Hadronization in nuclear DIS and ultra-relativistic HIC

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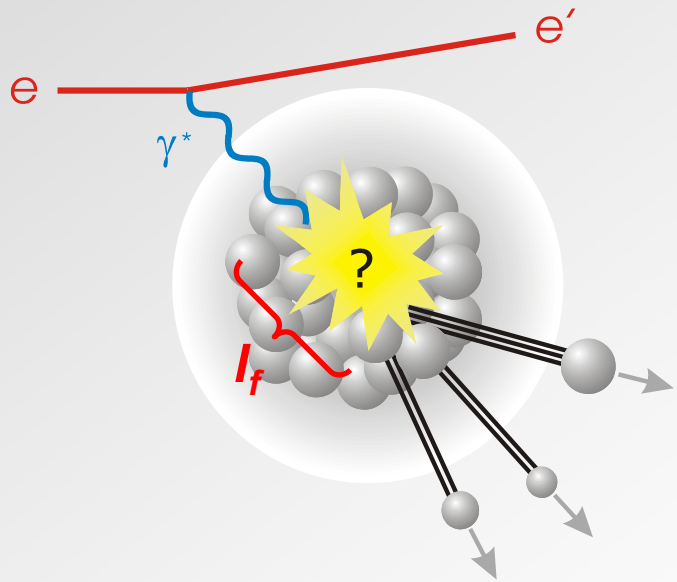
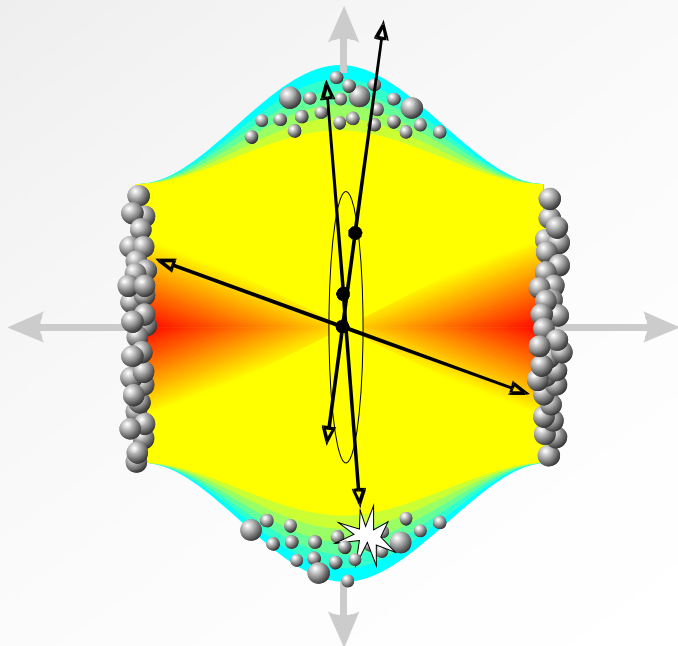
Motivation

- *eA* reactions at HERMES
  - reaction products traverse cold nuclear environment



→ **space-time picture of hadronization & (pre-)hadronic final state interactions**

- *AA* reactions at RHIC
  - jets traverse hadronic gas created in soft interactions

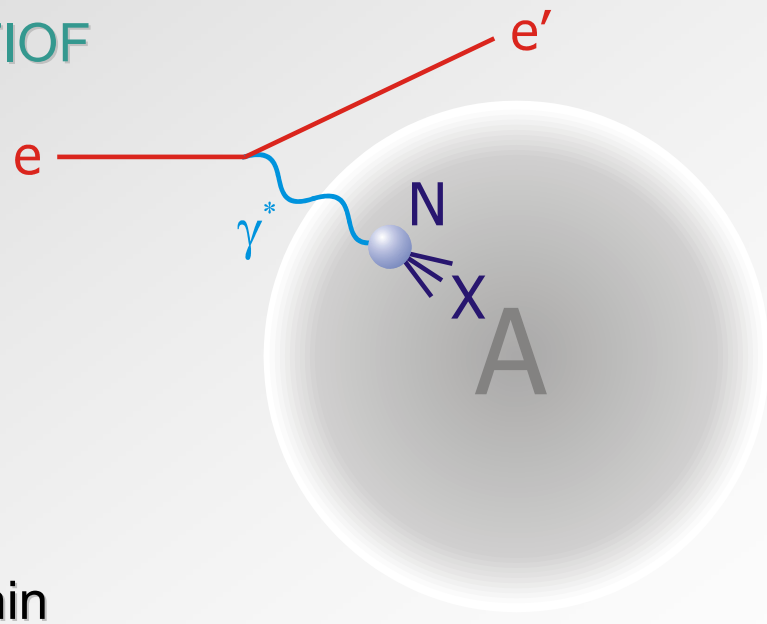


→ **(upper) estimate of (pre-)hadronic contribution to jet quenching**

Model

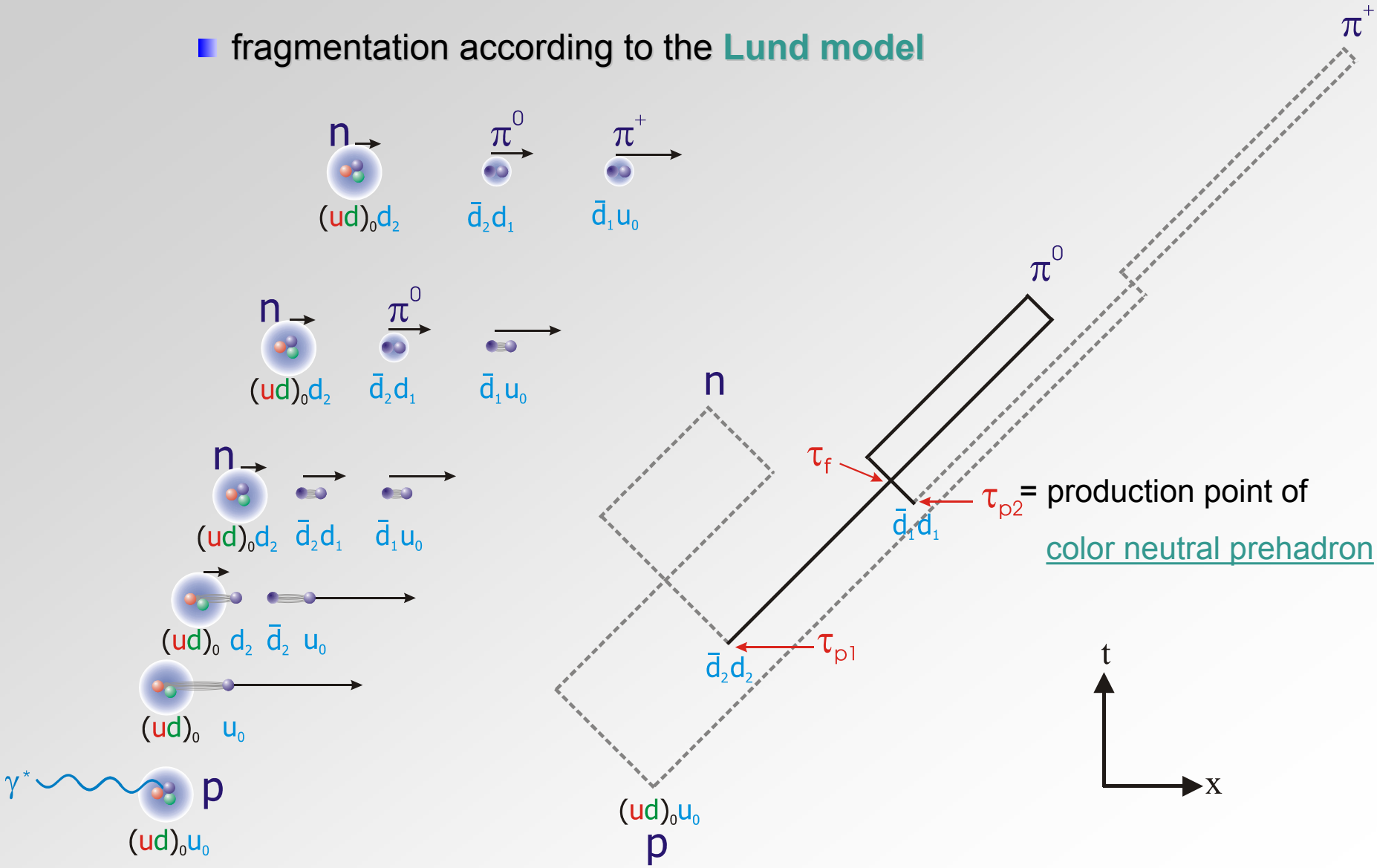
- γA, eA reaction splitted into 2 parts :

  - $\gamma^* N \rightarrow X$ using PYTHIA & FRITIOF
    - additional consideration of
      - binding energies
      - Fermi motion
      - Pauli blocking
      - coherence length effects



  - propagation of final state X within BUU transport model
    - consideration of
      - elastic and inelastic scattering (coupled channels)

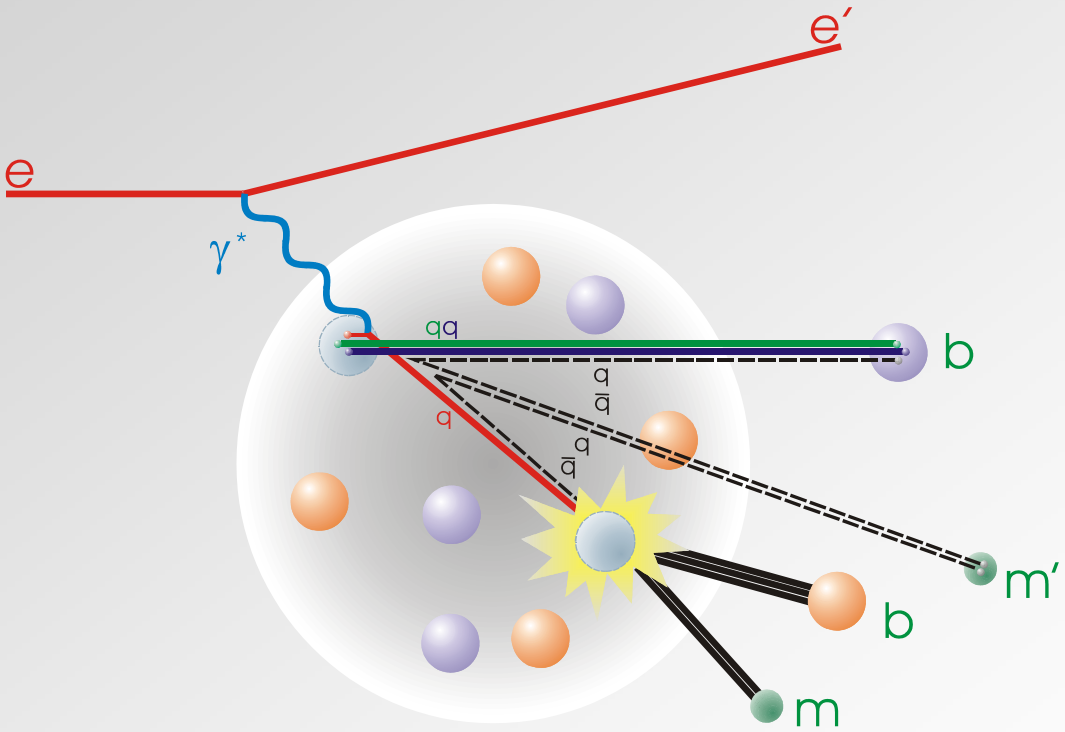
- hard interactions (e.g. direct $\gamma^* N$ reaction)
  - excitation of hadronic strings
  - fragmentation according to the **Lund model**



general approach in transport models

- string fragments very fast into color-neutral prehadrons $t_p = 0$
- prehadrons need formation time $t_f = \gamma_h \tau_f$ to build up hadronic wave function
- prehadronic cross section σ^* determined by constituent quark model

$$\sigma_b^* = \frac{\#q_{orig}}{3}\sigma_b$$
$$\sigma_m^* = \frac{\#q_{orig}}{2}\sigma_m$$



"leading" prehadrons
(= target-, beam remnants)
can undergo FSI directly
after $\gamma^* N$ interaction

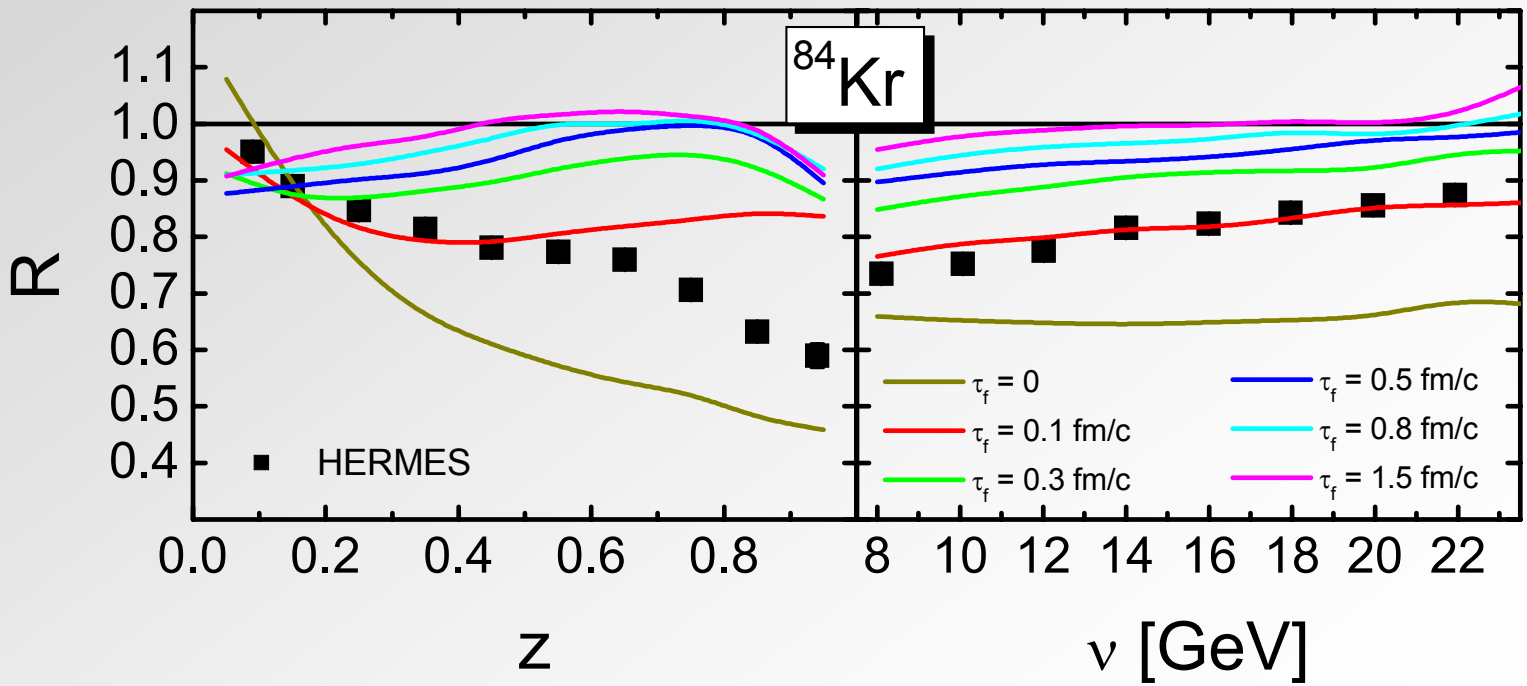
hadrons that solely contain quarks from string fragmentation
start to interact after t_f

Results

- hadron attenuation in DIS off nuclei at HERMES (E_{beam}=27.5 GeV)
  - multiplicity ratio:

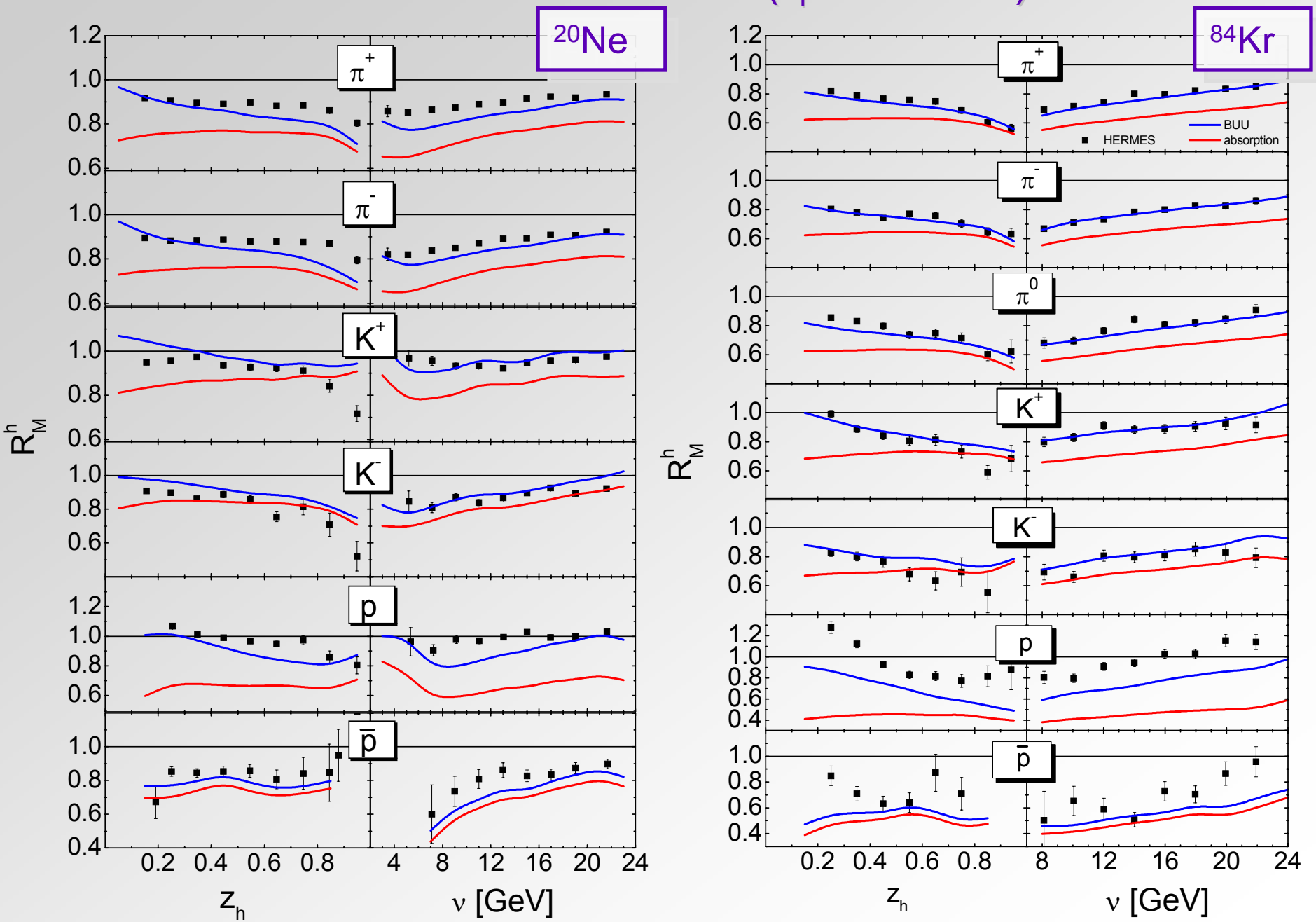
$$R_M^h(z_h, p_T, \nu) = \frac{\left(\frac{N_h(z_h,p_T,\nu)}{N_e(\nu)}\right)_A}{\left(\frac{N_h(z_h,p_T,\nu)}{N_e(\nu)}\right)_D} \qquad z_h = \frac{E_h}{\nu}$$

  - w/o prehadronic FSI:



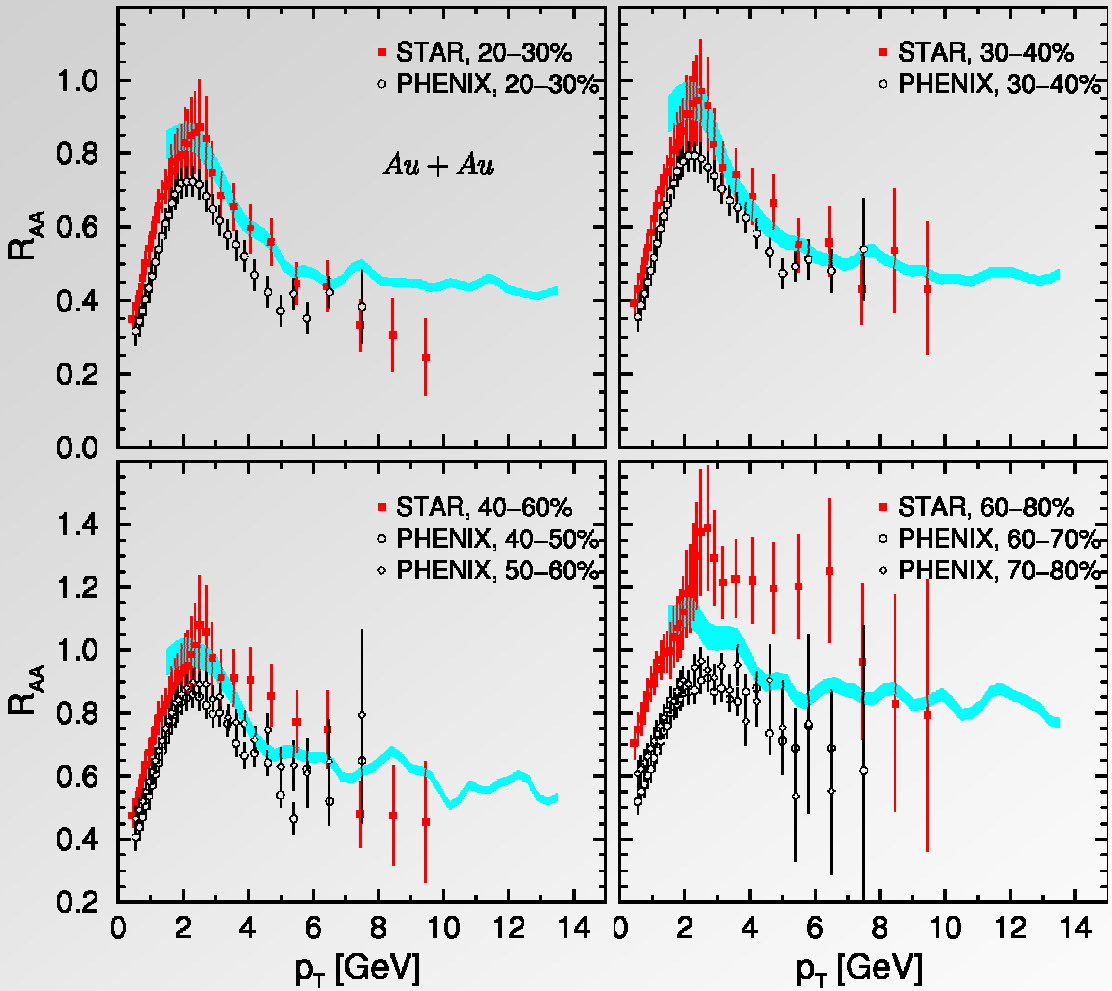
prehadronic interactions needed

attenuation of identified hadrons (τ_f = 0.5 fm/c)



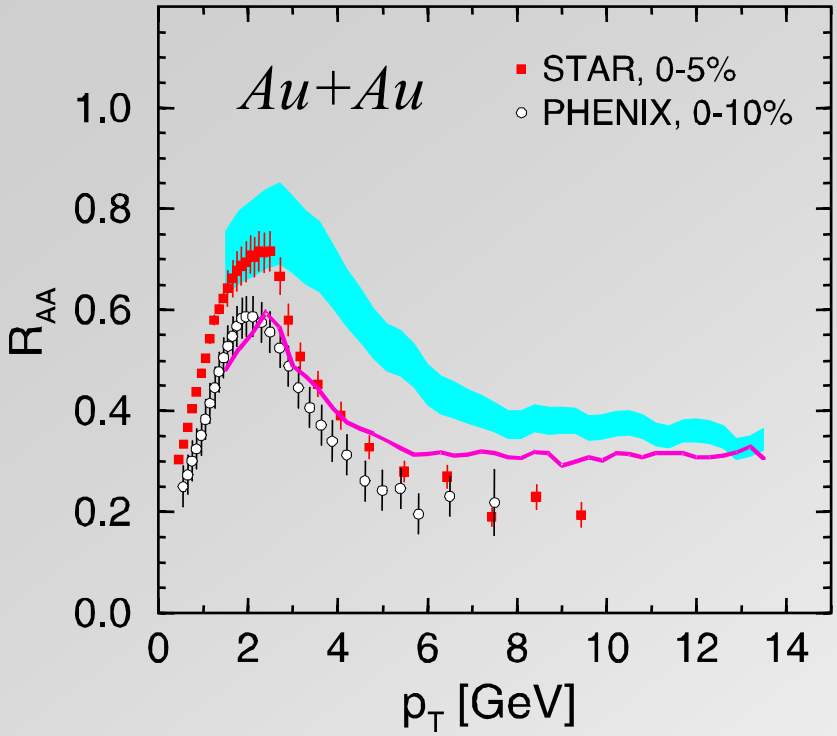
peripheral and mid-central Au+Au collisions

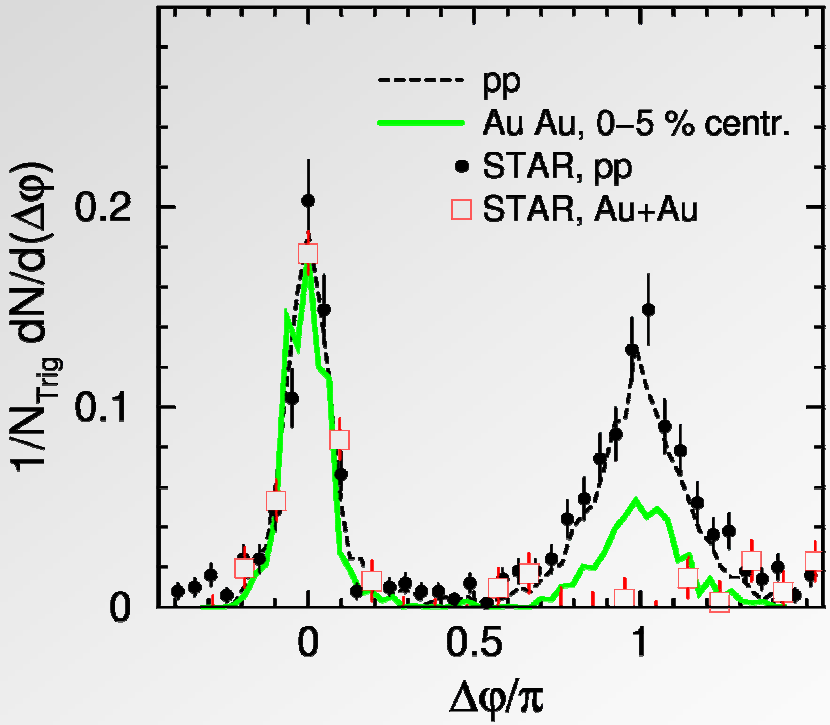
– suppression factor $$R_{AA}(p_T) = \frac{(1/N_{AA}^{\text{event}})d^2N_{AA}/dy/dp_T}{(\langle N_{\text{coll}}\rangle/\sigma_{pp}^{\text{inel}})d^2\sigma_{pp}/dy/dp_T}$$



peripheral and mid-central collisions dominated by (pre-)hadronic FSI

most central Au+Au collisions





– not enough suppression of
  - high p_T hadrons
  - far-side jets

→ additional partonic energy loss in QGP

Summary & Outlook

- coupled channel transport model
  - (pre-)hadronic FSI contribute significantly to
    - hadron attenuation in e+A @ HERMES
    - jet suppression in peripheral and mid-central A+A @ RHIC
  - (pre-)hadronic FSI cannot completely explain
    - jet suppression in most central HIC @ RHIC

partonic interactions in a possibly colored medium (QGP)

- future plans:
  - more realistic space-time picture of hadron production
  - string propagation
  - analysis of JLab, EMC, eRHIC experiments