c Fragmentation into D*

Summer Student Session 2006

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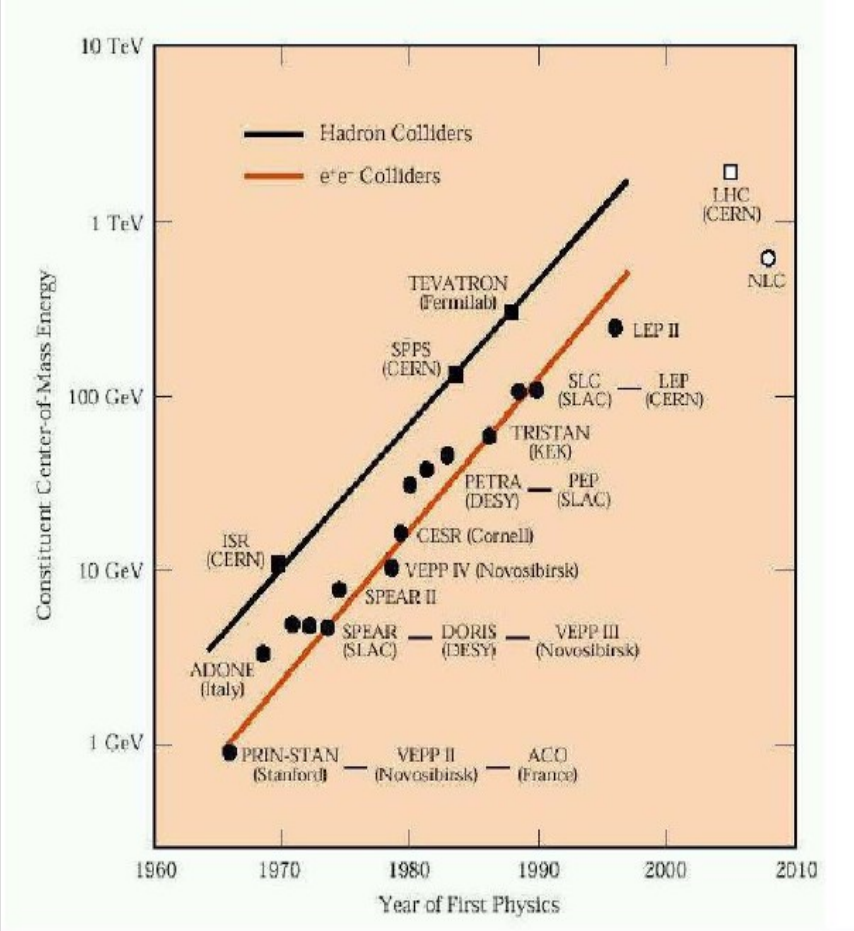
in collaboration with Torsten Leddig

Outline

- Basic Concepts
- Fragmentation Functions
- Kerstin's Work
- Torsten's Work
- Conclusion

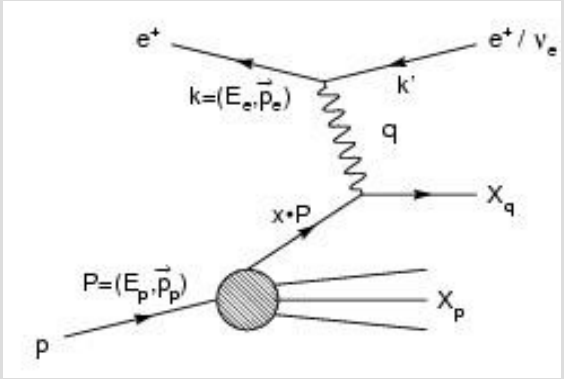
Particle Accelerators

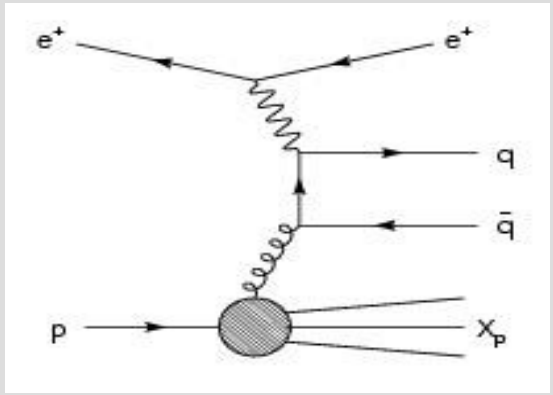


Time evolution

DESY with the HERA ring

Basic Concepts





- c quarks or $c\,\bar{c}$ pairs can be produced in DIS events
- D*+ $(c\,\bar{d}\,)$
- D*- $(\bar{c}\,d)$
- c can fragment to D* ⟶ process is described by fragmentation functions

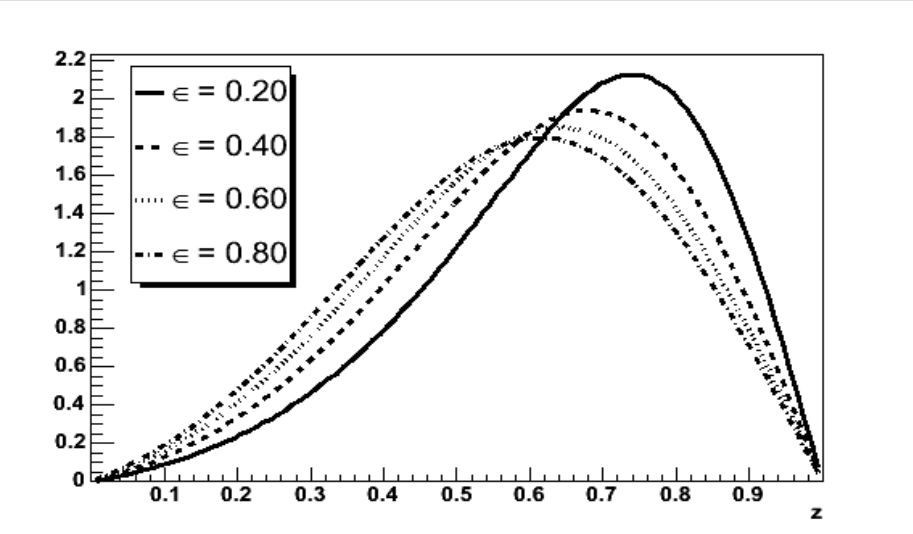
- Decay mode of interest:

$$D^{*+/-} \rightarrow D^{o}\ \pi_{s}^{+/-} \rightarrow K^{-/+}\ \pi^{+/-}\ \pi_{s}^{+/-}$$

Fragmentation Functions

- **Peterson FF**

$$D_Q^H(z) = \frac{N}{z\left[1 - 1/z - \varepsilon_Q/(1-z)\right]^2}$$



→ parameter ϵ

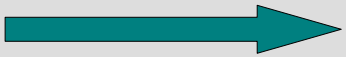
- **Kartvelishvili FF**

$$D_Q^H(z) = N\, z^{\alpha}(1-z)$$

→ parameter α

Fragmentation Functions

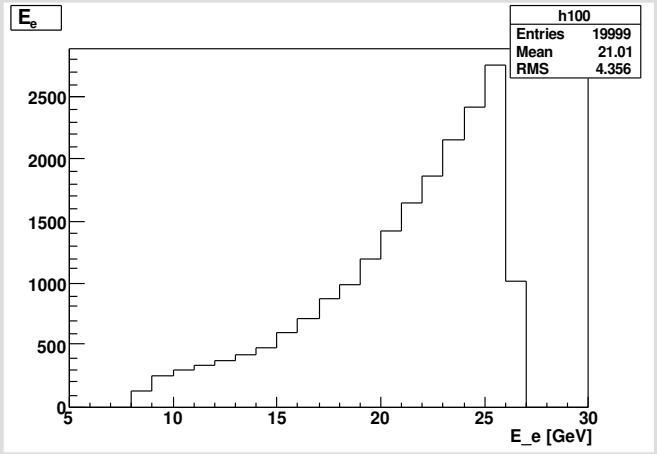
- General case: $$z = \frac{(E + p_L)_{hadron}}{(E + p)_{parton}}$$
- Hemisphere method: divide event space into two hemispheres one of which contains the D* of interest
- Jet method: find the jet containing the D*



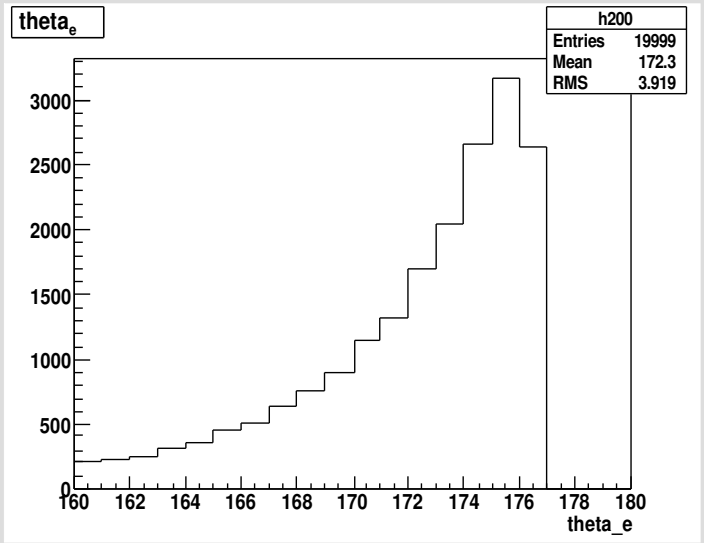
z_{jet} and z_{hemi}

General Remarks

- Monte Carlo generators RAPGAP and PYTHIA are used.
- Apply actual H1 and CLEO experimental settings.
- Selection algorithms have to be set.
- Event kinematics:



$E(e')$



$\theta(e')$

Kerstin's Work

Effects of different parameters

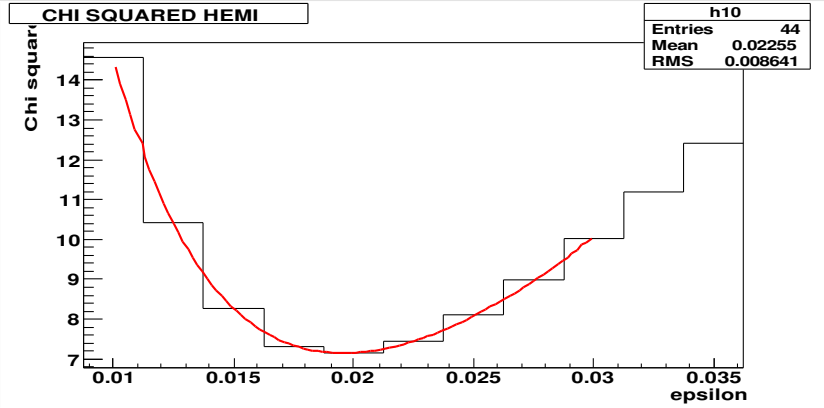
(in the MC generation process)

- Change the proton structure function to include only u, d and s quarks together with gluons : CTEQ5F3 (beforehand: CTEQ5L).

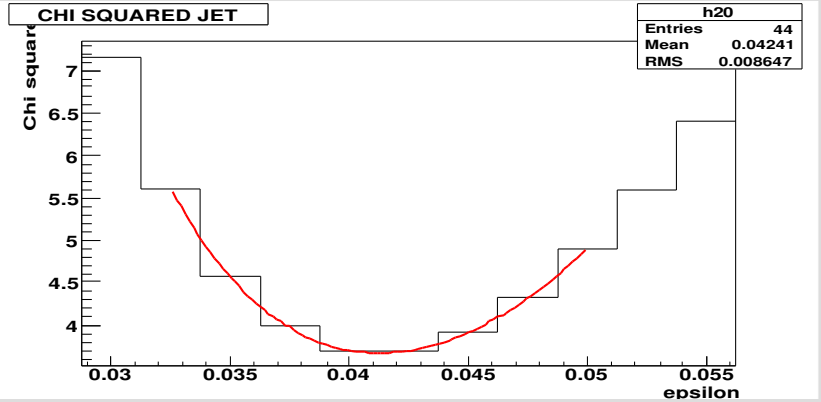
- Neglect higher resonances which can occur and then decay to produce a D*.

Kerstin's Work

Peterson FF: Compare the two z



ε=0.020+0.006-0.004

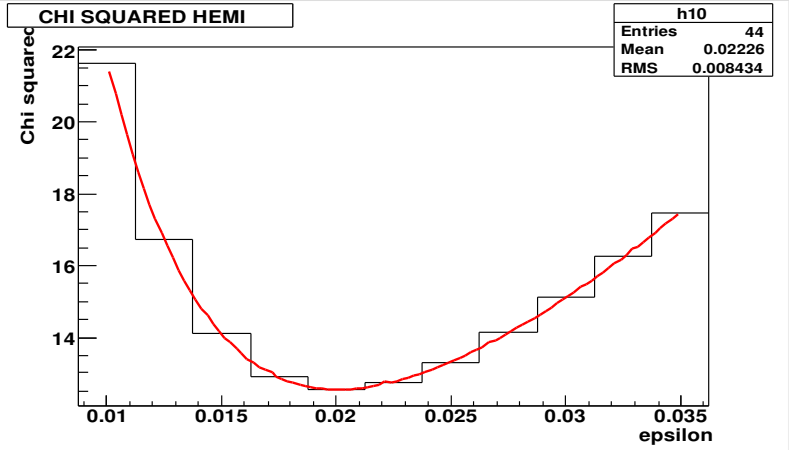


ε=0.041+0.008-0.007

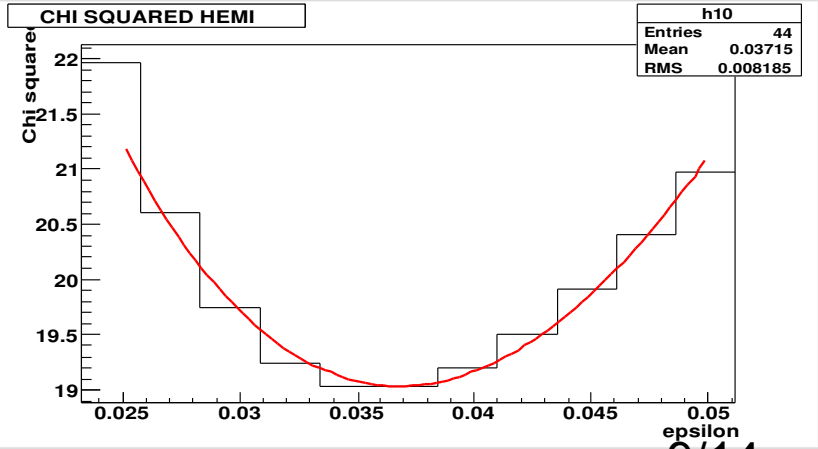
Using CTEQ5F3

W/o higher resonances

z hemi



ε=0.020+0.006-0.004

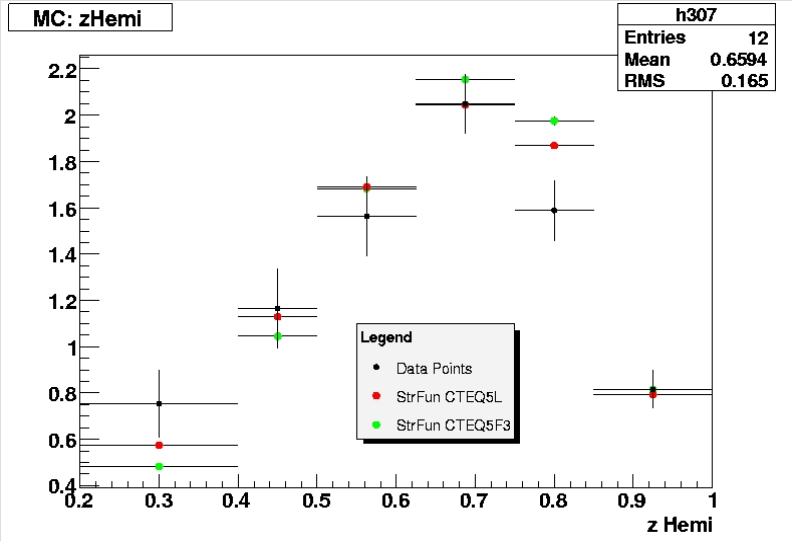


ε=0.034+0.009-0.007

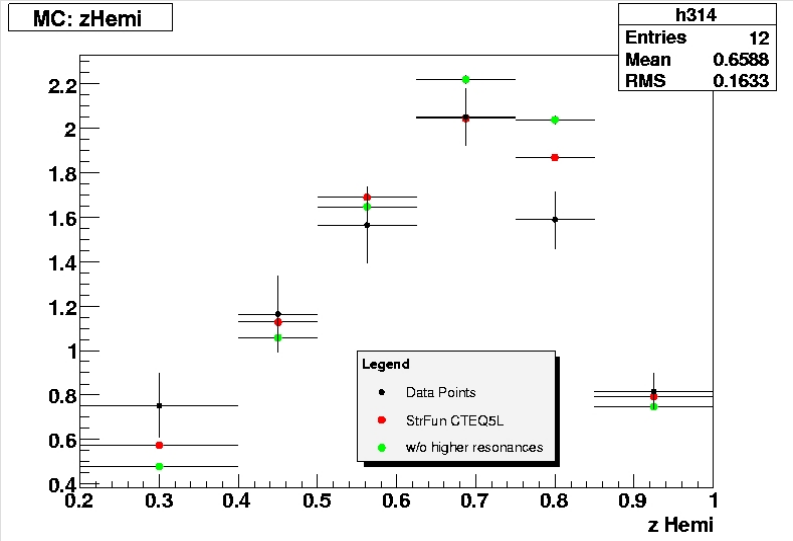
Kerstin's Work

z hemi

CTEQ5L ⟷ CTEQ5F3



CTEQ5L ⟷ w/o hi. res.



Results:

- CTEQ5F3 works quite well.
- Without higher resonances the values change a lot and errors get bigger.
- No perfect reproduction of the actual data.
- z hemi and z jet yield different results.

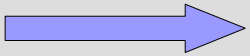
Torsten's Work

Universality test for the FF

- Generate MC files under exactly the same conditions as before just for an e+e- collider.

- Compare those results with data from CLEO.

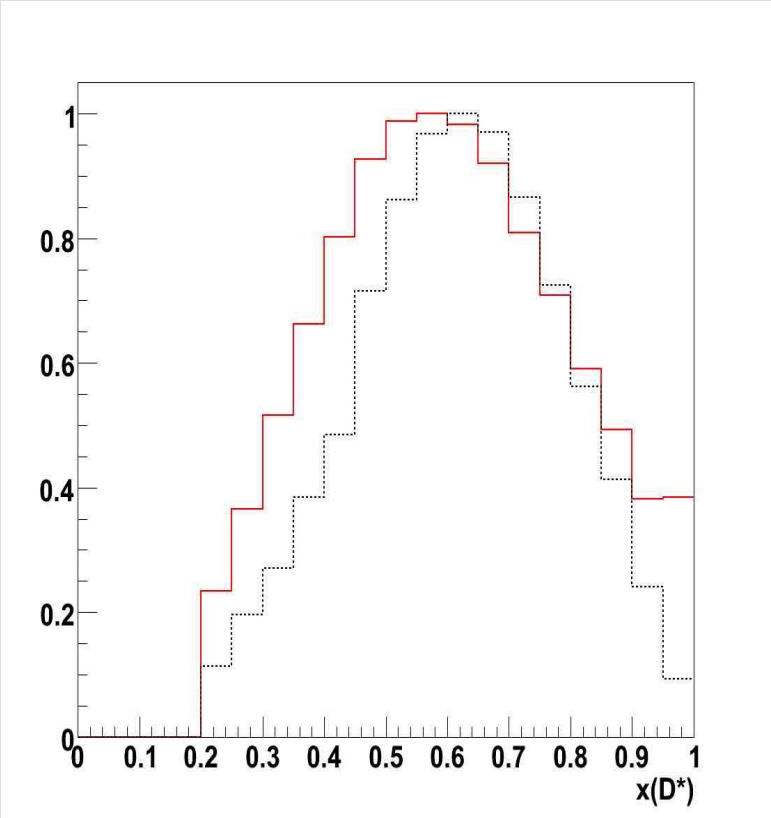
- Check, whether e+e- events are described by the same fragmentation function.



This would mean universality!

Torsten's Work

Playing around with CLEO data and parameters



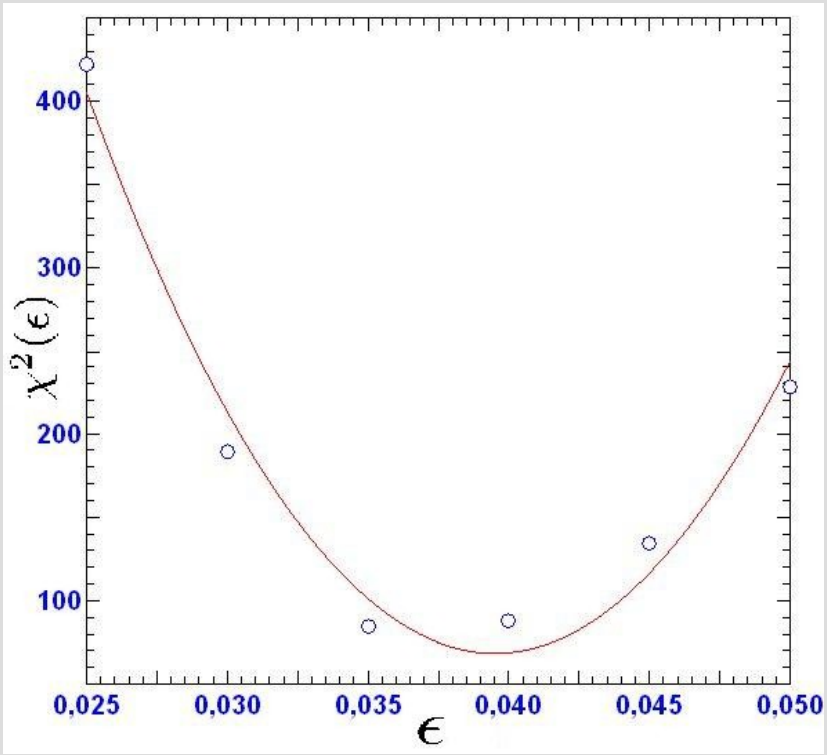
Specialized Aleph steering with the Lund model

- $x = \frac{p}{p_{max}}$
- Default setting did not describe data properly.

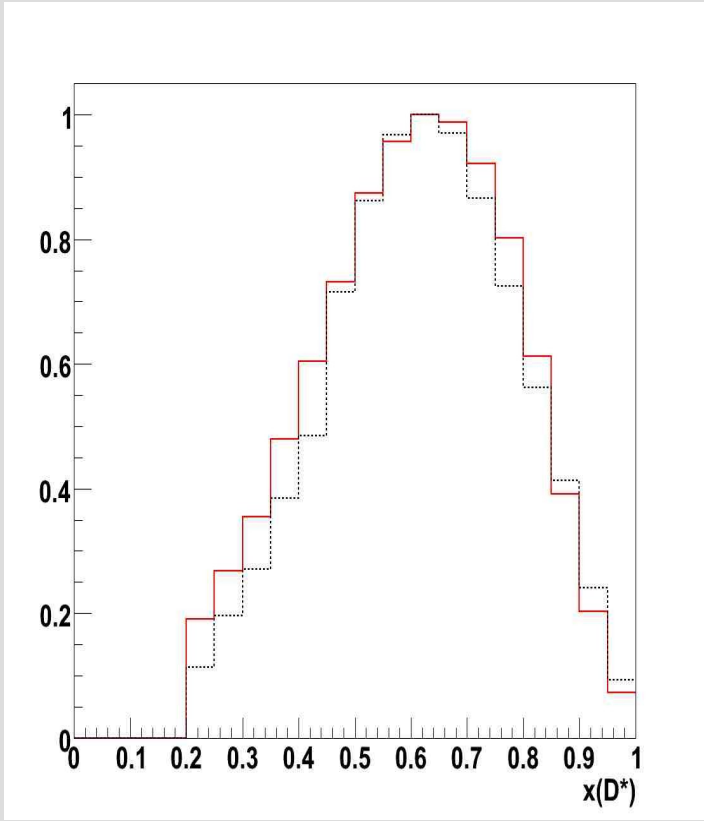
Torsten's Work

Using Peterson Fragmentation

χ^2 - test



$\chi^2_{min} \approx 3.5 \, (per\ dof)$



$\epsilon = 0.040 \pm 0.002$

Conclusion

- Charm physics is important for understanding QCD.
- Test of theoretical predictions.
- Old settings were optimal.
- Universality can now be tested further.
- Thanks to our supervisors!
- And thanks for your attention!