Event Shape Update

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Outline

- Event Shape Motivation and the Power Correction Method
- Out-of-Plane Momentum
- Event Selection
- Kinematic Checks
- Comparison of two analyses
- NLO Calculations

Approach to Non-Perturbative Calculations

pQCD prediction → measured distribution

- Correction factors for non-perturbative (soft) QCD effects

Theory reduces corrections for any infrared safe event shape variable, F:

Used to determine the hadronization corrections

$$\langle F \rangle = \langle F \rangle_{perturbative} + \langle F \rangle_{power\ correction}$$

$$\langle F \rangle_{pow} = a_F \frac{16}{3\pi} \frac{\mu_I}{Q} \ln^P \frac{Q}{\mu_I} \left[\overline{\alpha_0}(\mu_I) - \alpha_s(Q) - \frac{\beta_0}{2\pi}(\ln \frac{Q}{\mu_I} + \frac{K}{\beta_0} + 1)\alpha_s^2(Q) \right]$$

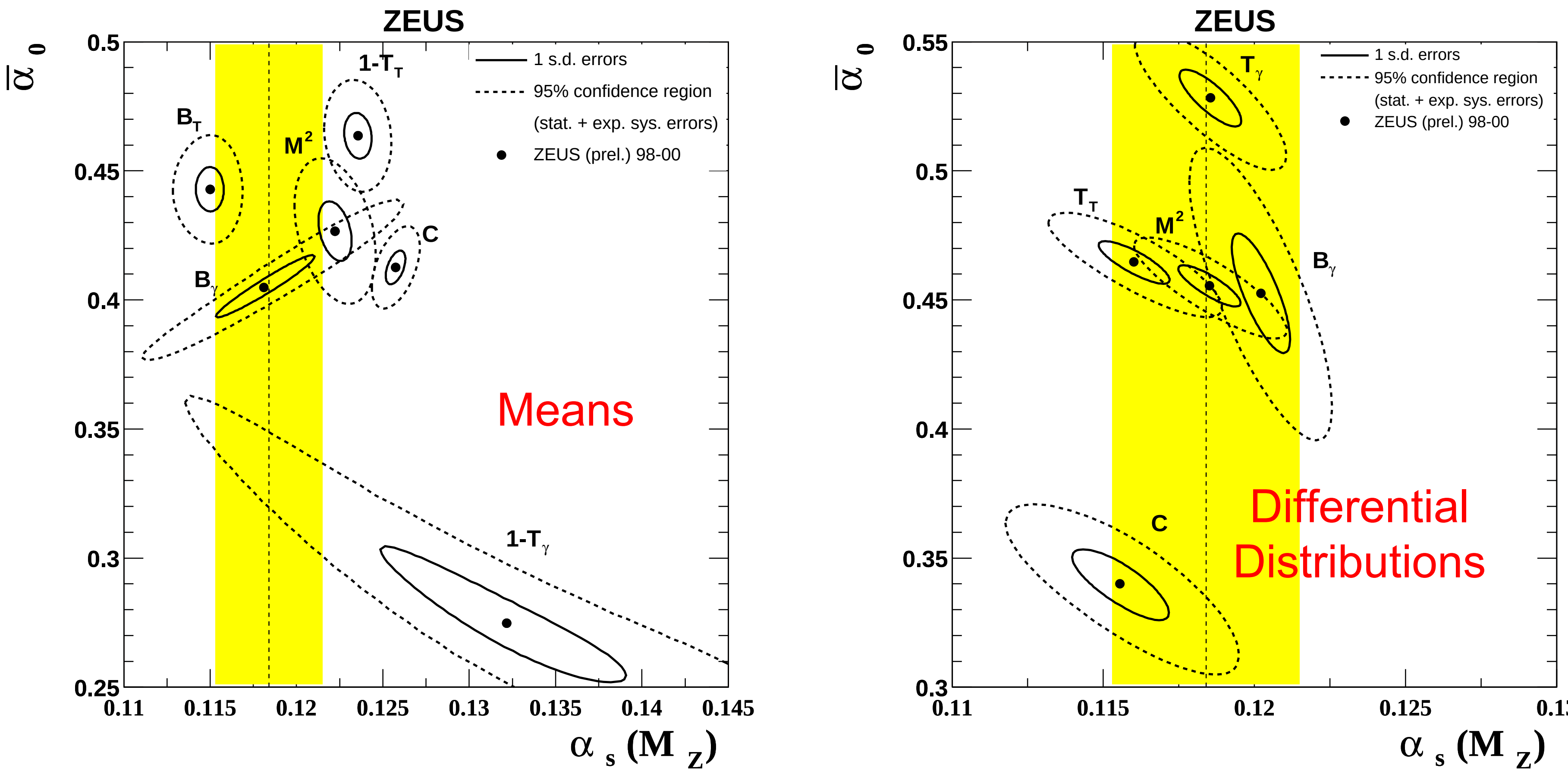
Power Correction

- independent of any fragmentation assumptions

$\overline{\alpha_0}$ = "non-perturbative parameter"

– (Dokshitzer, Webber, Phys. Lett. B 352(1995)451)

Extraction of Parameters



Test of Power Correction for Means and Differential Distributions already made preliminary

Energy Flow and Dijets

Instead of inclusive events, we use dijets in the current region of the Breit frame.

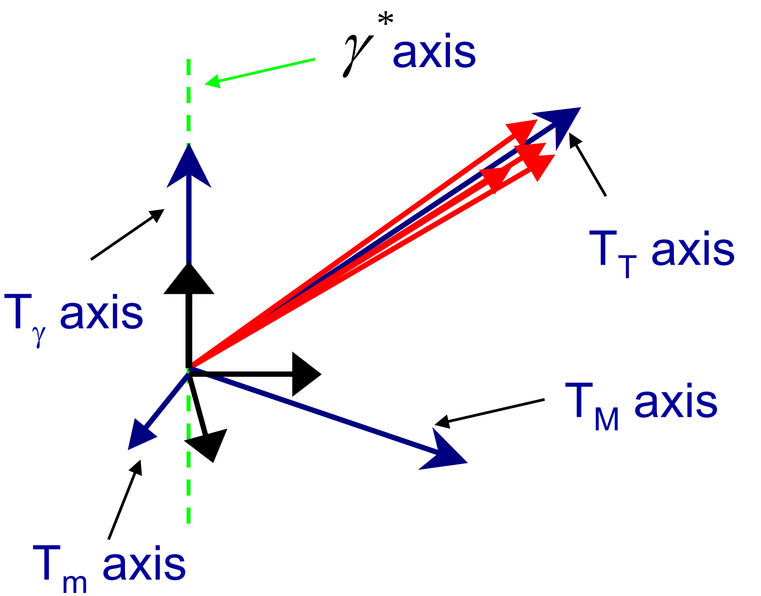
Dijets:

- pQCD part of <F> calculation well understood
- Event topology well understood

New Event Shape Variables: K_{out}, Azimuthal Correlation

- Must define an event plane in the Breit frame
- Use Thrust to define the event plane
- Transverse Energy Flow

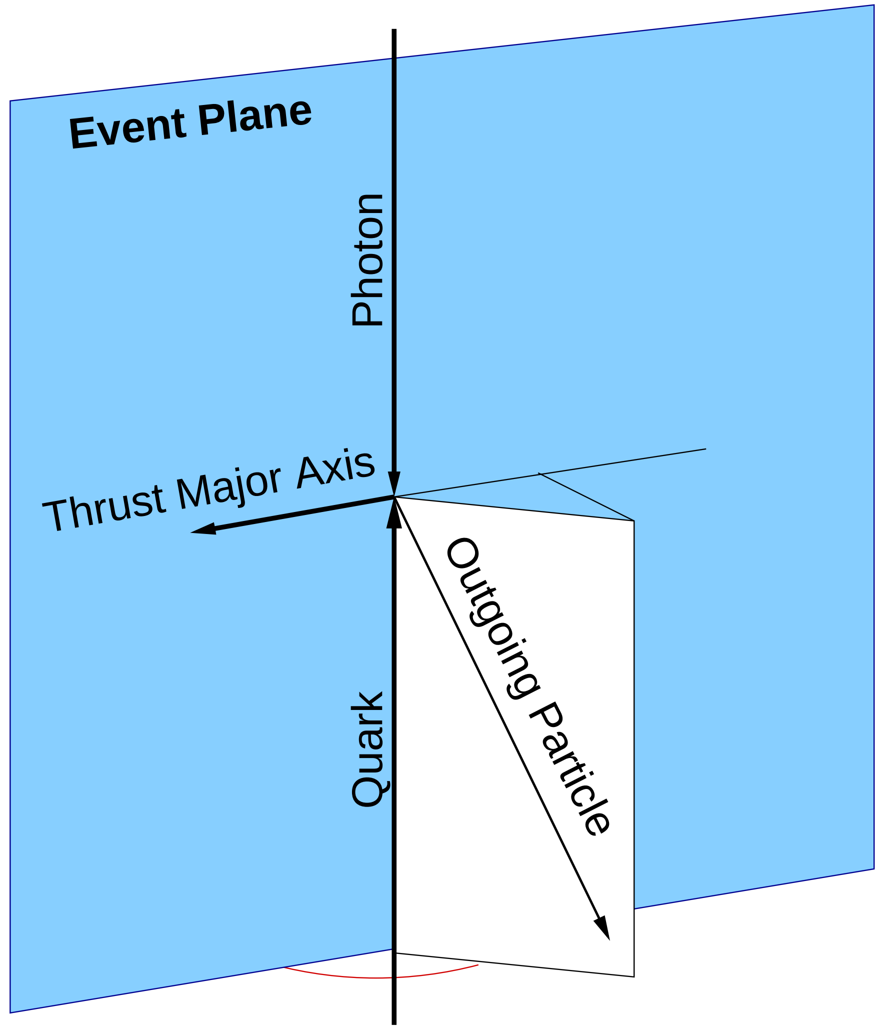
$$T_k = \max_{\hat{n}_k} \frac{\sum_i \left| \vec{p}_i \cdot \hat{n}_k \right|}{\sum_i \left| \vec{p}_i \right|}$$



Out-of-plane Momentum

- **Energy flow out of event plane defined by proton direction and thrust major axis**
  - **Sensitive to perturbative & non-perturbative contributions**
  - **Dijet event:**
    - Perturbative physics takes place in the plane
    - Non-perturbative physics give rise to out-of-plane momentum

$$K_{out} = \sum_{h}' \left| p_h^{out} \right|$$



Event Selection

Selection cuts

- $Q^2_{DA} \geq 100$ GeV^2
- $y_{JB} > 0.04$
- $y_{el} < 0.95$
- Vertex with $|z| < 40$ cm
- $38 < E\text{-}p_Z < 65$ GeV
- Good positron
  - Sinistra Probability > 0.9
  - $E_{e',DA} > 10$ GeV

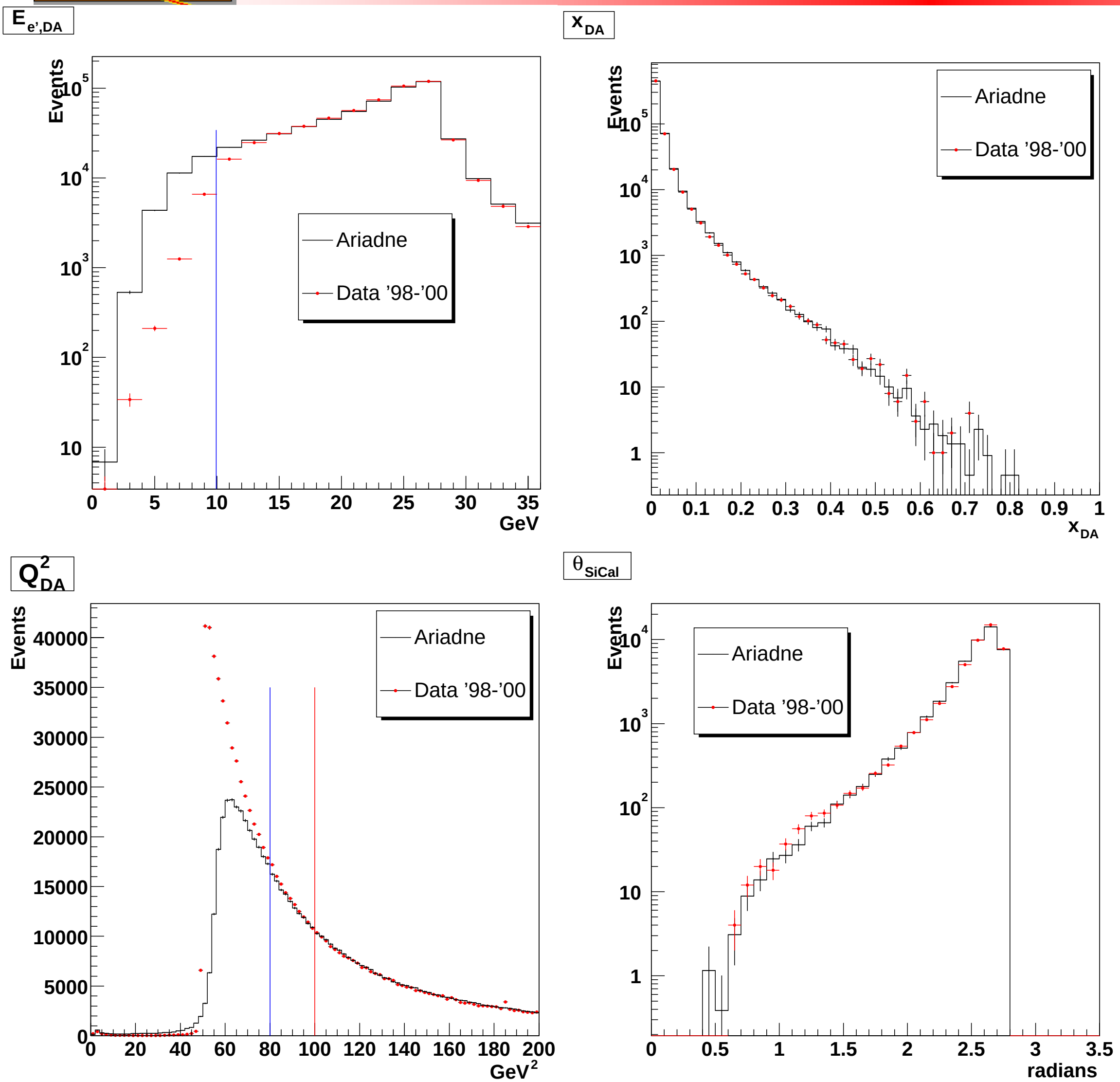
ZUFO selection

- $|\eta_{lab}| < 2.2$
- $|\eta_{Breit}| < 3.0$
  - good acceptance region
- $P_T > 0.5$ GeV

Breit frame jet cuts

- At least 2 jets in Breit frame:
  - $E_{1,T} > 6$ GeV
  - $E_{2,T} > 5$ GeV
  - $y_2 > 0.1$

Kinematic Reconstruction



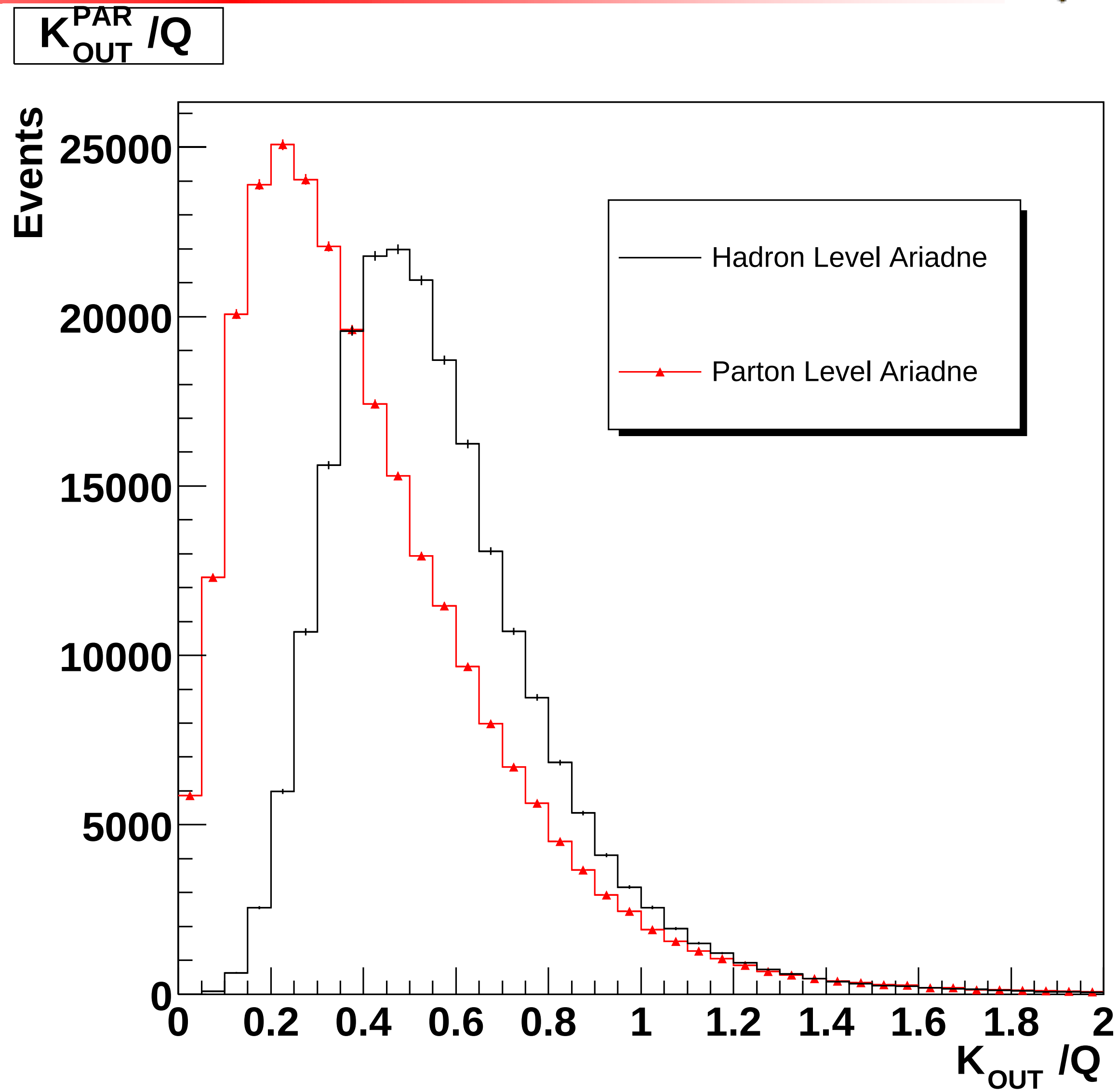
Choose Ariadne to calculate detector corrections

Ariadne is area normalized to the data within the cut boundaries

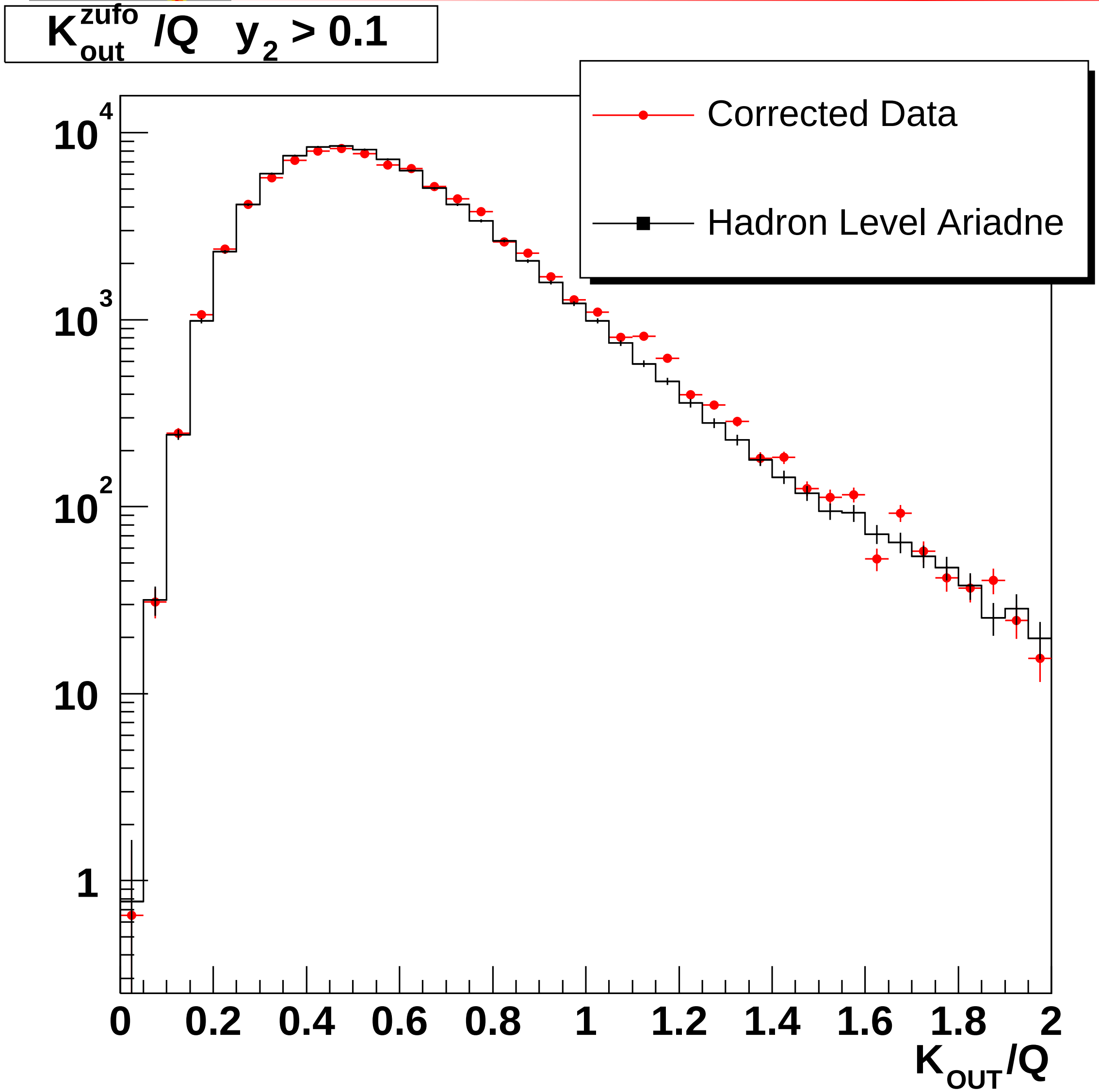
Hadronization Effect

Shift in peaks illustrates the hadronization effect

- **Use power correction to calculate this shift.**



K/Q – Comparison of Ariadne and Corrected Data

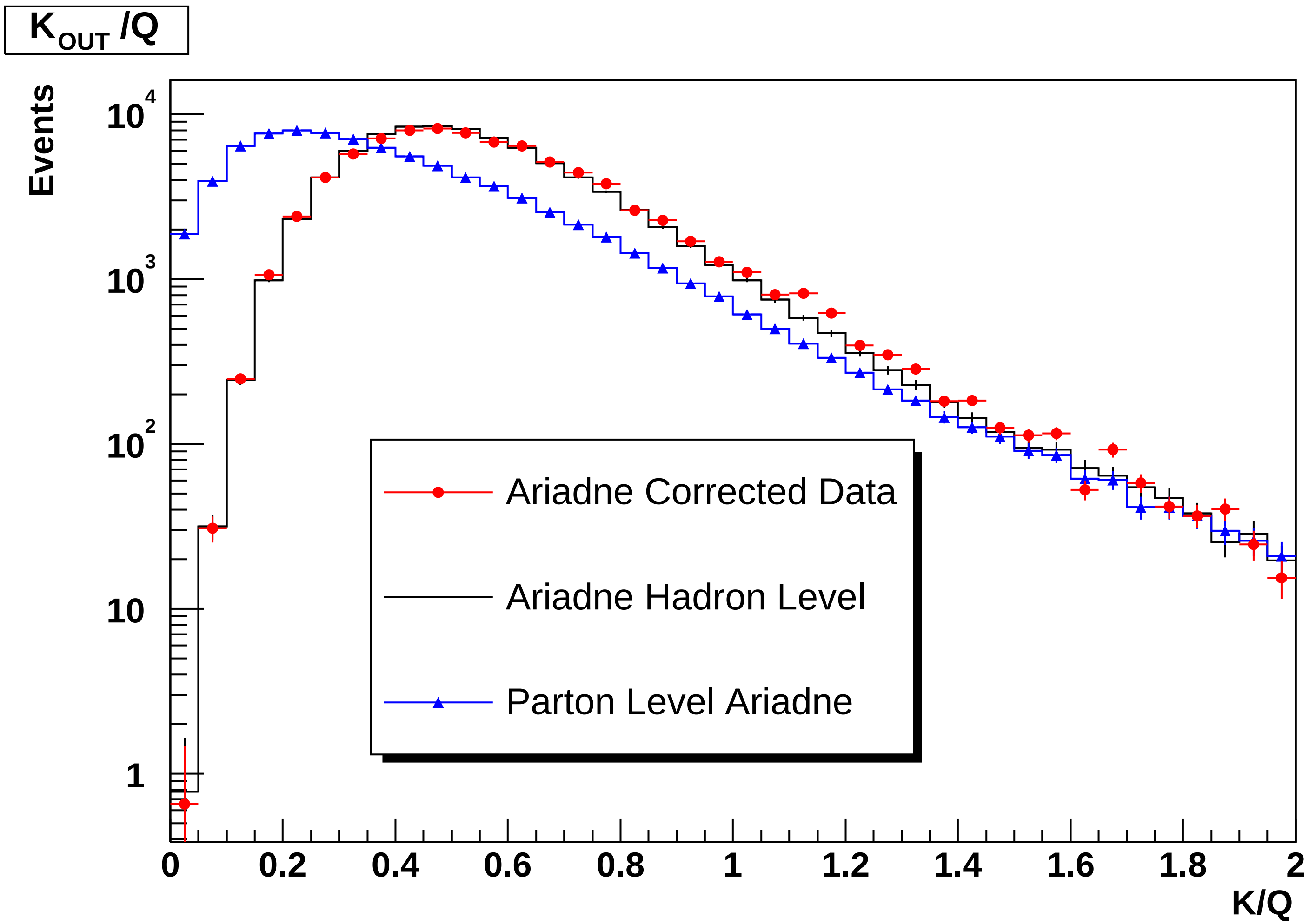


Measure K/Q because powers of ln(K/Q) are used in the resummation.

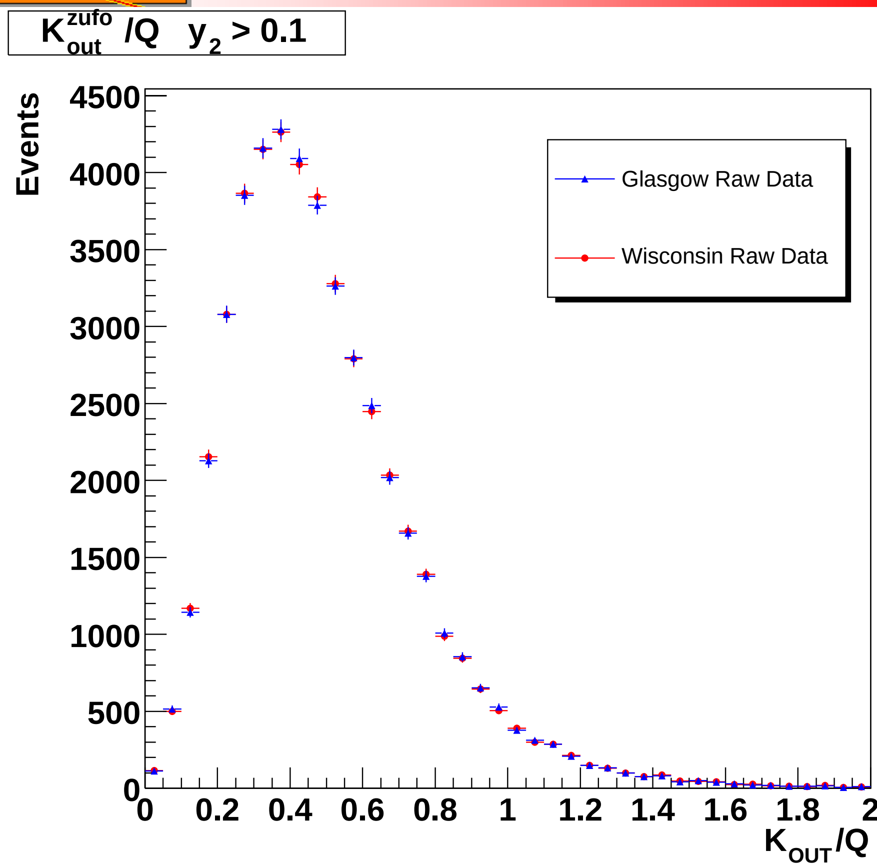
Use ZUFO to calculate the momentum out of the event plane.

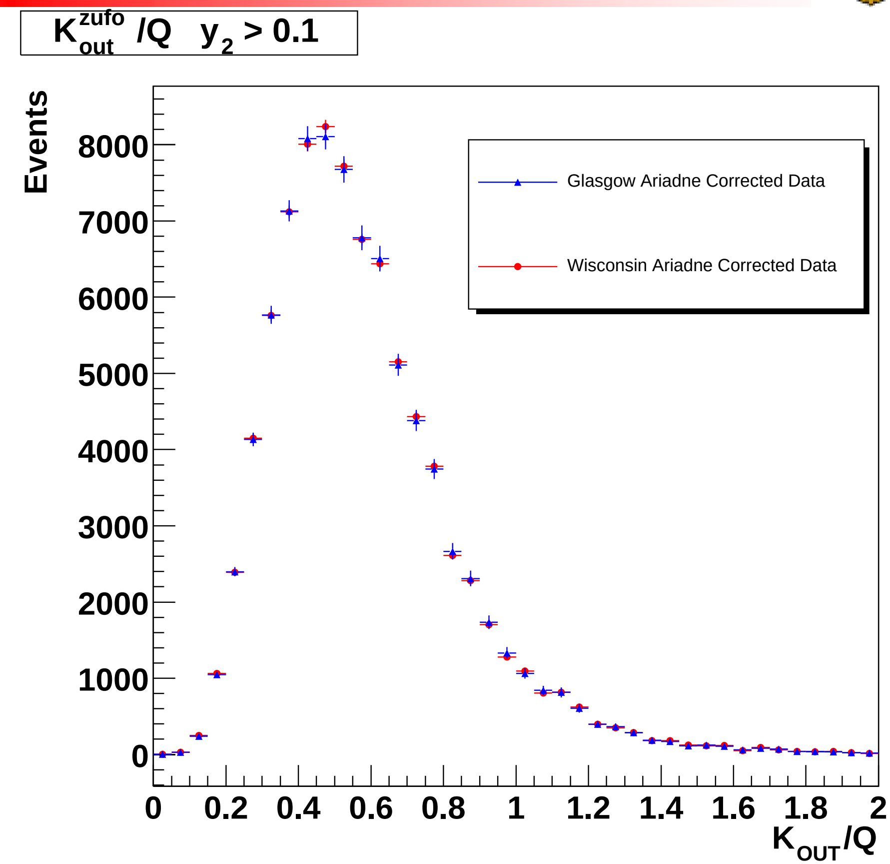
Ariadne describes the data well.

??? Should I Combine the Previous 2 Slides to 1 Using This Plot???



K/Q Analyses Comparison

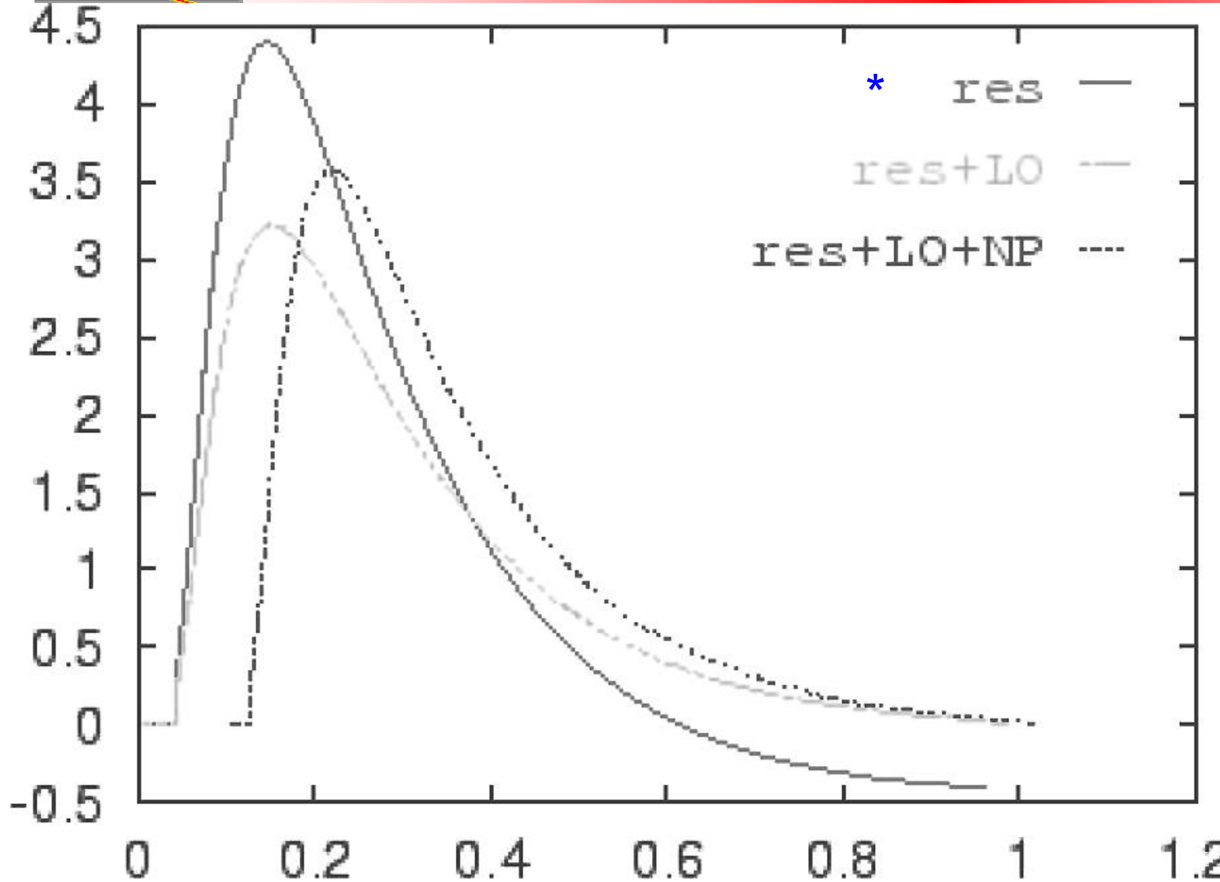




Some of the difference due to sensitivity in the Thrust calculation for determining the event plane.

A.E. and I.S. in good agreement.

K/Q NLO Prediction



K/Q

*Res = Resummation

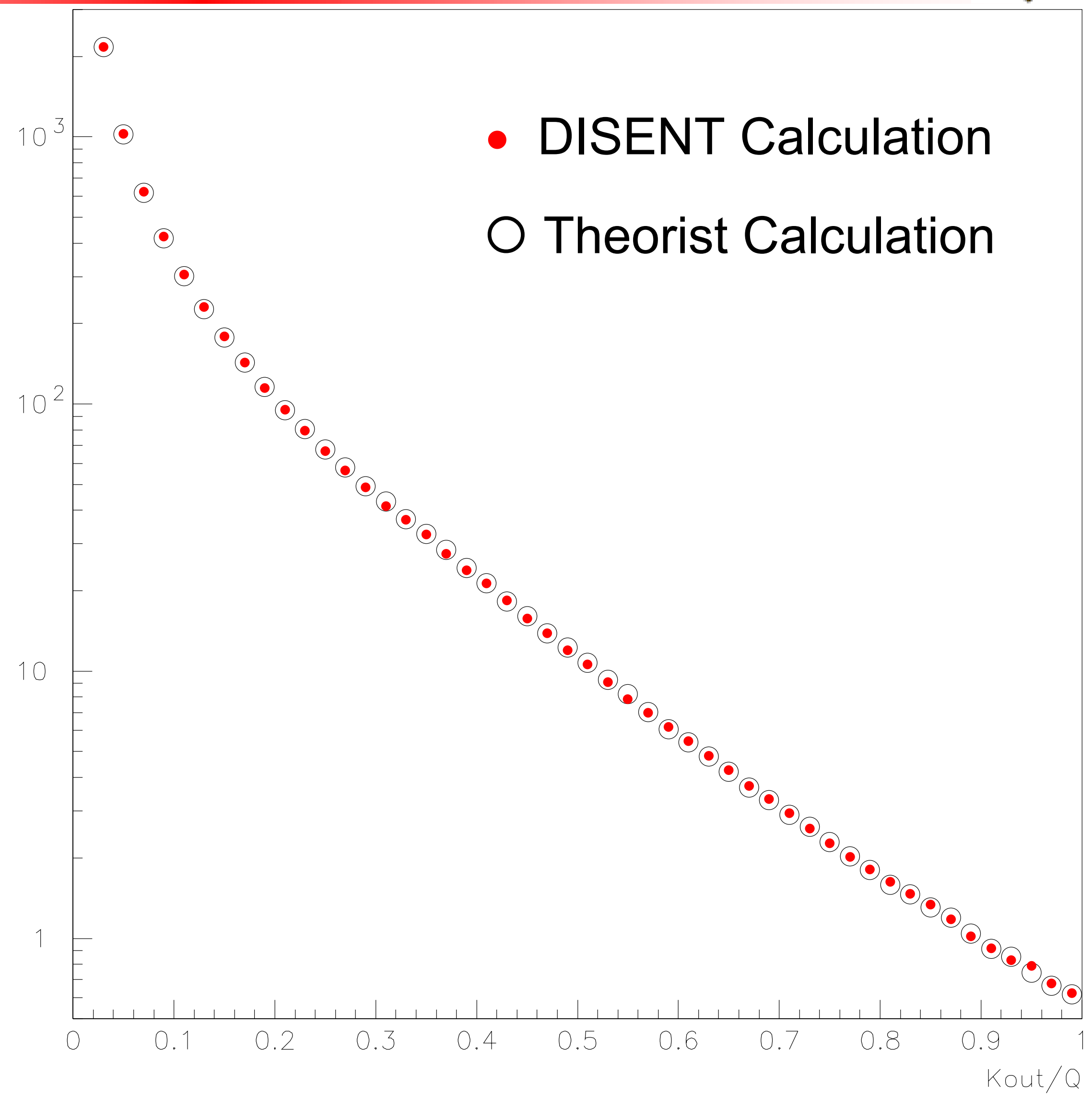
- Resummation + LO + NP line should be a good fit to our data.
- LO + Resummation necessary for power correction calculation.
- However, the theorists won't give us the program for calculating the resummation.

NLO Calculation

We continue to work while waiting for the theorists to give us the requested curves.

Our NLO calculation matches theorist NLO within 1%.

Just waiting for resummation . . .

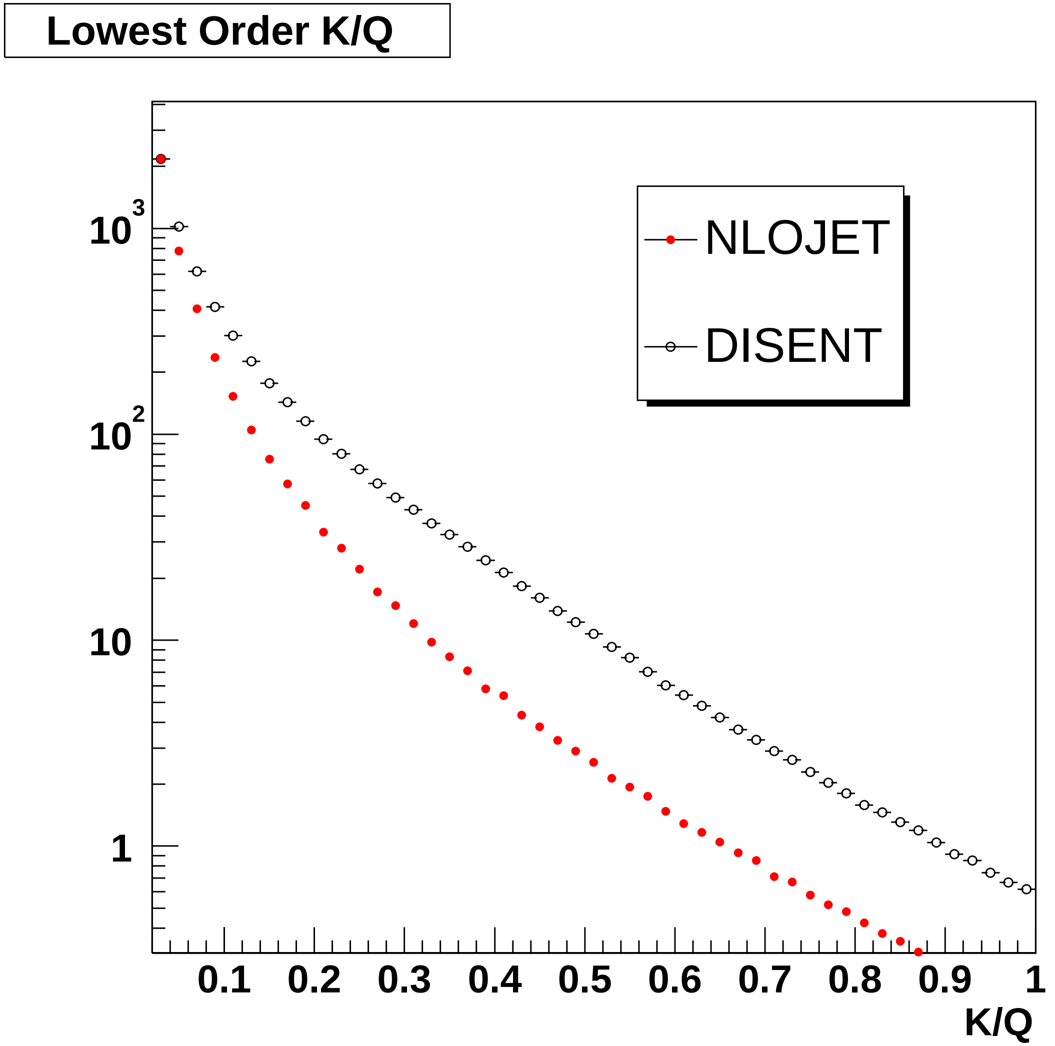


Additional NLO

DISENT calculates to lowest order in K/Q

Also use NLOJET++ to calculate perturbative K/Q

- **NLOJET can calculate to the next hgher order in K/Q**



Summary

Conclusion

- Dijet event shapes sensitive to non-perturbative physics
- Good agreement between first and second analyses, and previous and current measurements.

Plan

- Currently working on systematics.
- Plan to have measurement ready for ICHEP 2004.