Multidimensional Hadron Attenuation

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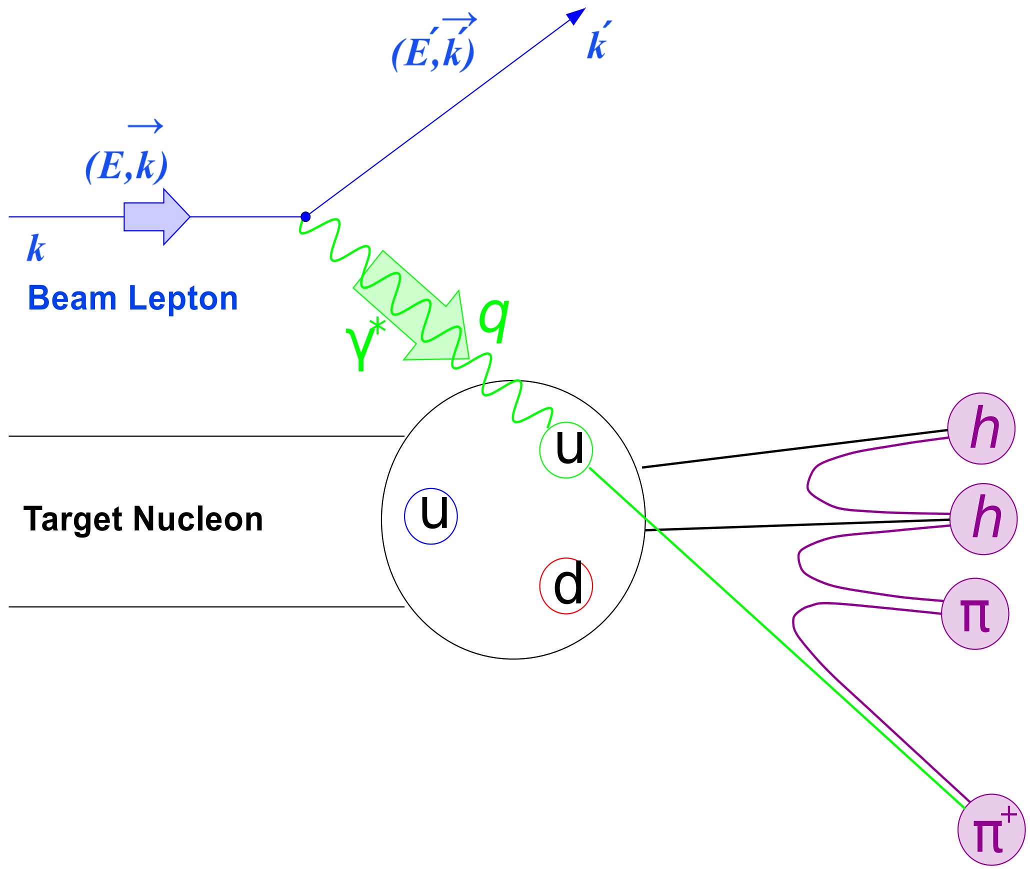
Overview

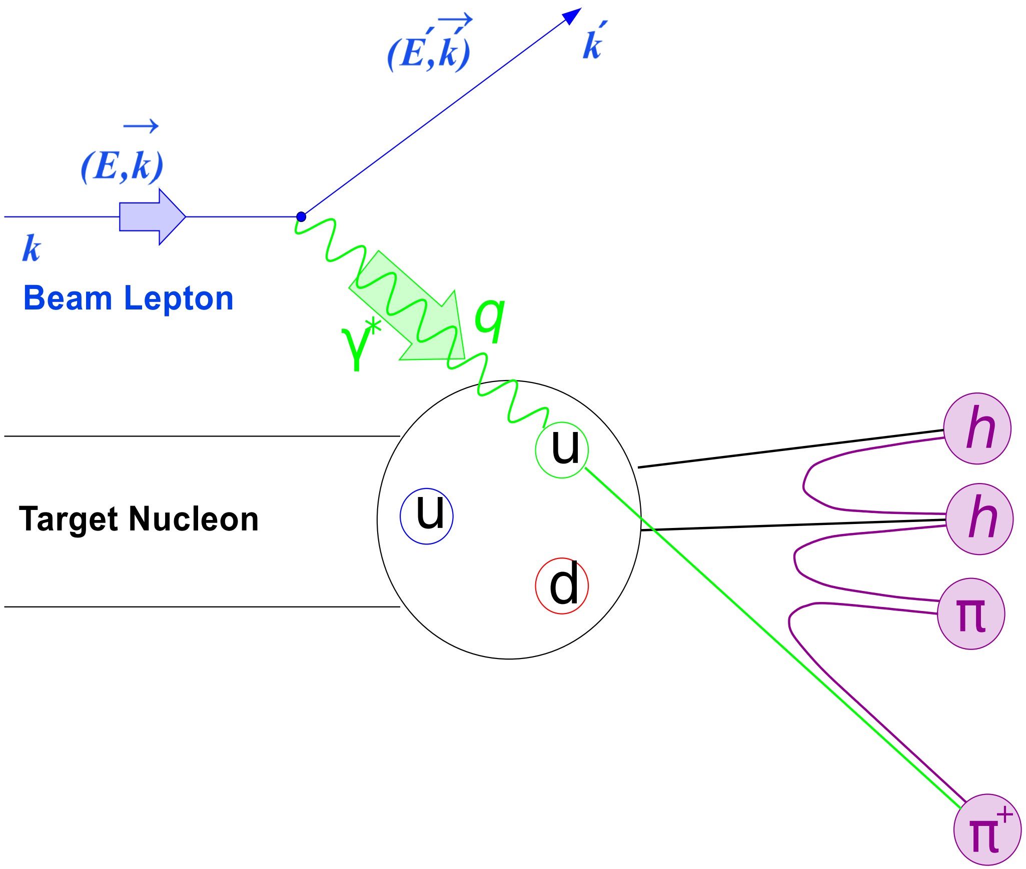
- Semi-Inclusive Deep-Inelastic Scattering (SIDIS)
- Nuclear Effects
- Experiment
- Results
- Summary

SIDIS



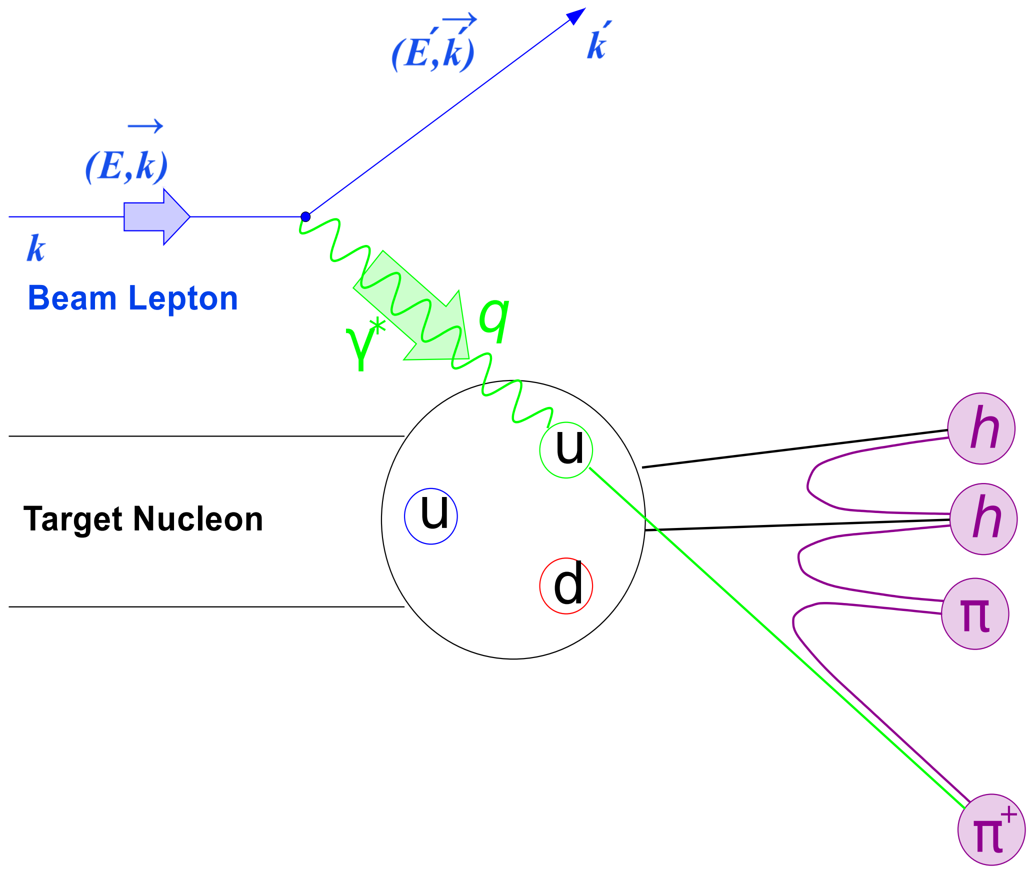
$(E',\vec{k'})$
k'
$(E,\vec{k})$
k
Beam Lepton
γ^*
q
Target Nucleon
u
u
d
h
h
π
π^+

SIDIS



- $Q^2 \equiv -q^2 = (k - k')^2$

SIDIS



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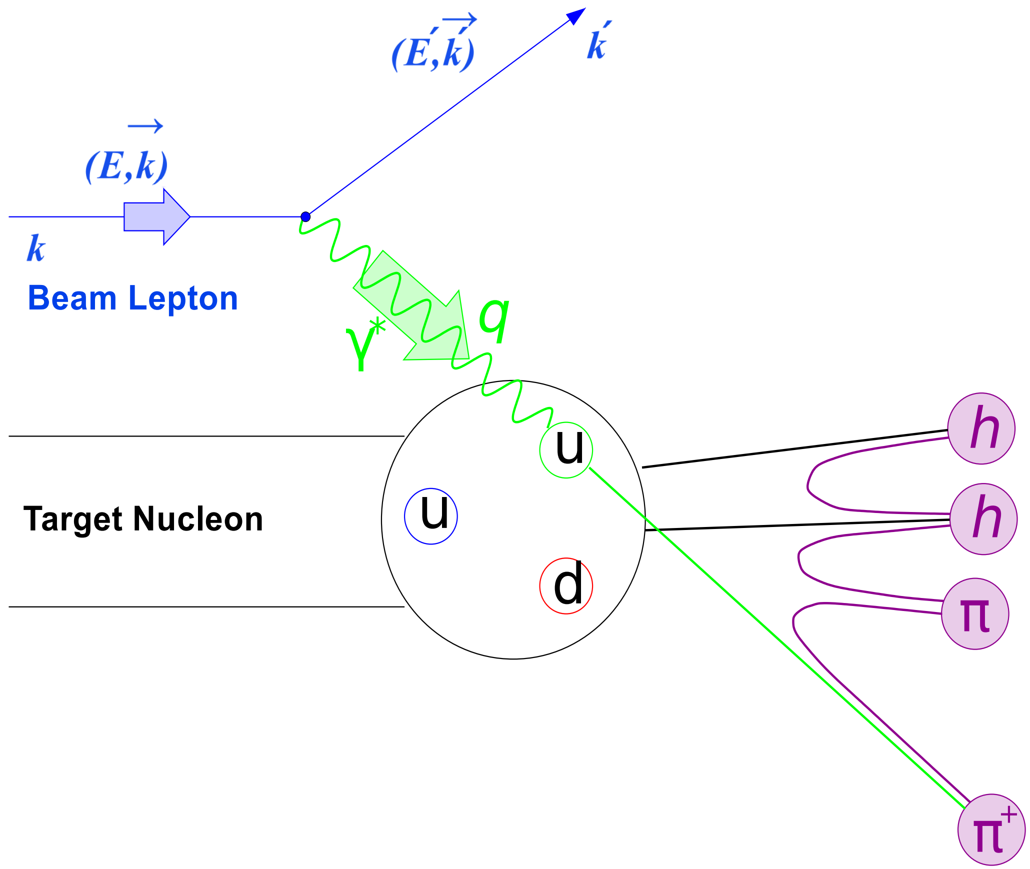
SIDIS



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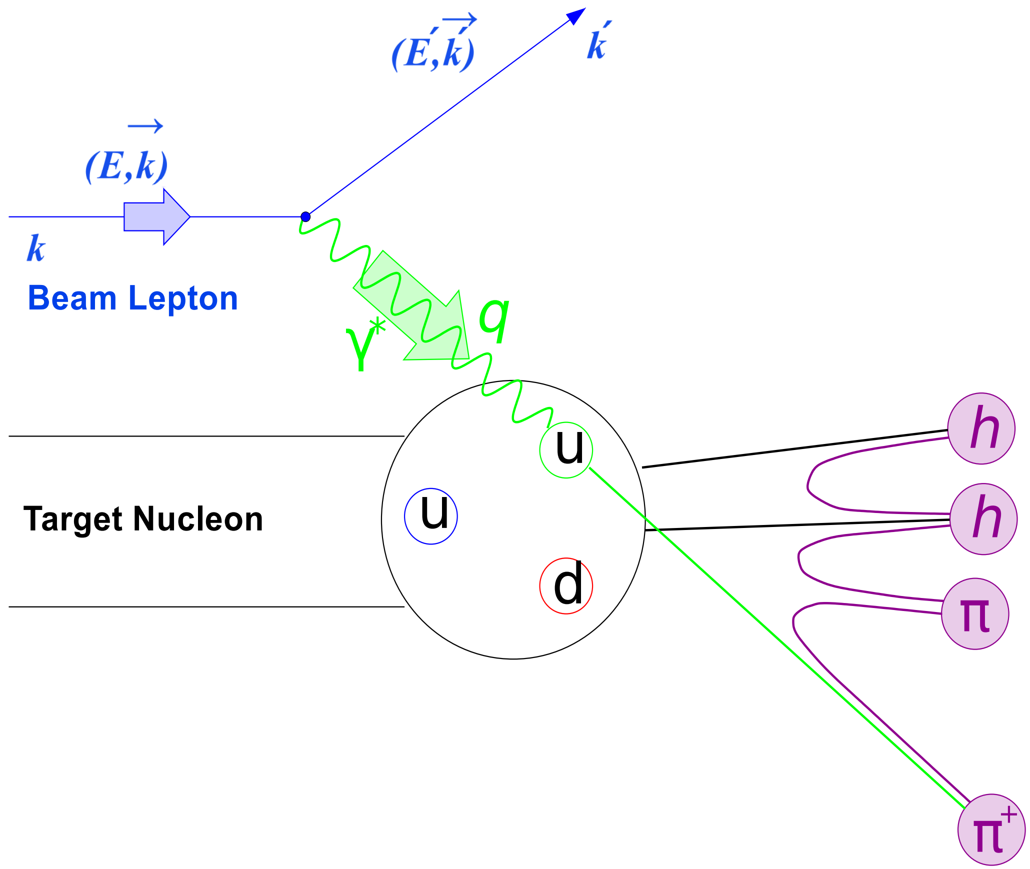

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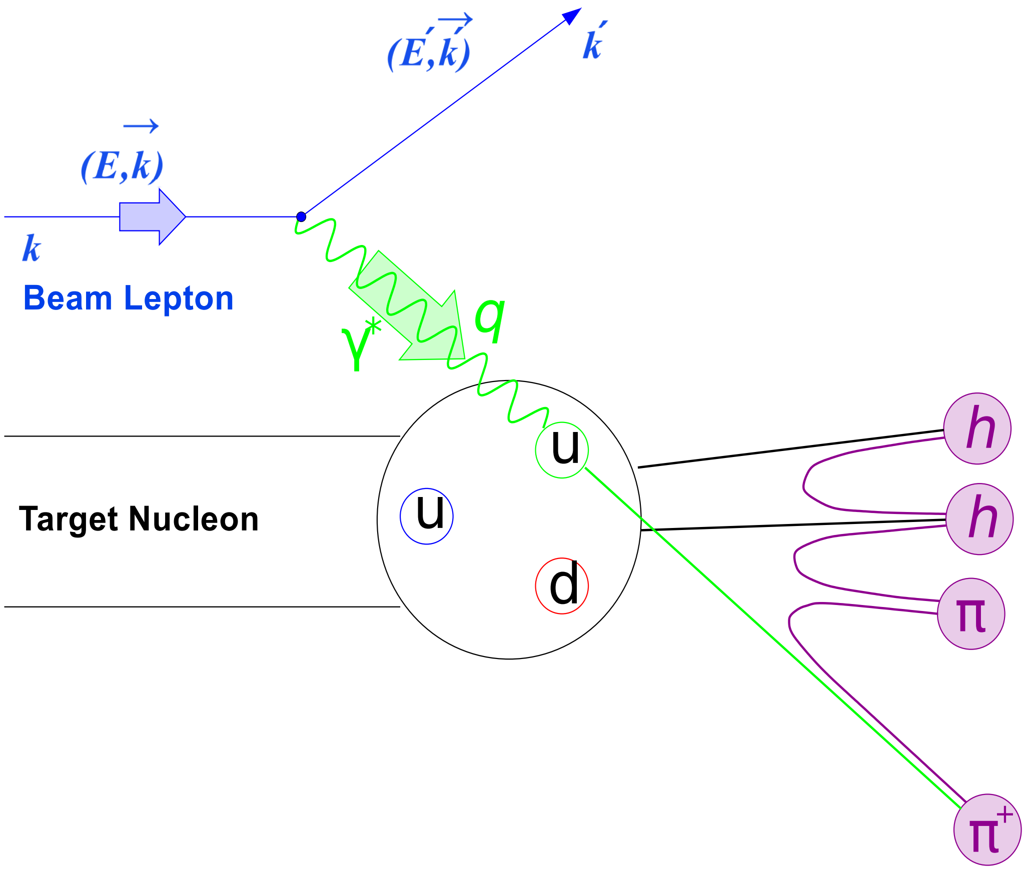
SIDIS



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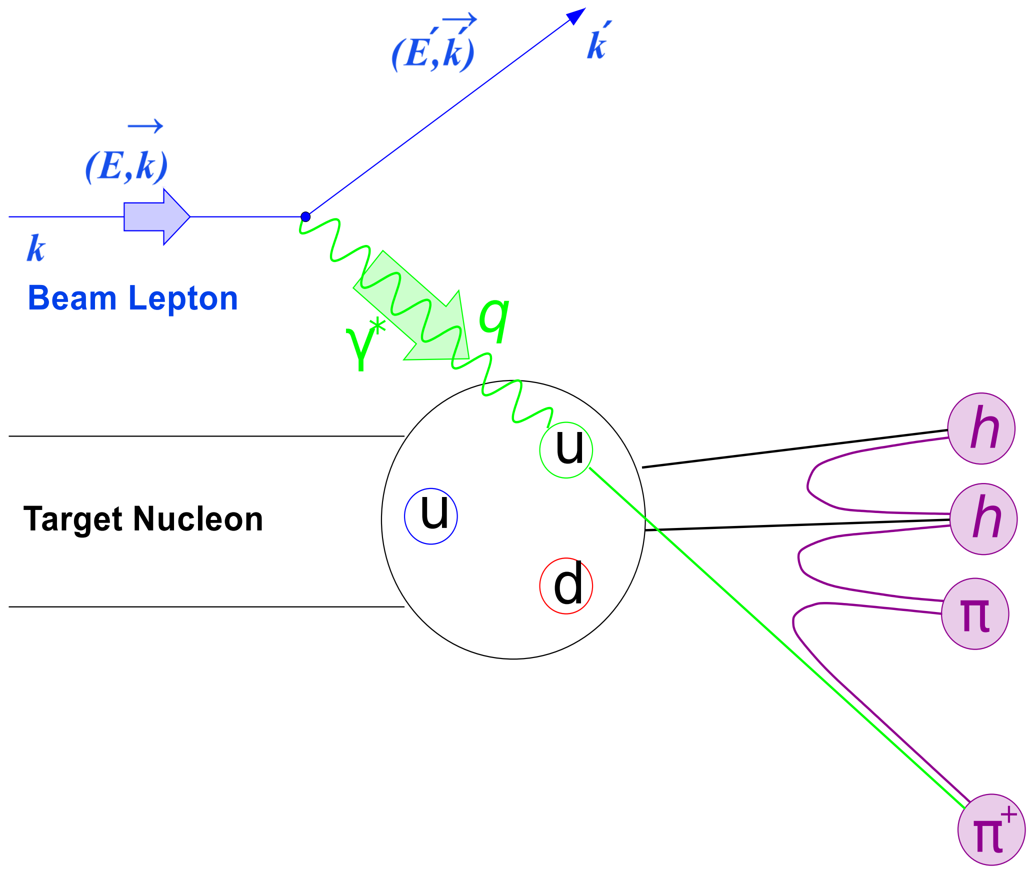
SIDIS



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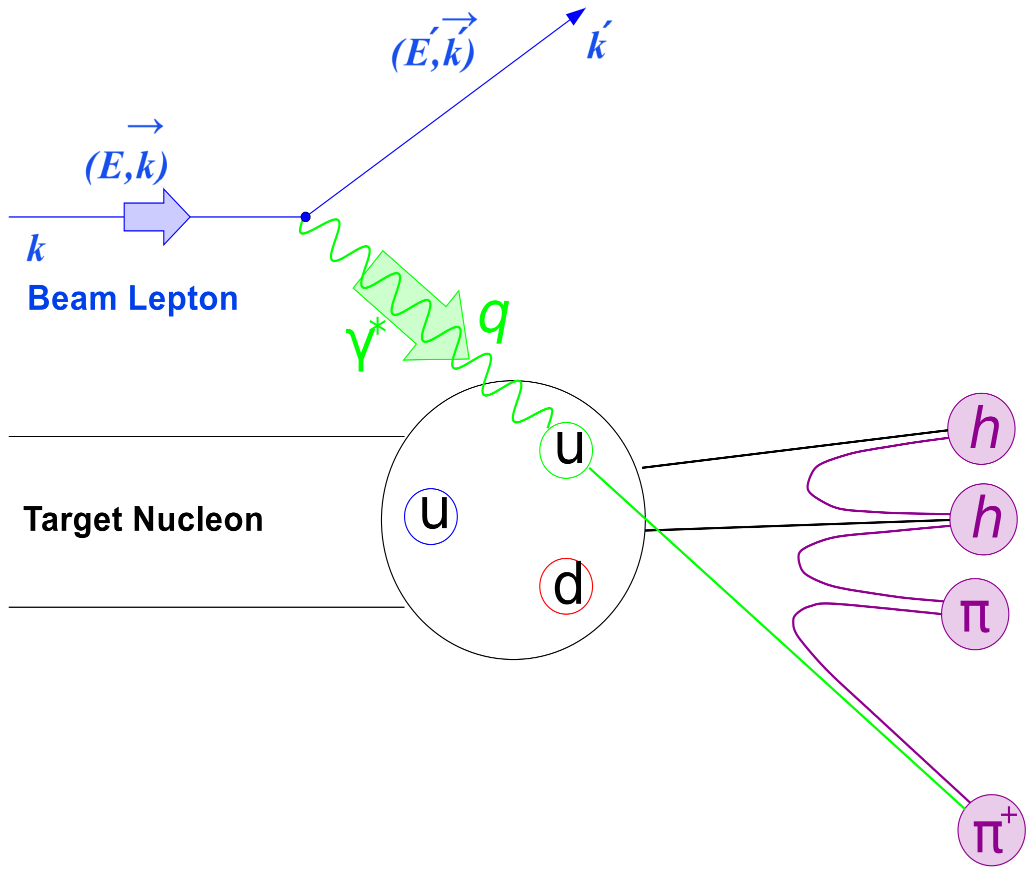
SIDIS



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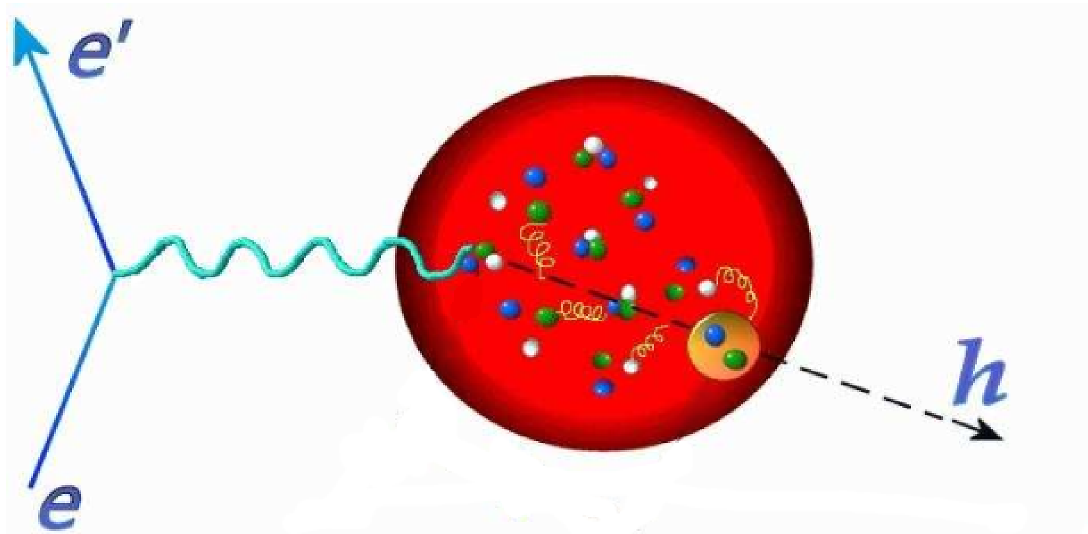
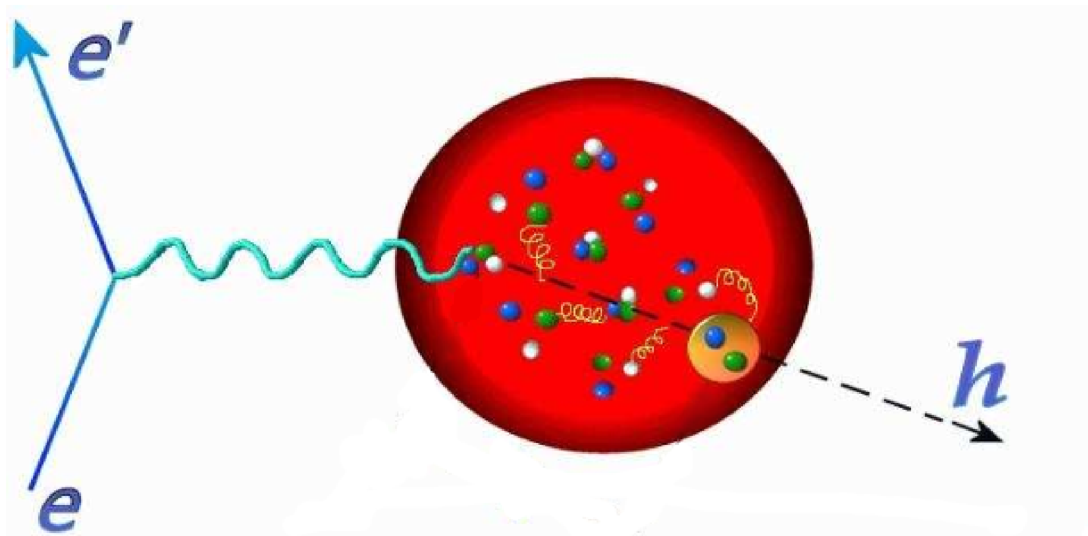
$$\sigma^{eN\to eh} \propto \sum_f e_f^2 \cdot q_f(x_{Bj}, Q^2) \cdot \sigma^{eq\to eq} \cdot D_f^h(z_h, Q^2)$$

Nuclear Effects

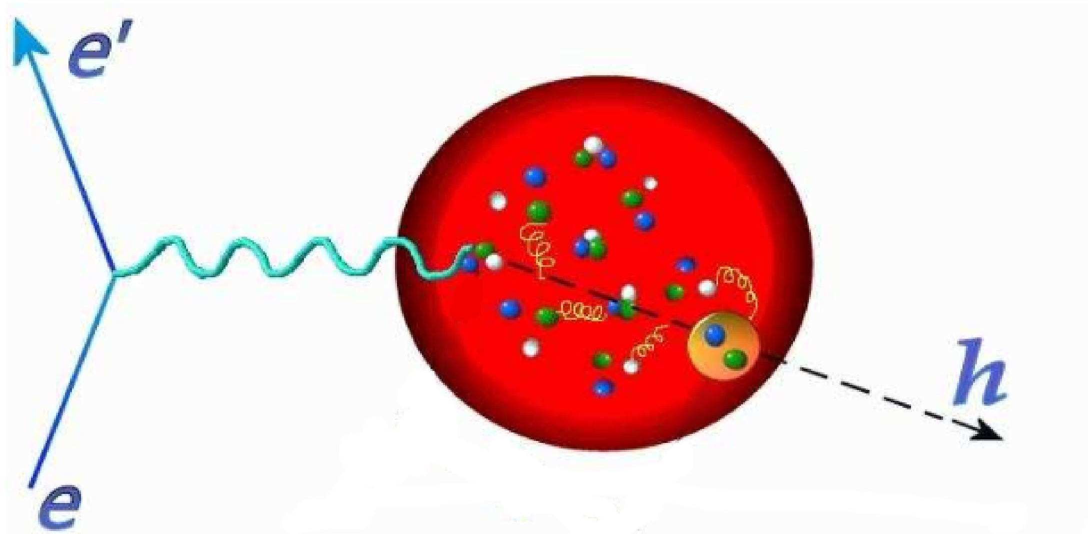


Nuclear Effects



Partonic Effects

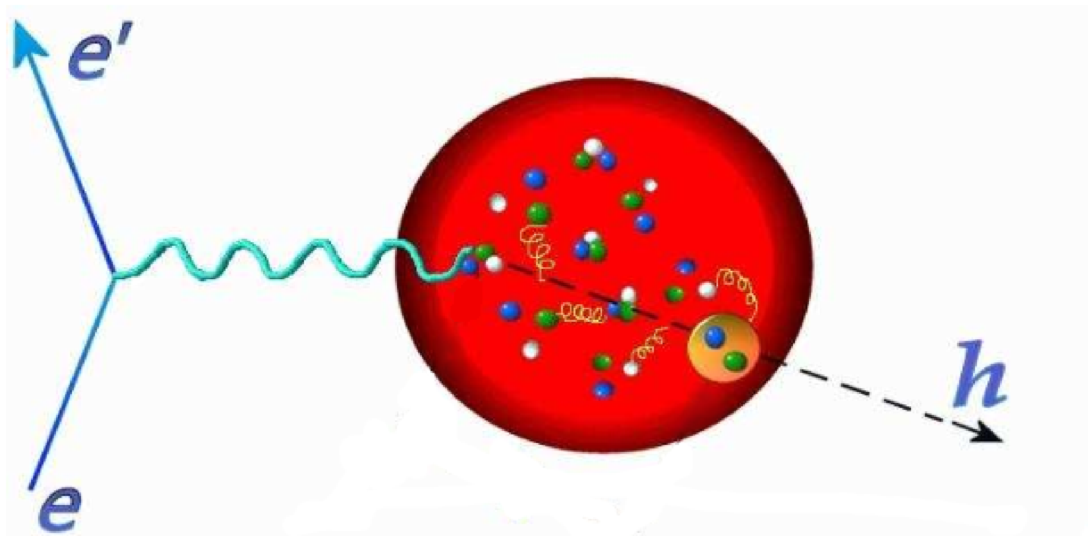
Nuclear Effects



Partonic Effects

- **Gluon Radiation**
- **Parton Rescattering**

Nuclear Effects



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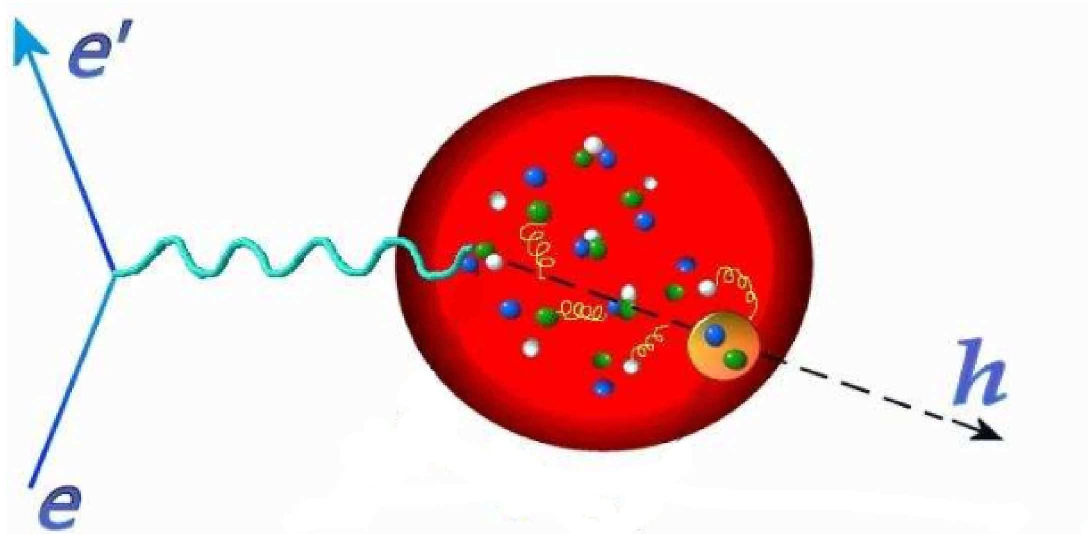


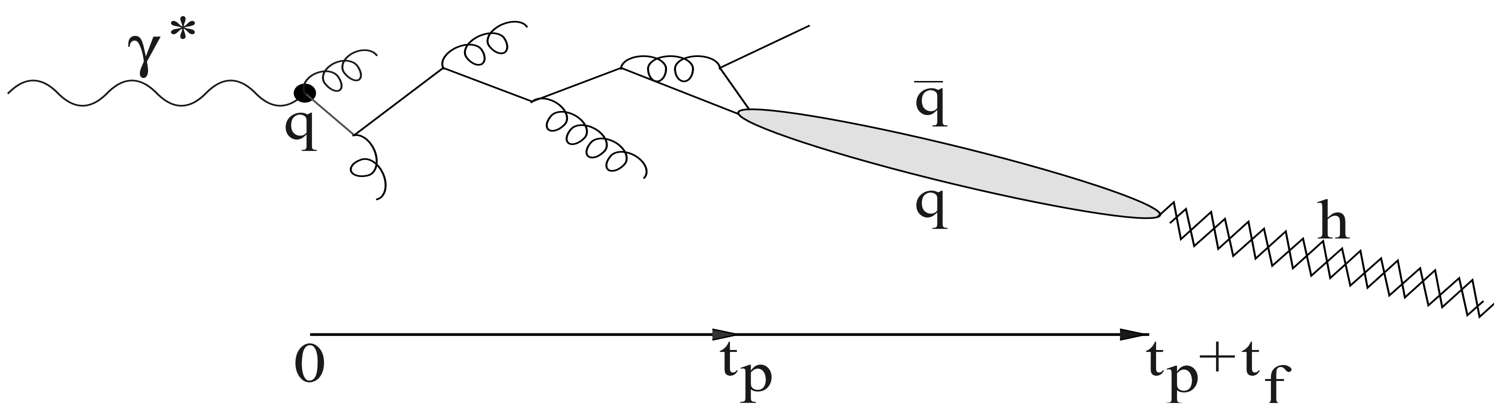
Partonic Effects

- Gluon Radiation
- Parton Rescattering

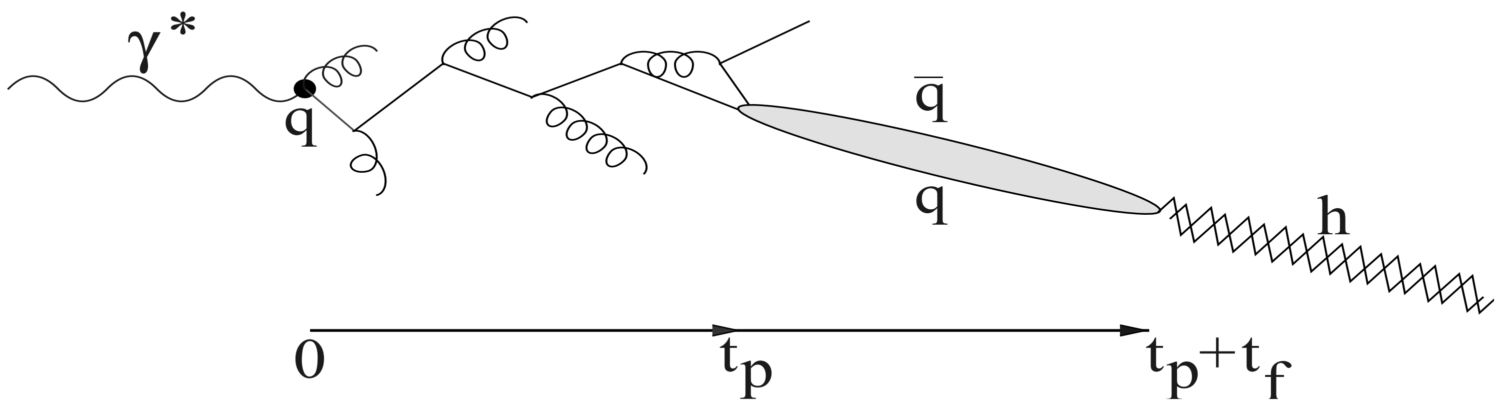
Hadronic Effects

- Colorless Prehadron Interaction
- Hadronic Final State Interaction

Nuclear Effects

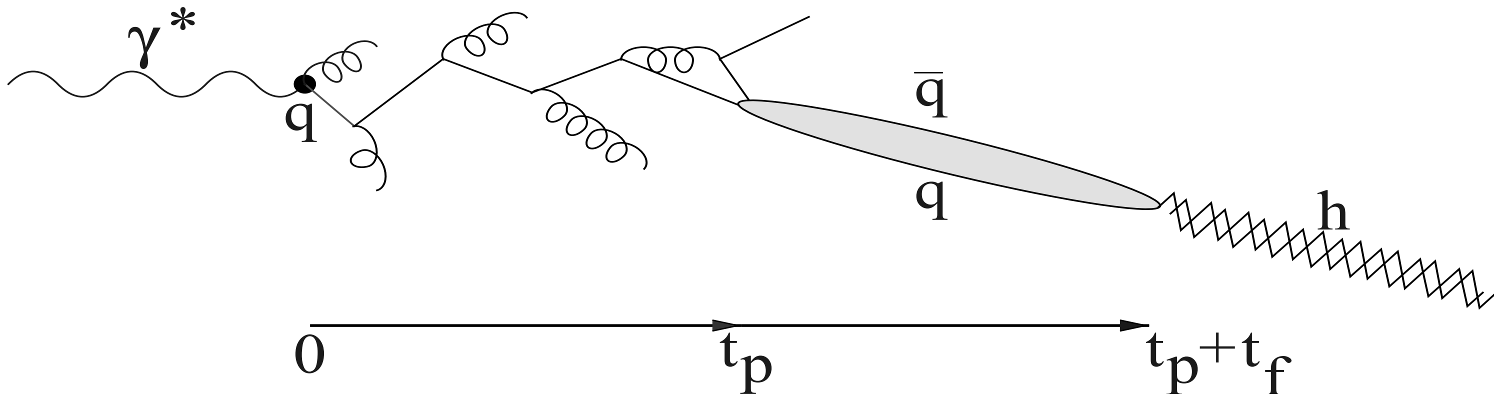


Nuclear Effects



Partonic Effects **Hadronic Effects**

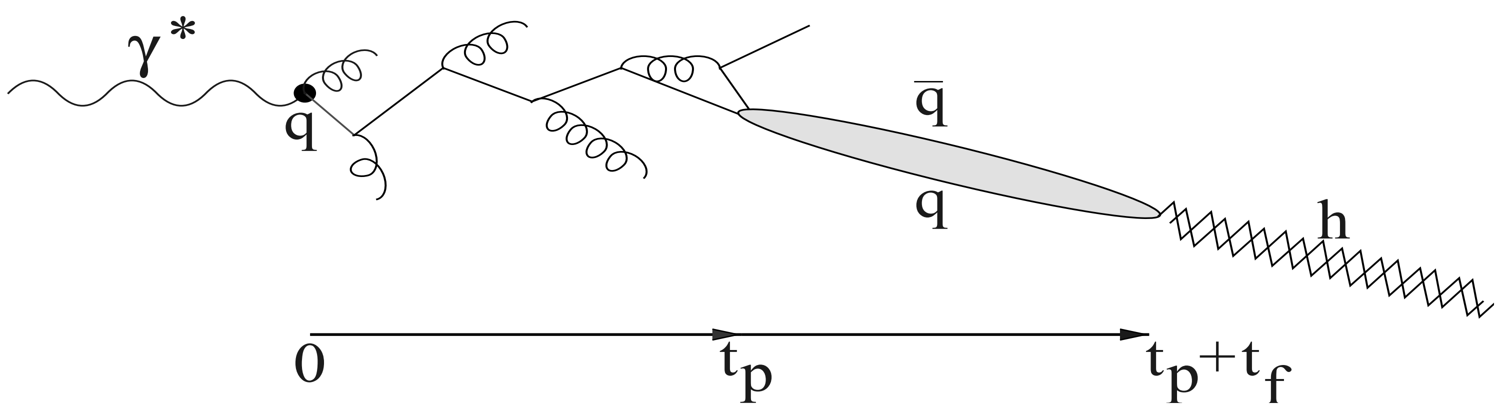
Nuclear Effects



Partonic Effects **Hadronic Effects**

Nuclear Attenuation

Nuclear Effects

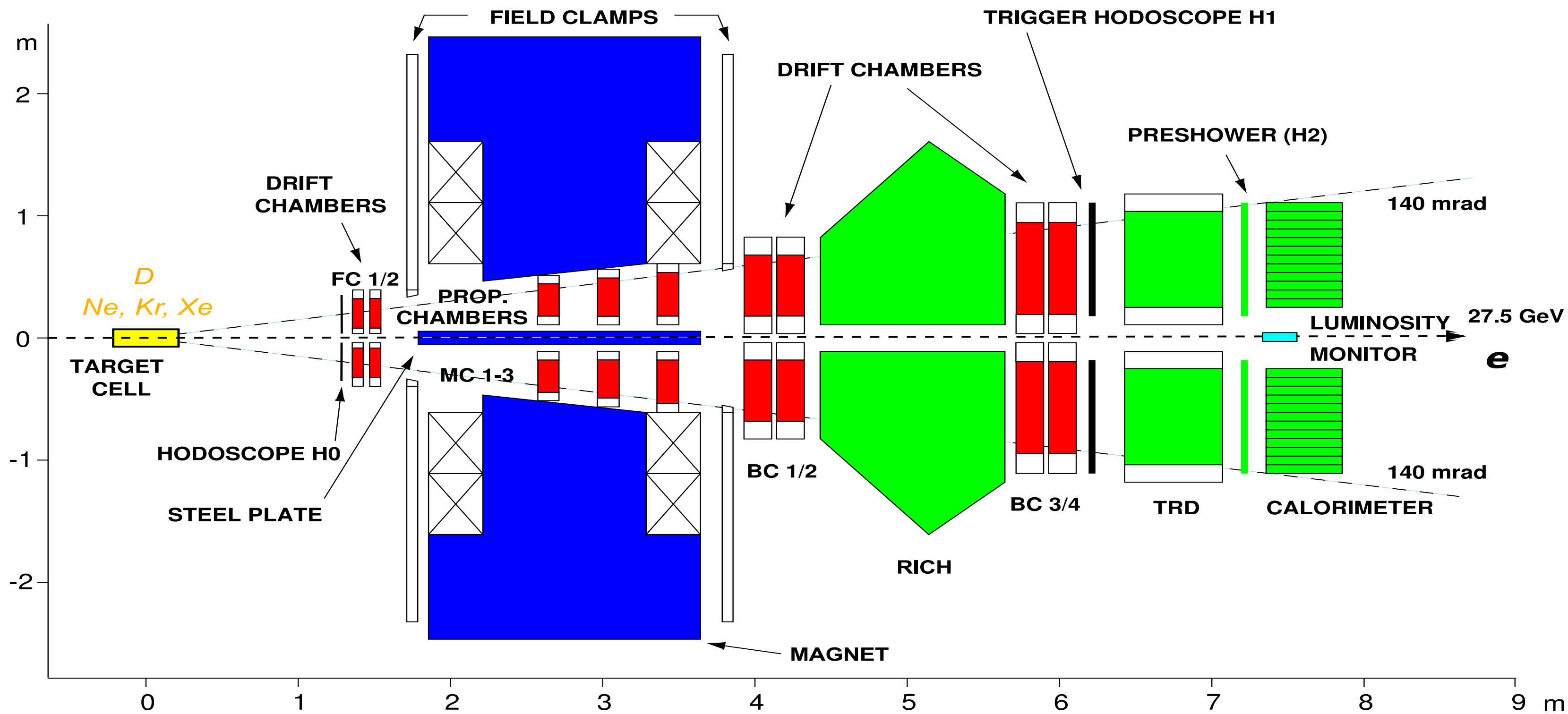


Partonic Effects **Hadronic Effects**

Nuclear Attenuation

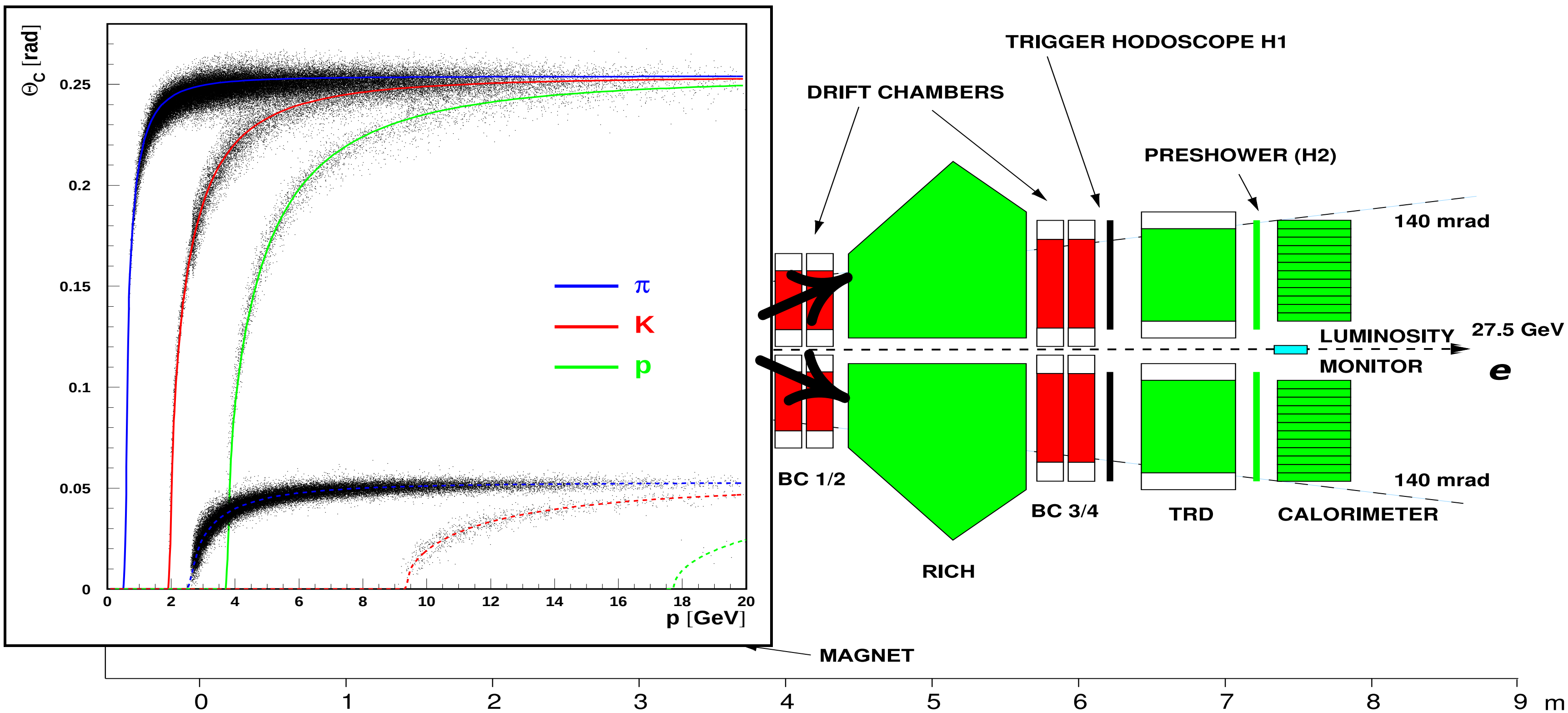
$$R_A^h(\nu, Q^2, z, p_t^2, \phi) = \frac{\left(\frac{N^h(\nu, Q^2, z, p_t^2, \phi)}{N^e(\nu, Q^2)}\right)_A}{\left(\frac{N^h(\nu, Q^2, z, p_t^2, \phi)}{N^e(\nu, Q^2)}\right)_D}$$

Experiment



- $e^{\pm}$ **beam of 27.6 GeV energy**
- **Nuclear Target(** $\mathbf{D, Ne, Kr, Xe}$ **)**
- **Good Momentum Resolution(** $\mathbf{\Delta p/p < 2\%}$ **)**
- **Excellent Particle Identification Capabilities**

Experiment



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Results

Multidimensional representation of $\mathbf{R_A^h}$

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- ν **for three** $\mathbf{z}$ **slices**
- $\mathbf{z}$ **for three** ν **slices**
- $\mathbf{p_t^2}$ **for three** $\mathbf{z}$ **slices**
- $\mathbf{z}$ **for three** $\mathbf{p_t^2}$ **slices**

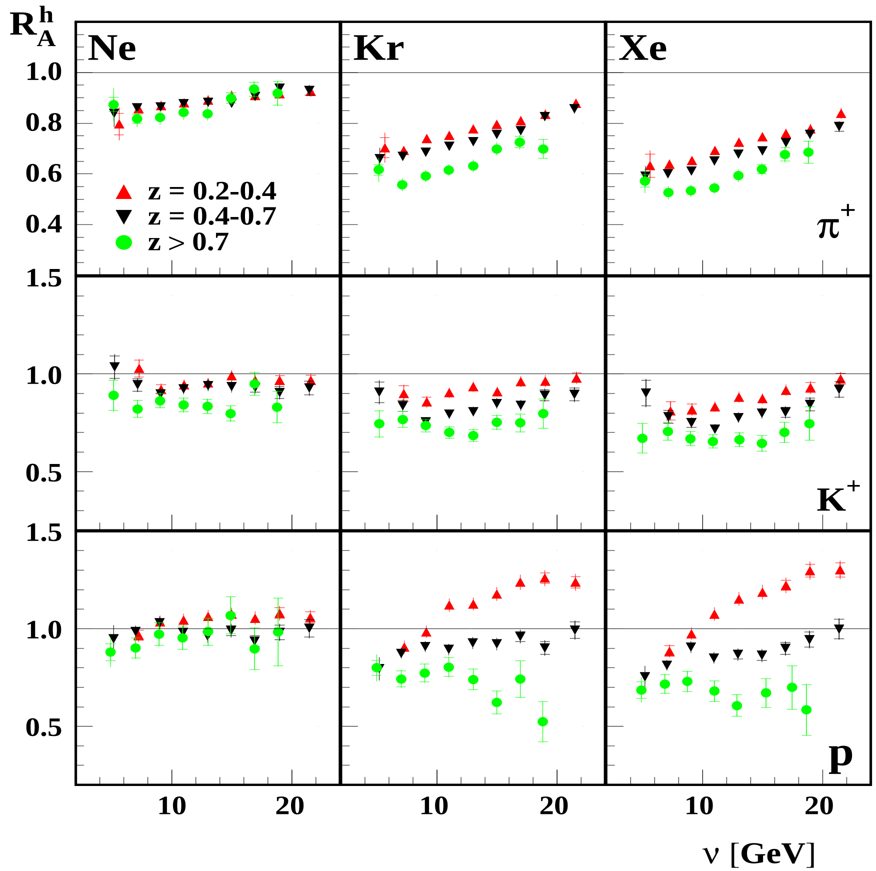
Results

Multidimensional representation of $\mathbf{R_A^h}$

- ν for three $\mathbf{z}$ slices
- $\mathbf{z}$ for three ν slices
- $\mathbf{p_t^2}$ for three $\mathbf{z}$ slices
- $\mathbf{z}$ for three $\mathbf{p_t^2}$ slices

Eur. Phys. J. A 47 (2011) 113, arXiv: 1107.3496

Results



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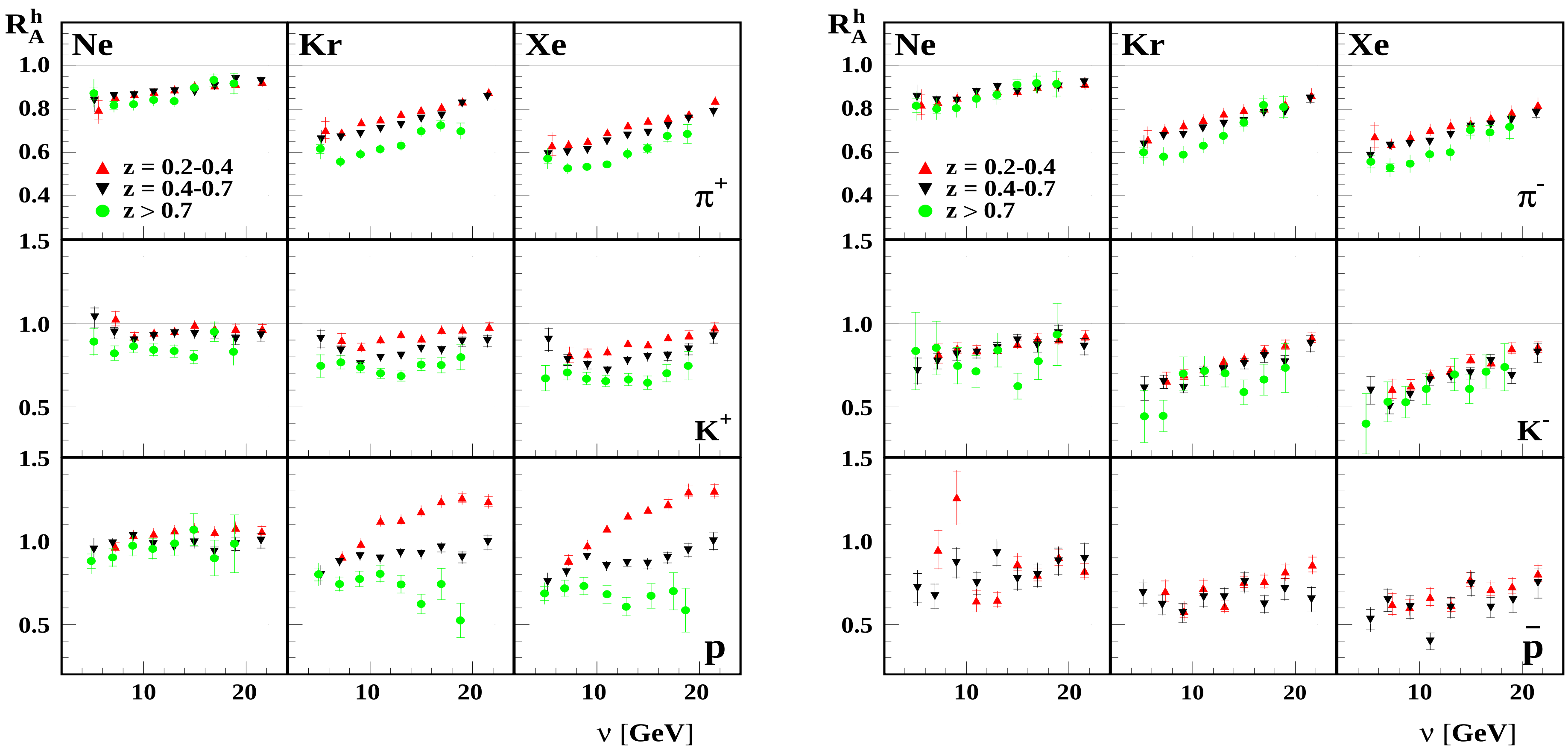
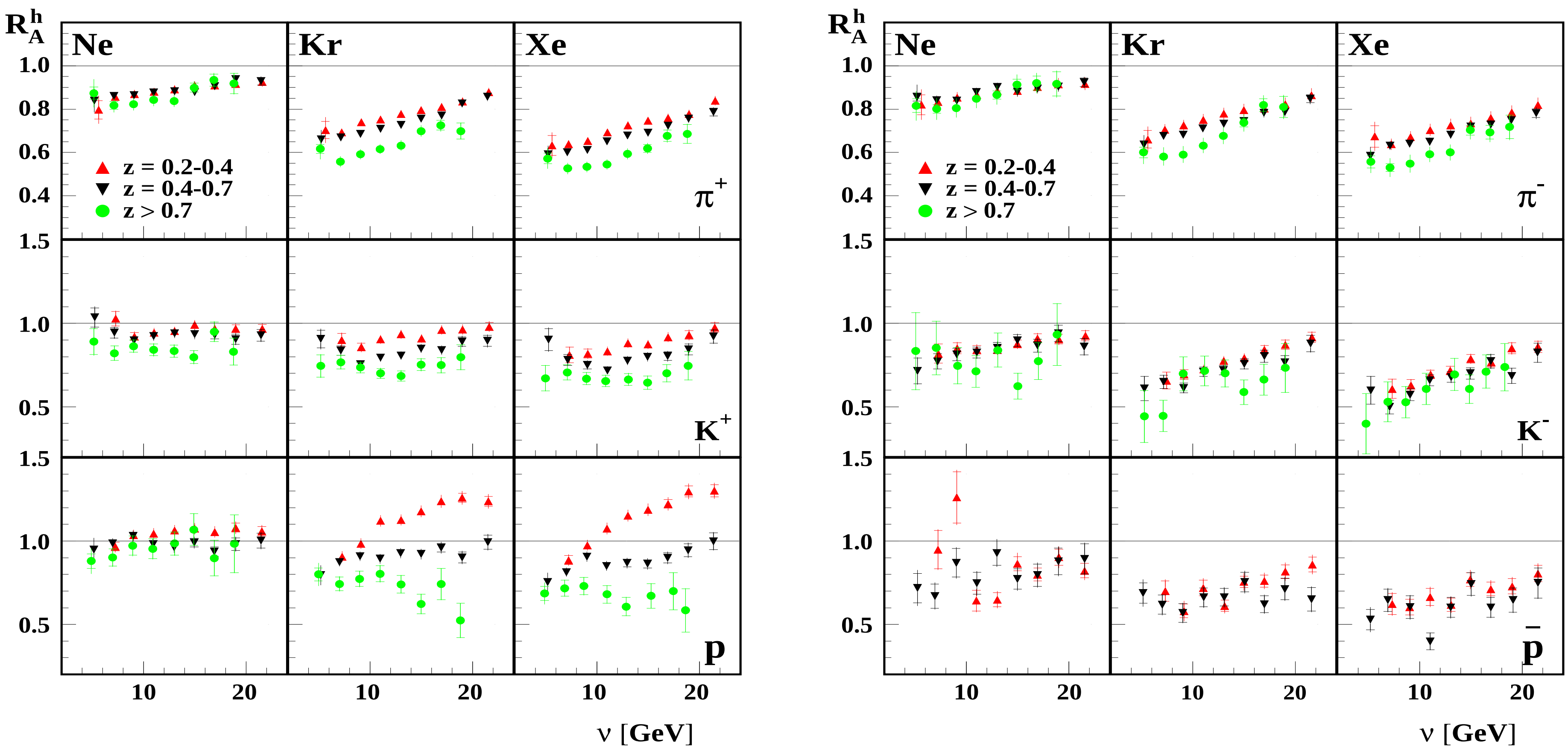


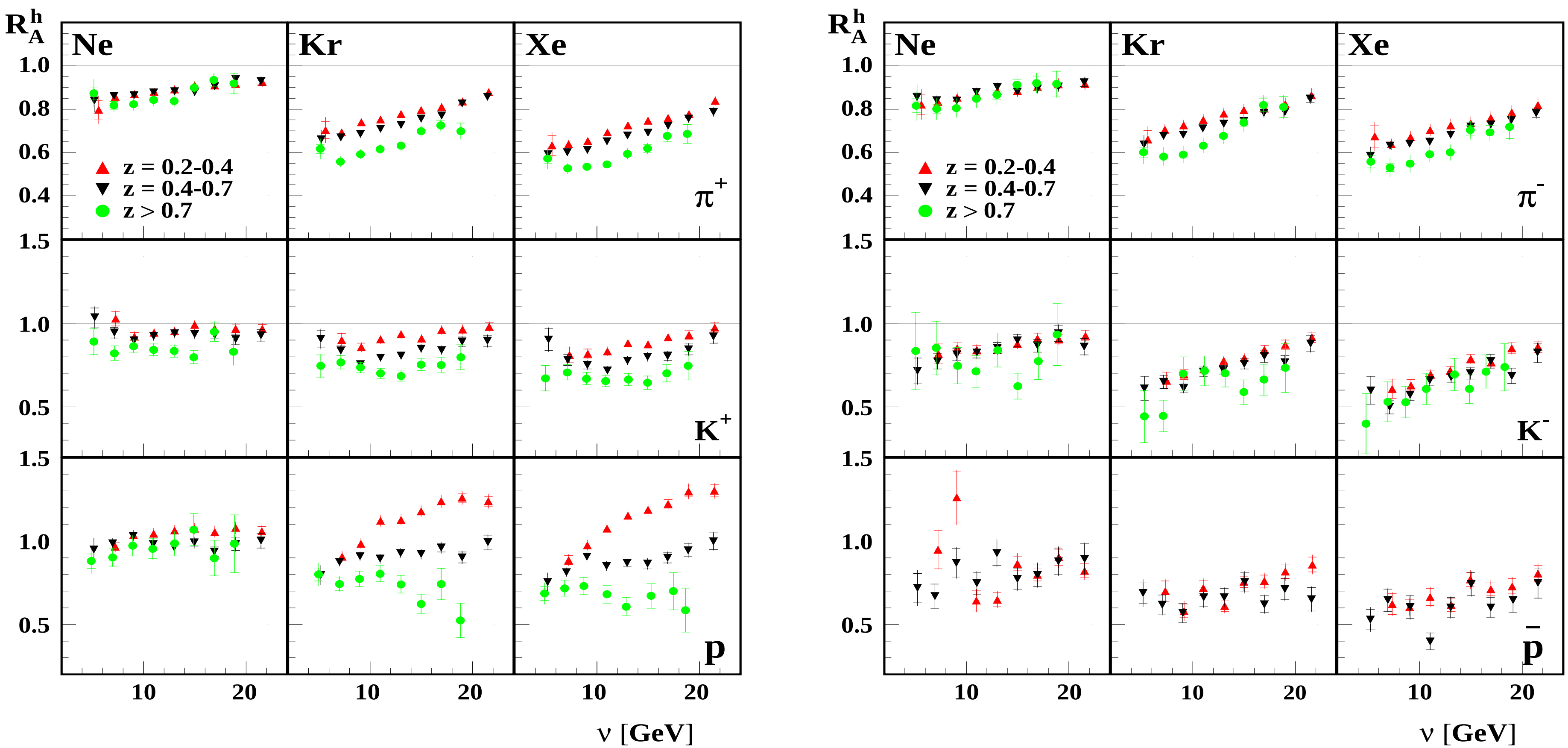
R_A^h
Ne
Kr
Xe
z = 0.2-0.4
z = 0.4-0.7
z > 0.7
π^+
K^+
p
π^-
K^-
$\bar{p}$
1.0
0.8
0.6
0.4
1.5
0.5
10
20
ν [GeV]

Results



Attenuation is larger for heavy nuclei.

Results



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R^{K^+} **is different from** R^{π^+}, R^{π^-} **and** R^{K^-} .

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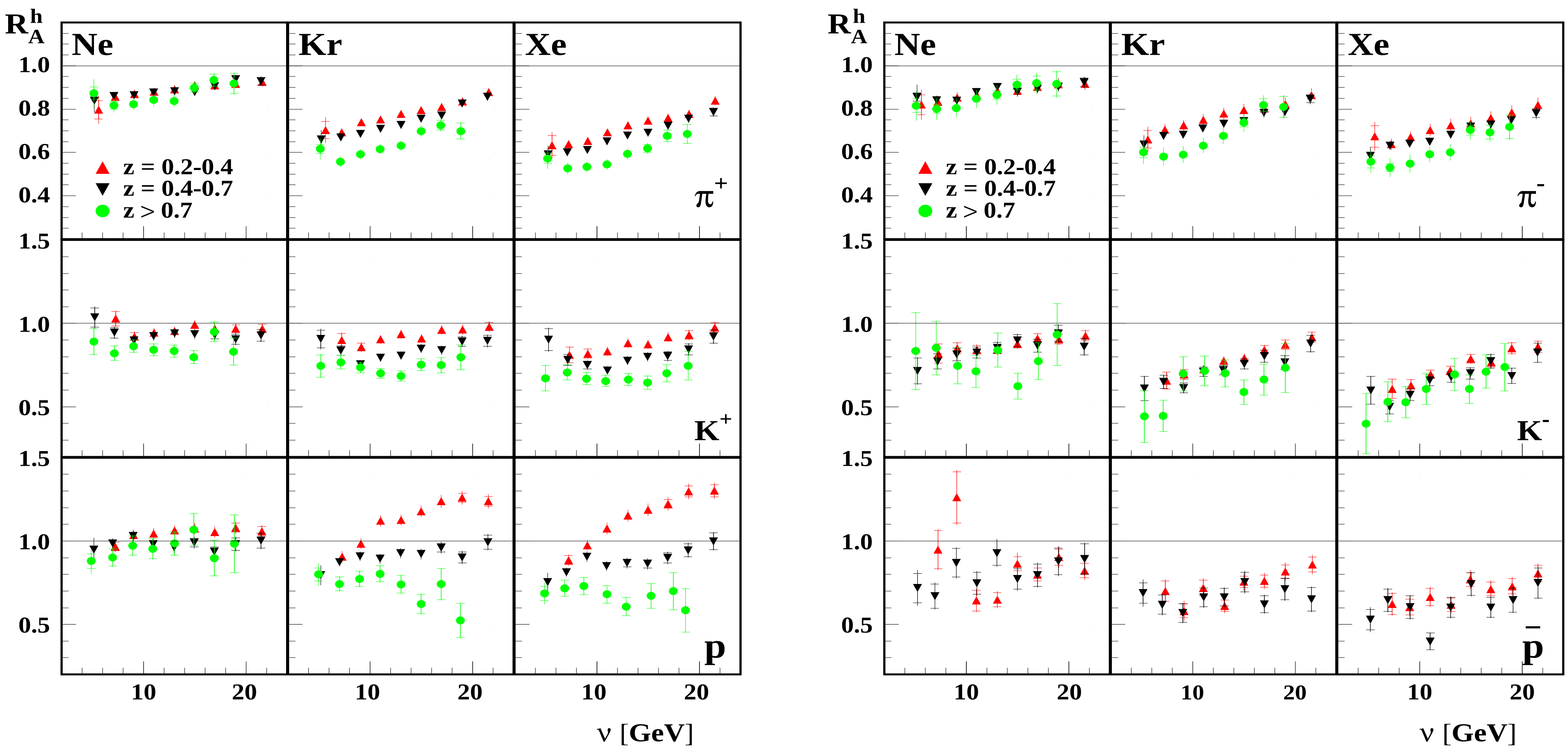

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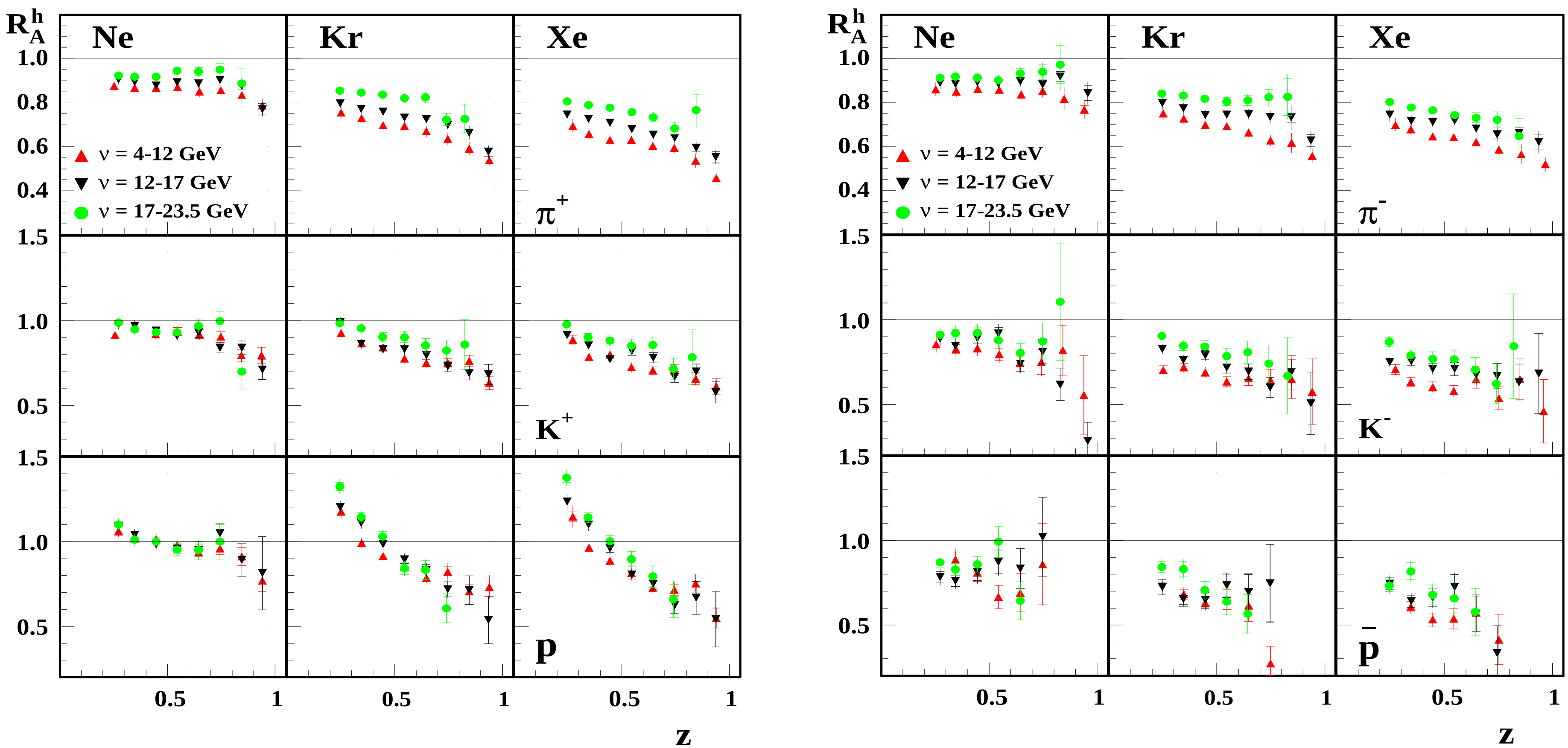
R^{K^+} **is different from** R^{π^+}, R^{π^-} **and** R^{K^-} .

Protons behave very differently from the other hadrons.

Results



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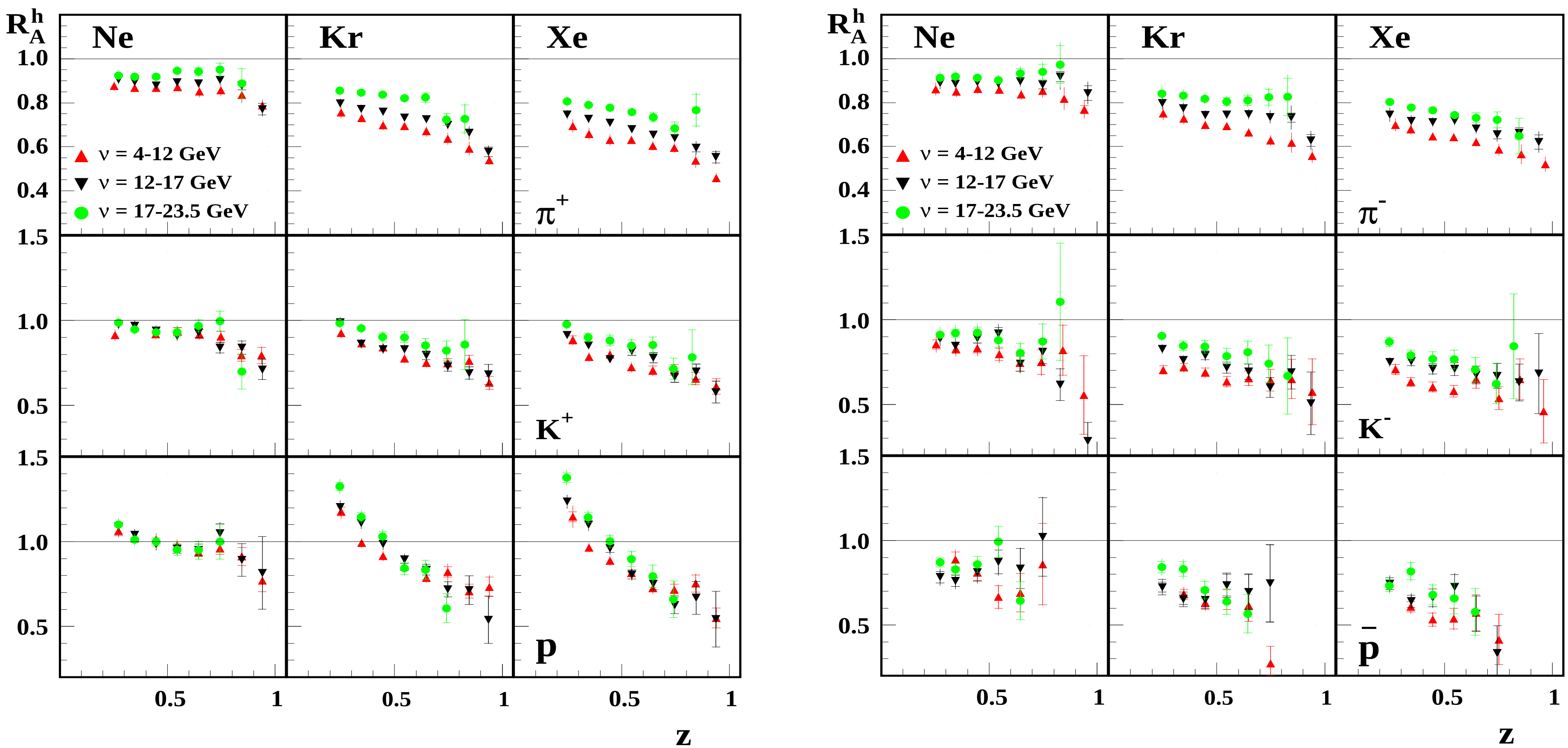
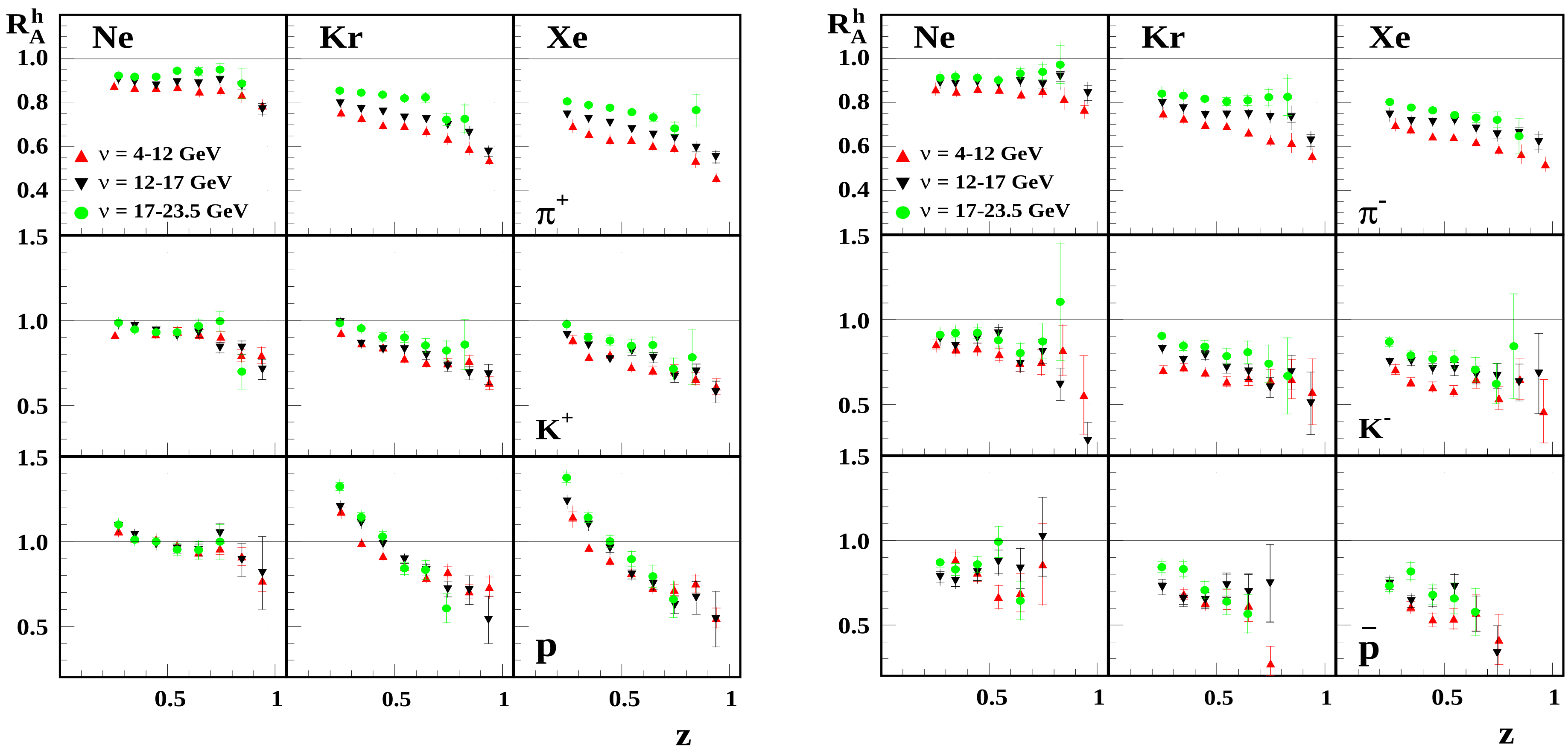


R^{K^+} is different from R^{K^-} at small values of z .

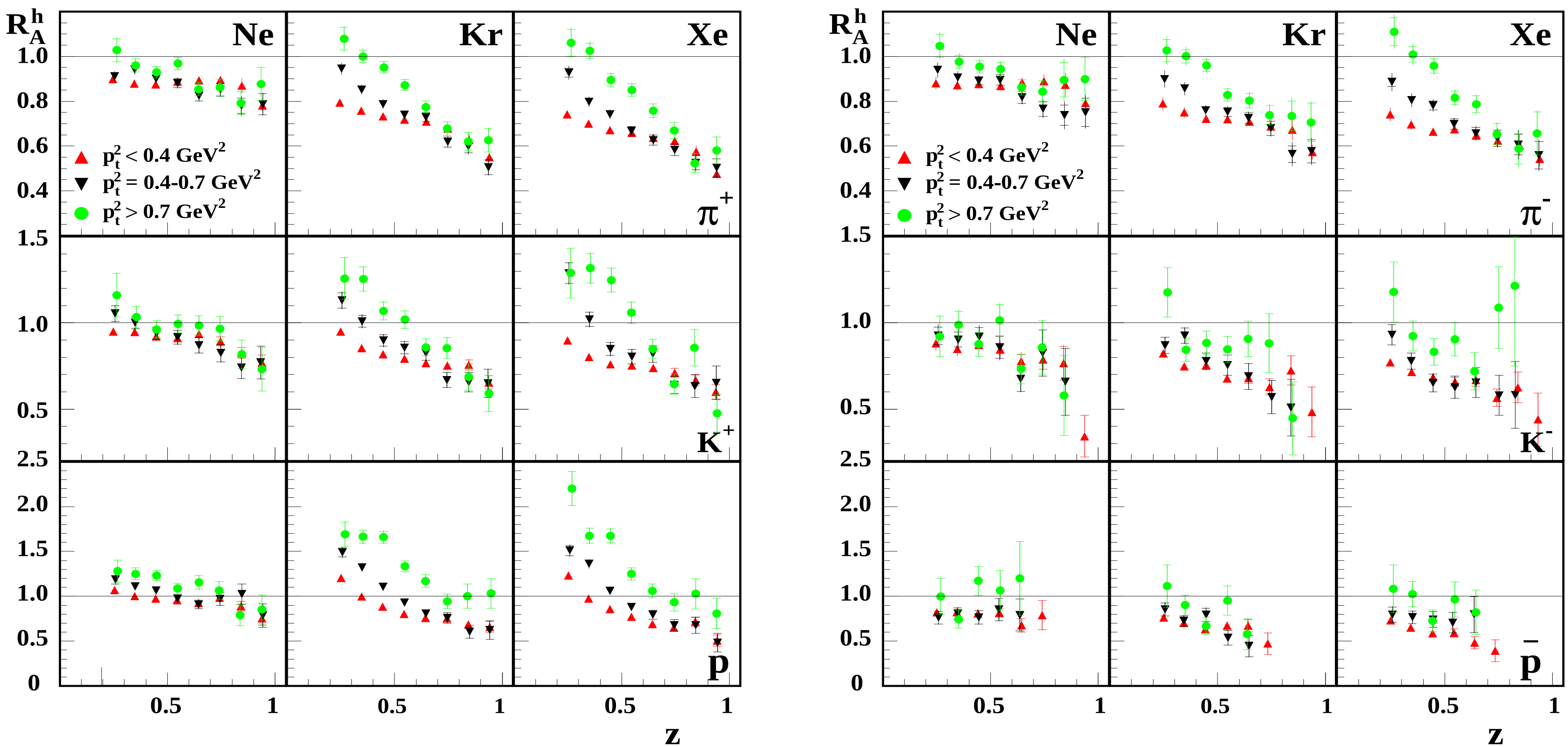
Results



R^{K^+} is different from R^{K^-} at small values of z.

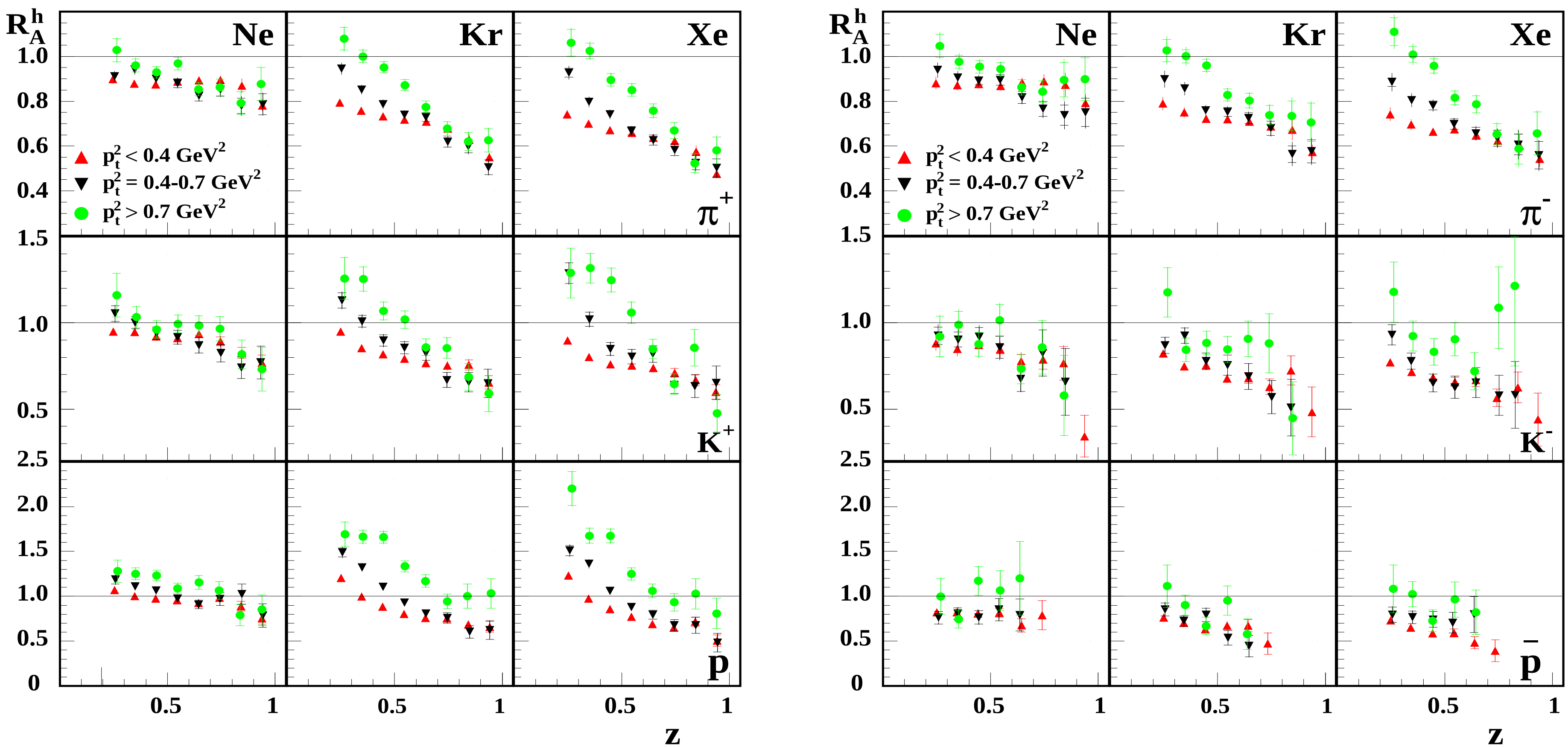
Strong dependence of R^p on heavy nuclei.

Results



R_A^h
Ne
Kr
Xe
$p_t^2 < 0.4$ GeV^2
$p_t^2 = 0.4$-0.7 GeV^2
$p_t^2 > 0.7$ GeV^2
π^+
π^-
K^+
K^-
p
$\bar{p}$
z

Results



Reduction of R_A^h with increasing of z .

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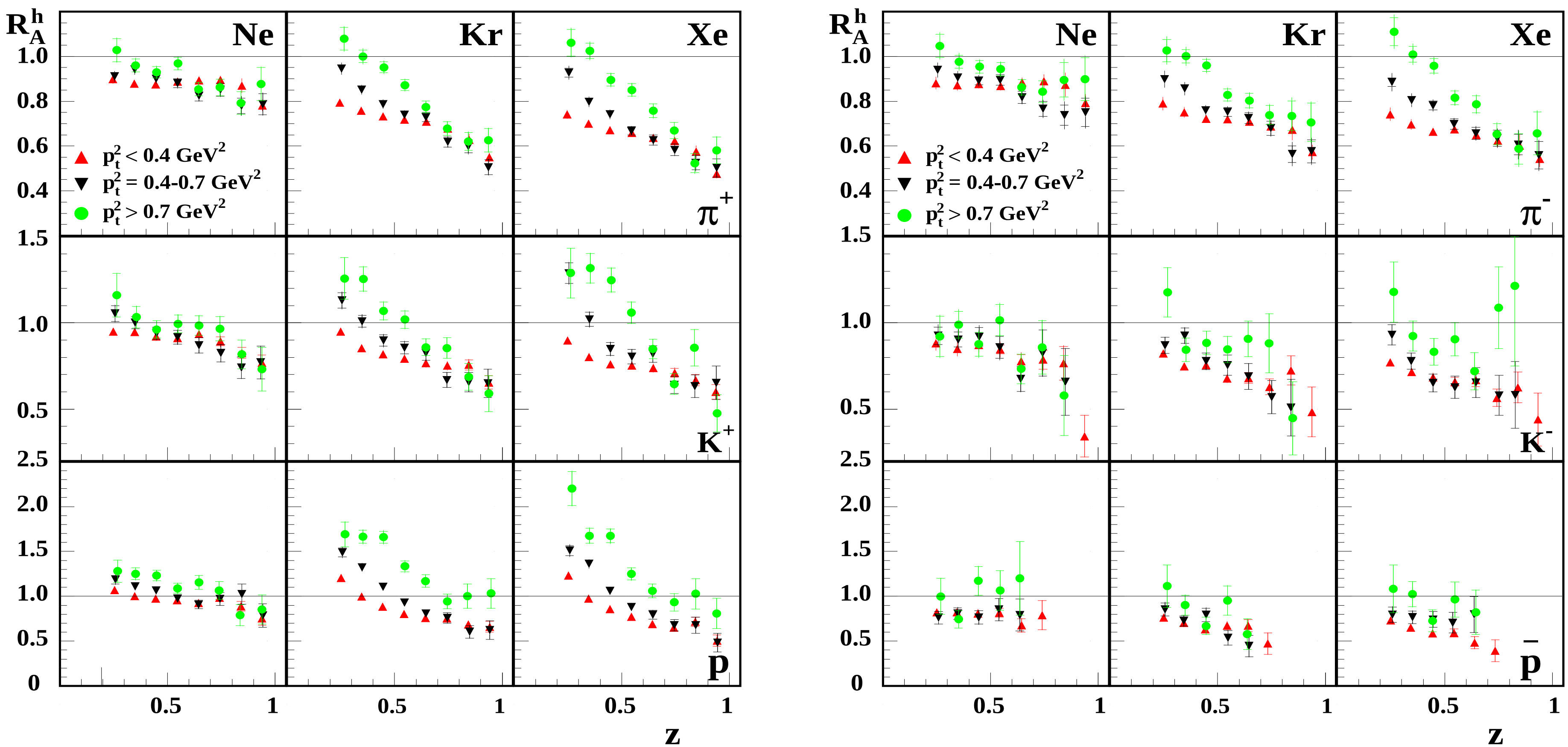
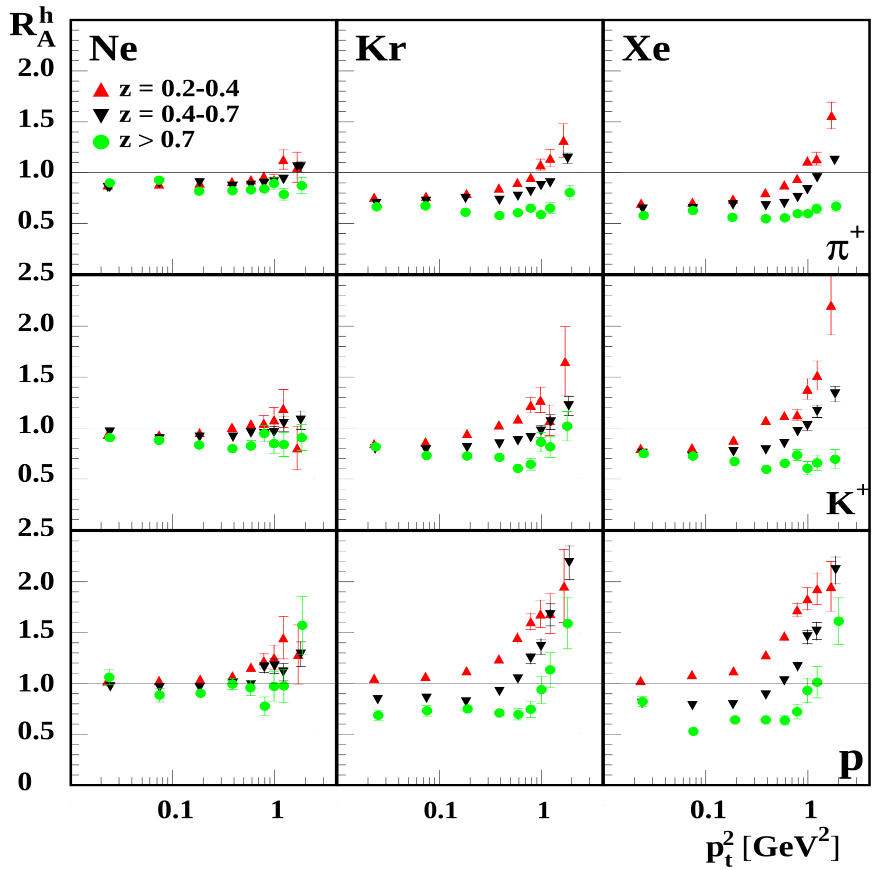


Reduction of R_A^h with increasing of z .

Strong dependence of R_A^h on p_t^2 at small values of z for heavy nuclei.

Results



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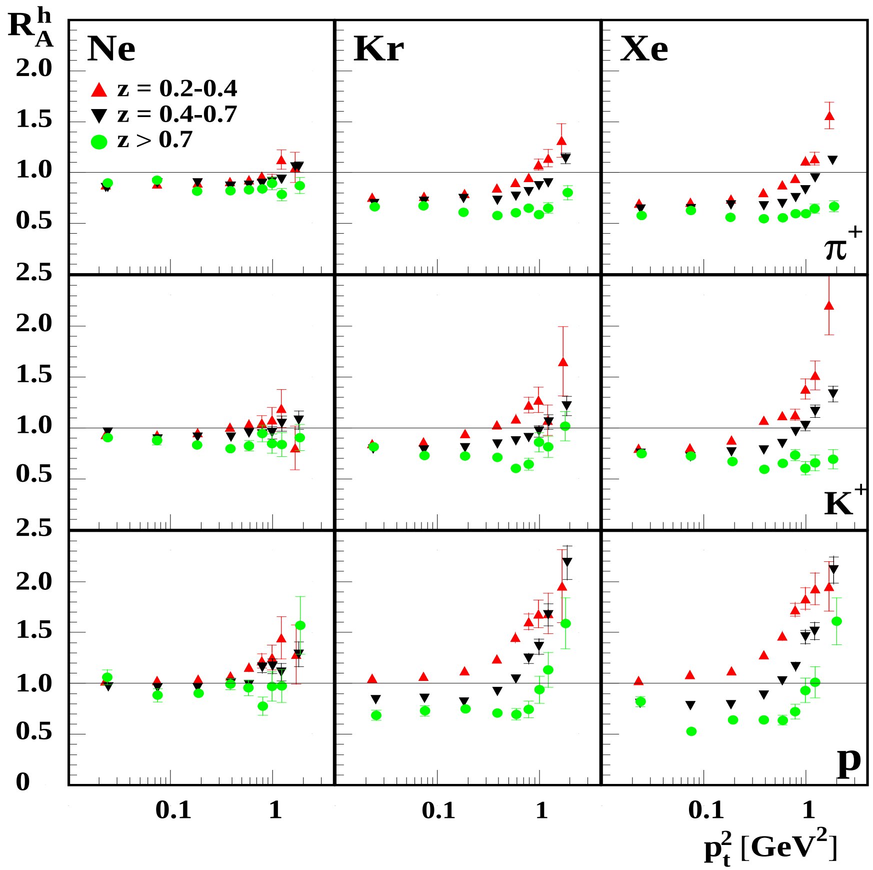

The Cronin effect is larger for protons.

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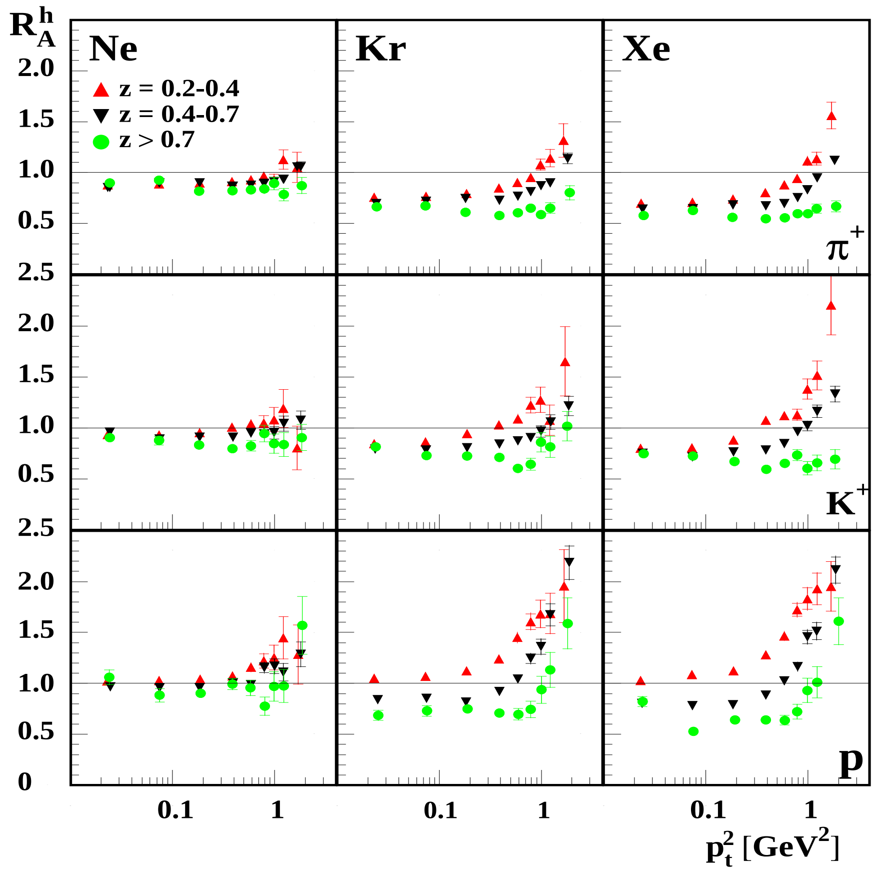

The Cronin effect is larger for protons.

It is suppressed for mesons in the highest z slice.

Summary

- **Multidimensional kinematic dependencies of $\mathbf{R_A^h}$ for π^+, π^-, $\mathbf{K^+}$, $\mathbf{K^-}$, $\mathbf{p}$ and $\mathbf{\bar{p}}$ on $\mathbf{Ne}$, $\mathbf{Kr}$ and $\mathbf{Xe}$ targets.**

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- ν dependence of $\mathbf{R_A^{K^+}}$ for positively charged kaons is different from $\mathbf{R_A^{\pi^+}}$, $\mathbf{R_A^{\pi^-}}$ and $\mathbf{R_A^{K^-}}$ in different $\mathbf{z}$ slices.

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- $\mathbf{R_A^p}$ for protons is very different compared with the other hadrons.