HERMES実験における
原子核標的を用いた深非弾性散乱での
2ハドロン生成過程に対する
原子核効果の測定

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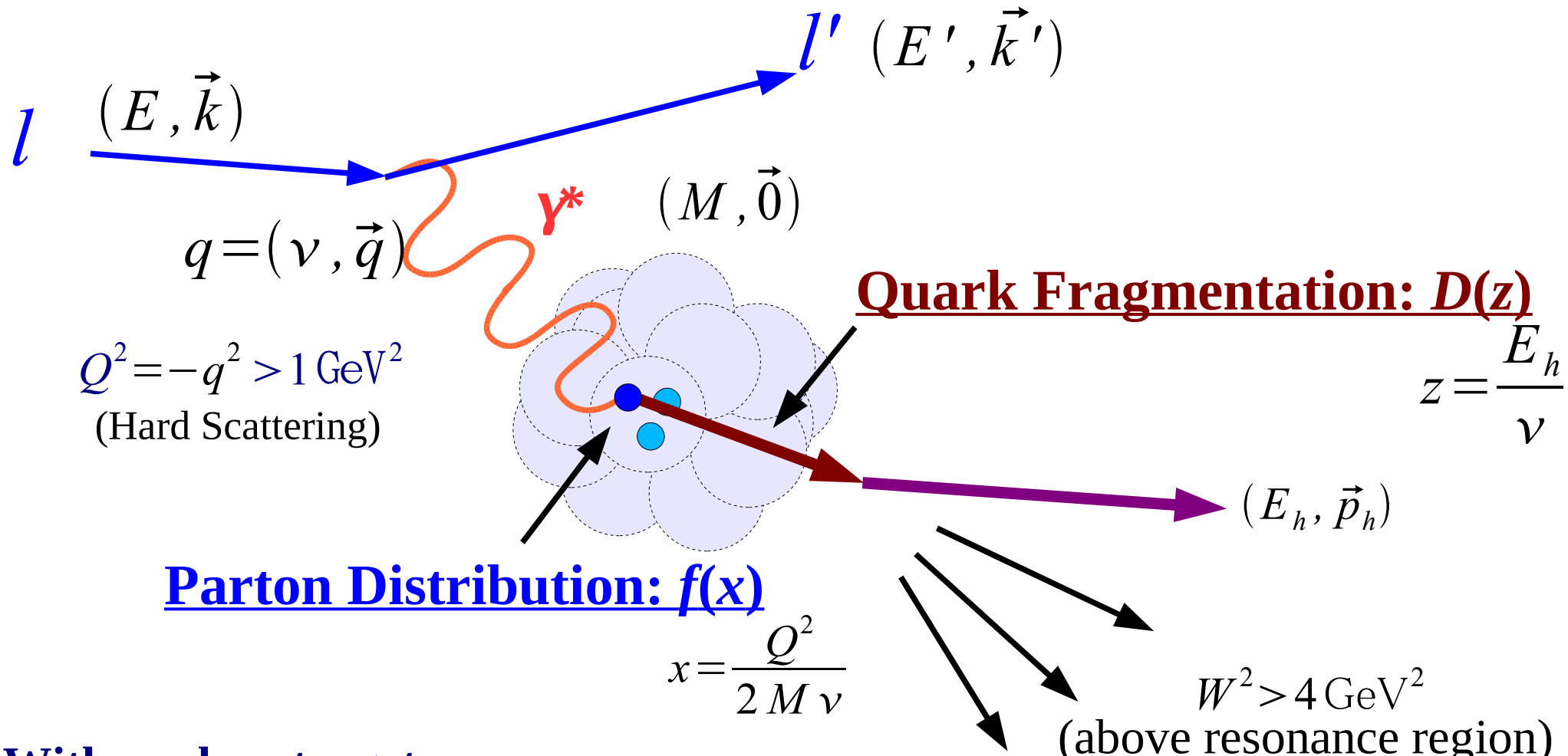
深非弾性散乱におけるハドロン生成と原子核効果



With nuclear targets:

modifications on $f(x)$ and $D(z)$

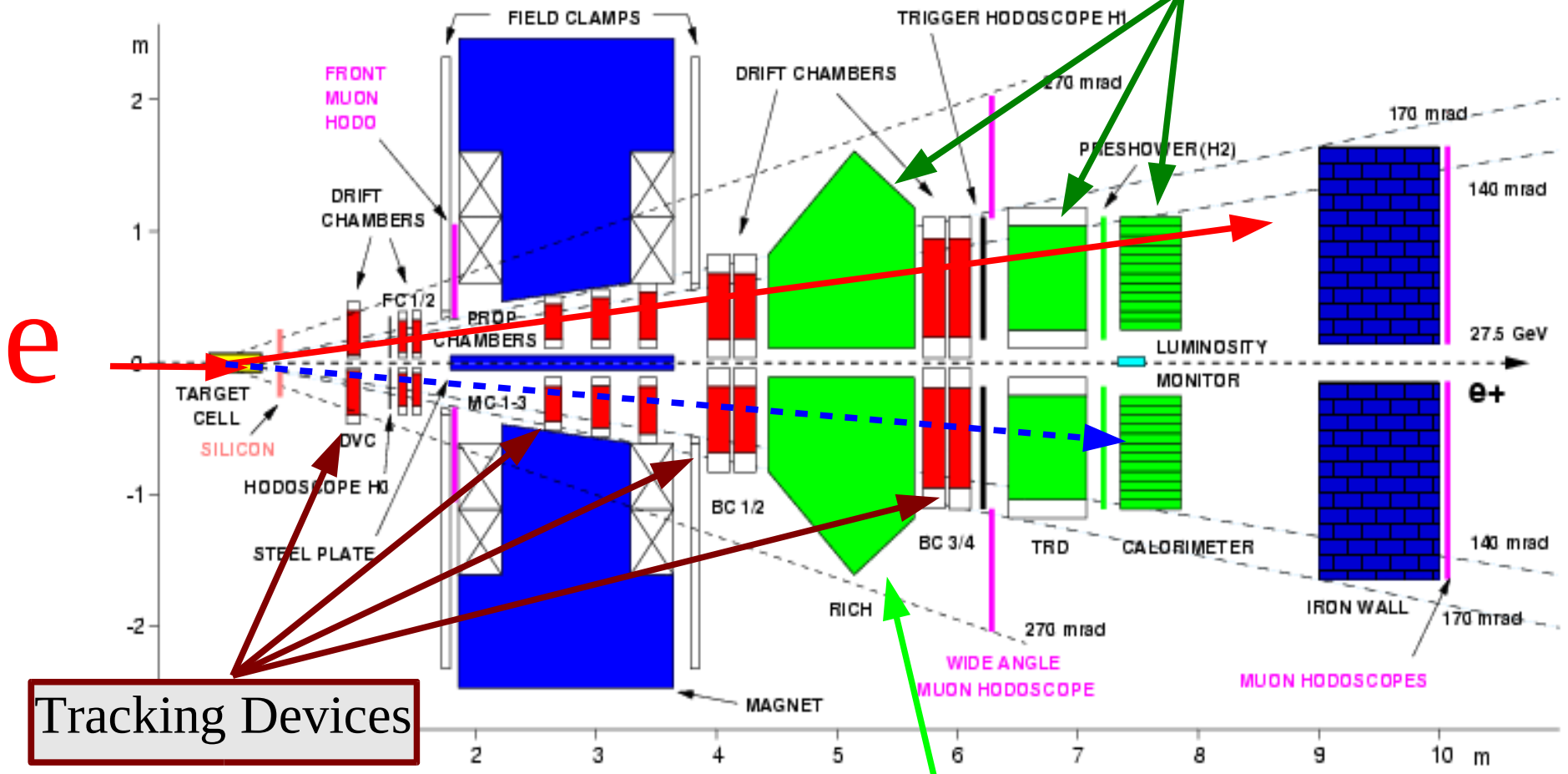
→ Important for interpretation of hadron production in hot and dense matter

HERMES Experiment

- 偏極電子@HERA
  - 27.6 GeV, 12 GeV
  - Longitudinally polarized
- (非)偏極ガス標的
  - Pol.: H, D, ^{3}He
  - Unpol.: **H, D, ^{4}He, ^{14}N, ^{20}Ne, ^{89}Kr, ^{131}Xe**
  - 10^{15}~**10^{17}** nucl./cm^2
- 核子スピン構造研究
- ハドロン生成に対する原子核媒質の影響
  - 構造関数比測定, Phys. Lett. B 475 (2000) 386, erratum Phys. Lett. B 567 (2003) 339
  - ハドロンMultiplicity(多重度)測定, Phys. Lett. B 577 (2003) 37

HERMES Spectrometer

Detectors for Particle IDentification (PID)



Tracking Devices

RICH:
π, K, p identification from 2 to 15 GeV/c

Nuclear attenuation on hadron multiplicity in DIS

HERMES, Phys. Lett. B 577 (2003) 37.

Hadron multiplicity ratio: (HERMES Preliminary)

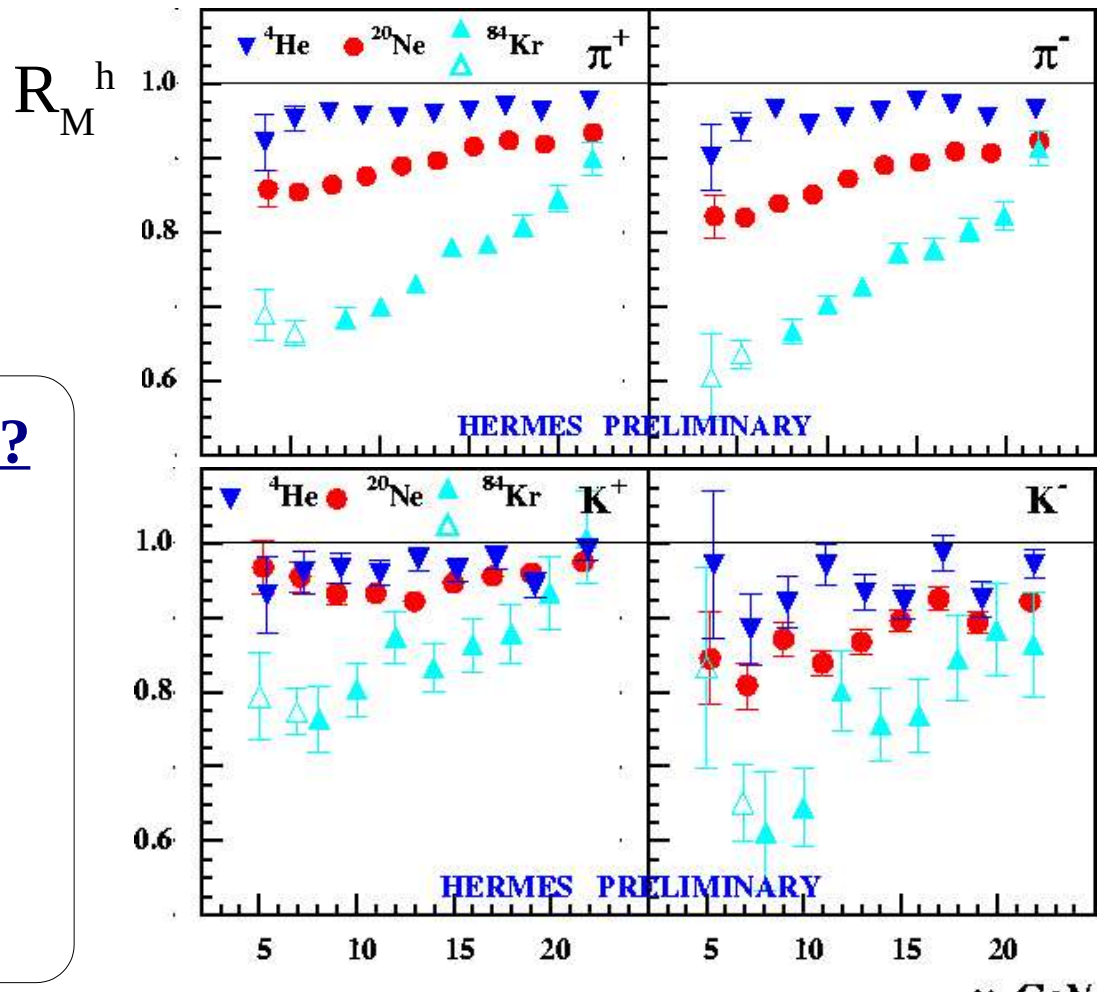
with 27.6GeV $e^{+(-)}$

Various Nuclear Targets → ▼^{4}He, ●^{20}Ne, ▲^{84}Kr

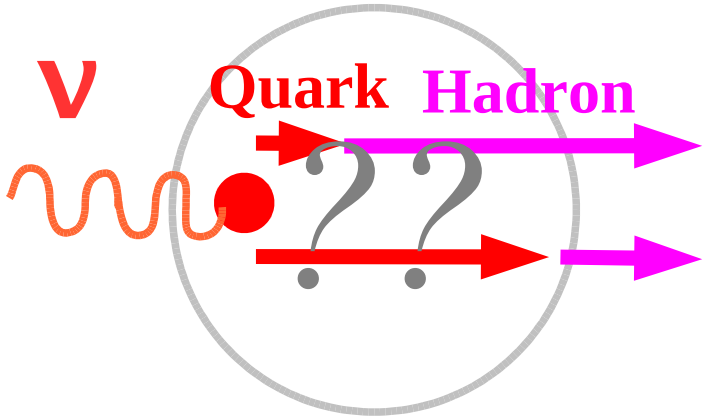
Hadron Identification with RICH

pion, kaon, proton from 2 to 15 GeV/c

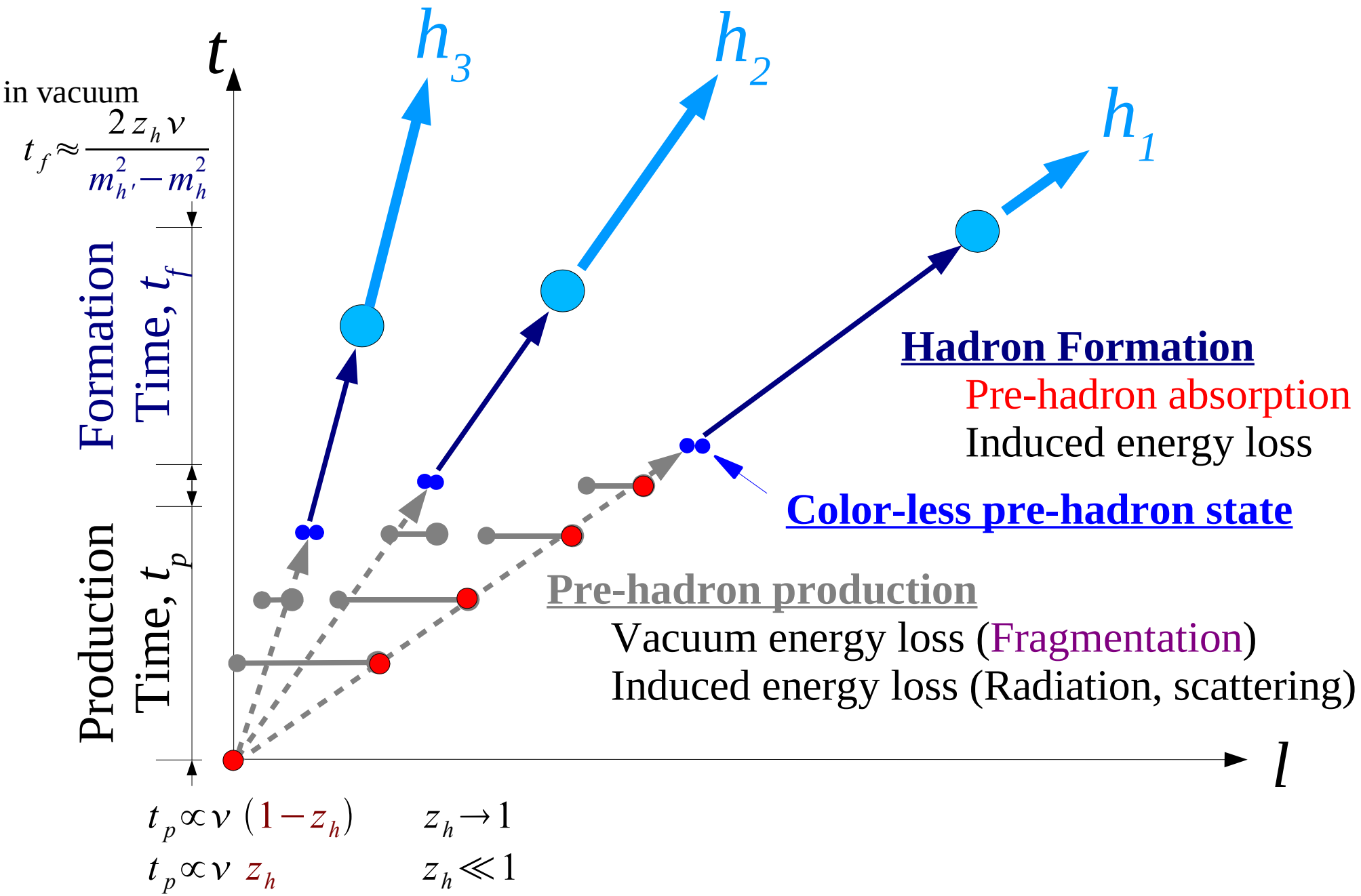
$$R_M^h = \frac{\left(N^h / N^{DIS}\right)_A}{\left(N^h / N^{DIS}\right)_D} \rightarrow \frac{D_A(z)}{D_D(z)}$$



How/Where is hadron produced?



Hadron Production Mechanism (string model)



Hadron Formation

Pre-hadron absorption

Induced energy loss

Color-less pre-hadron state

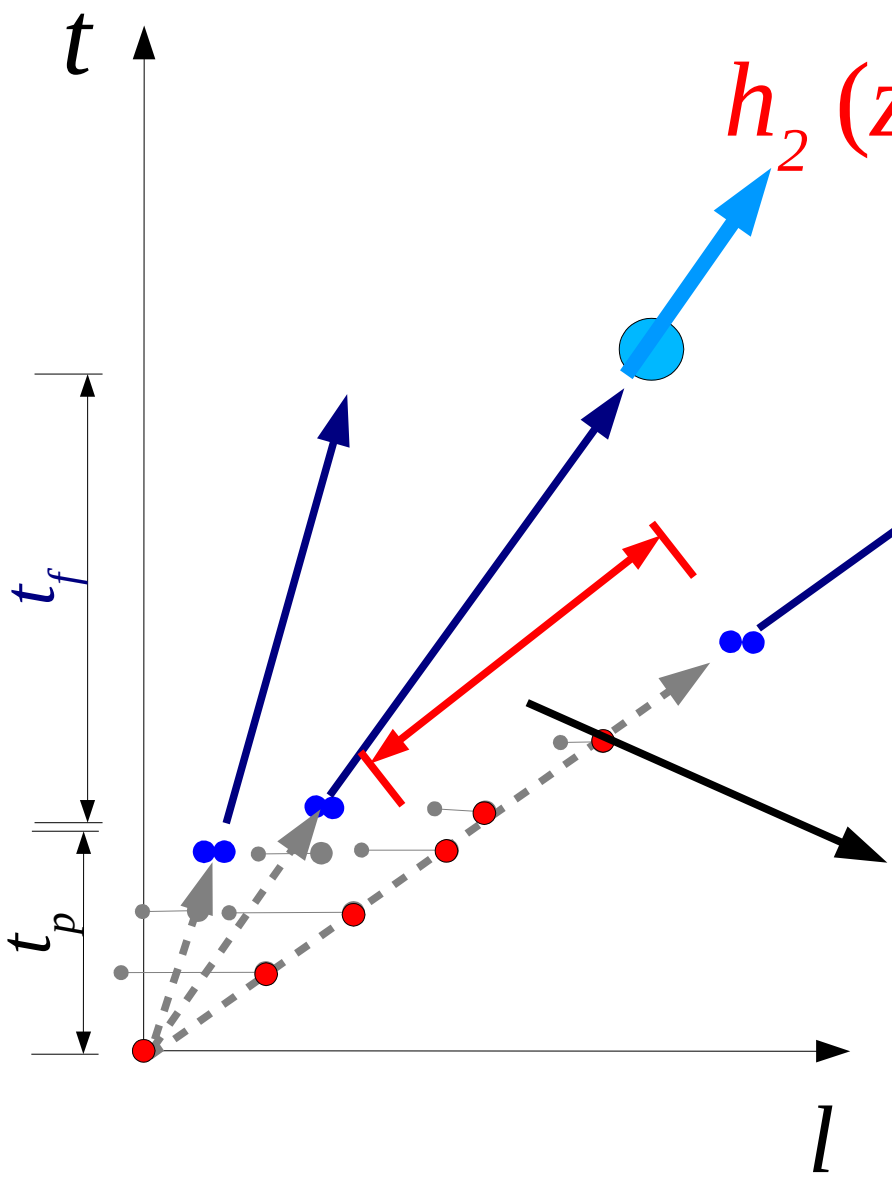
Pre-hadron production

Vacuum energy loss (Fragmentation)

Induced energy loss (Radiation, scattering)

Double hadron production measurement

B.Z. Kopeliovich *et al.*, Nucl. Phys. A 740 (2004) 211



Double hadron production ratio:

$$R_{2h}=\frac{\left(N(z_1>0.5\,,z_2)/N(z_1>0.5)\right)_A}{\left(N(z_1>0.5\,,z_2)/N(z_1>0.5)\right)_D}$$

$R_{2h}=1$: no pre-hadron absorption
vacuum energy loss dominant

Double Hadron Production Ratio @ HERMES

Event selection:

DIS $Q^2 > 1\,\mathrm{GeV}^2,\ W^2 > 4\,\mathrm{GeV}^2$

$\nu > 7\,\mathrm{GeV},\ E_h > 1.4\,\mathrm{GeV}$

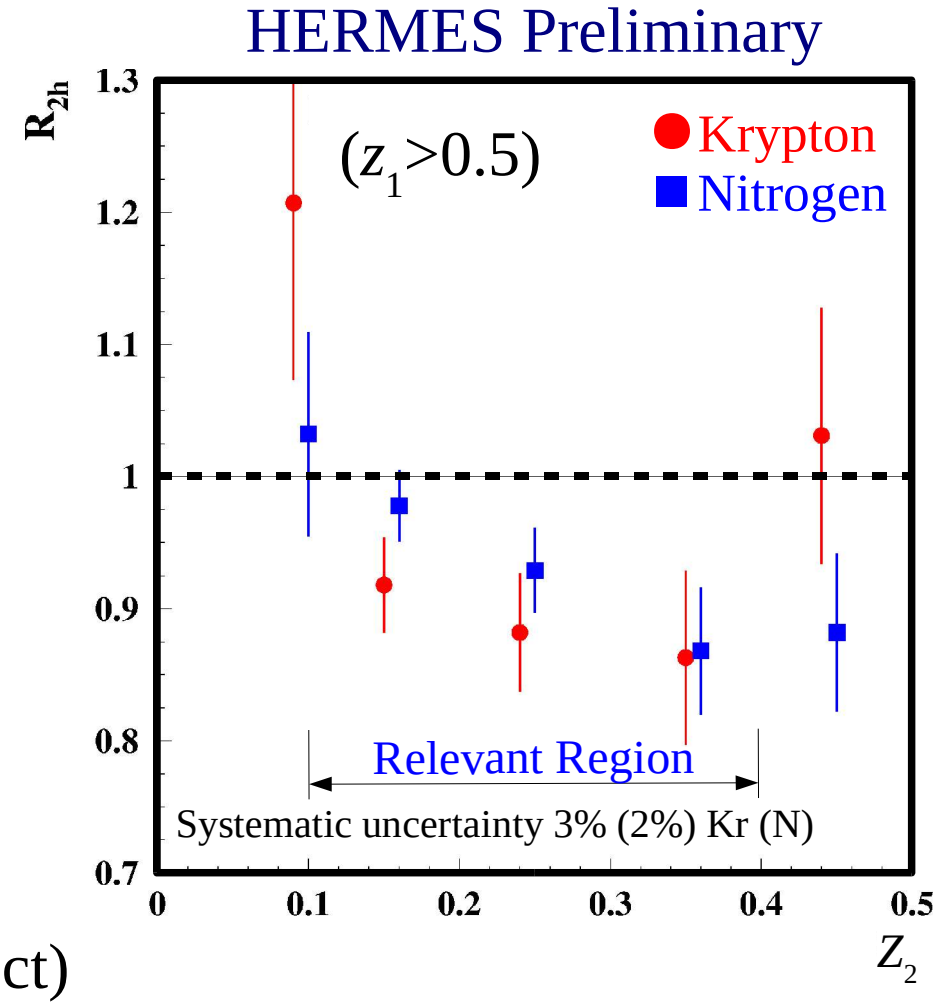
Leading hadron $z_1 > 0.5$

+ sub-leading hadron(s)

Production ratio:

$$R_{2h} = \frac{\left(N(z_1 > 0.5, z_2)/N(z_1 > 0.5)\right)_A}{\left(N(z_1 > 0.5, z_2)/N(z_1 > 0.5)\right)_D}$$

A: ^{14}N and ^{89}Kr



Attenuation in the relevant z region:

$R_{2h} < 1$ was observed. (about 10% effect)

Stronger attenuation for ^{89}Kr than ^{14}N

Pre-hadron absorption inside nuclei should not be ignored.

Summary

- HERMES has measured “nuclear effects” with various targets.
- Attenuation for double hadron production probes pre-hadron absorption inside the nuclei.
- HERMES measured the double hadron production ratios for ^{14}N and ^{89}Kr.
  - $R_{2h} < 1$ for both ^{89}Kr and ^{14}N, about 10% attenuation
  - **Pre-hadron absorption** inside nucleus should no be ignored.
- Important for interpretation of hadron production in hot and dense matter
- Measurements in multi-dimension, (ν, z, p_t^2), are important
  - @ HERMES and JLAb