Main tool for exclusive processes is color coherence (CC) property of QCD
and resulting Color transparency (CT)

Brief Summary of CT: squeeze and freeze

Squeezing: *(a) high energy CT*

- Select special final states: diffraction of pion into two high p_t jets: $d_{q\bar{q}} \sim 1/p_t$
- Select a small initial state: γ^*_L - $d_{q\bar{q}} \sim 1/Q$ in $\gamma^*_L + N \to M + B$

QCD factorization theorems are valid for these processes with the proof based on the CT property of QCD

Implication for mEIC.

In the range of momentum transfers to the target nucleon feasible for collider lumi - $-t < 2$ GeV^2 expansion is fast and so *color transparency effects for propagation of nucleons in the nucleus fragmentation region are very small*.

Possible exception - chiral transparency effects - will discuss briefly

In the current fragmentation region freezing is very effective $\Rightarrow$ *color transparency effects for propagation of hadronic components of the photon are not suppressed by diffusion effects.*

Main tool for exclusive processes is color coherence (CC) property of QCD
and resulting Color transparency (CT)

CT phenomenon plays a dual role:

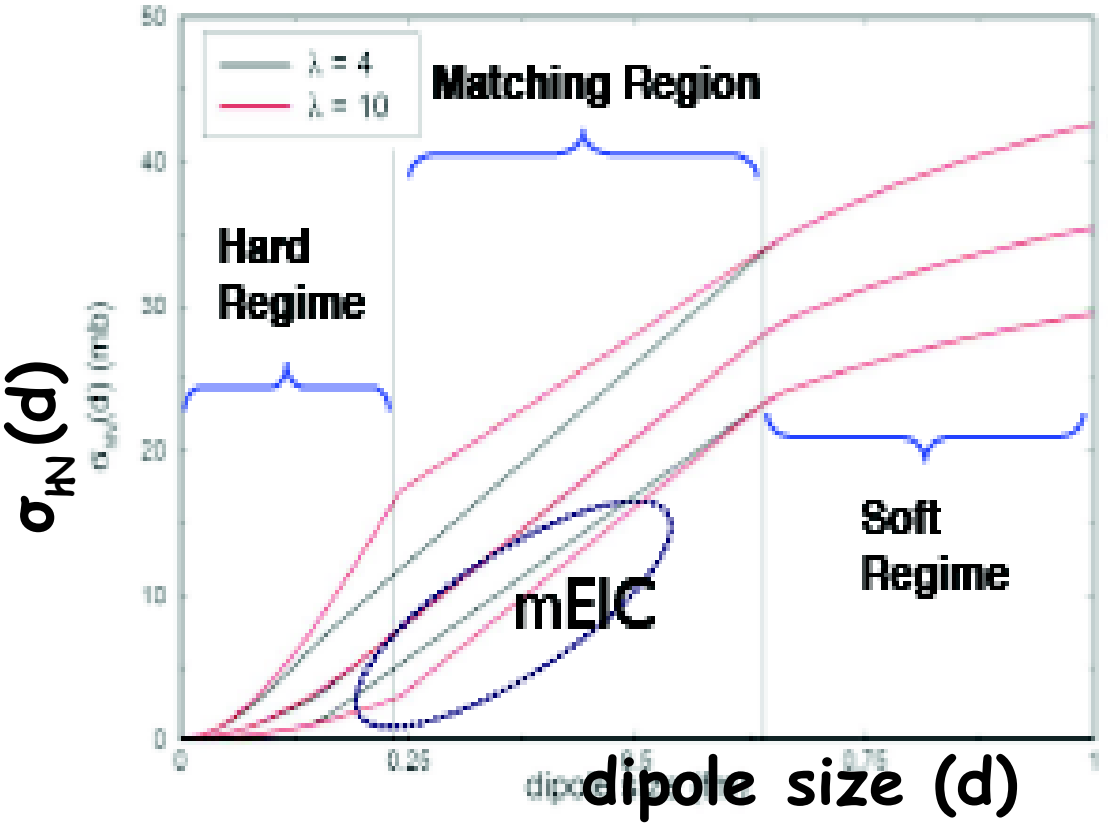
- probe of the high energy dynamics of strong interaction
- probe of minimal small size components of the hadrons

at intermediate energies also a unique probe of the space time evolution of wave packages

Basic tool of CT: suppression of interaction of small size color singlet configurations = CC

For a dipole of transverse size d:

$\sigma = cd^2$

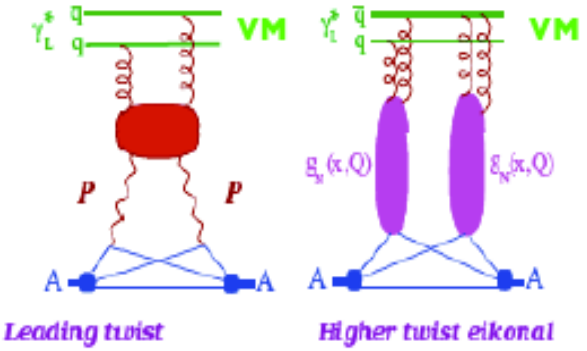


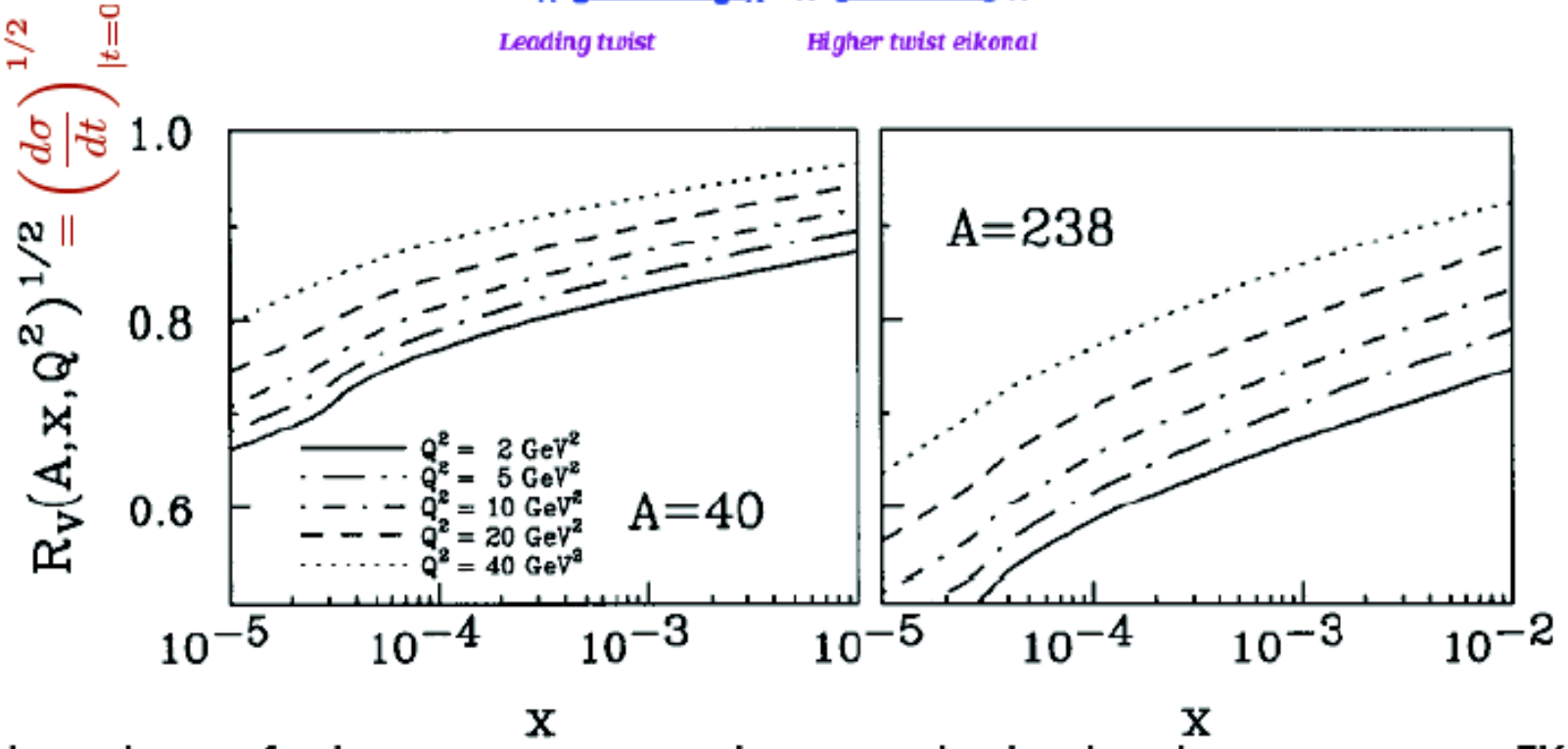
x=0.0001

x=0.001

x=0.01

light VM production in exclusive DIS



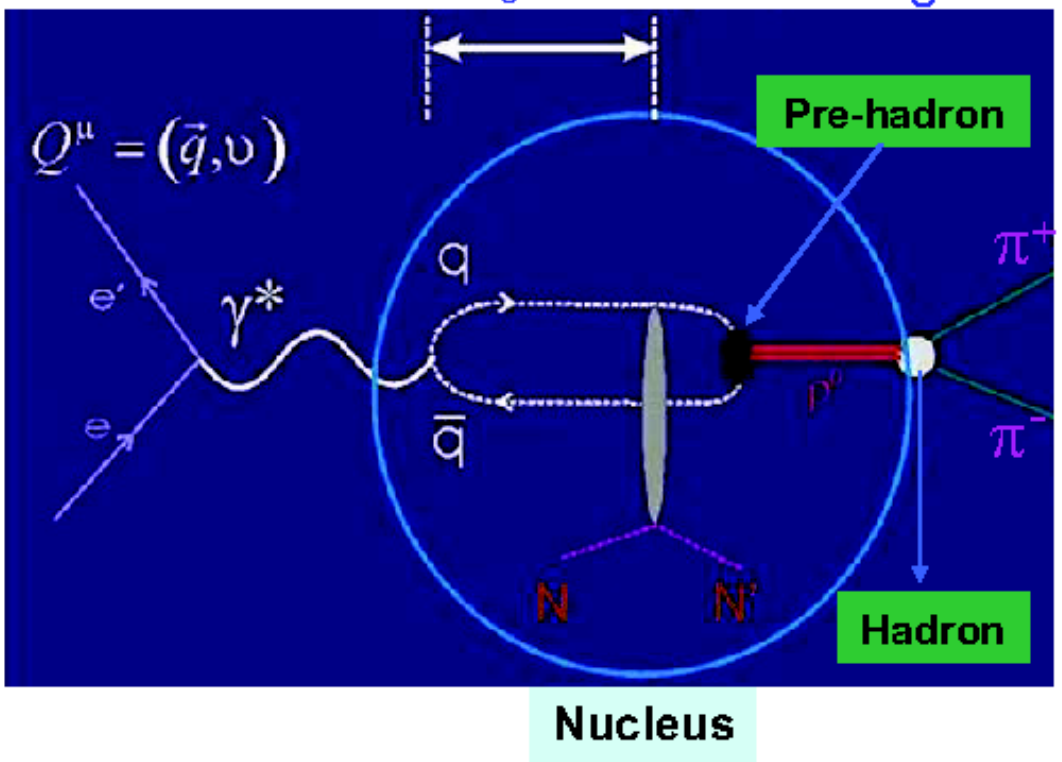


A-dependence of coherent ρ-meson production in dipole eikonal approximation - FKS95

General features of A-dependence of the coherent VM production : for fixed Q^2 - R_V decreases with decrease of x, for fixed x - R_V increases with Q^2

Exclusive Diffractive ρ^0 production off Nuclei

$$e + N \rightarrow e' + N + \rho^0$$

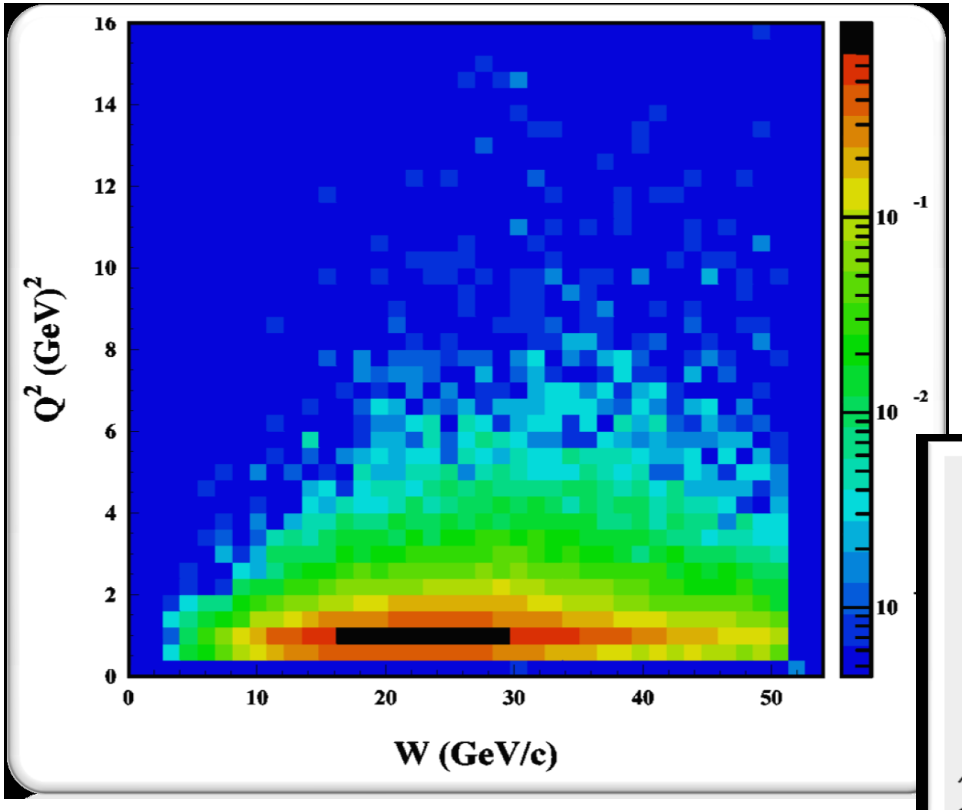


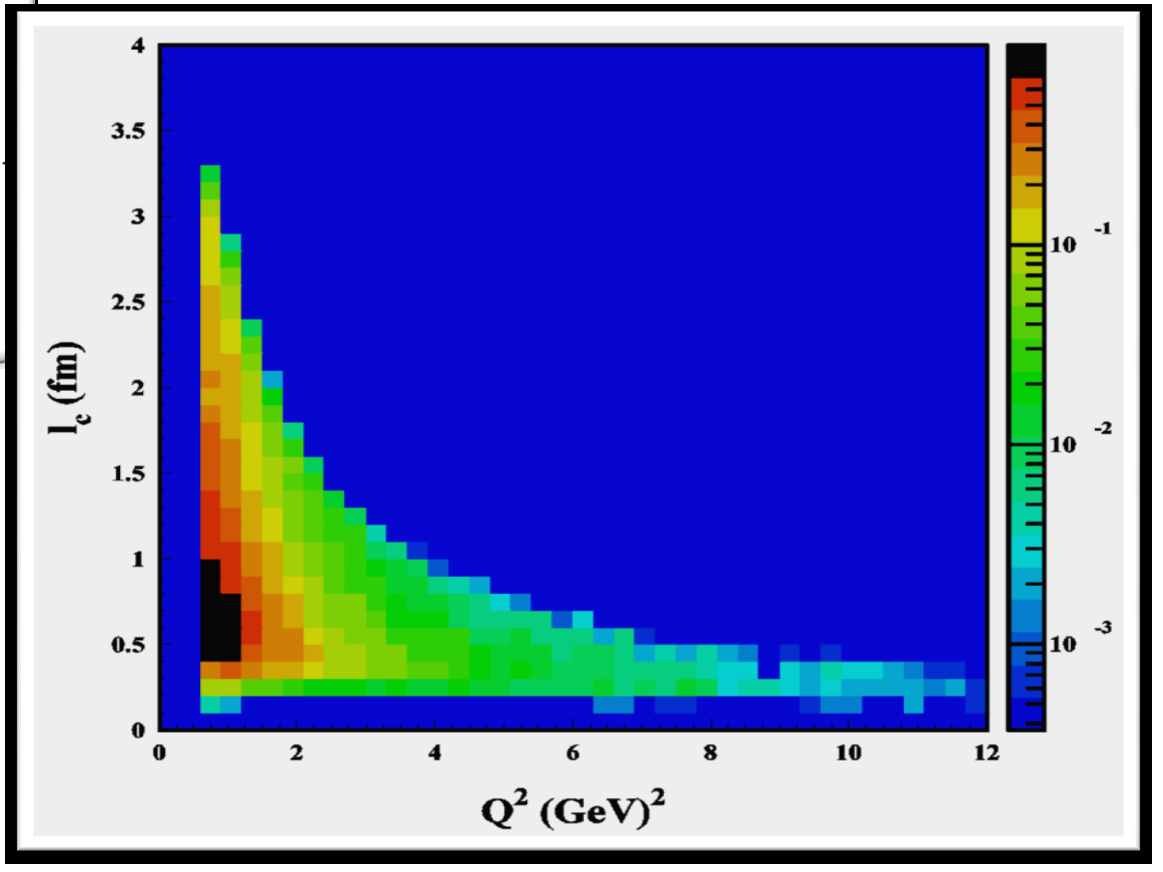
Finite propagation distance l_c (lifetime) of the (q,q-bar) virtual state

$$\ell_c = 2\nu/(M^2 + Q^2)$$

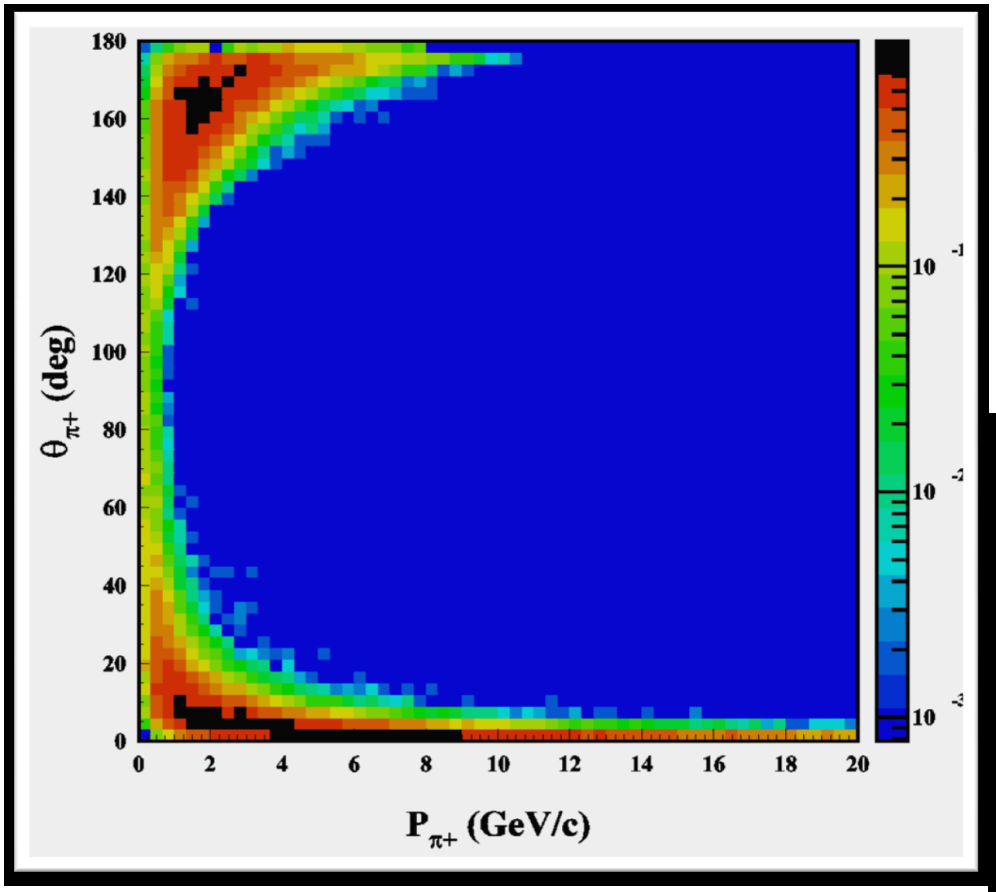
Detected particles are:
scattered electron &
π^+ and π^- from ρ^0 decay

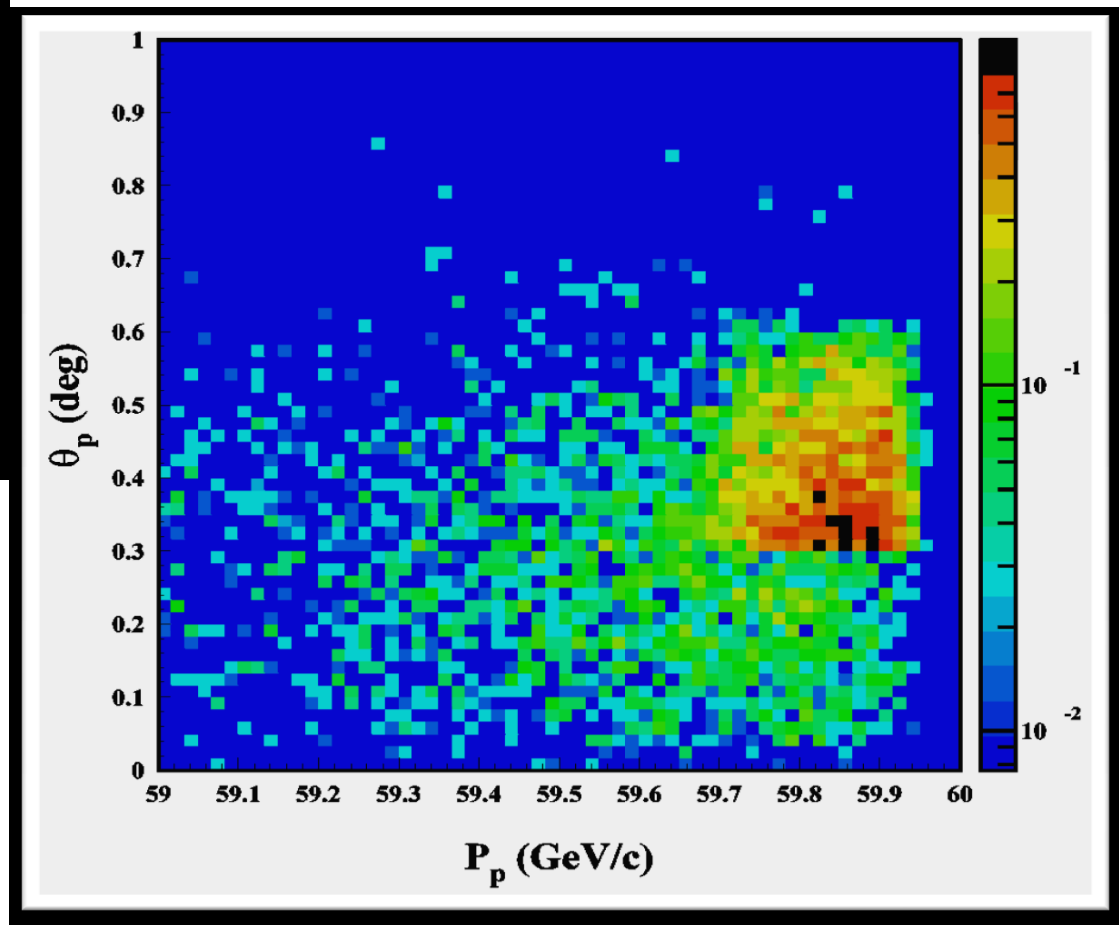
MEIC kinematics: 11/60 GeV electron/proton beam energy





MEIC kinematics: 11/60 GeV electron/proton beam energy





Other directions of study

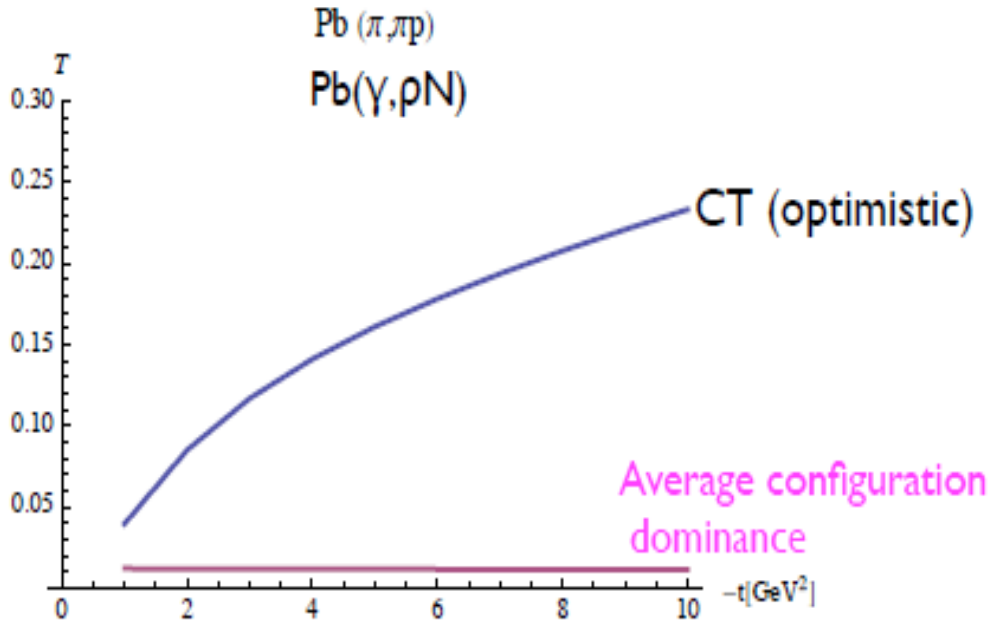
At what t squeezing occurs in elastic scattering like $\gamma+p\rightarrow \rho+p$?

If t is large enough we study pQCD interaction at large t.
Expectation - amplitude in this limit is ~ s ($\alpha_{eff}{}^{P}(t)=1$)

Blok, LF, MS 10

Consider $\gamma+A\rightarrow \rho+p+(A-1)^*$ $\quad (p_t(\rho)+p_t(N)\leq k_F)$

Transparency ratio: $T=\sigma(\gamma+A\rightarrow \rho+p+(A-1)^*)/Z\sigma(\gamma+p\rightarrow \rho+p) >>$ Glauber value



It is likely that
$T(Pb(\gamma,\rho N)) > T(Pb(\pi,\pi N))$

Early squeezing - graduate shift of $\langle\sigma\rangle$ for dominant configurations

Negligible effect from proton squeezing - fast expansic

G.Miller, MS

New type of hard hadronic processes - branching exclusive processes of large c.m. angle scattering on a "cluster" in a target/projectile (MS94)

to study both CT of 2 → 2 and hadron GPDs

For e p collider possible processes

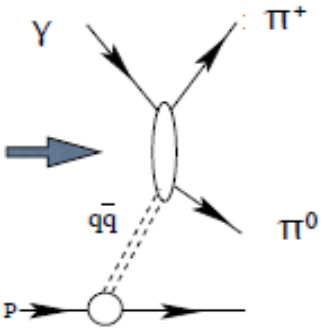
$\gamma\ (\gamma^*) + p \to \underbrace{\pi^+\pi^0}\ n$

current fragmentation

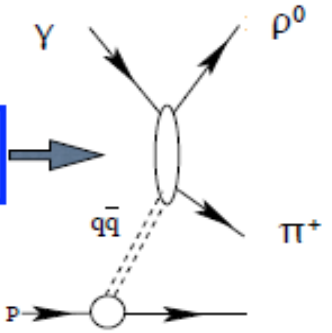
$\gamma\ (\gamma^*) + p \to \rho^0\ \underbrace{\pi^+ n}$

nucleon fragmentation

quark exchange in t -channel



vacuum exchange in t -channel



For e A collider examples of possible processes

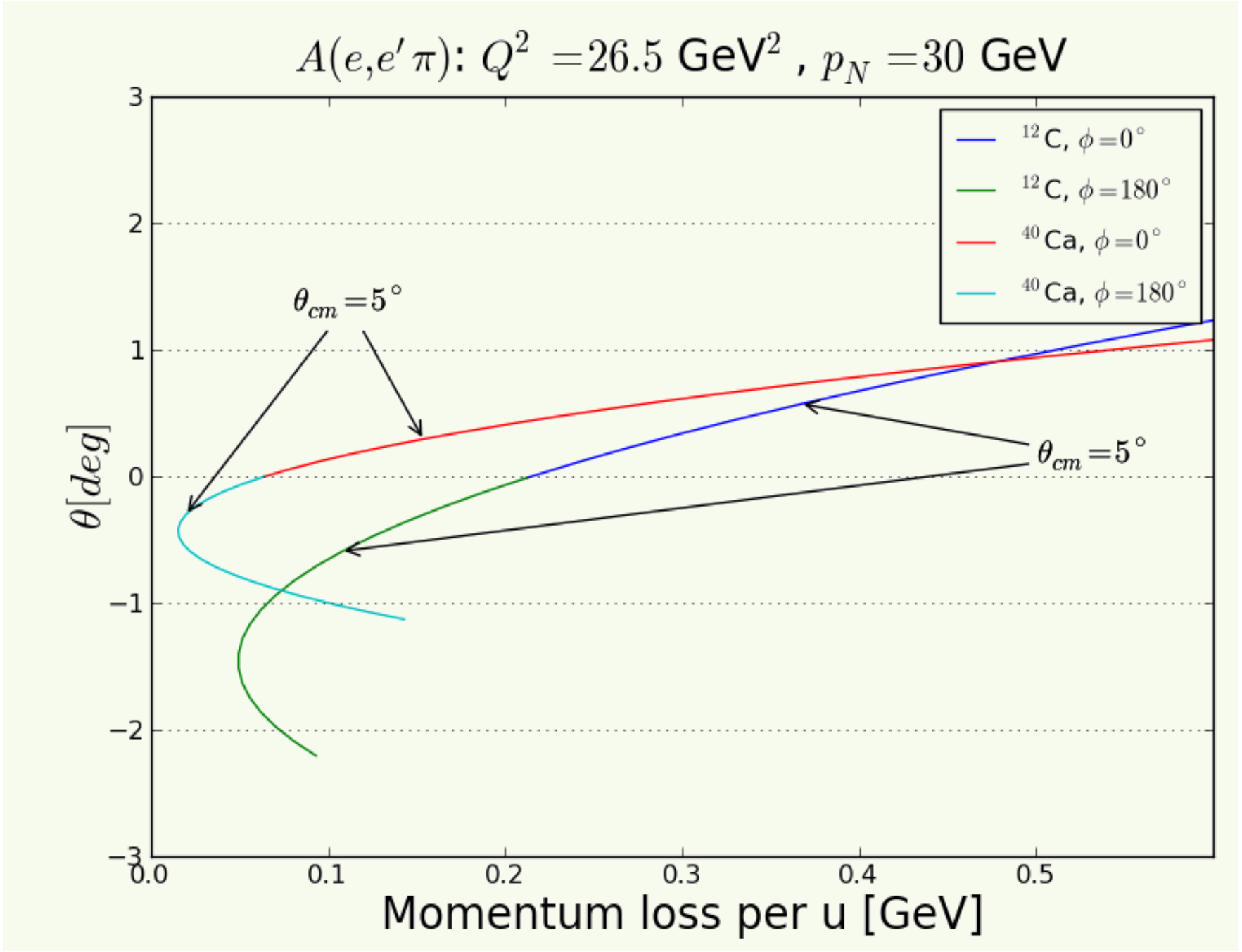
$\gamma^* + A \to \underbrace{\pi^+\pi^0}\ A^*$

current fragmentation

$\gamma^* + A \to \rho^0\ \underbrace{\pi^+ A^*}$

nuclear fragmentation

rapidity interval between π^+ and A regulates formation time and hence CT!!!


$A(e,e'\pi)$: Q^2 =26.5 GeV^2 , p_N =30 GeV
^{12}C, $\phi=0^\circ$
^{12}C, $\phi=180^\circ$
^{40}Ca, $\phi=0^\circ$
^{40}Ca, $\phi=180^\circ$
$\theta_{cm}=5^\circ$
$\theta_{cm}=5^\circ$
$\theta[deg]$
Momentum loss per u [GeV]
3
2
1
0
−1
−2
−3
0.0
0.1
0.2
0.3
0.4
0.5

Wim Cosyn

Summary exclusive π

- Longitudinal/Transverse responses:
  Dynamics different
  - Longitudinal cross section ➔ hadronic
  - Transverse cross section ➔ partonic (DIS)

- DIS:
  - Lund String fragmentation (cross section level)
  - s-channel baryonic resonances (amplitude level)

- describe data with CT in σ_T

Summary exclusive rho0

- Strong effect of Fermi Motion with Q^2
- FSI for D important
- large contribution of pion FSI
- Describe data with (nearly) no CT
- Sensitive to details,
  complicated interplay of cuts

Kai Gallmeister