**MULTIDIMENSIONAL HADRON ATTENUATION**


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 Dependence of $R_3^A$ on $v$ for positively charged hadrons for three slices in $z$ (scale uncertainties are 3%, 5%, 4%, and 10% for $\pi$, $K$, $p$, and $\bar{p}$ respectively).

![Diagram of semi-inclusive deep inelastic scattering.](image)

$$R_3^A(\nu, Q^2, x, p_t^2) = \frac{N^h(\nu, Q^2, x, p_t^2)}{N^l(\nu, Q^2, x, p_t^2)}$$  \hspace{1cm} (1)

- $N^h(\nu, Q^2, x, p_t^2)$ - number of semi-inclusive hadrons in a given $(\nu, Q^2, x, p_t^2)$ bin
- $N^l(\nu, Q^2)$ - number of inclusive deep inelastic scattered leptons in the same $(\nu, Q^2)$ bin
- $\nu = E - E'$ - energy of a virtual photon
- $Q^2 = -q^2 = -(k - k')^2$ - negative squared four momentum transfer
- $p_t^2$ - transverse momentum square of a hadron
- $x = \frac{2Et}{\nu}$ - energy fraction of a hadron
- $e^+e^-$ beam of 27.6 GeV energy
- Nuclear targets: $^1D_{2.2}^6$Ne,$^12$Kr,$^{130}$Xe
- Good momentum resolution: $\Delta p/p < 2\%$
- Excellent particle identification capabilities

The HERMES spectrometer.

**Particle Tracking System**

**Particle Identification System**

 Dependence of $R_3^A$ on $p_t^2$ for positively charged hadrons for three slices in $z$.

 Dependence of $R_3^A$ on $z$ for positively charged hadrons for three slices in the hadron’s transverse momentum.

 Dependence of $R_3^A$ on $z$ for negatively charged hadrons for three slices in the hadron’s transverse momentum.

- **Attenuation is larger for heavy nuclei**
- **Protons behave very differently from the other hadrons**

Momentum dependence of the Cherenkov angle for different hadron types and radiators. The upper band corresponds to aerogel and the lower band to C$_2$F$_{13}$ gas respectively.

- **Charge-separated $\pi, K, p$**
- **Separation of $\pi, K$ and $p$ in momentum range of 2 – 15 GeV**

- **Cronin effect suppressed at large $z$**
- **Less attenuation with larger $\nu$ and small $z$**