Particle production properties (fragmentation functions) in hard processes and experimental view on NOMAD

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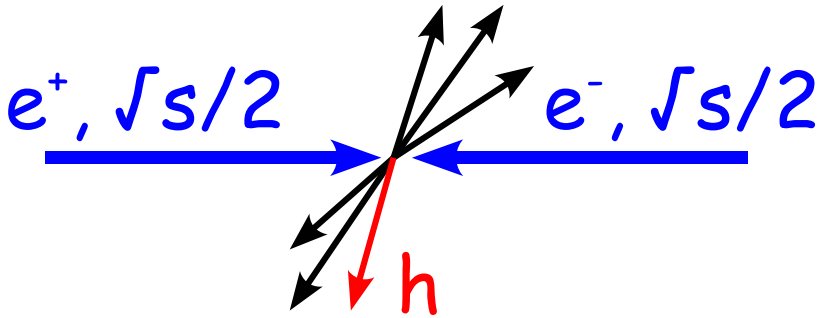
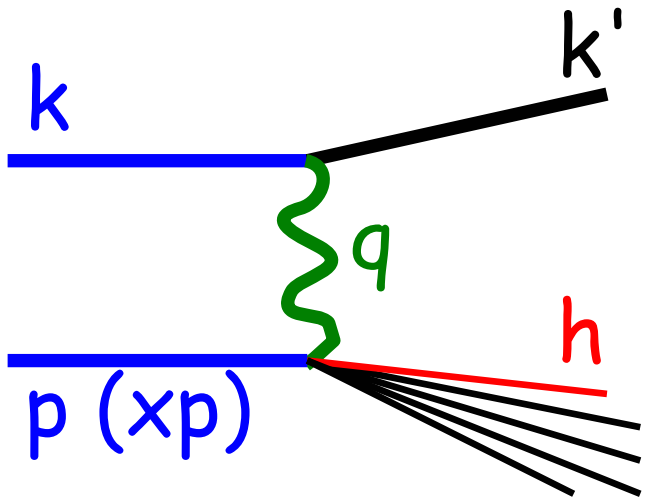
Outline

OUTLINE

WHAT ARE FRAGMENTATION FUNCTIONS?

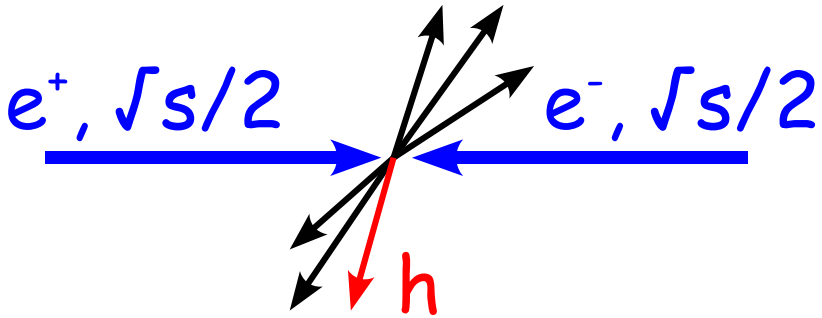
1. They are dimensionless functions that discribed the final state single-particle energy distributions in hard scattering process
   $$F^h(x,s) = 1/\sigma_{tot} \cdot d\sigma/dx(e^+e^- \to hX),$$
   where $x = 2E_h/\sqrt{s}$ is the scaled hadron energy, $\sqrt{s}$ is c.m. energy
2. Multiplicity of those hadrons
   $$n_h(s) = \int dx\, F^h(x,s)$$

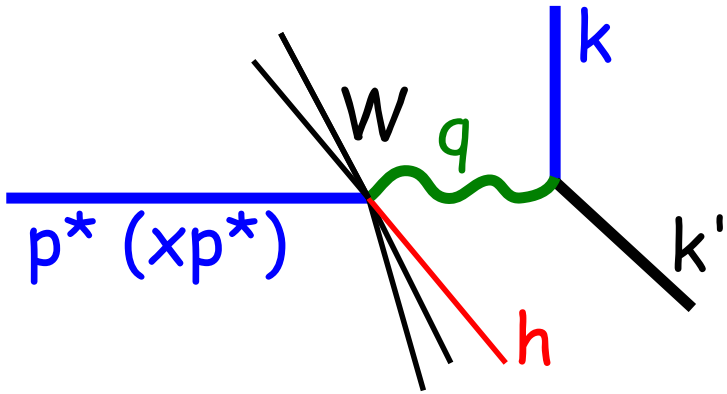




FRAGMENTATION FUNCTIONS IN DIS

1. Fragmentation function in hadronic c.m. frame (HCMS)
   $$F^h(x_F, W) = 1/\sigma_{tot} \cdot d\sigma/dx_F(\ell N \to \ell' h X),$$
   where $x_F = 2p_z^*/W$ is the Feynman-x variable, W is the invariant mass of the hadrons in HCMS
2. Multiplicity of those hadrons
   $$n_h(W) = \int dx_F \; F^h(x_F, W)$$





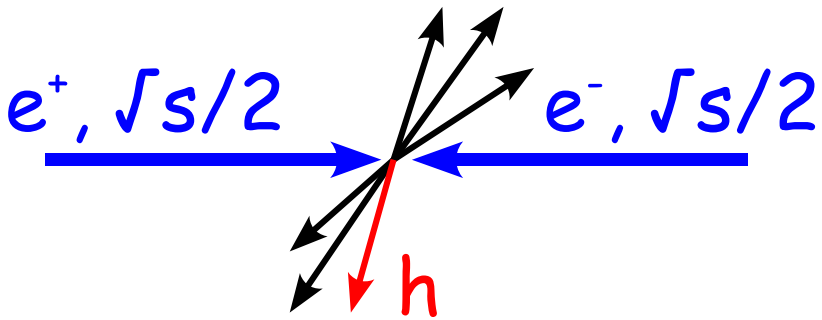
FRAGMENTATION FUNCTIONS IN DIS

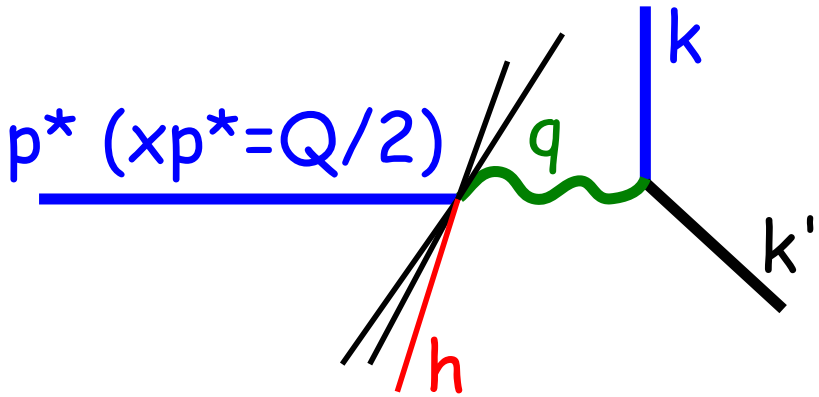
1. Fragmentation function in Breit frame (BF) (connected to the HCMS by a longitudinal boost such that the time component of q becomes 0)

   $$F^h(x_p, Q) = 1/\sigma_{tot} \cdot d\sigma/dx_p(\ell N \to \ell' h X),$$

   where $x_p = 2p^*/Q$ is the scaled hadron momentum, Q is the invariant mass of the exchanged boson
2. Multiplicity of those hadrons

   $$n_h(Q) = \int dx_p \, F^h(x_p, Q)$$

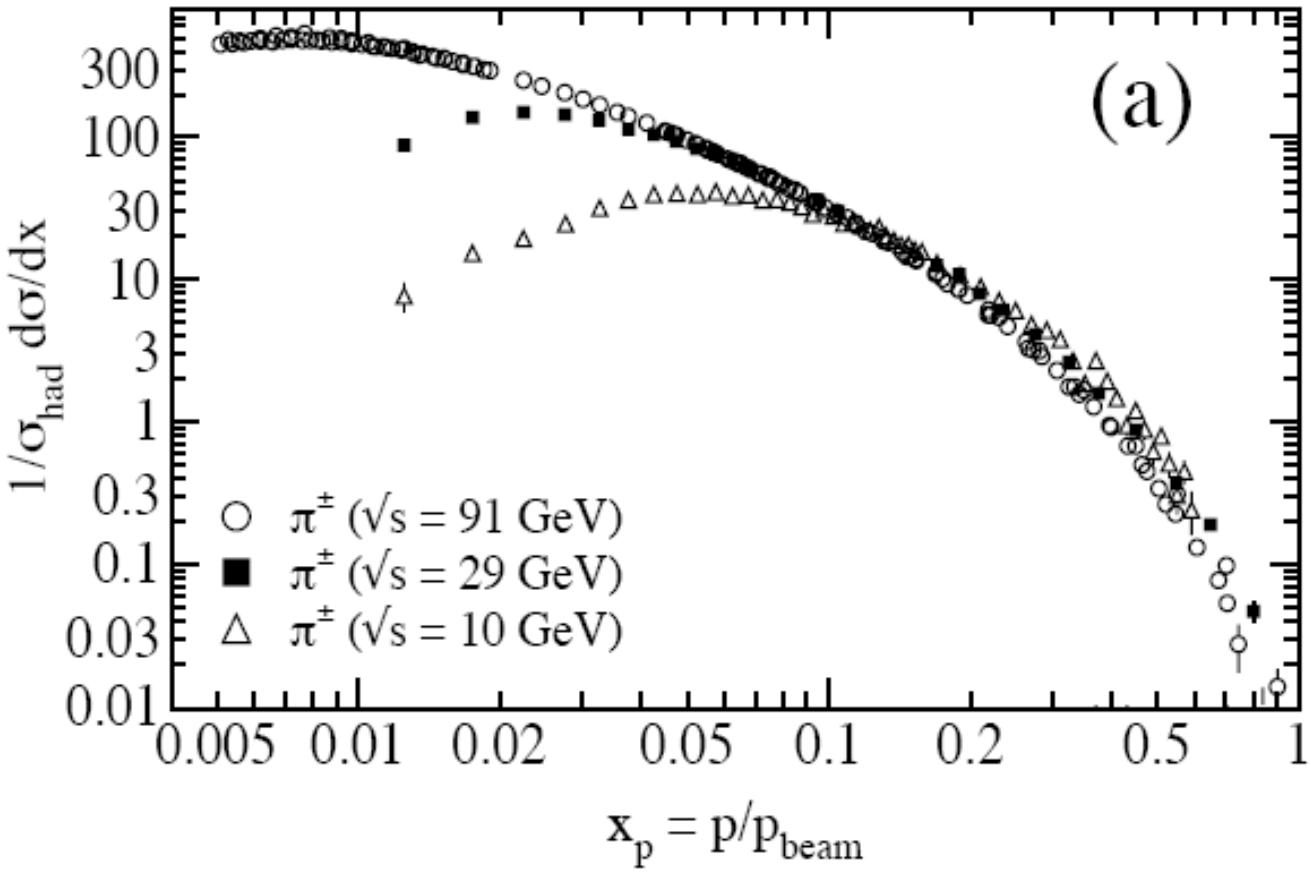




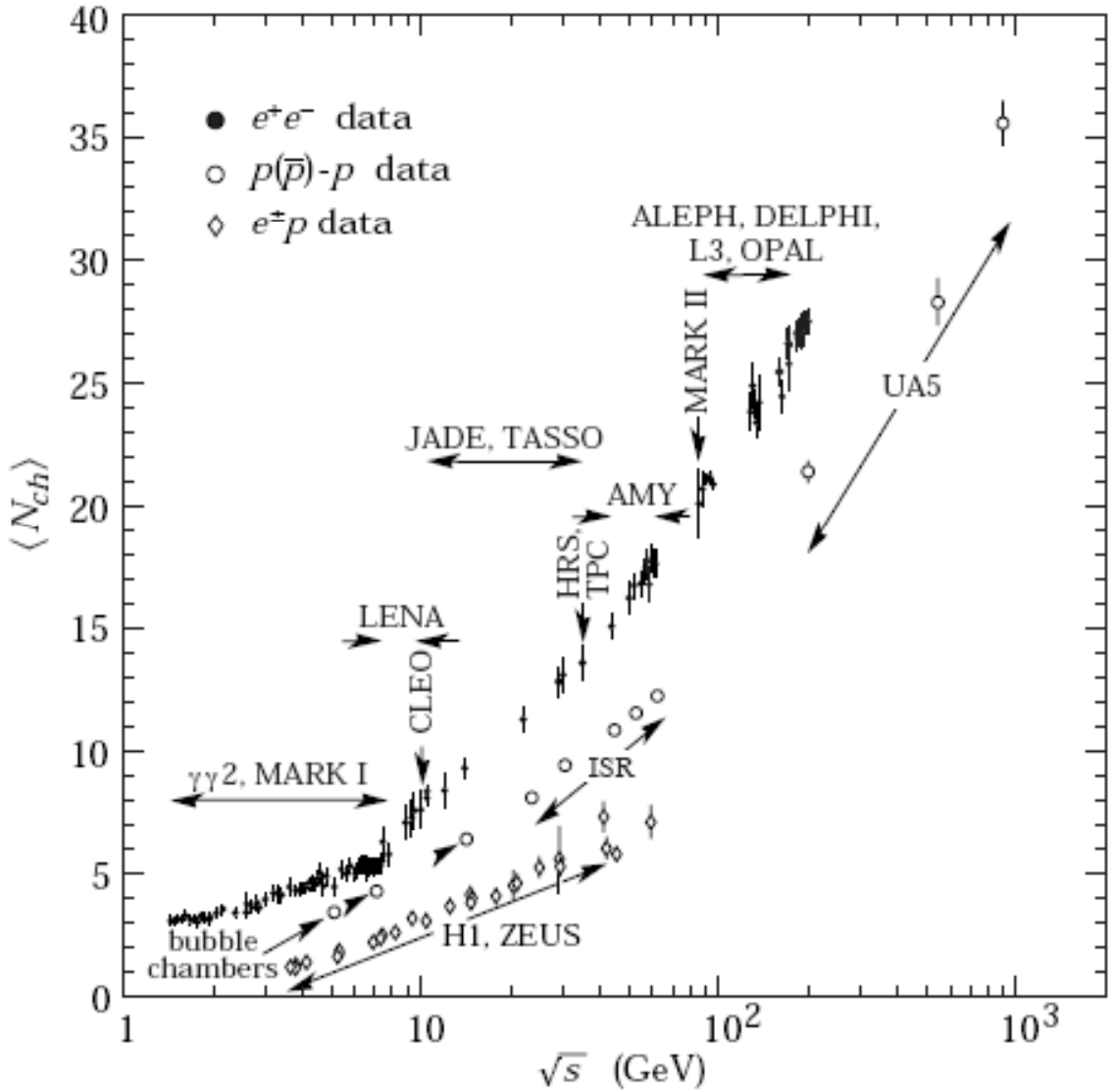
DATA RESULTS EXAMPLE

SLD, TPC, DELPHI, ALEPH, ARGUS, OPAL experiments

$(e^+e^- \to \gamma/Z^0 \to hX)$

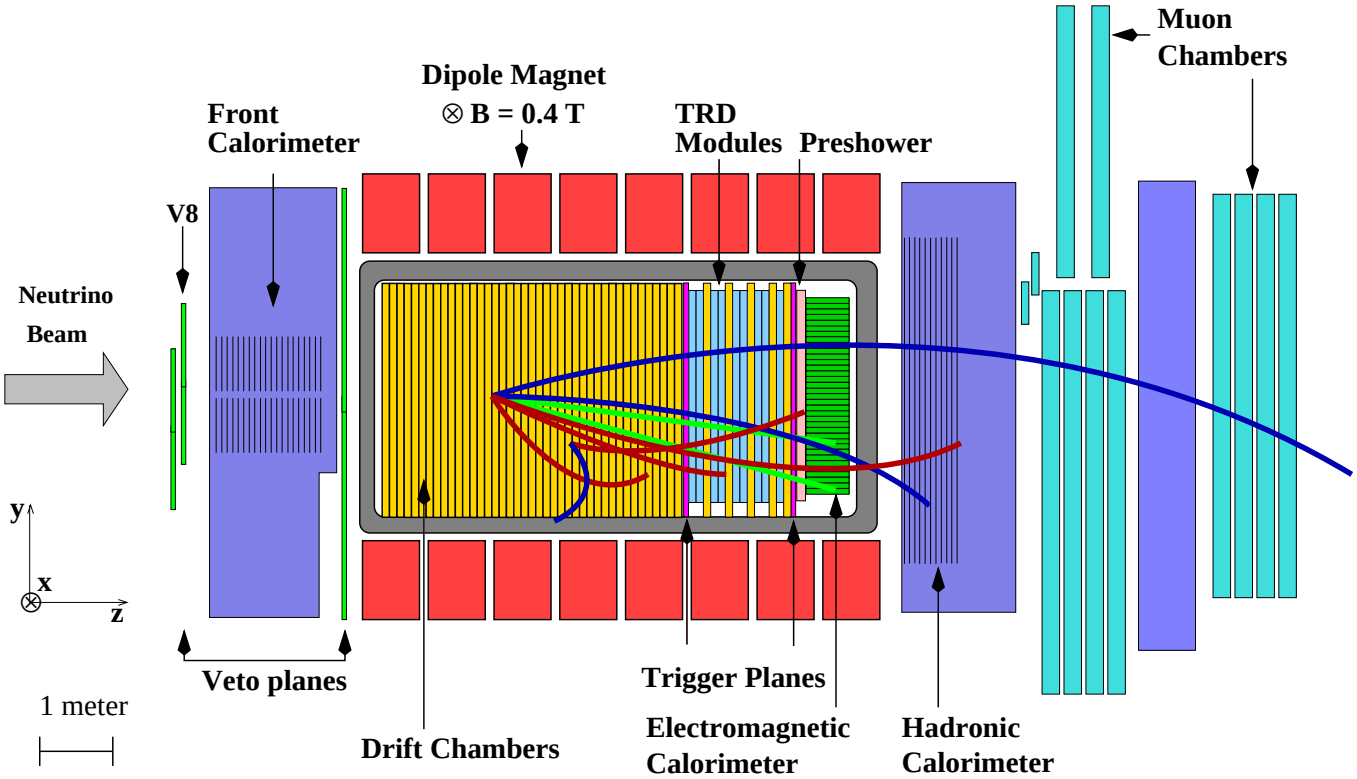


AVERAGE CHARGED HADRONS MULTIPLICITY



WHY ARE FRAGMENTATION FUNCTIONS?

1. NOMAD potentials
   – wide energy spectrum
   provides us study different variables $E_\nu, Q^2, W, x_{B_j}, x_F, x_p$
   – excellent reconstruction and resolution of the individual tracks, good calorimetry
   let us taking good quality of the distributions
   – largest statistics of the neutrino interactions ($\sim$ 1.1M DIS)
   is good chance to get most accurate results
2. Important for theory
   Today exist THREE THEORIES: QEL, RES, DIS
   and no one for just νN (see talks by V.Naumov, O.Teryaev)
   Fundamental ingredients are prepared as model's cuts on Q^2, W

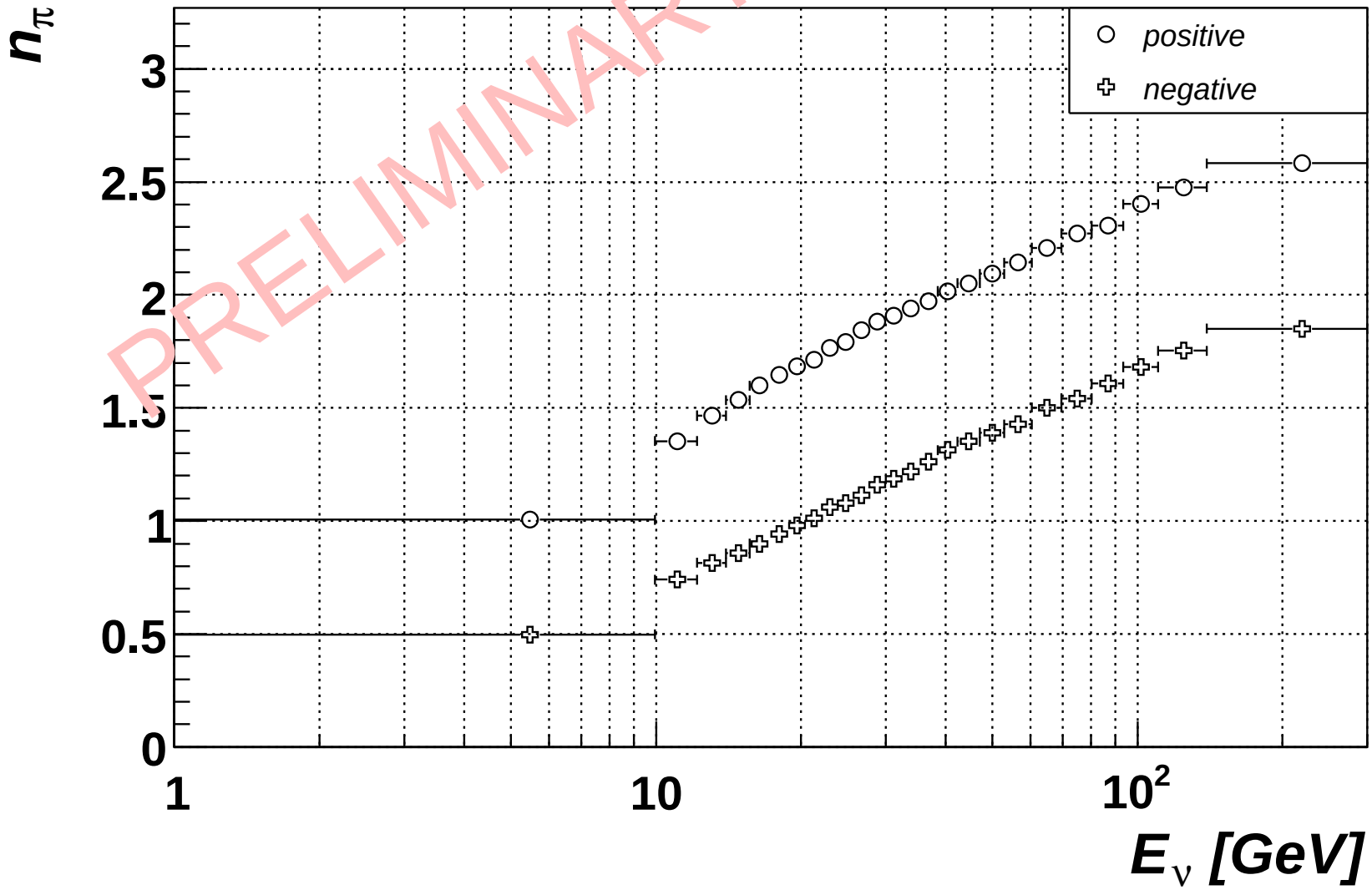


GOOD QUALITY OF THE PARTICLE IDENTIFICATION

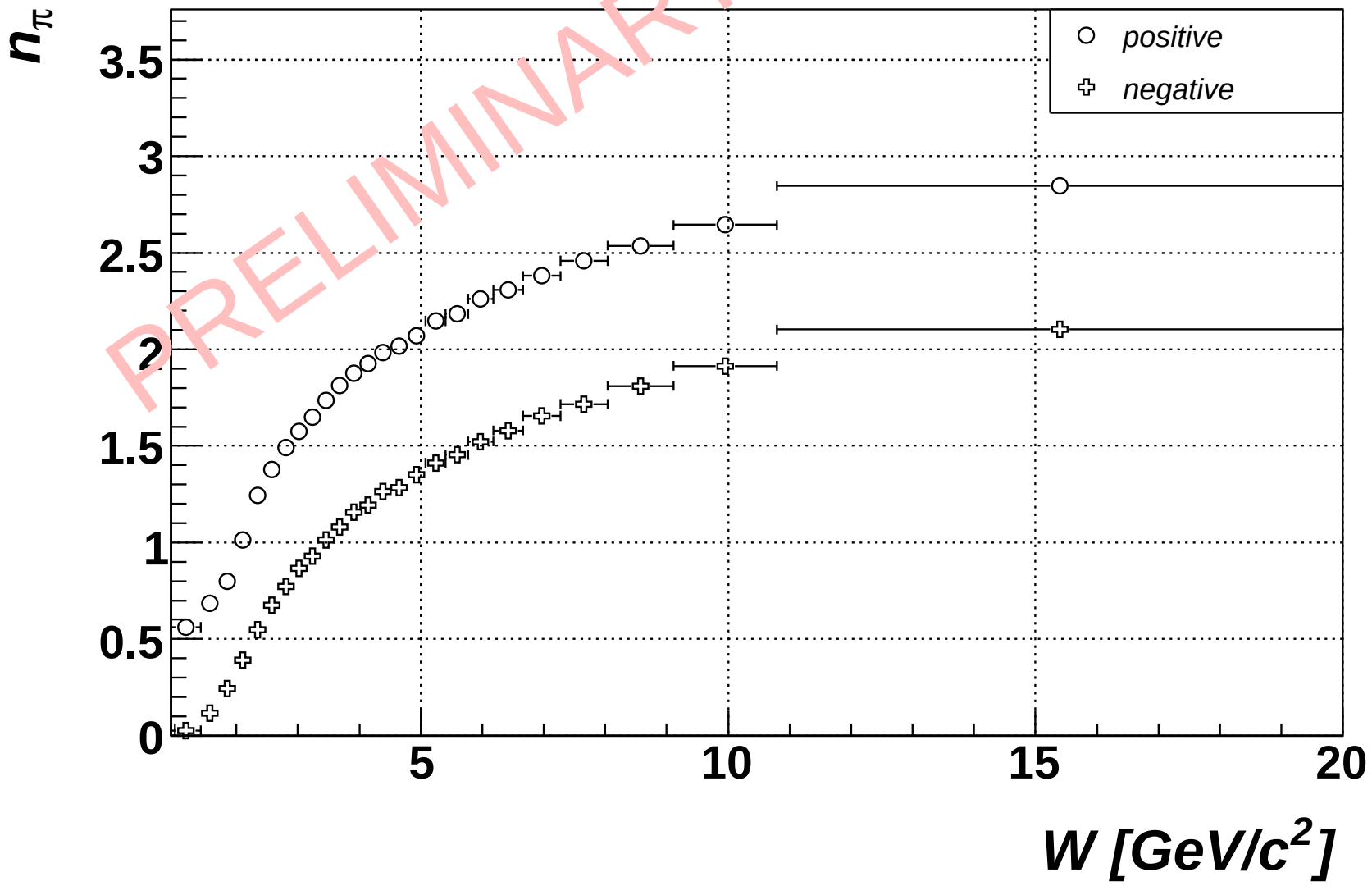
1. Current muon in Muon Chambers
2. Charged particles ($\pi^{\pm}$, p, ...) in Drift Chambers
3. Neutral particles (γ, n, ...) in Electromagnetic Calorimeter
4. Neutral strange particles (K^0_S, Λ, $\bar{\Lambda}$) and photons ($\gamma \rightarrow e^+e^-$) by V-like vertexes
5. Possibility to study $\pi^0 \rightarrow \gamma\gamma$ production

OUTLINE

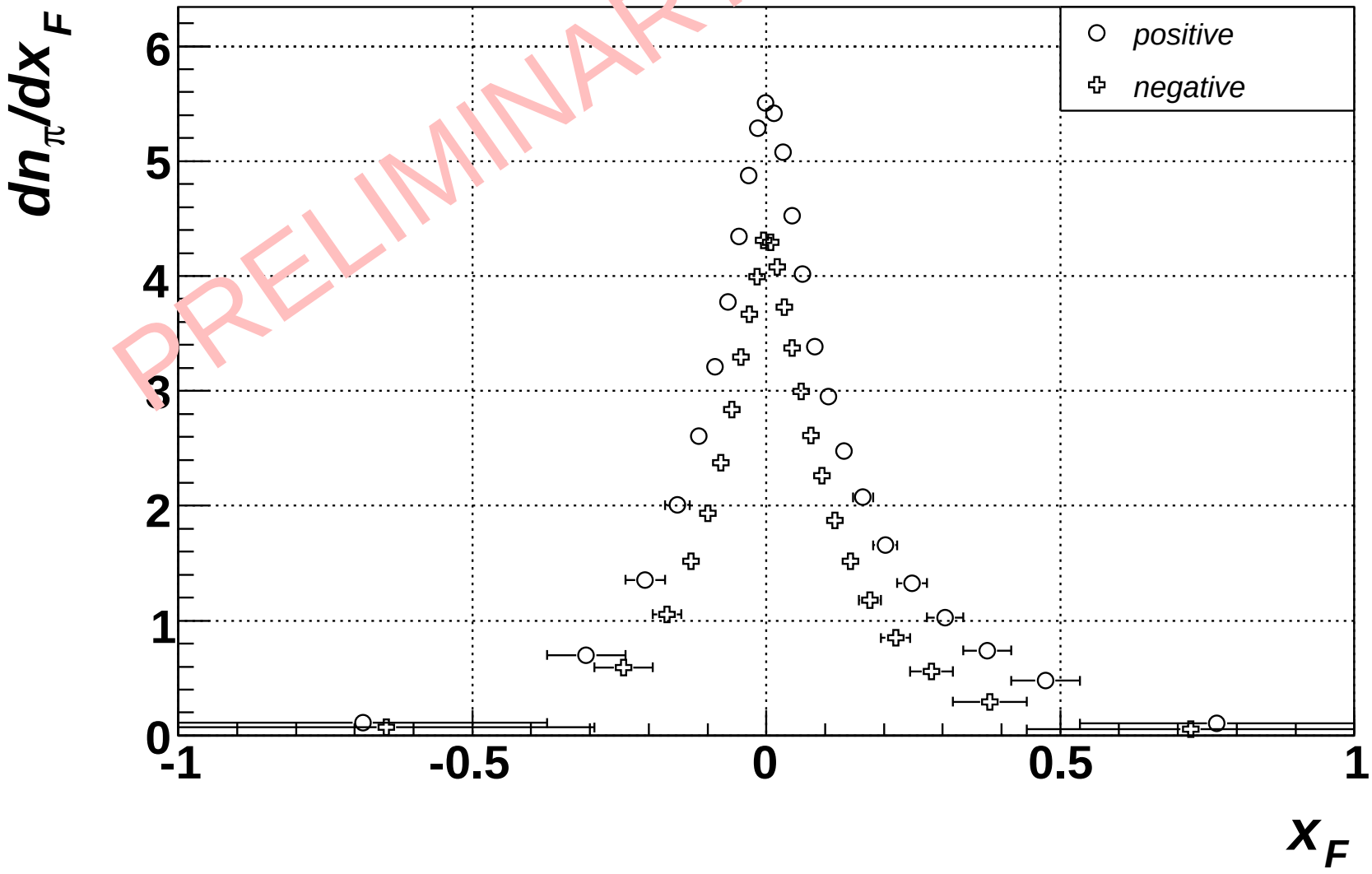
π production



π production



π production



Thank you for your attention!