Strangeness at Low Q^2

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on behalf of H1 collaboration

1. Motivation for strange particle production studies.
2. Identification of K^0_s, Λ^0.
3. Results.

– Differential cross sections in laboratory and Breit frame.

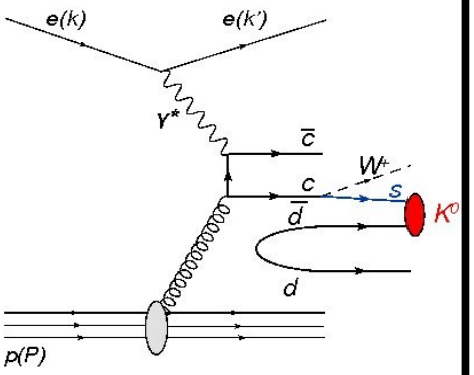
– Strange to charged particle ratio.

– Baryon to meson ratio.

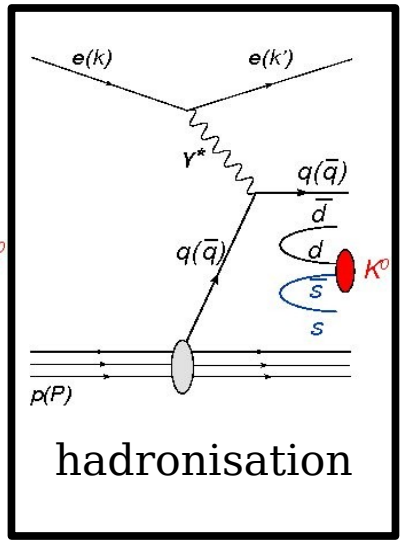
– Baryon-antibaryon asymmetry.

4. Summary.

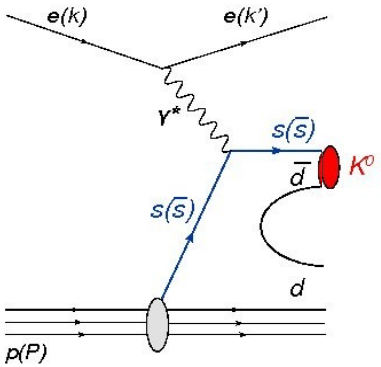
Motivation – Why Strangeness?



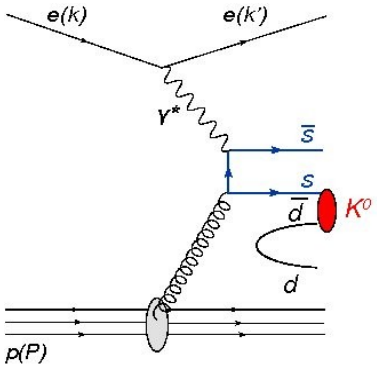
decays of heavy quarks



hadronisation



hard scattering of sea quark



boson-gluon fusion

Dominated by hadronisation **non perturbative process**

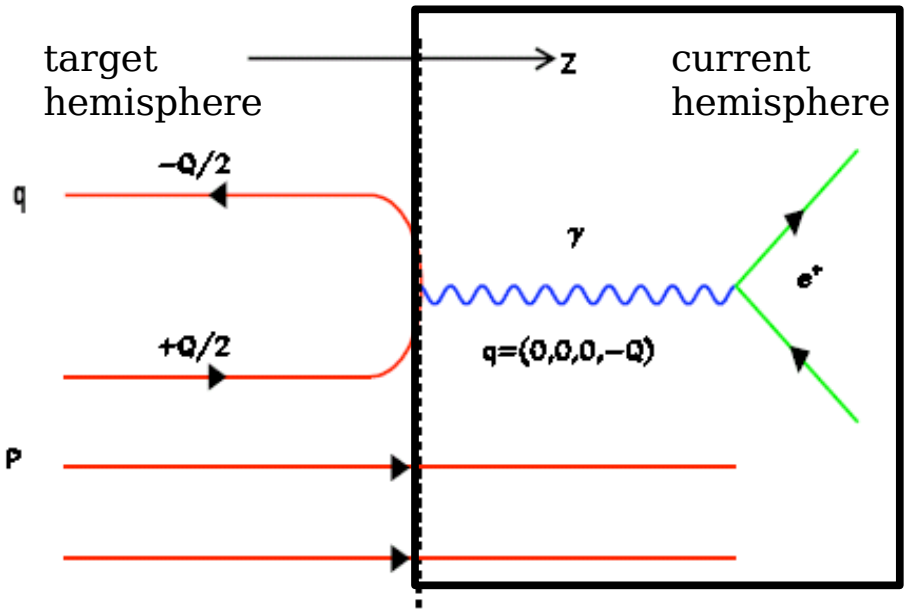
LUND string fragmentation model

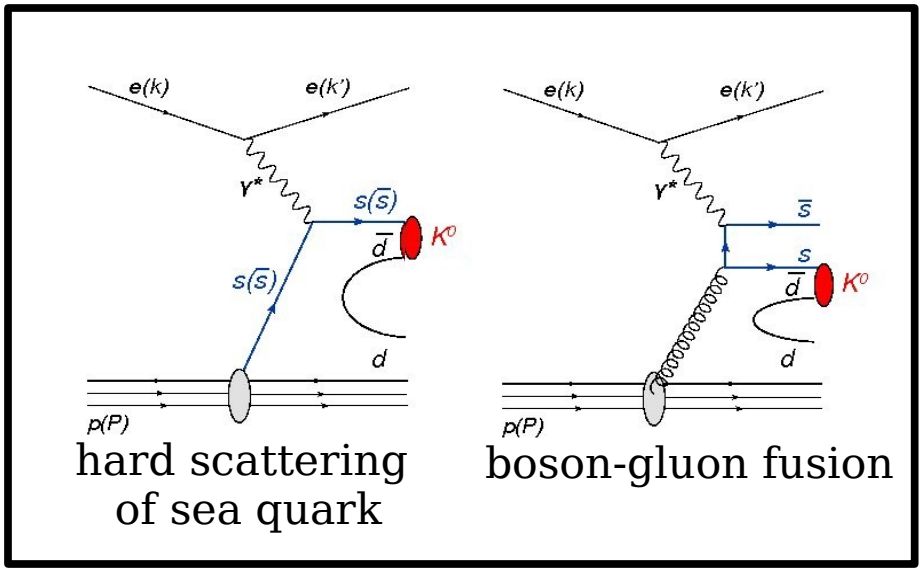
strangeness suppresion: $\lambda_s = P(s)/P(u)$

e^+e^-(LEP) $\lambda_s = 0.3$

hadronisation and parametrs which determine LUND string fragmentation universal?

Breit Frame

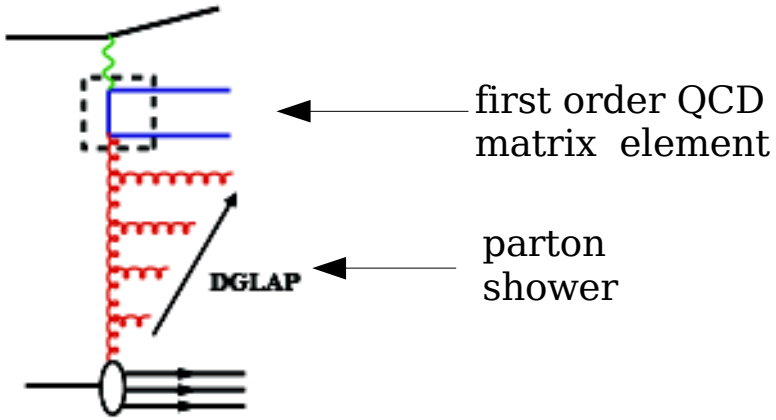




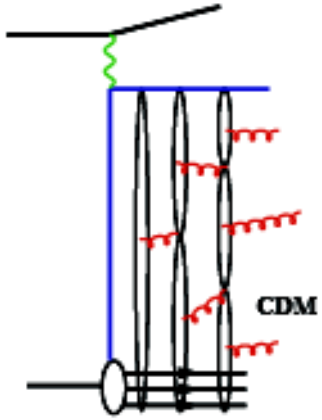
in QPM ep current region of Breit frame (struck quark) is analogic to LO $e^+e^- \rightarrow qq$

Products of hadronisation of strange quarks produced in QPM are contained in current region of Breit frame
This is also valid to some extent for HO (BGF, QCDC)

QCD Models based on DGLAP and CDM



LEPTO
(DIRECT)



ARIADNE

Matrix Element Parton Shower (MEPS)

DGLAP resums $\ln Q^2$ at low x, strong ordering of k_T of emitted partons

Color Dipole Model (CDM)

radiate independently k_T non-ordered partons

Both are interfaced to JETSET for hadronisation

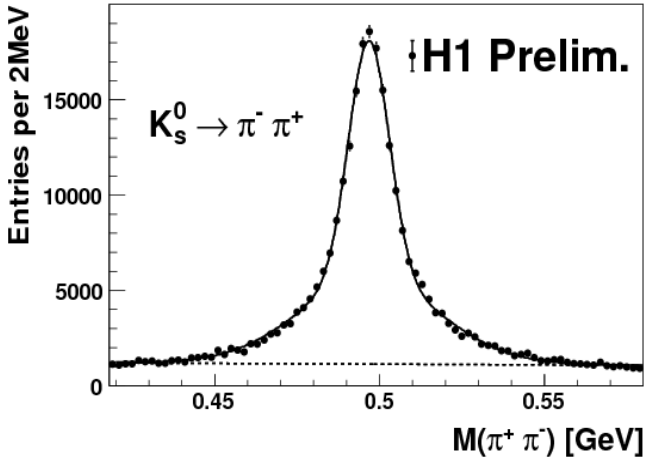
K^0_s and Λ signals in DIS

$K^0_s \rightarrow \pi^+ \pi^-$ $c\tau$=2.68cm

$\Lambda \rightarrow p\,\pi$ and c.c. $c\tau$=7.89cm

reconstruct neutral secondary vertices

- 2 oppositely charged tracks from vertex radially displaced from interaction vertex
- using cuts on decay length, dca

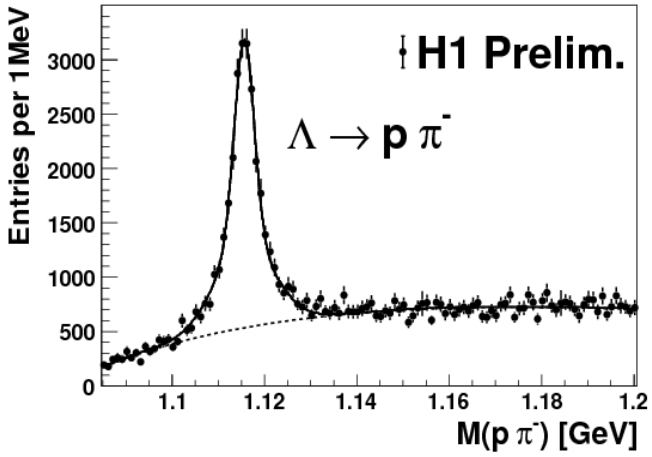


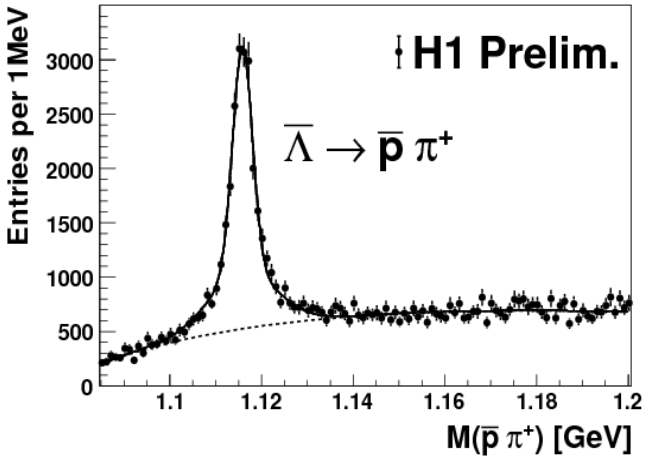
mass (K^0_s)=496.9±0.1 MeV

mean width(K^0_s)=13.08±0.4 MeV

mass (Λ)=1115.8±0.1 MeV

mean width(Λ)=4.3±0.3 MeV





visible range

- $0.5<p_T<3.5$ GeV
- $|\eta|<1.3$

Inclusive K^0_s and Λ cross sections results

H1 e^+ data 1999/2000 $L=49.9\ pb^{-1}$

- $2<Q^2<100\ GeV^2$
- $0.1<y<0.6$

visible range

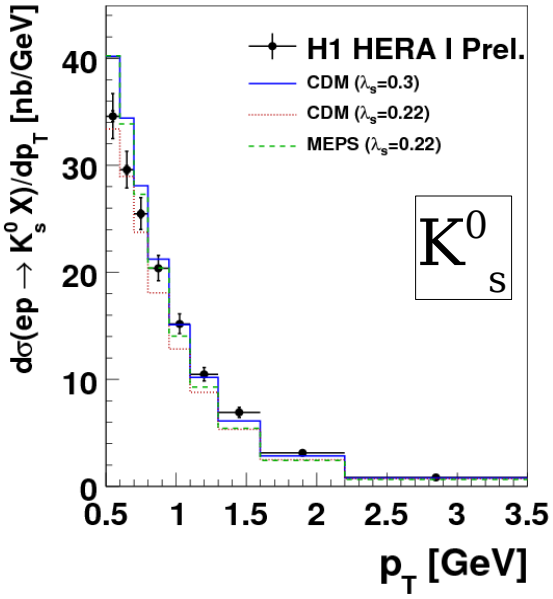
- $0.5<p_T<3.5\ GeV$
- $|\eta|<1.3$

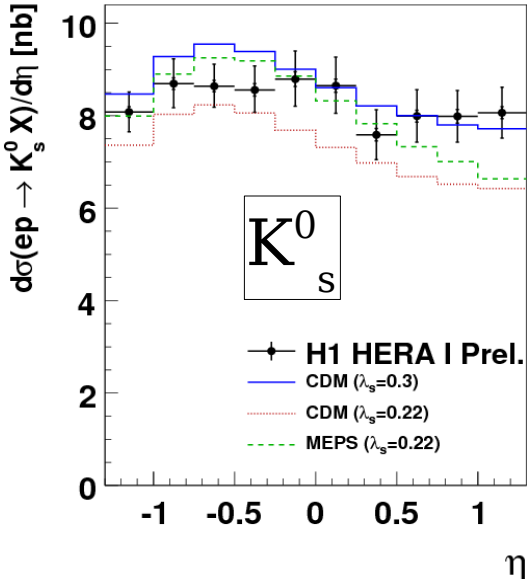
measurement	CDM (ALEPH-tuned JETSET, CTEQ6L)
$\sigma_{vis}(ep\to e' K^0_s X) = 21.18\pm0.09(stat.)\ ^{+1.19}_{-1.23}(syst.)\ nb$	$\sigma_{vis}(ep\to e' K^0_s X) = 21.77\ nb$
$\sigma_{vis}(ep\to e'[\Lambda,\bar{\Lambda}]X) = 7.88\pm0.10(stat.)\ ^{+0.45}_{-0.47}(syst.)\ pb$	$\sigma_{vis}(ep\to e'[\Lambda\bar{\Lambda}]X) = 7.94\ pb$

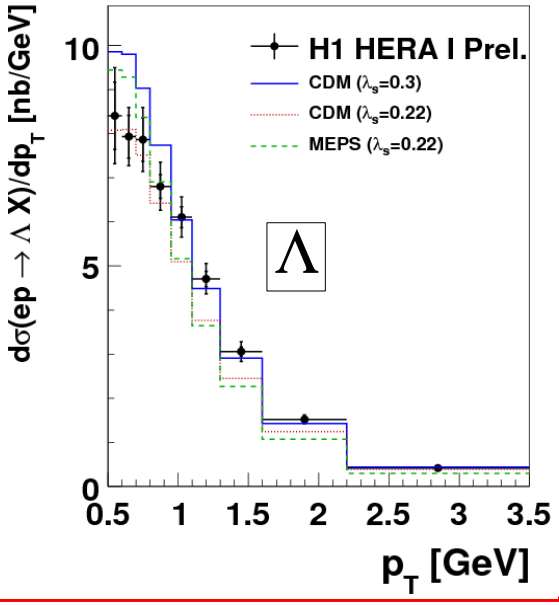
$$\sigma_{vis}(ep\to e'[\Lambda]X) = 3.96\pm0.06(stat.)\ pb$$
$$\sigma_{vis}(ep\to e'[\bar{\Lambda}]X) = 3.94\pm0.07(stat.)\ pb$$

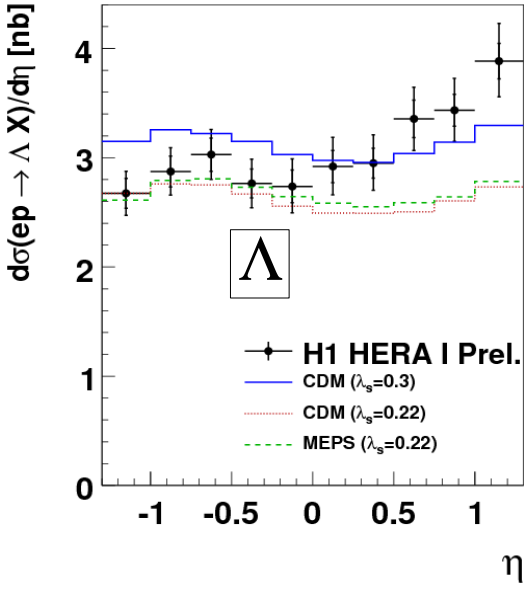
- CDM ALEPH-tuned predictions is in good agreement with the measurement of the total cross section for neutral strange particle production

Differential K^0_s and Λ cross sections in Lab. Frame









Comparison with MEPS and CDM

p_T, η spectrum of K^0_s

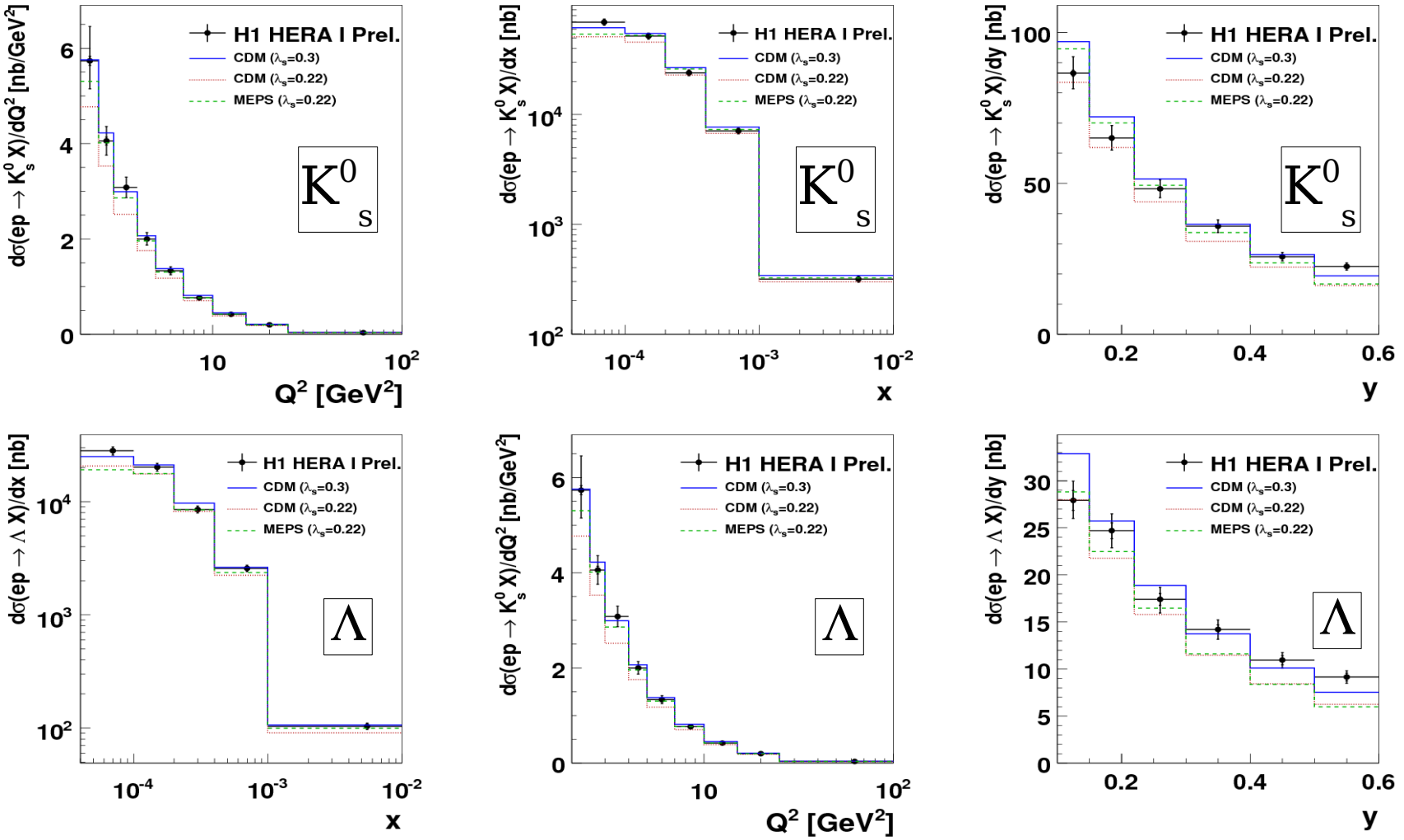
- CDM λ_s =0.3 close to the data, at low p_T region smaller λ_s =0.22 preferred
- MEPS λ_s =0.2 close to the data

p_T, η spectrum of Λ

- CDM λ_s =0.3 preferred
- MEPS λ_s =0.3

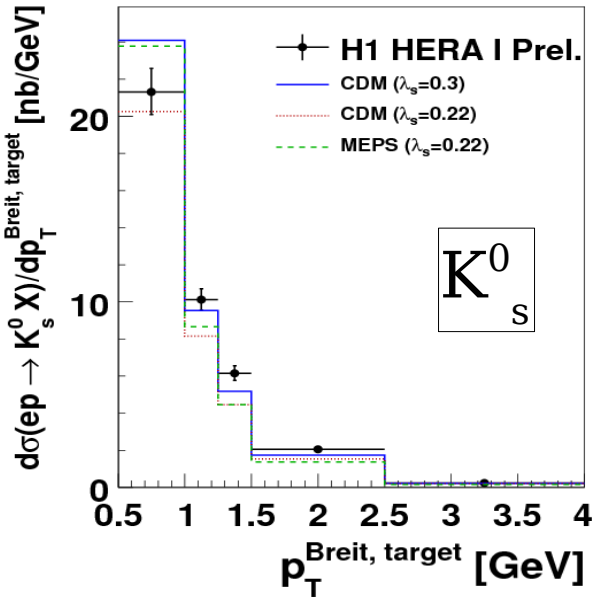
(baryon production depends not only on λ_s but also on diquark creation parameters)

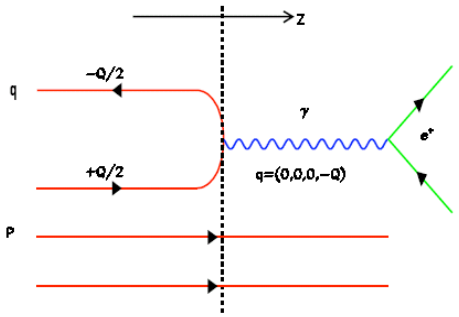
Differential K^0_s and Λ cross sections in Lab. Frame

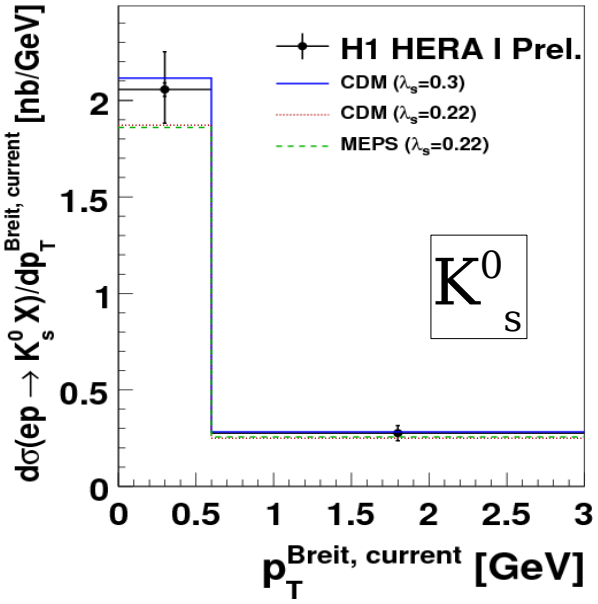


- **K^0_s**: CDM $\lambda_s = 0.3$ and MEPS $\lambda_s = 0.2$ provides good description
- **Λ**: CDM and MEPS $\lambda_s = 0.3$ describe the data reasonably well

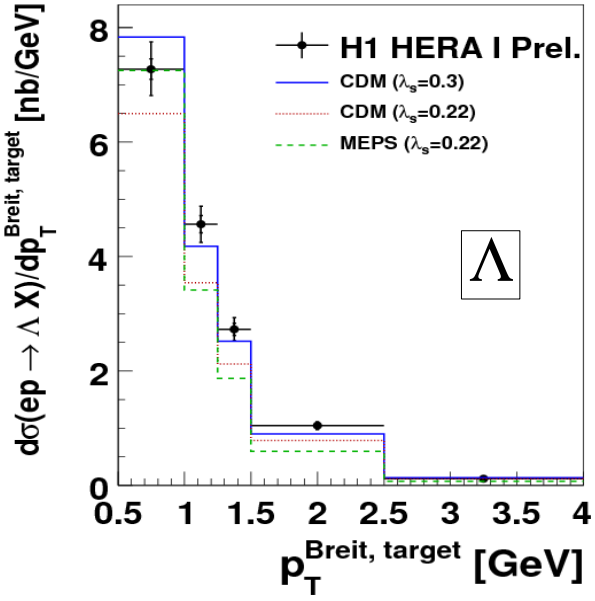
Differential K^0_s and Λ cross sections in Breit Frame

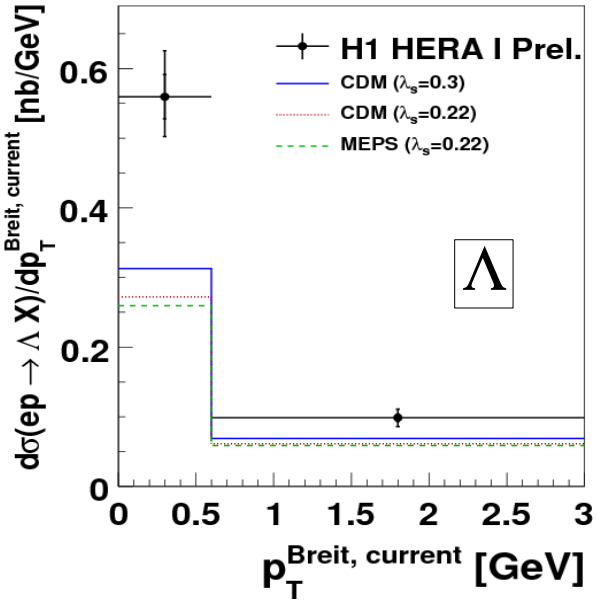




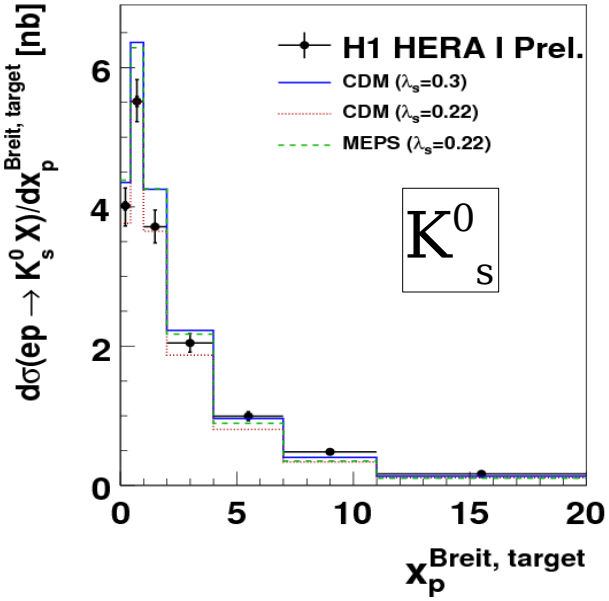


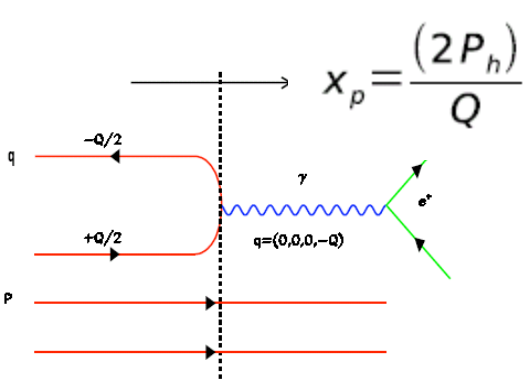
- **Target:** cross sections in target hemisphere favor λ_s=0.3
- **Current K^0_s:** good description of the data by both models
- **Current Λ:** both models below the data (factor 2)

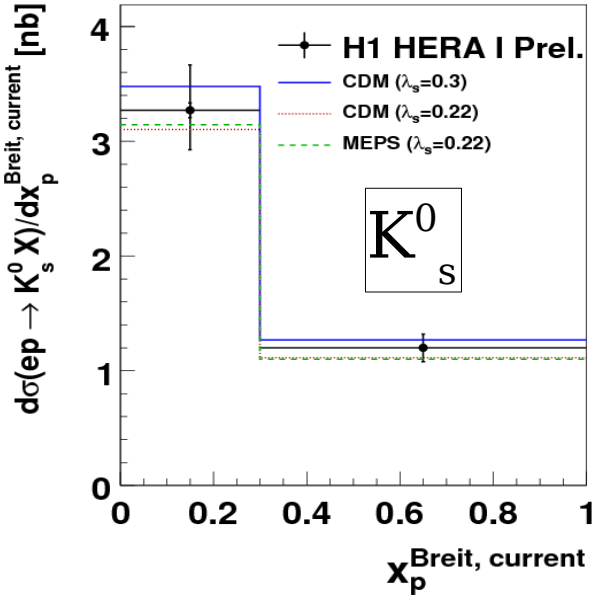




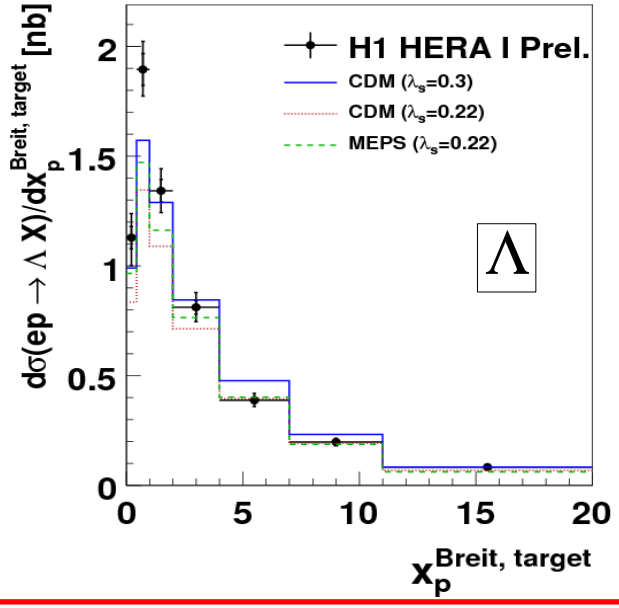
Differential K^0_s and Λ cross sections in Breit Frame

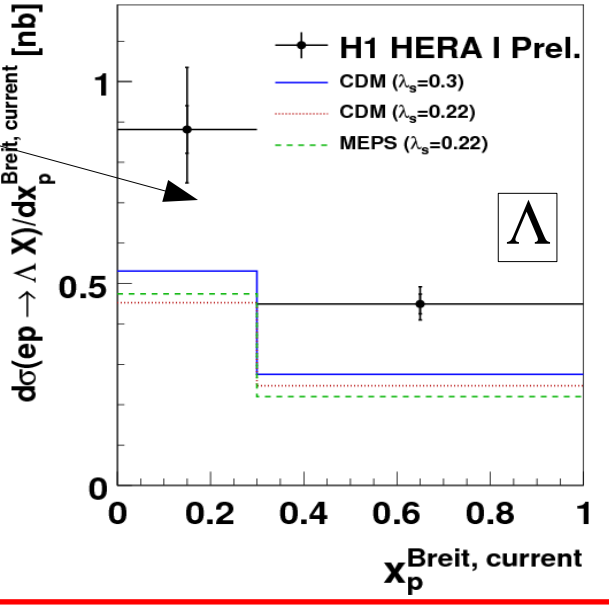




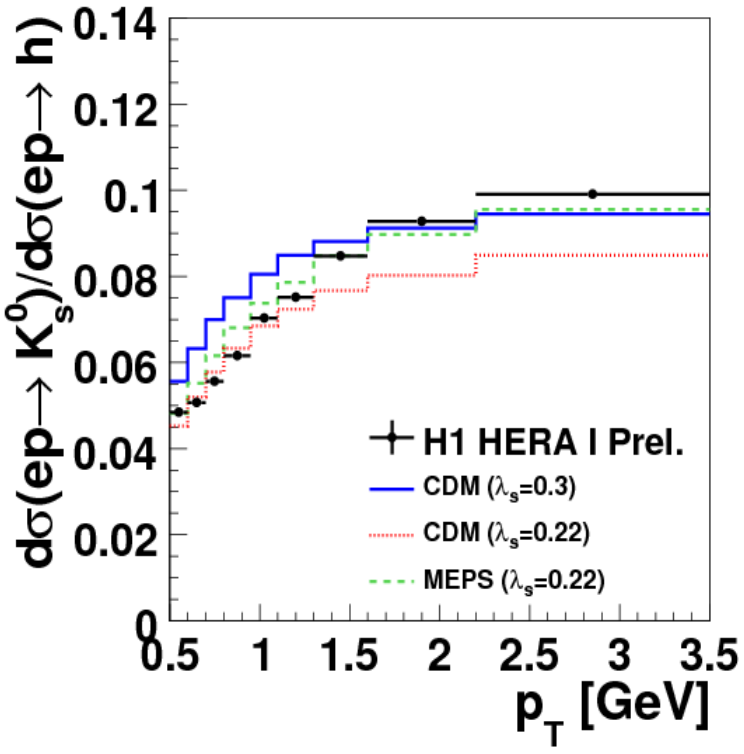


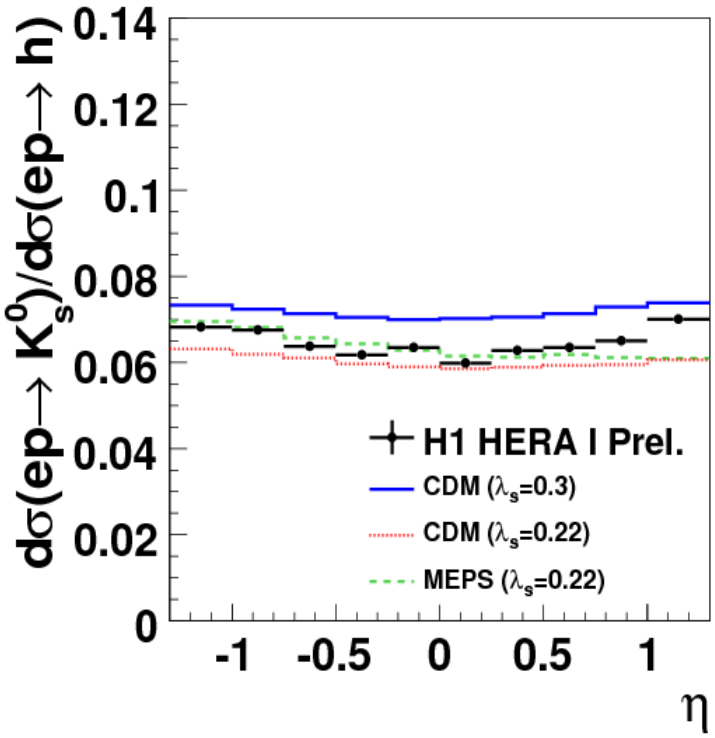
- Models fail to describe Λ production in current hemisphere





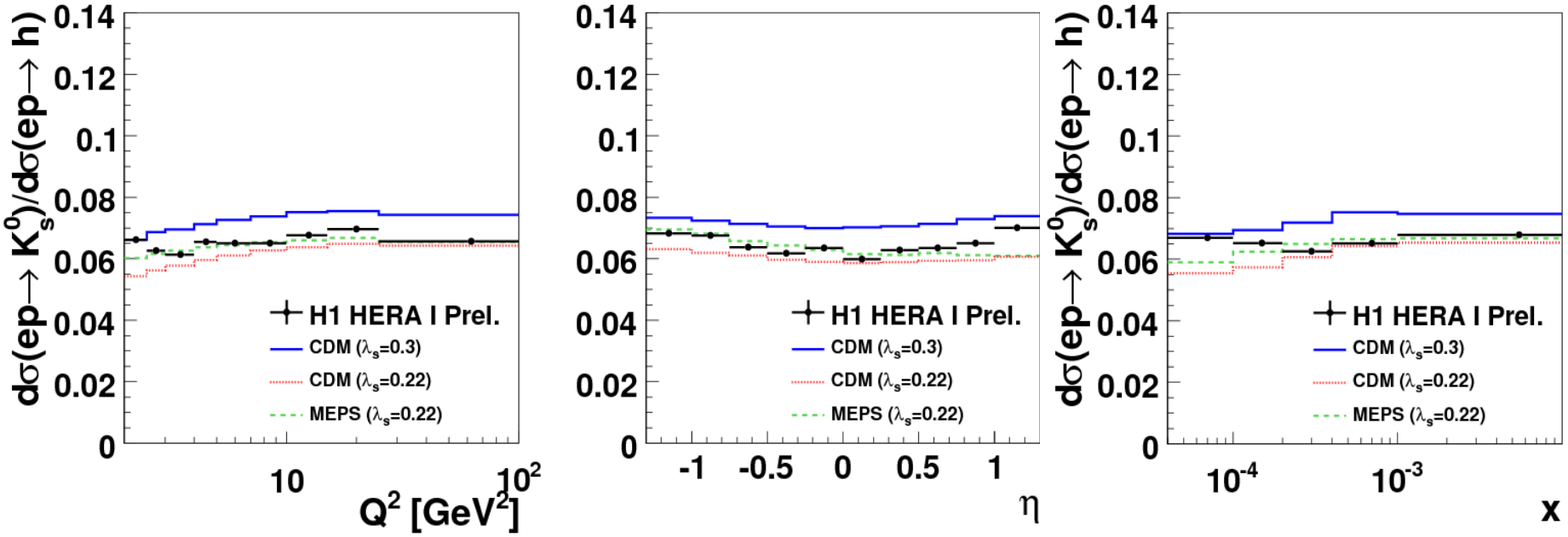
K^0_s Meson to Charged Hadrons Ratio (Lab. Frame)





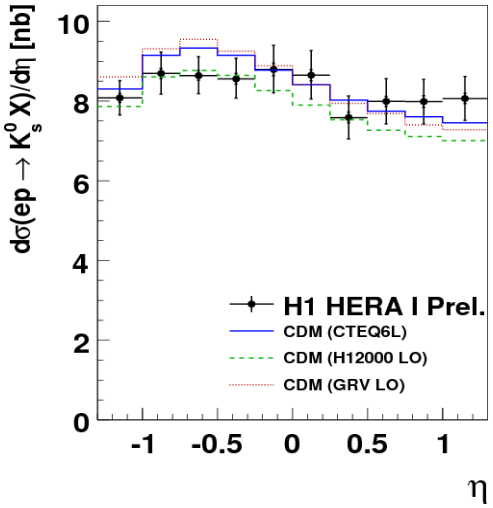
- MEPS is consistent with constant λ_s=0.22 over almost full range p_T and η
- CDM requires λ_s=0.22 at lower p_T region and λ_s=0.3 at higher p_T region (consistently with indications from cross section measurement)

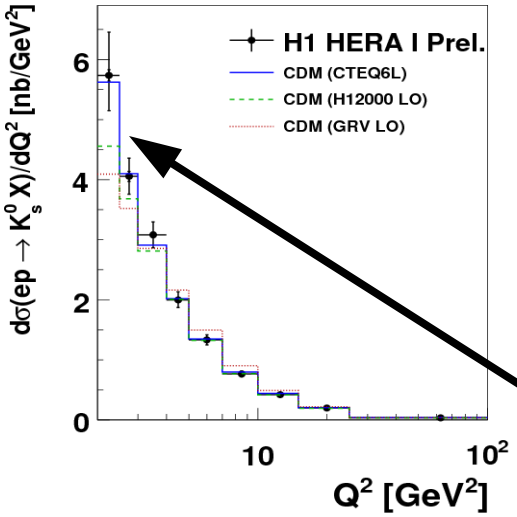
K^0_s Meson to charged hadrons ratio (Lab. Frame)



- Ratios are constant as a function of kinematical variables
- MEPS: prediction with λ_s=0.22 describes the data reasonably well
- CDM: data not consistent with constant λ_s and fall between λ_s=0.2 and λ_s=0.3 curves

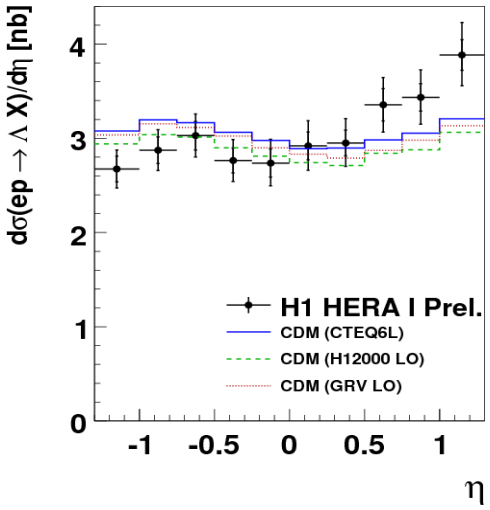
Sensitivity to proton PDF

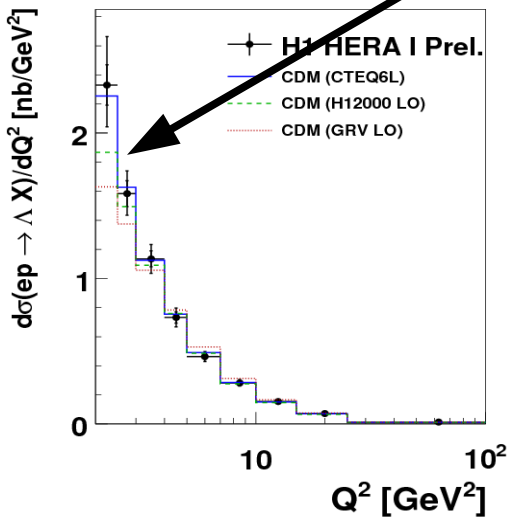




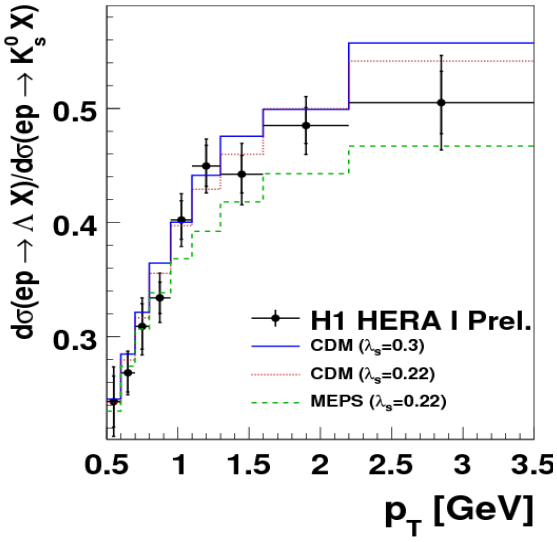
CTEQ 6L
H1 2000 LO
GRV LO

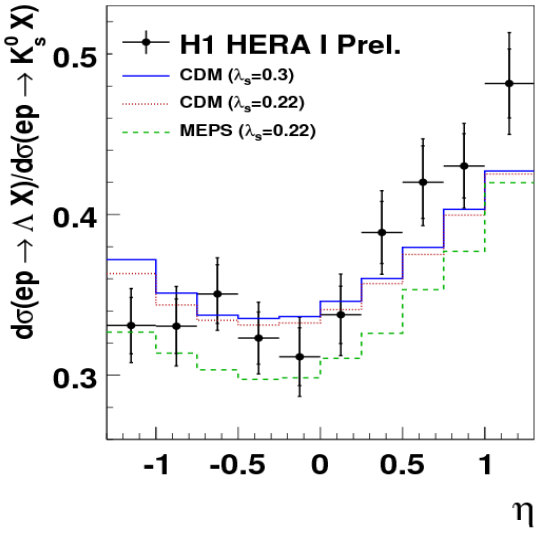
sensitivity of strangeness production to proton PDF at small Q^2





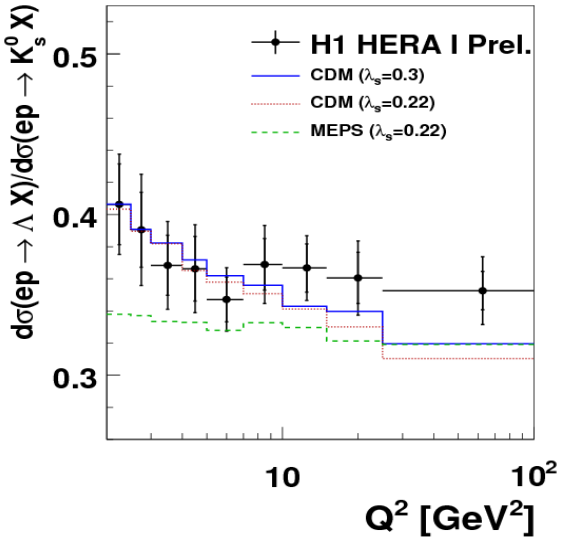
Baryon to meson ratio (Lab. Frame)

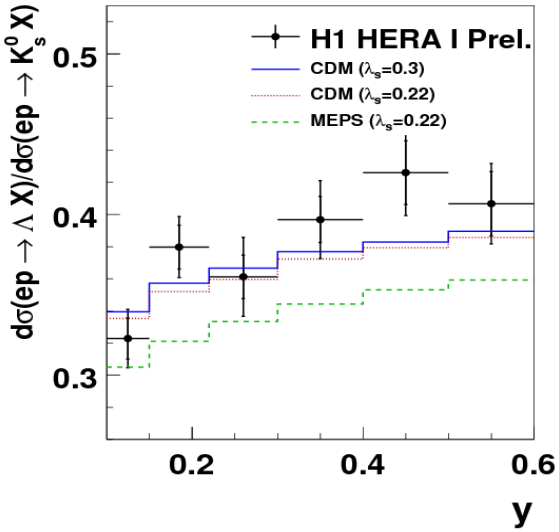


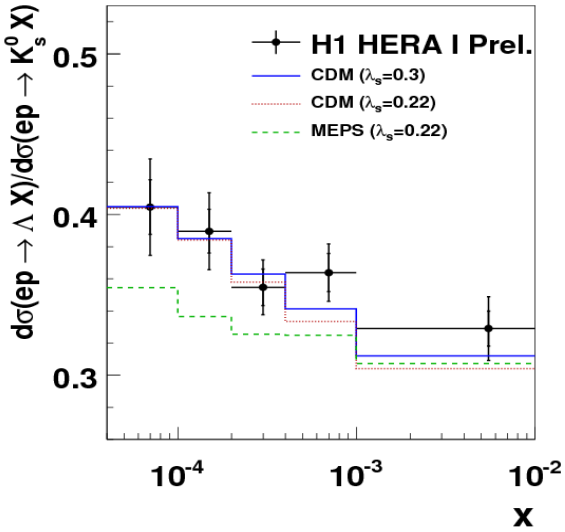


Baryon production in LUND string model:

- input for tuning diquark creation parameters
- insensitive to λ_s variation

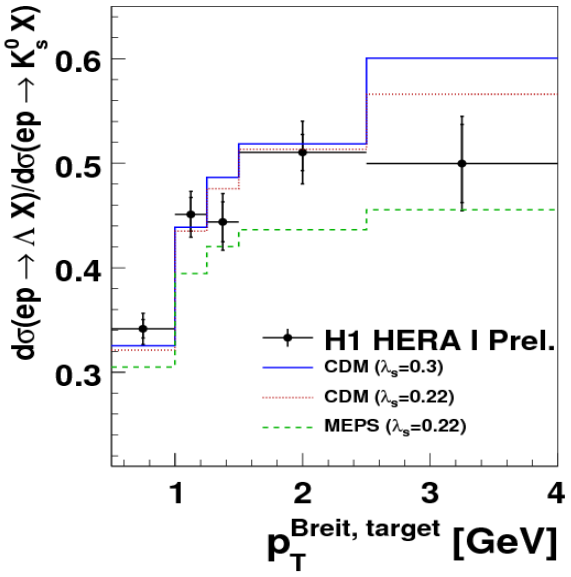


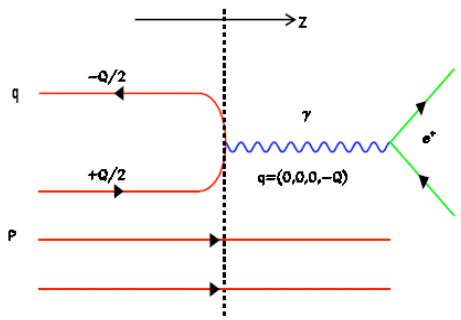


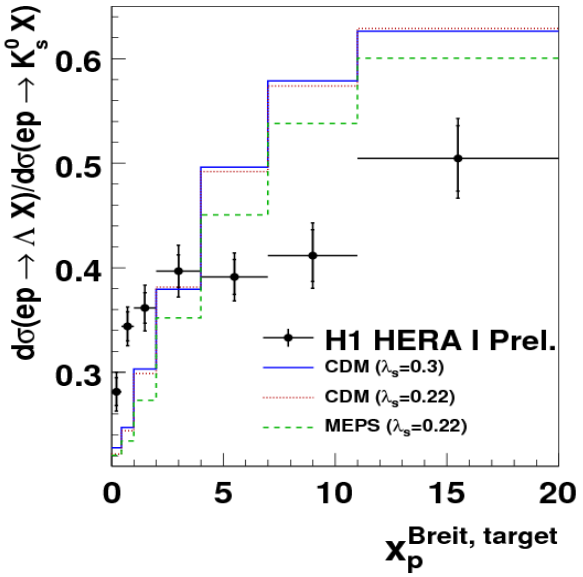


- Reasonably good description by CDM
- MEPS fails to describe the data

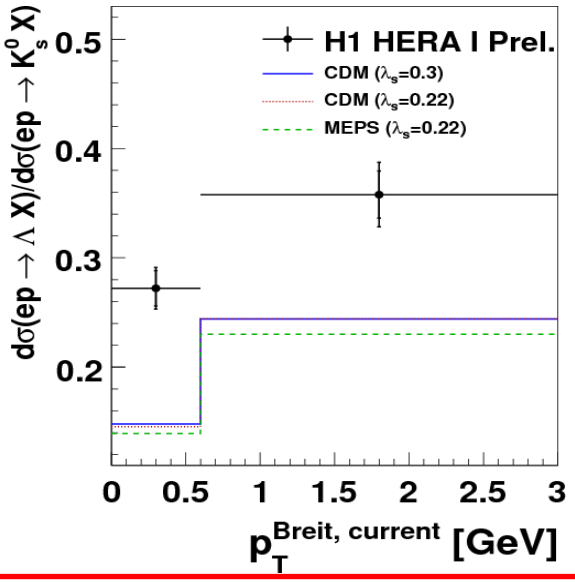
Baryon to meson ratio (Breit Frame)

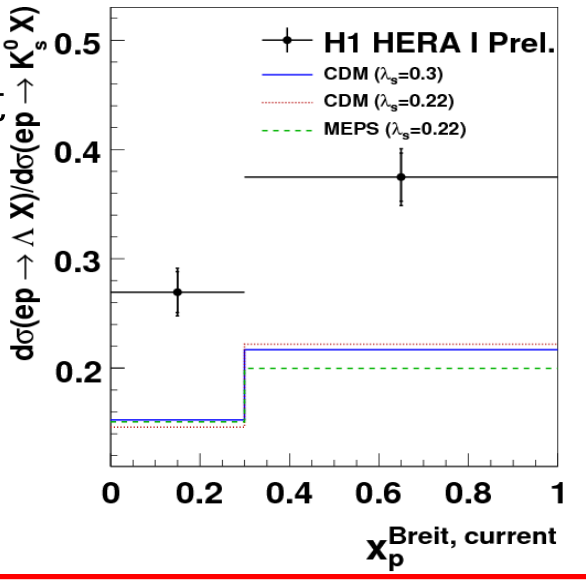




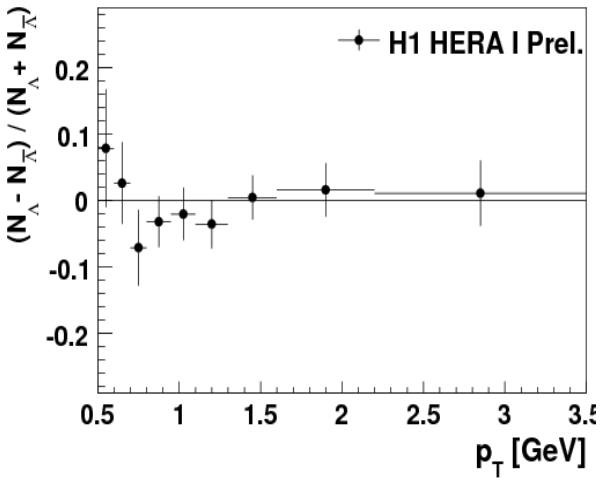


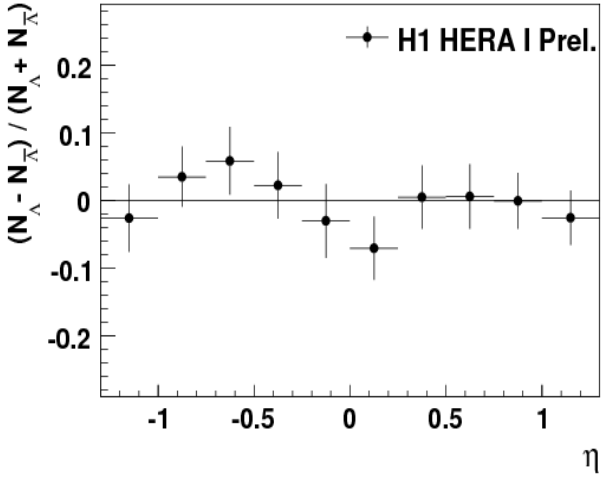
- models do not describe ratios except for p_T spectrum
- smaller baryon to meson ratio in current



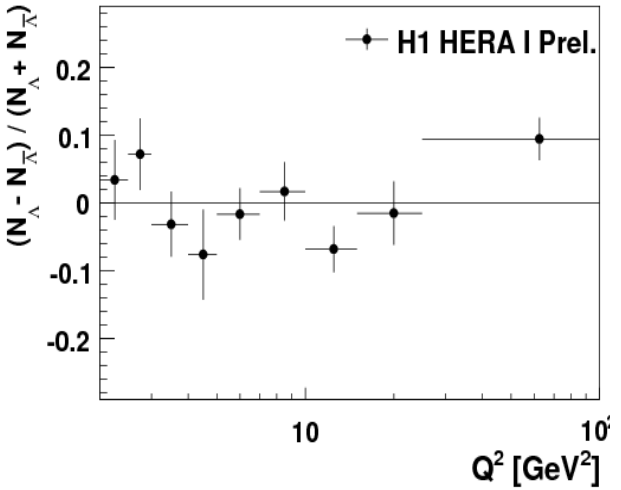


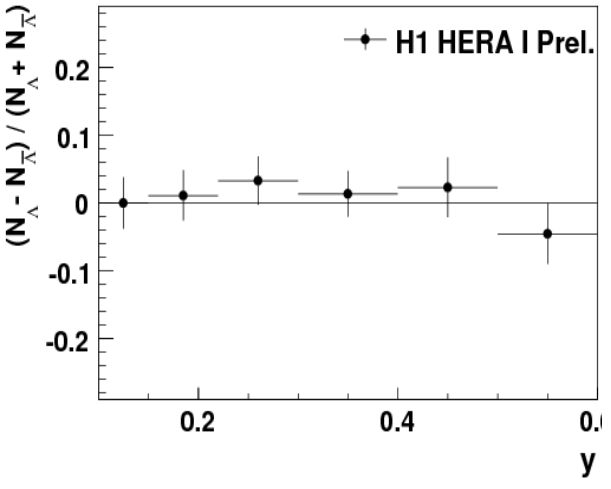
Baryon-antibaryon Asymmetry (Lab. Frame)

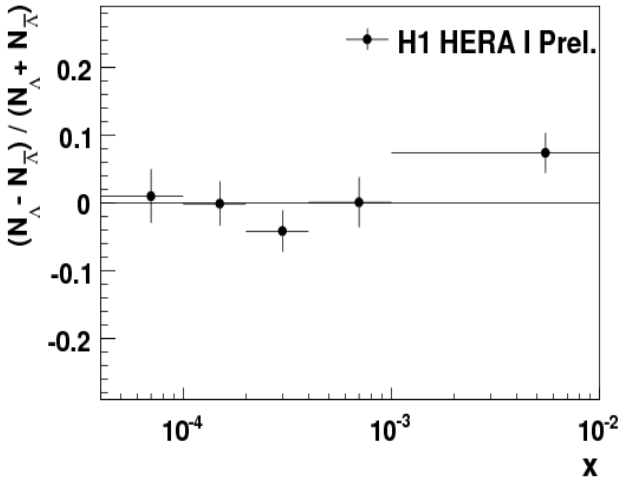




$$\frac{N_\Lambda - N_{\bar\Lambda}}{N_\Lambda + N_{\bar\Lambda}}$$

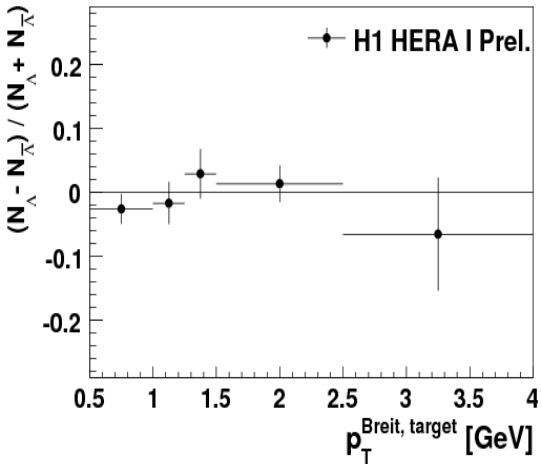


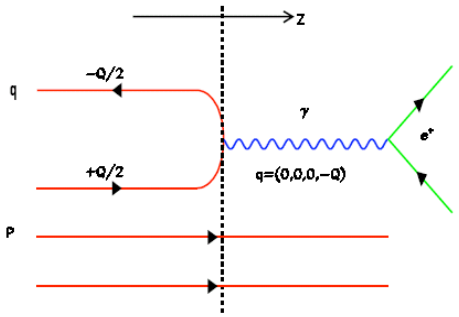


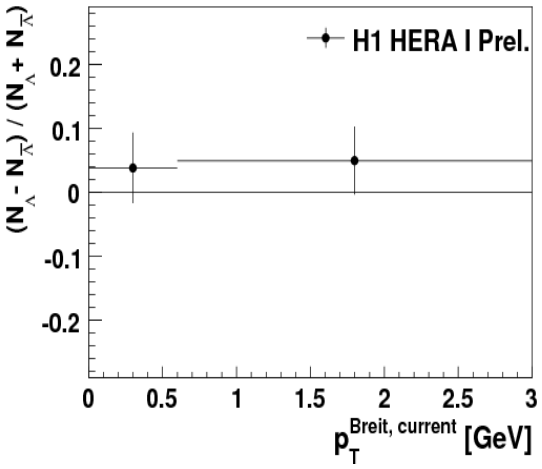


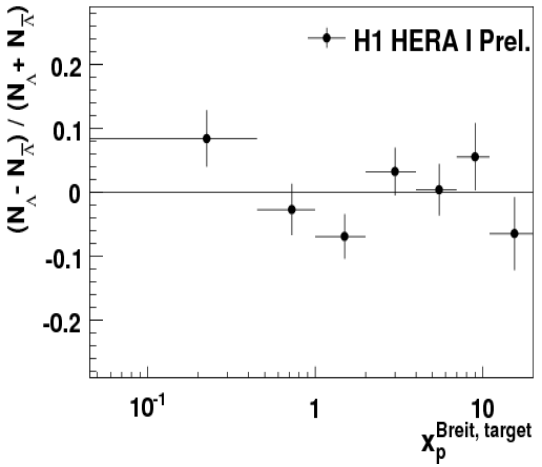
- All distributions compatible with zero within errors

Baryon-antibaryon Asymmetry (Breit Frame)

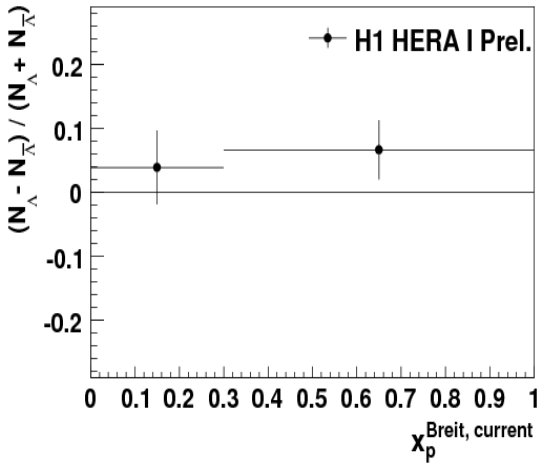








- All distributions compatible with zero within errors



Summary

- Measurements of K^0_s and Λ inclusive and differential cross sections have been made.

- Neither MEPS nor CDM with a single λ_s value is able to give a complete description of the K^0_s and Λ cross sections:
- CDM λ_s =0.3 close to the data but fails to describe all the details.
- MEPS λ_s =0.22 close to K^0_s data.
- MEPS λ_s =0.3 close to Λ data.

- **K^0_s cross sections and K^0_s to charged hadrons reasonably well described by MEPS with λ_s =0.22.**

- CDM describes baryon to meson ratio in laboratory frame.
- Models fail to describe baryon to meson ratio in breit frame.

- No sizable baryon-antibaryon asymmetry is observed.