u</sup>

In agreement with HERMES DVCS result

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Summary and Outlask			

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

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