ICHEP-31
27/07/02

CHARGE and SPIN ASYMMETRIES from POMERON-ODDERON INTERFERENCE

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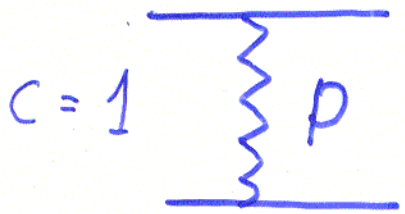
hep-ph/0202231
07224
PLB 535 (02) 117
540 (02) 224

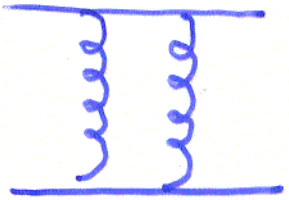
- Why Pomeron-Odderon Interference?
- Which Asymmetries?
- QCD Factorization: Perturbative and Non-Perturbative Inputs
- Numerical results

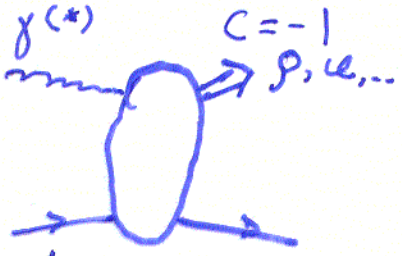
Regge | QCD | Probe

Pomeranchuk

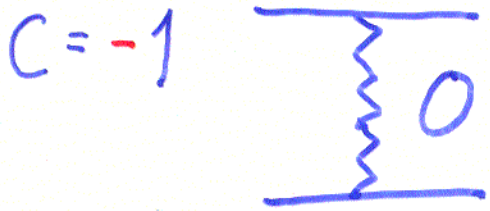


BFKL

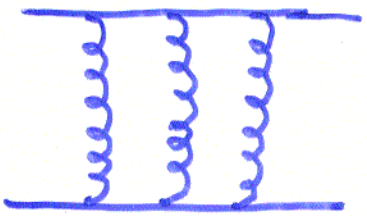


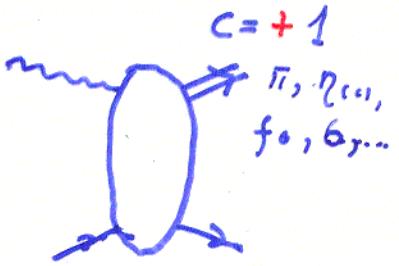


Lukaszuk, Nicolescu



BKP



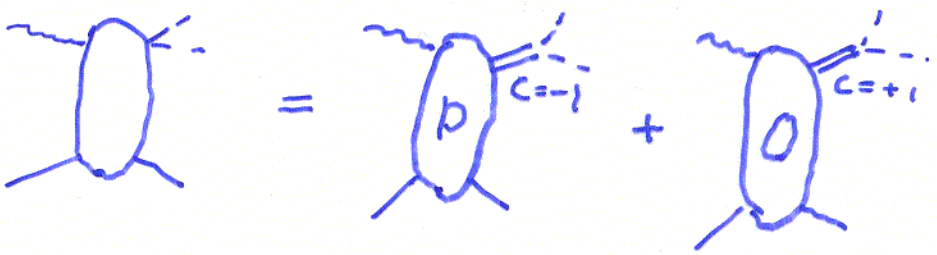


Cross-section may be small

$$\frac{\sigma_O}{\sigma_P} = \left(\frac{|M_O|}{|M_P|}\right)^2$$

P – background

Consider meson $(\pi^+\pi^-)$ pair in mixed C-state



$$\sigma = \sigma_P + \sigma_O + \sigma_{P\text{-}O}$$

$$\frac{\sigma_{P\text{-}O}}{\sigma_P + \sigma_O} \sim \frac{|M_P||M_O|}{|M_P|^2 + |M_O|^2} \sim \frac{|M_O|}{|M_P|}$$

P – probe

Interference ⟷ Asymmetries

- M_p ~ imaginary M_0 ~ real

Ideally suited for Single Spin Asymmetry

$$\frac{\sigma_+ - \sigma_-}{\sigma_+ + \sigma_-} = A_s \sim \frac{Im(M_p M_0^*)}{|M_p|^2 + |M_0|^2}$$

Requires polarized proton or circular polarized (virtual) photon

- - Charge Asymmetry

$$A_c \sim \frac{Re(M_p M_0^*)}{|M_p|^2 + |M_0|^2}$$

– Subdominant (real) part of M_p — Brodsky Merino

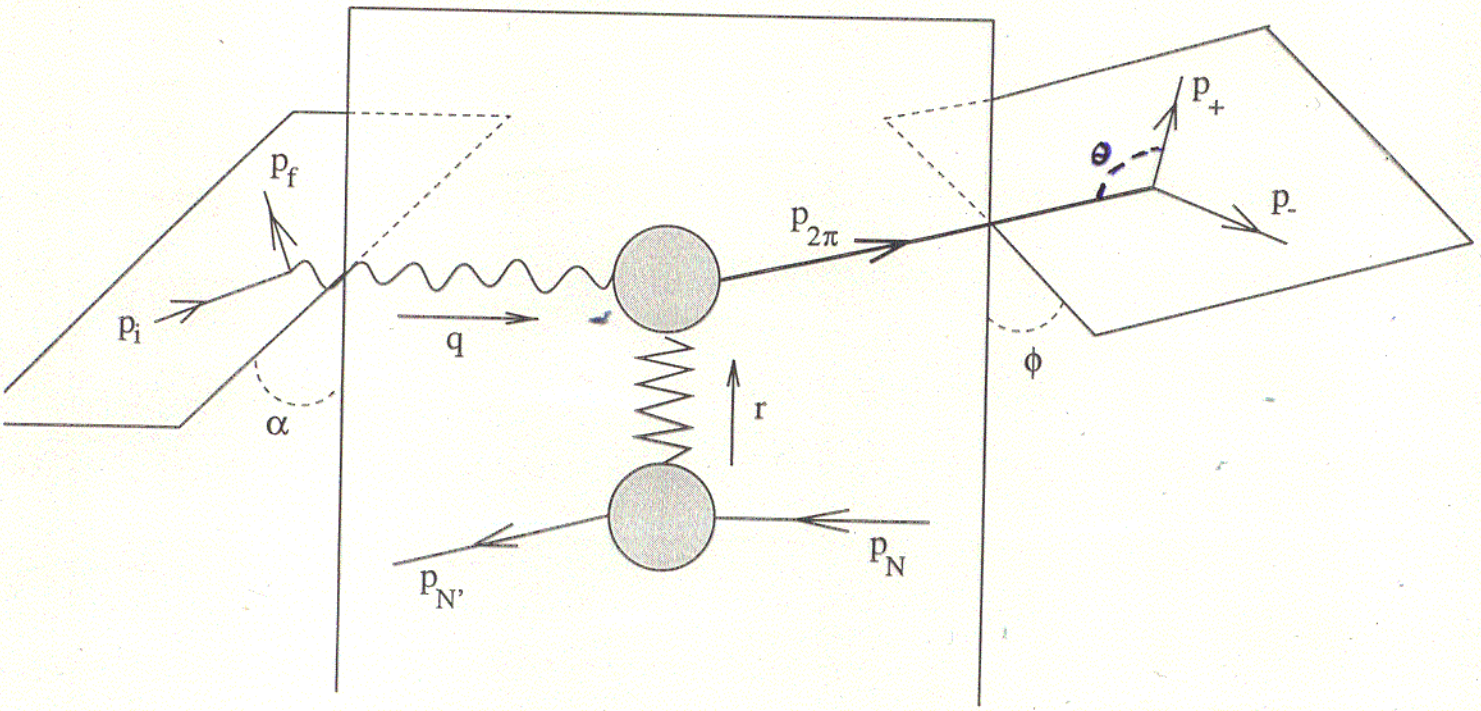
Dijet charge asymmetry

– Compensation of P-O phase shift By pions Final-State Interactions — Ivanov Ginzburg Nikolaev

$$A_c \sim \sin(\delta_{I=1} - \delta_{I=0})$$

Our approach – hard (QCD) P(O)

$\gamma \to \gamma^*$ Experiment – HERA (II)



$$A_c \sim \int d\sigma \cdot \cos\theta$$

$$A_s \sim \int d\sigma \cdot \sin 2\phi \cos\theta$$

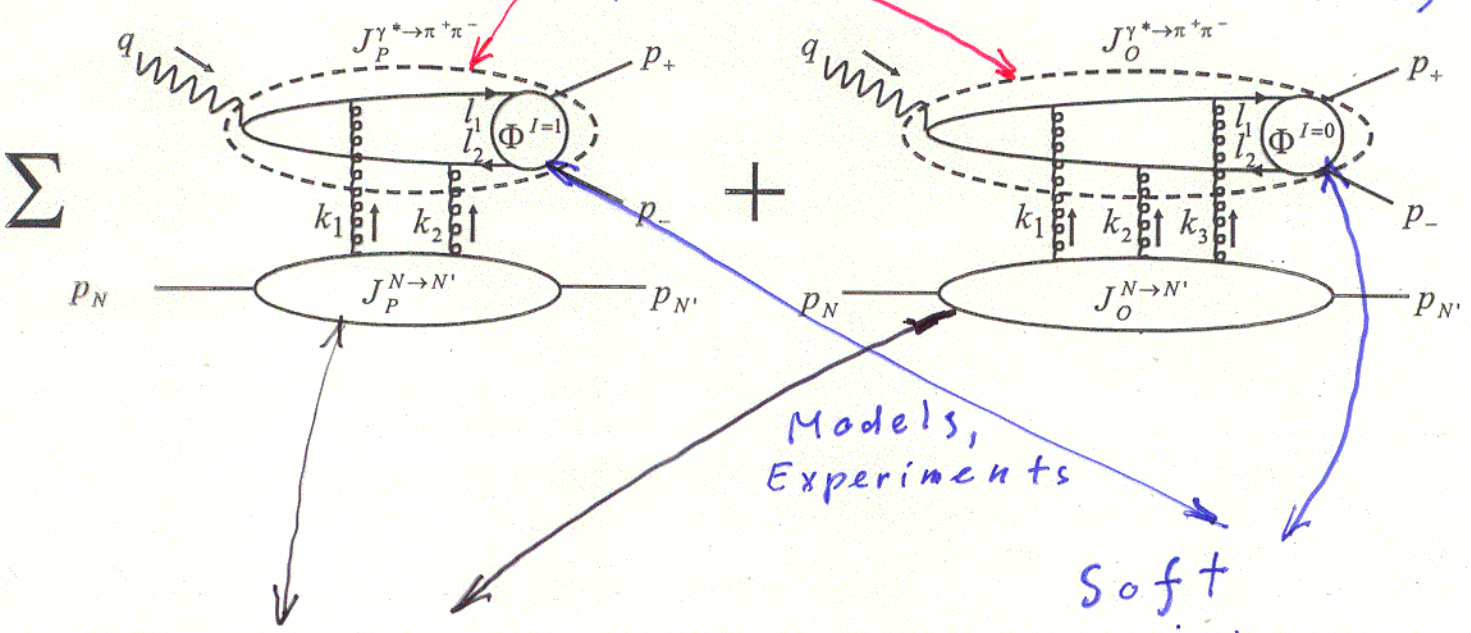
QCD factorization

→ convolution of hard and soft inputs

Hard Impact Factors

$J(\vec{k}_i, Q^2, t)$ ← γ, d (QED)

pQCD



Models, Experiments

Soft Impact Factors

$J(\vec{k}_i, t)$

Soft 2-pion wave functions

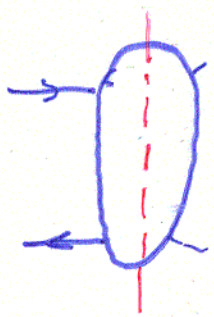
(Generalized Distribution Amplitudes)

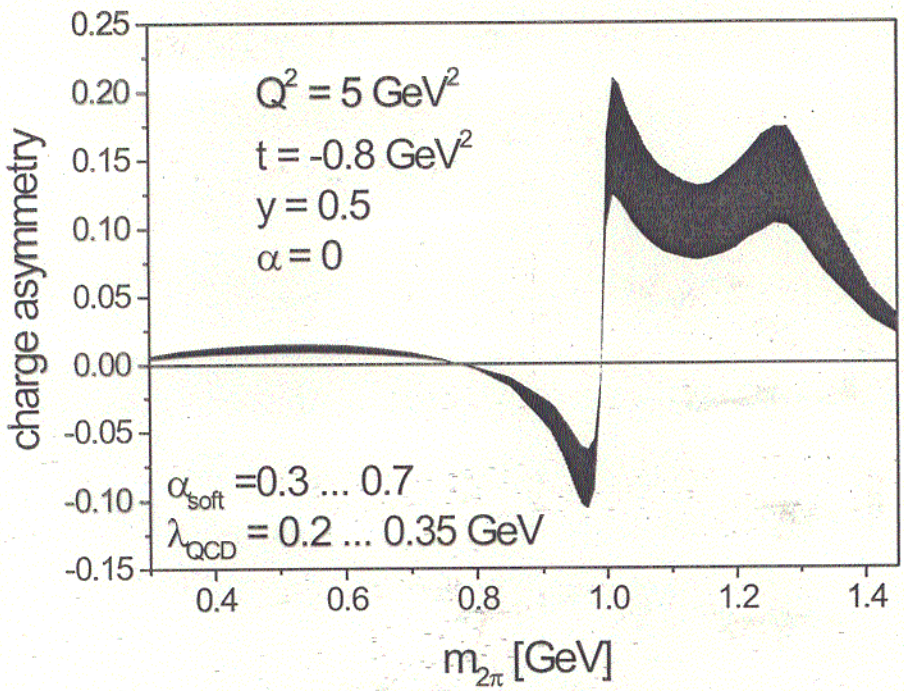
$\Phi(z, m_{2\pi}^2, \theta)$

Diehl, Gousset, Pire, O.T.

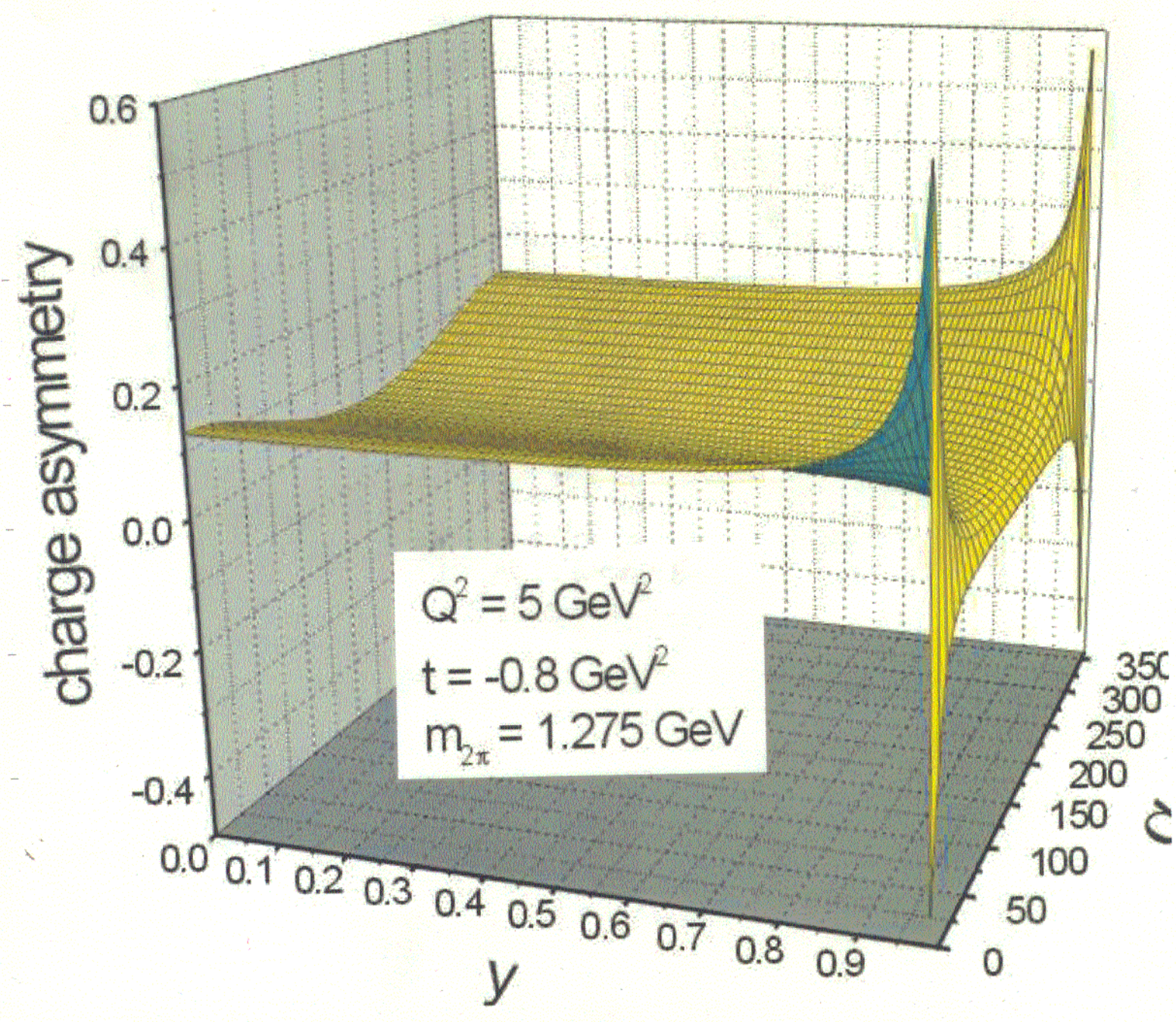
- GDA - only source of $m_{2\pi}$, θ, ~~φ~~ Leading twist

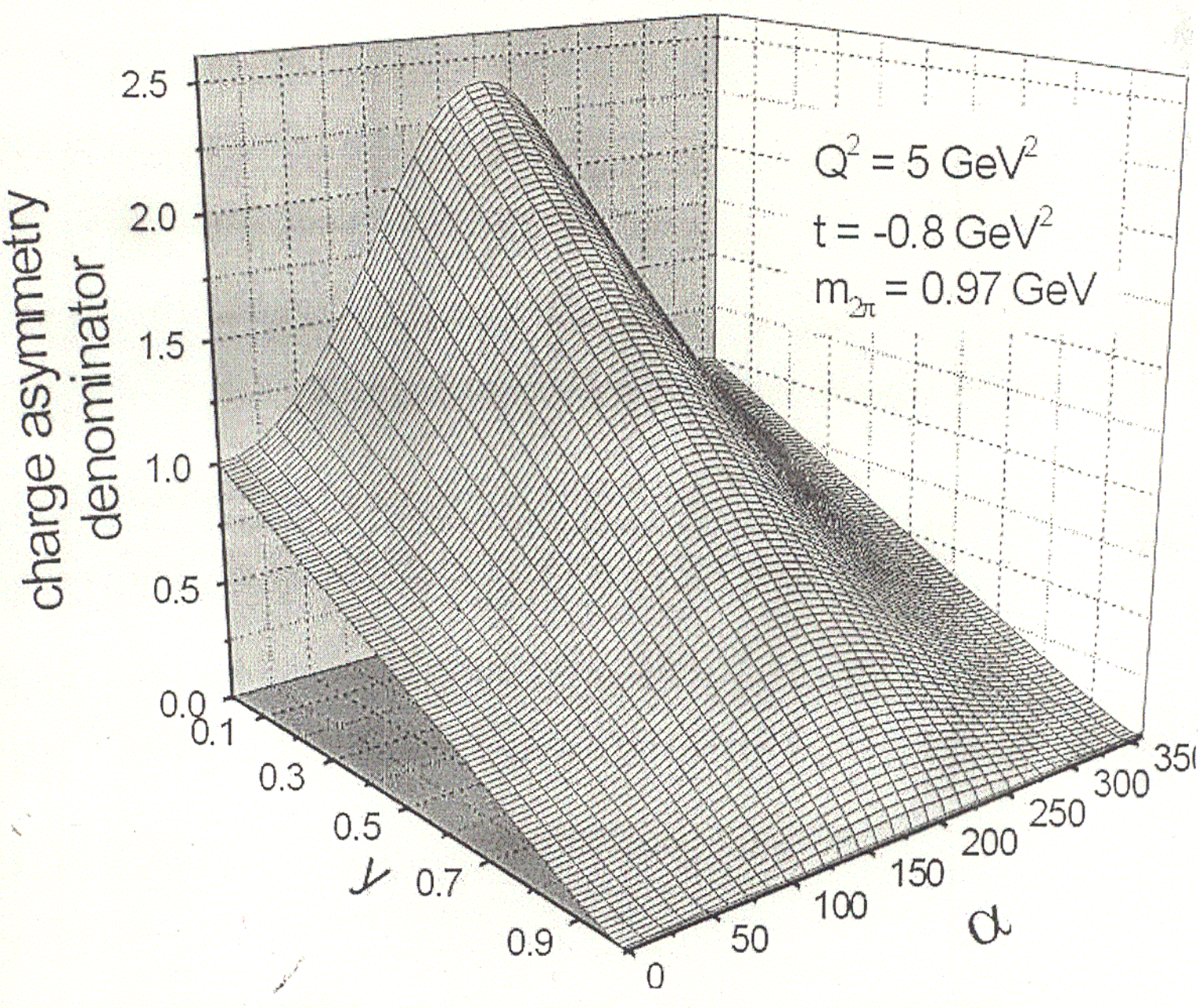
Naturaly contain phases

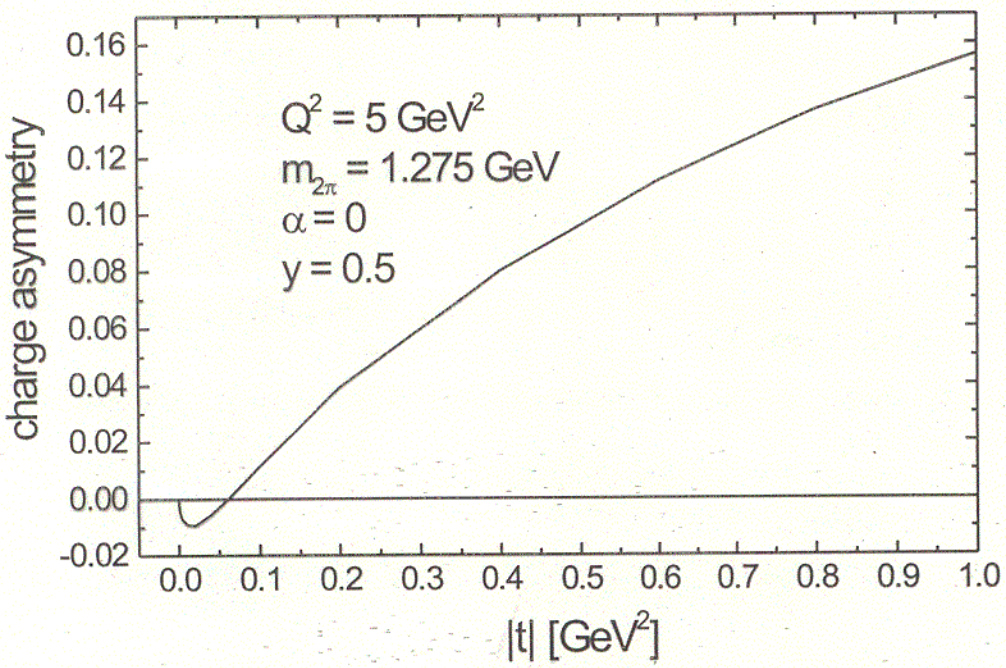




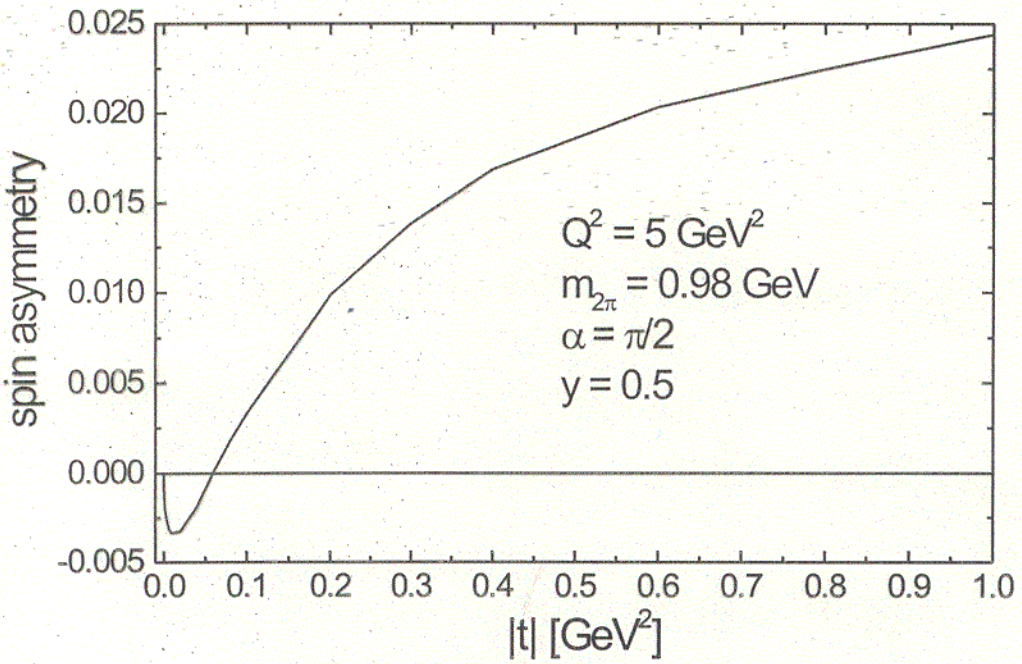
Sensitive to Φ


charge asymmetry
0.6
0.4
0.2
0.0
-0.2
-0.4
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
y
0
50
100
150
200
250
300
Q² = 5 GeV²
t = -0.8 GeV²
m2π = 1.275 GeV


charge asymmetry denominator
2.5
2.0
1.5
1.0
0.5
0.0
0.1
0.3
0.5
0.7
0.9
ν
0
50
100
150
200
250
300
α
$Q^2 = 5\ GeV^2$
$t = -0.8\ GeV^2$
$m_{2\pi} = 0.97\ GeV$



Sensitive to $J_0^{p \to p'}$



$A_c \sim \sin(\delta_{I=0} - \delta_{I=1})$

$A_s \sim \cos$

Complementary probe

Leading twist → longitudinal dipion + transverse photon

$\downarrow \sqrt{t}$

$A_s \rightarrow$ larger t, smaller Q^2

CONCLUDING REMARKS

- p as a probe for O
- A_p, A_s - complementary
- HERA (II)
- A_c at HERMES

  same GDA
  (due to factorization)
  ↓
  Linc of collider/fixed target experiments

- Robust prediction - very existence of asymmetries
  Observation → measurement of Φ, J_p, J_o