Comments on promising reactions,

Mark Strikman, PSU

CT requires both freezing and squeezing

Best if f & s could be studied separately

Difficult in two body 90^o c.m . h+N —> h' +N (or ep elastic)

$$-t \sim s/2, L_{coherence} \propto -t/2m_N$$ strong correlation of t and L

$$L_{coherence} \sim cP_h$$

c=0.4 fm - correlation mechanism

c~0.1 ÷ 0.2 fm - mean field (Feynman) mechanism

Frankfurt's talk

solutions: consider two body processes at field t as a function of s PANDA, FAIR, ...

boost hard two body process relative to the nucleus (2 —> 3 processes)

Kumano's talk

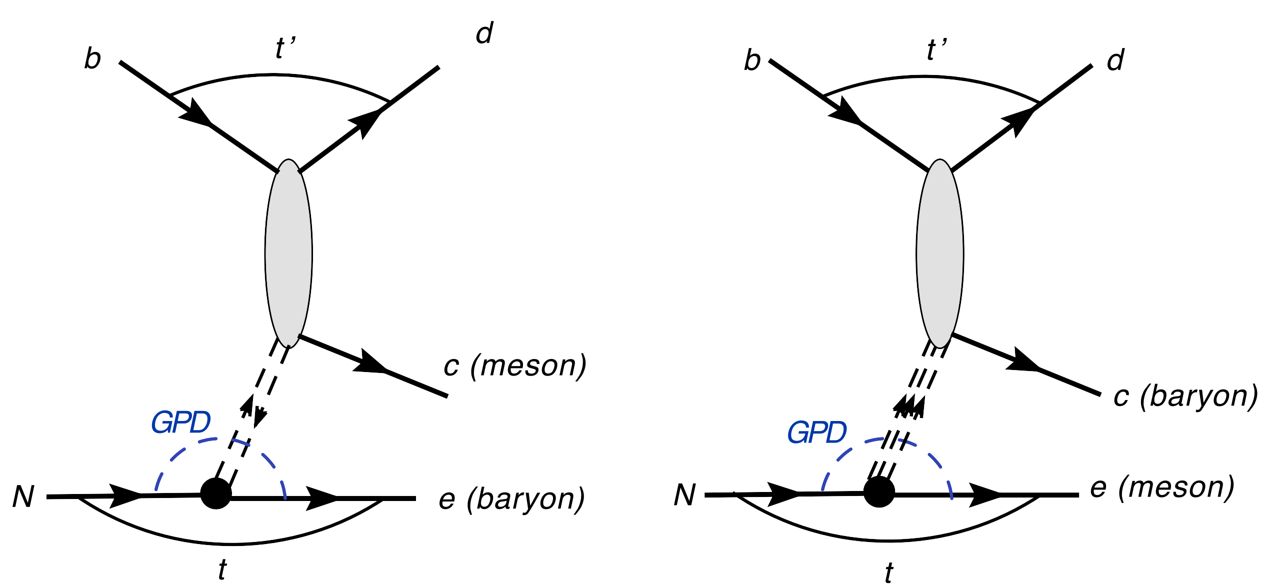
Kumano's talk

2 →3 branching processes:

- test onset of CT for 2 →2 avoiding diffusion effects

For example at what s',t process γπ→ππ is due to scattering in small configurations, when point -like component of photon starts to dominate.

- measure transverse sizes of b, d,c
- measure cross sections of large angle (γ)pion - pion (kaon) scattering
- probe 5q in nucleon and 4q in mesons
- measure GPDs of nucleons, photons, and mesons(!)
- measure pattern of freezing of space evolution of small size configurations



For e p collider possible processes

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

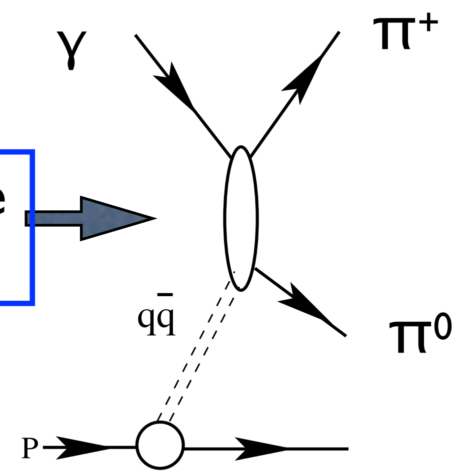
current fragmentation

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

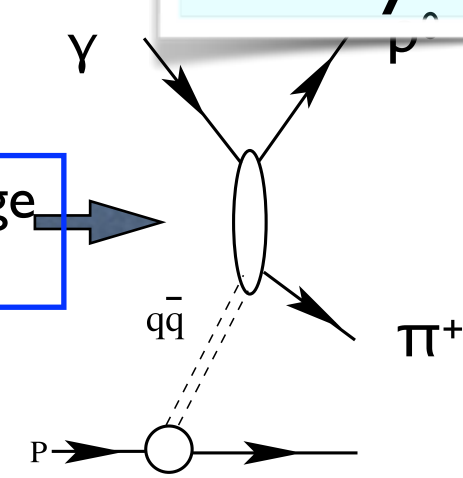
nucleon fragmentation

Hardness is regulated by p_t of produced hadrons not by Q

quark exchange in t -channel



vacuum exchange in t -channel



For e A collider examples of possible processes

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

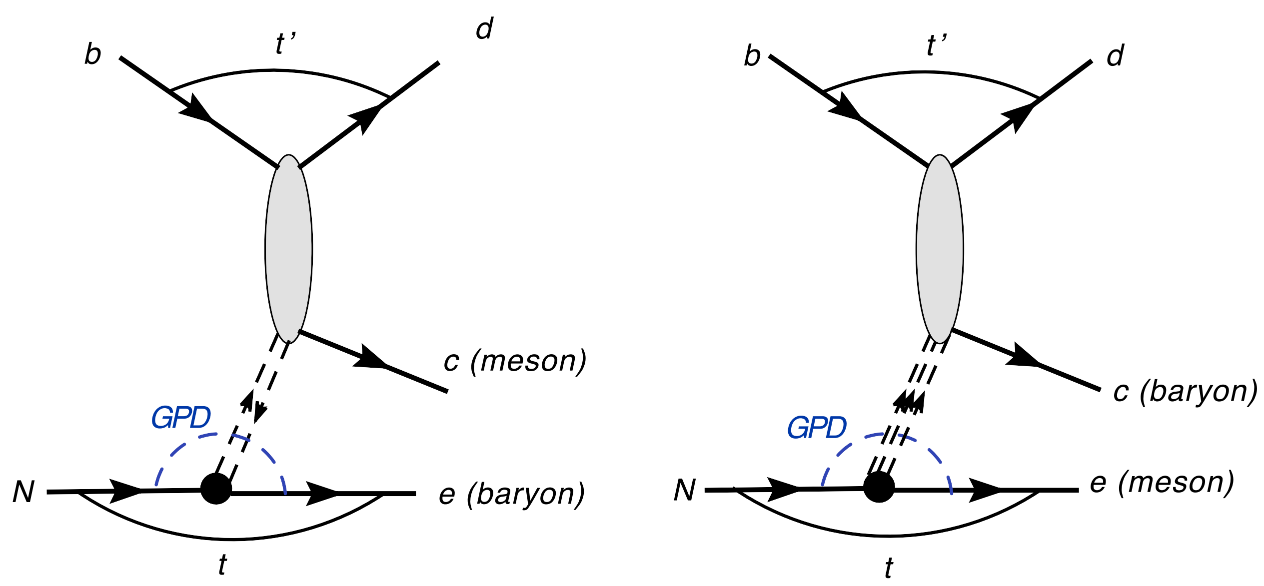
current fragmentation

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

nuclear fragmentation

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

Factorization:



If the upper block is a hard (2 →2) process, "b","d","c" are in small size configurations as well as exchange system (qq, qqq). Can use CT argument as in the proof of QCD factorization of meson exclusive production in DIS (Collins, LF, MS 97)

$$\Downarrow$$

$$\mathcal{M}_{NN\to N\pi B} = GPD(N \to B) \otimes \psi_b^i \otimes H \otimes \psi_d \otimes \psi_c$$

pion beam (two forward mesons) safest

pion + N connects to lack of CT in ep.

How to check that squeezing takes place and one can use GPD logic?

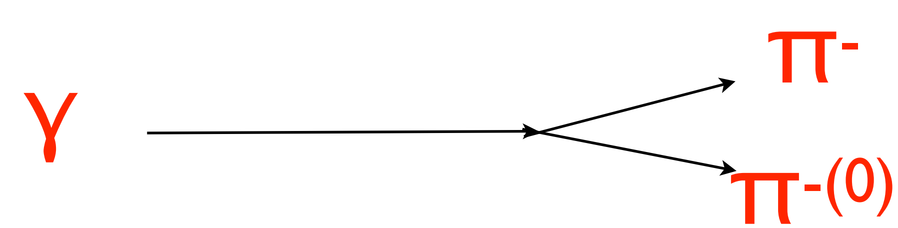
Obvious analog for pion beams $\pi^- \to \pi^- \pi^-$

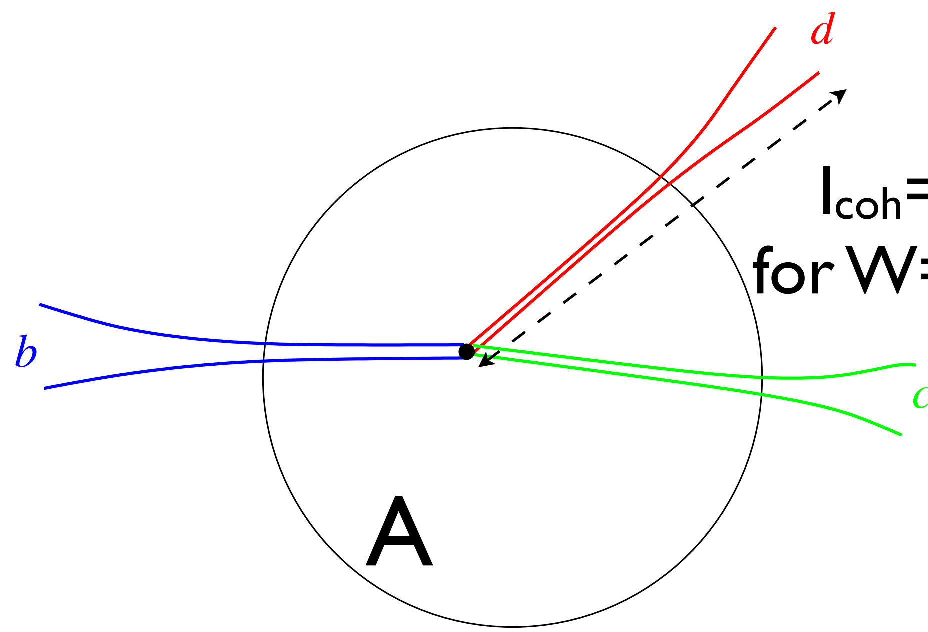
Use as example process $\gamma A \to \pi^- \pi^0 A^*$

consider the rest frame of the nucleus

- COMPASS 190 GeV data on tape
- Early data from pion beam FNAL

$p_f(\pi) - p_\gamma/2$, vary $p_{ft}(\pi) \geq 1$ - 2 GeV/c; $p_{ft}(\pi^-) + p_{ft}(\pi^{-(0)}) \sim 0$





l_{coh}=60 fm for W=20 GeV

Branching (2→3) processes with nuclei - freezing is 100% effective for p_{inc} > 100 GeV/c - study of one effect only - size of fast hadrons

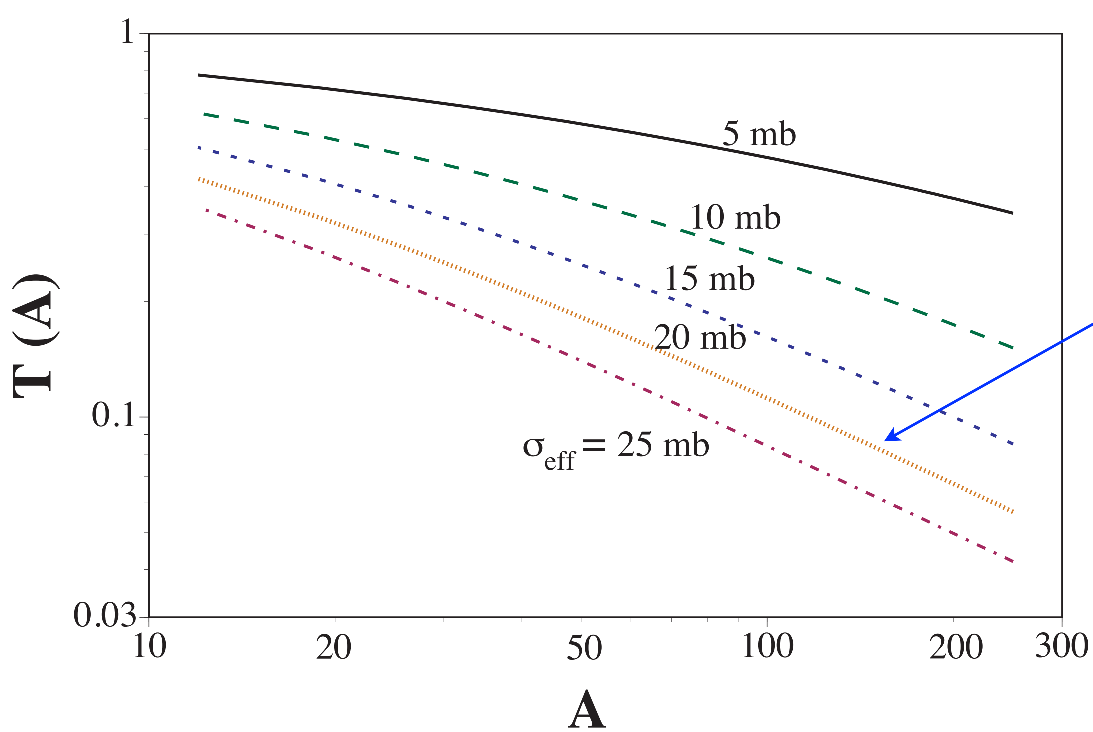
$$T_A = \frac{\frac{d\sigma(\gamma A \to \pi^- \pi^{-(0)} A^*)}{d\Omega}}{Z\frac{d\sigma(\gamma p \to \pi^- \pi^{-(0)} n)}{d\Omega}}$$

$$T_A(\vec{p}_b, \vec{p}_c, \vec{p}_d) = \frac{1}{A}\int d^3r \rho_A(\vec{r}) P_b(\vec{p}_b, \vec{r}) P_c(\vec{p}_c, \vec{r}) P_d(\vec{p}_d, \vec{r})$$

where $\vec{p}_b, \vec{p}_c, \vec{p}_d$ are three momenta of the incoming and outgoing particles b, c, d; ρ_A is the nuclear density normalized to $\int \rho_A(\vec{r}) d^3r = A$

$$P_j(\vec{p}_j, \vec{r}) = \exp\left(-\int_{\text{path}} dz\, \sigma_{\text{eff}}(\vec{p}_j, z)\rho_A(z)\right)$$

"Boosted Hall D CT experiment"



Large effect even if the pion radius is changed just by 20%

If there are two scales in pion (Gribov) - steps in $T(k_t^\pi)$ as a function of k_t^π

If squeezing is large enough can measure quark- antiquark size using dipole - nucleon cross section which I discussed before

$$\sigma(d,x) = \frac{\pi^2}{3}\alpha_s(Q^2_{eff})d^2\left[xG_N(x,Q^2_{eff}) + \frac{2}{3}xS_N(x,Q^2_{eff})\right]$$