Measurement of Lambda fragmentation function in HERMES experiment

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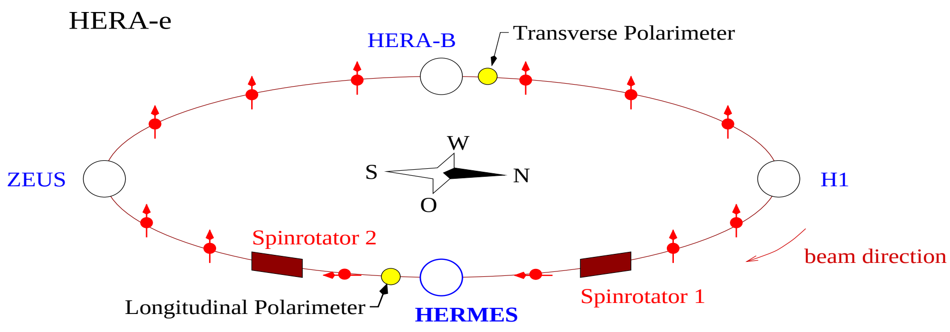
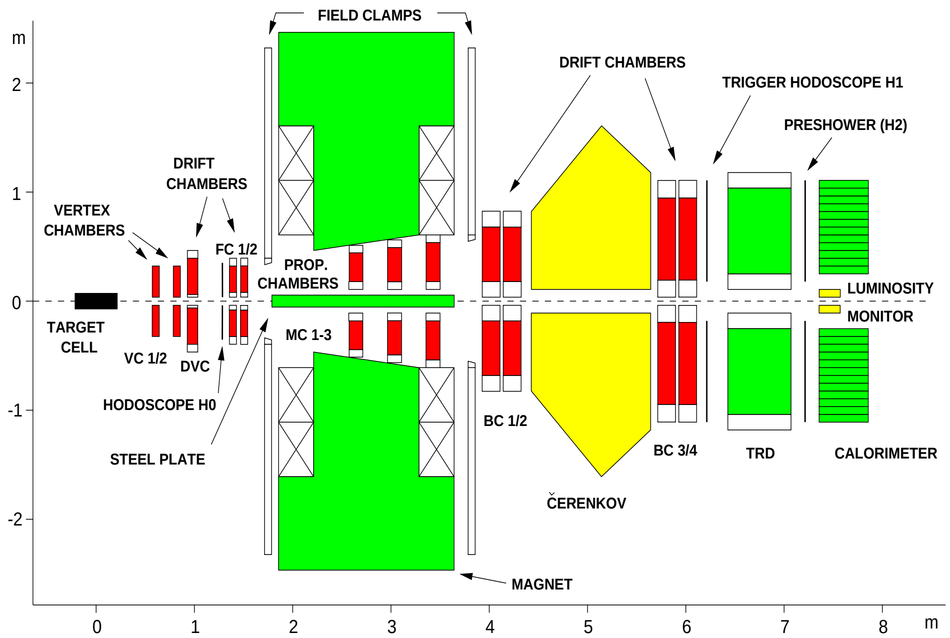
DUBNA, September 2000.

- Experiment HERMES.
- Λ-production in SIDIS.
- z-definition.
- Fragmentation Function D_u^{Λ}.
- Summary.

Experiment HERMES.



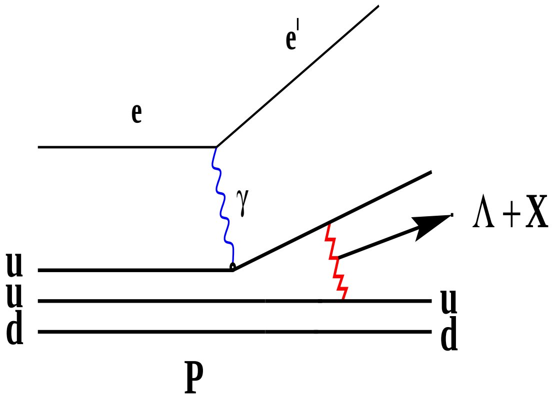
- Polarized beam: e^+, $E_{e^+} = 27.5 GeV$
- Target: open-ended storage sell H, D, ^{3}He and ^{14}N (in 1996-1997).



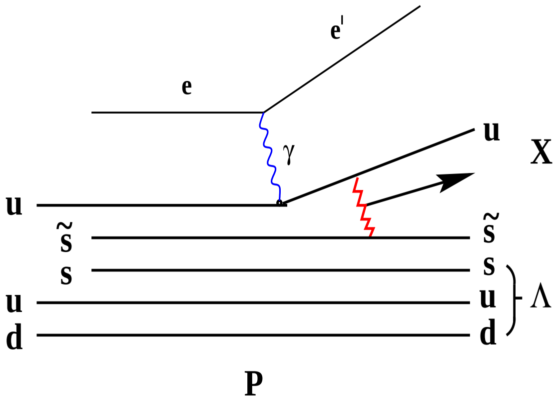
- 57 chamber planes, 40 mrad $< \theta <$ 220 mrad.
- momentum resolution $\frac{\Delta P}{P} \approx 1\%$, $\frac{\Delta \theta}{\theta} < 0.6$ mrad.

Λ production in SIDIS.

$$e + p \to e^{'} + \Lambda + X$$



contribution of: $u + d$ is 75% and s is 3.5%



contribution of $\bar{s}$ is 19%.

According to QPM:

$$n_\Lambda(z) = \frac{1}{N_e}\frac{\Delta N^\Lambda(z)}{\Delta z} = \sum_f \omega_f D_f^\Lambda(z)$$

D_f^Λ- Fragmentation Function.

$$\omega_f = \frac{e_f^2 \int R(Q^2,y)xq_f(x)dQ^2dy}{\sum_f e_f^2 \int R(Q^2,y)xq_f(x)dQ^2dy}$$

$$R(Q^2, y) = \frac{4\pi\alpha}{Q^4}[1 - y + y^2/2]$$

Experimental procedure.

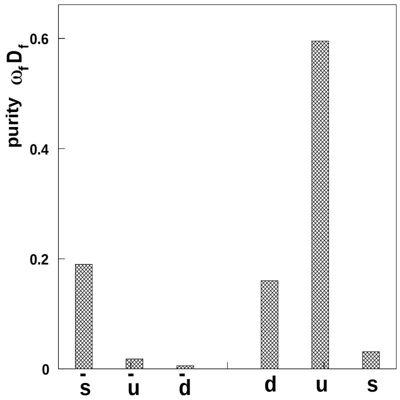
Experimental data set.

$1 < Q^2 < 24$, $0.02 < x_{bj} < 0.8$, $0.3 < y < 0.85$, $W^2 > 4$.

In our analysis we have: $N_\Lambda \approx 4060$, $N_{e^+} \approx 7 \cdot 10^6$.

Extraction procedure.

- up down quark dominance:



- From the Monte-Carlo based on JETSET:

$$D_u^\Lambda(z) \approx D_u^\Lambda(z, Q^2)$$

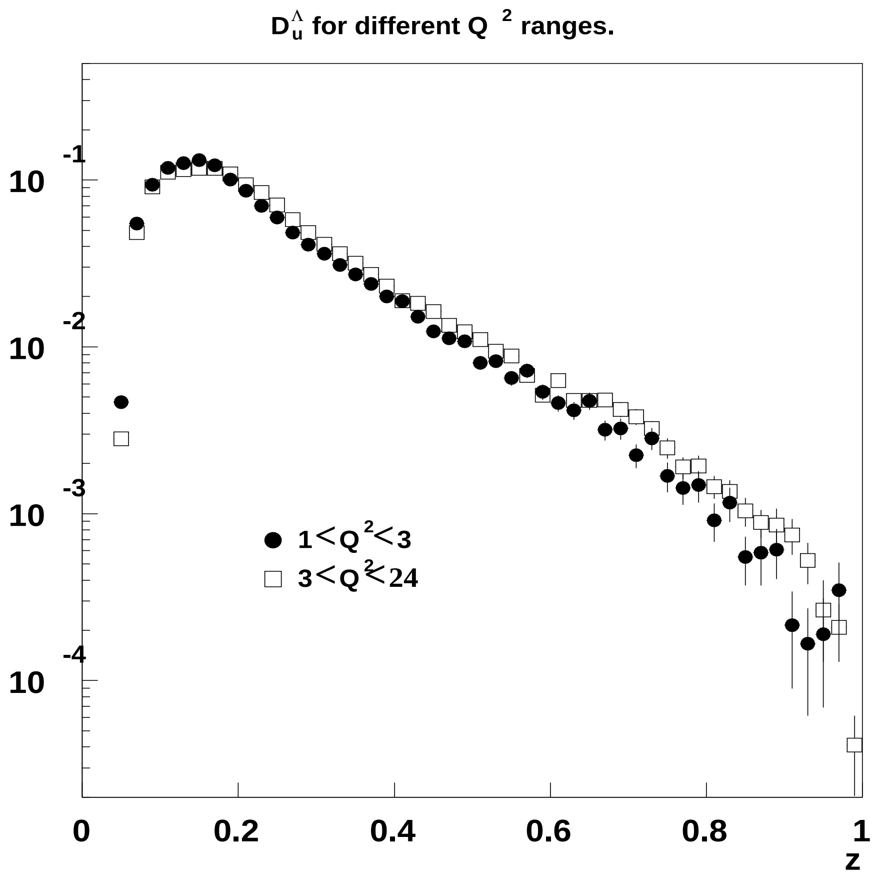
- Due to isotopic invariance:

$$D_u^\Lambda(z) = D_d^\Lambda(z)$$

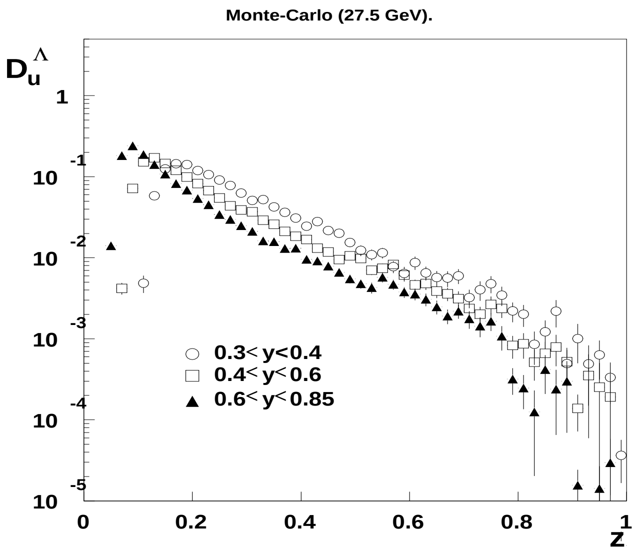
$$n_\Lambda(z) = \frac{1}{N_e}\frac{\Delta N^\Lambda(z)}{\Delta z} = \underbrace{(\omega_u + \omega_d) D_u^\Lambda(z)}_{75\%} + \sum_{f=s,\bar{u},\bar{d},\bar{s}} \omega_f D_f^\Lambda(z)$$

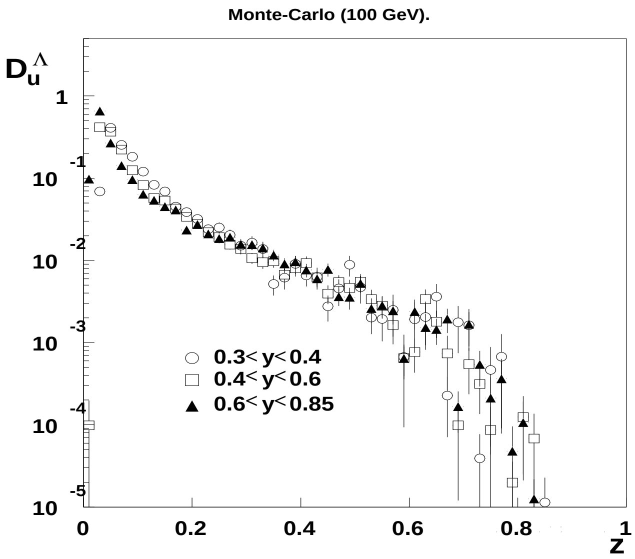
- 1-dim. unfolding procedure is used to get acceptance corrected $n_\Lambda(z)$.

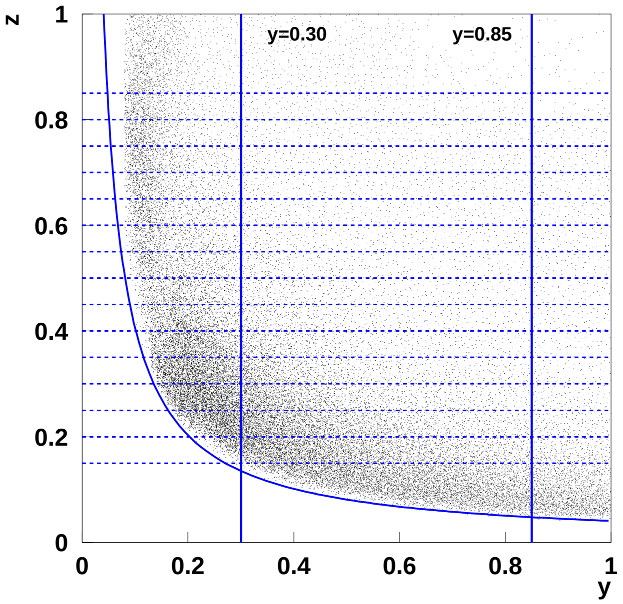
$Q^2 - dependence$ of D_u^{Λ} (Monte-Carlo).



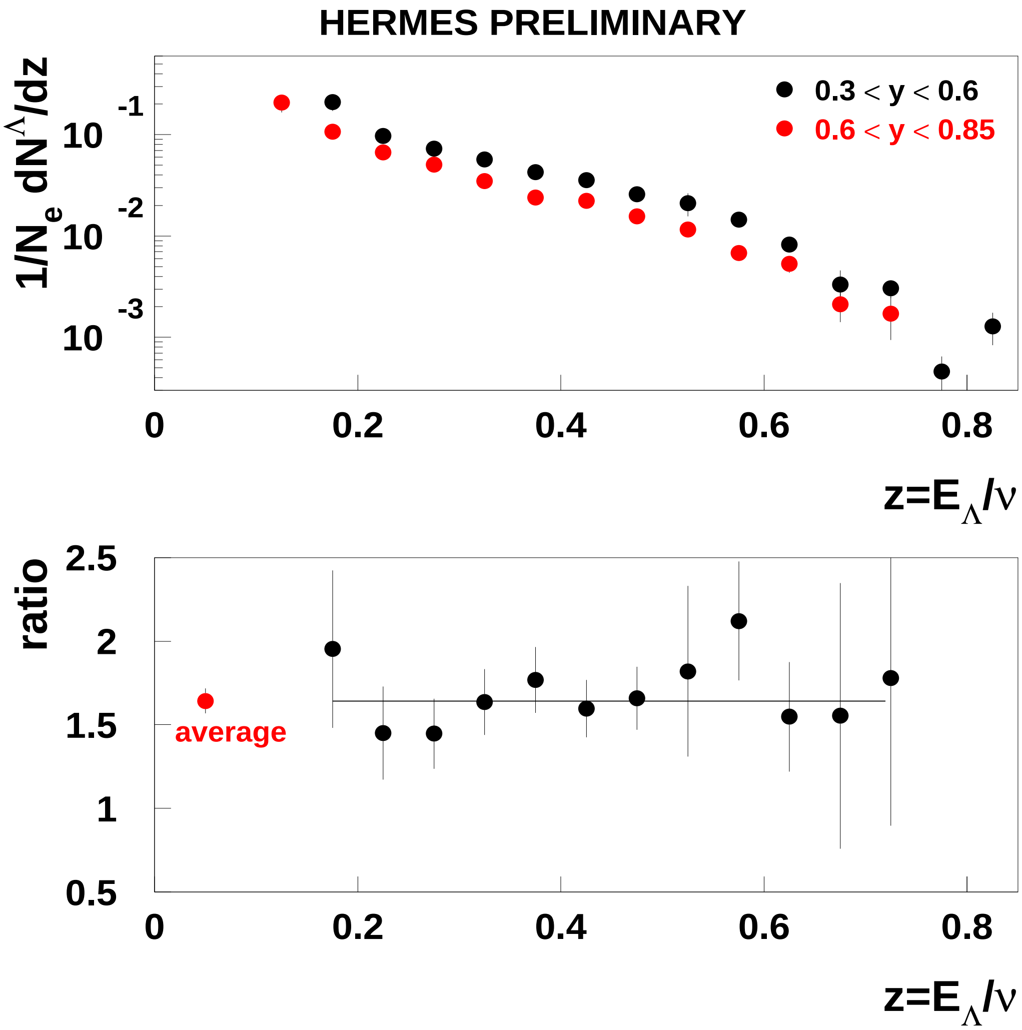
Kinematical limit for Λ production (Monte-Carlo).





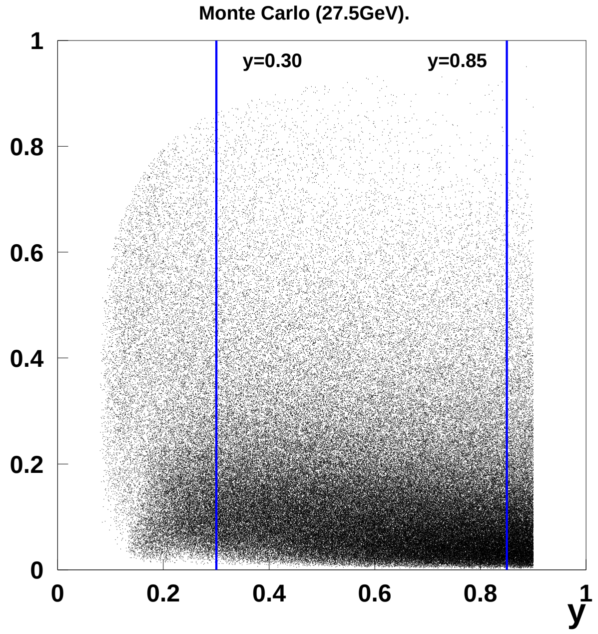


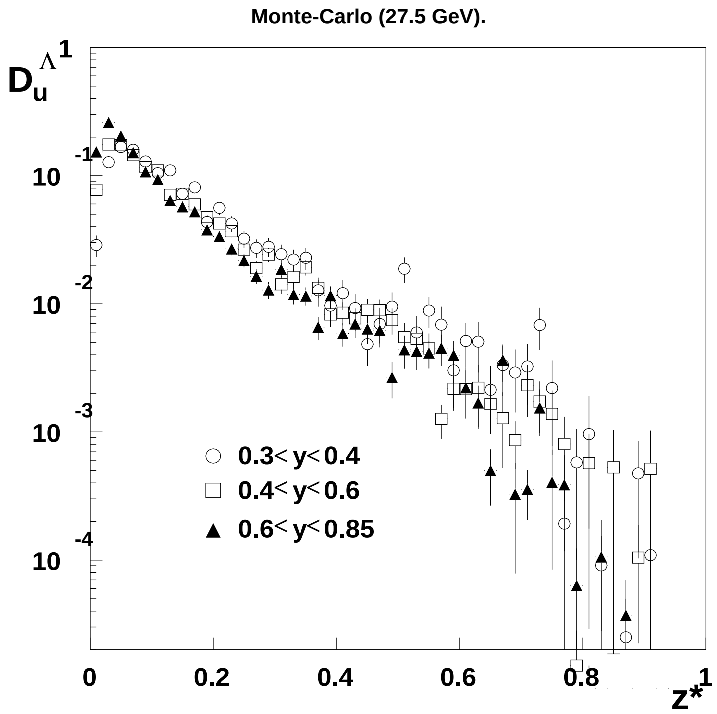
Multiplicity with $z = \frac{E_\Lambda}{y \cdot 27.5}(Experiment)$.



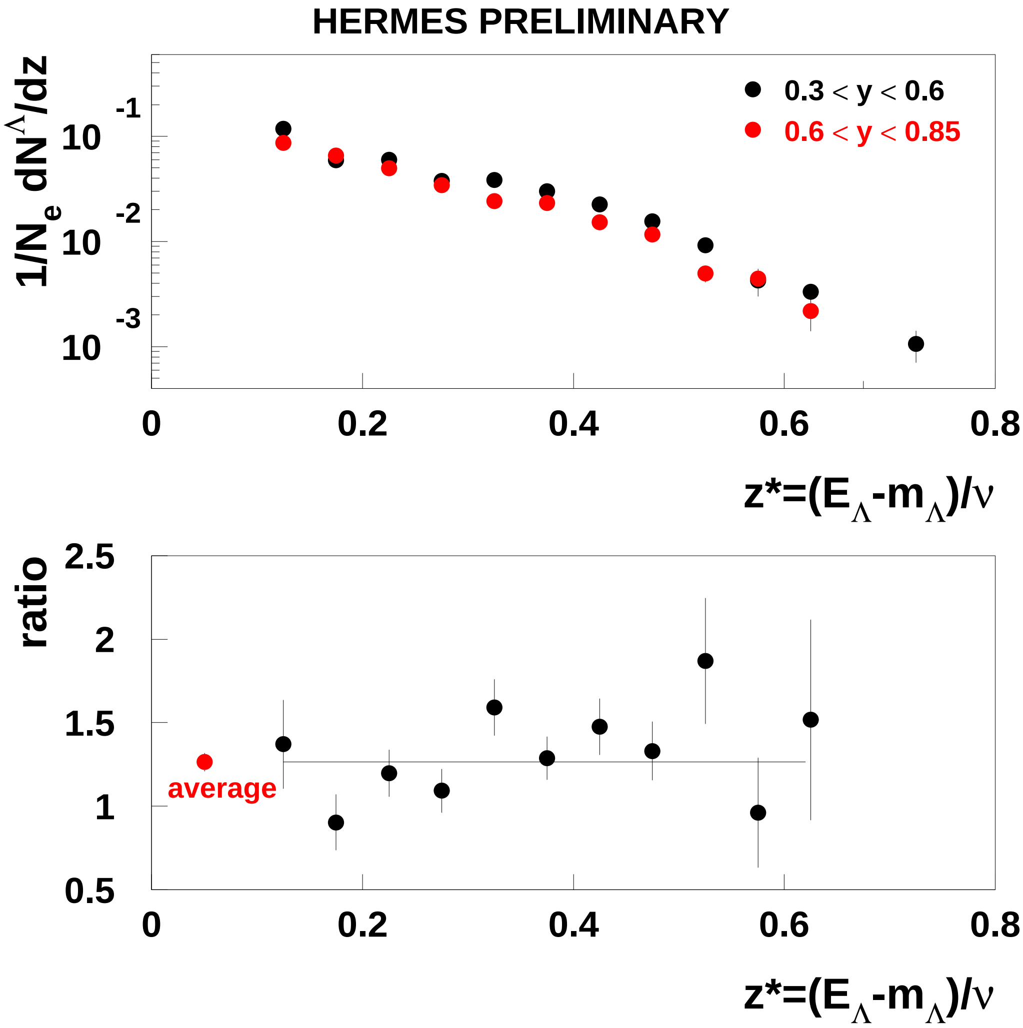
D_u^Λ with $z^* = \frac{E_\Lambda - m_\Lambda}{y \cdot 27.5}$ (Monte-Carlo).

$$z = \frac{E_\Lambda}{y \cdot 27.5}, \qquad z \Rightarrow z^* = \frac{E_\Lambda - m_\Lambda}{y \cdot 27.5}$$

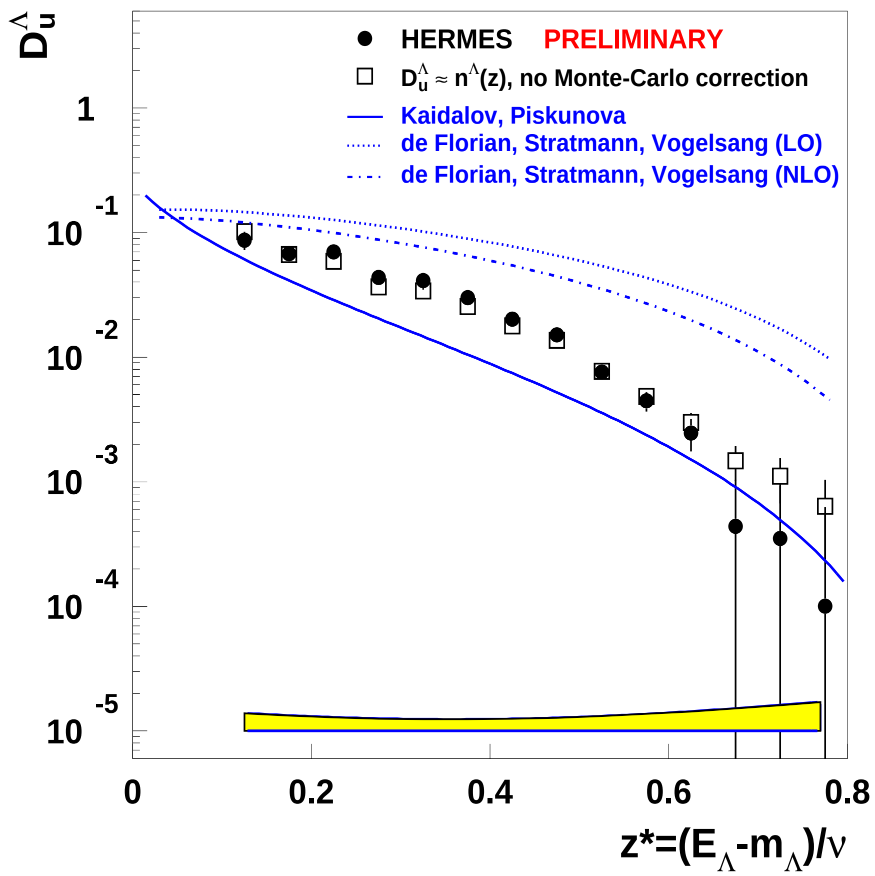




Multiplicity with $z^* = \frac{E_\Lambda - m_\Lambda}{\nu}$ (Experiment).



Fragmentation function D_u^{Λ}.



- A.B. Kaidalov and O.I. Piskunova fragmentation function(1984):
  $F(z^*) = \frac{\alpha}{z^*}(1-z^*)^{\beta}$ where: $\alpha = 0.02, \beta = 2.5$
- D. de Florian, M. Stratmann, W. Vogelsang fragmentation function:
  $F(z^*) = Nz^*\alpha(1-z^*)^{\beta}$
  where: $N = 0.63$, $\alpha = 0.23$ and $\beta = 1.83$

Systematic error is: $15 - 55\%$.
Sourcies of the systematic uncertainties are:
Efficiency matrix, backg. suppression cuts, MC generator.

Summary.

- Fragmentation Function D_u^Λ is extracted.
- Comparisons with the existing prediction and parametrization is done.

  Parametrization done by D. de Florian, M. Stratmann, W. Vogelsang based on hypotesis: $D_u^\Lambda = D_d^\Lambda = D_s^\Lambda$ is very different from HERMES data.

  Fragmentation Function suggested by A.B. Kaidalov and O.I. Piskunova is close to HERMES result.

- New definition of z variable is introduced to reduce y-dependence of the fragmentation function at HERMES kinematics.