Multijet in Neutral Current Deep Inelastic Scattering

ZEUS Collaboration Meeting
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Event Selection and Jet Reconstruction

1998-2000 data, 82.2 pb^{-1}

DIS Events

- Corrected E_e > 10 GeV, |Zvertex| < 50 cm, 40 < $E-P_z$ < 60 GeV

Trigger Selection

- Combination of HPP14, DIS03 and DIS01

Kinematic Range

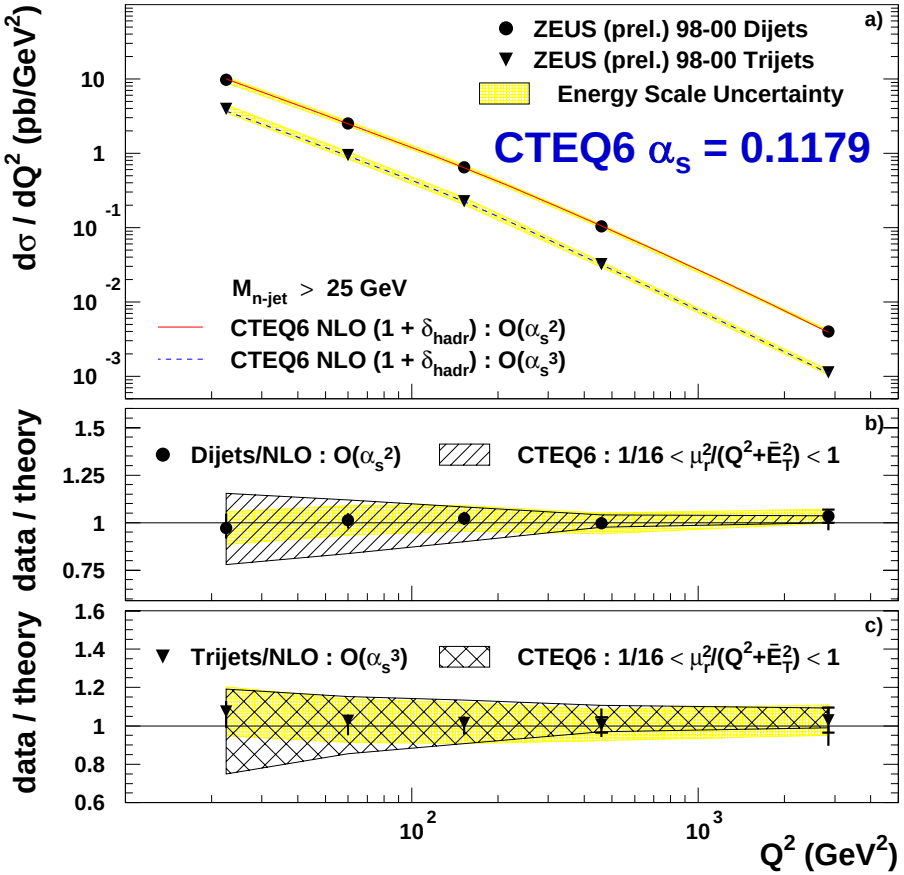
- $10 < Q^2 < 5000$ GeV^2, $Y_{EL} < 0.6$, $Y_{JB} > 0.04$, $\cos\gamma_{had} < 0.7$

Jet Reconstruction

- Longitudinally invariant KT algorithm on ZUFOs in Breit frame
- At least 2 jets found in Breit frame
- $E_T^{BRT} > 5$ GeV, $-1 < \eta^{LAB} < 2.5$
- Invariant mass $M_{2,3jet}$ >25 GeV

Compare Data vs. NLOJET: CTEQ6 PDF

ZEUS



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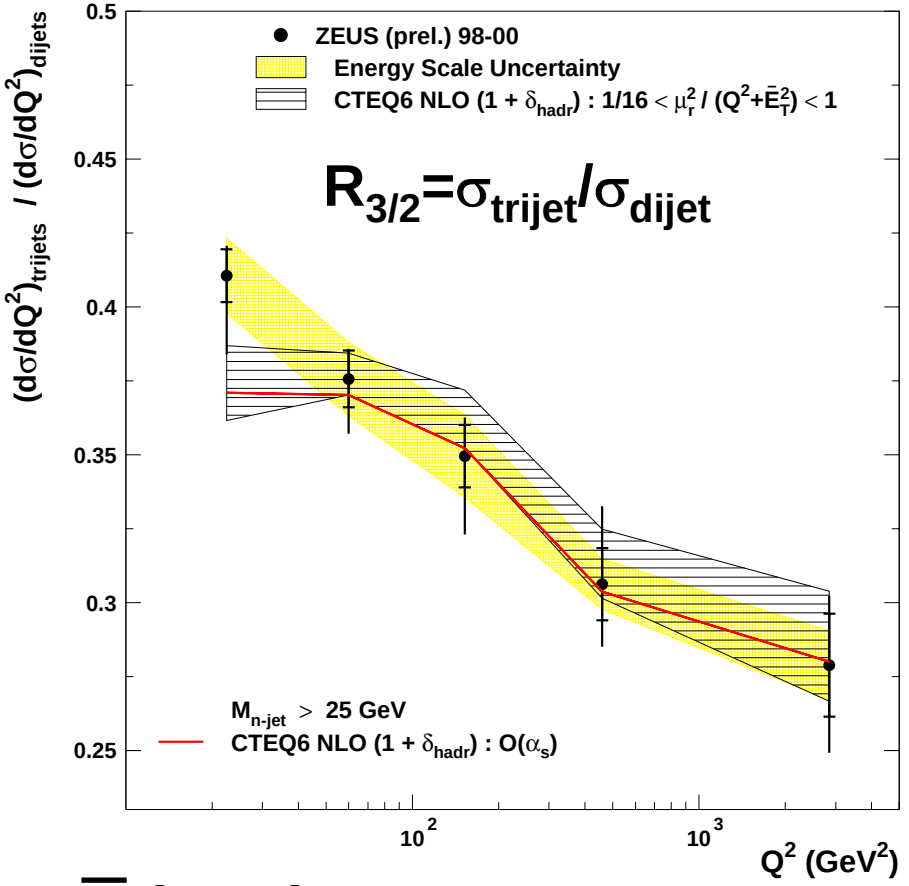
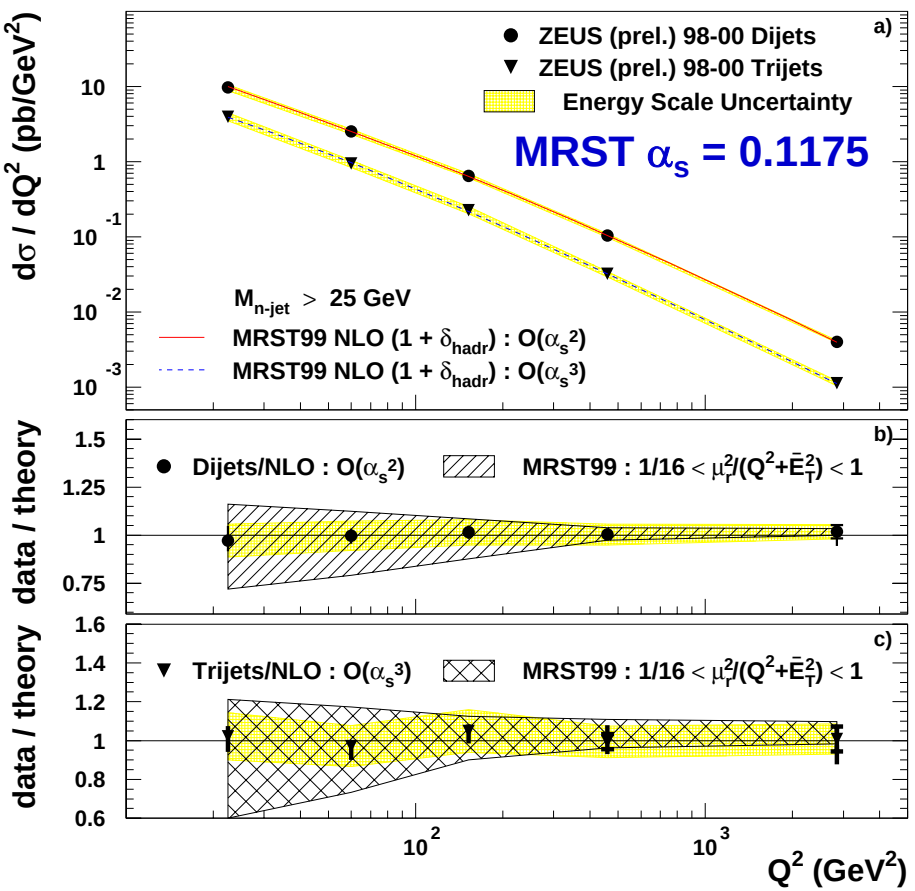
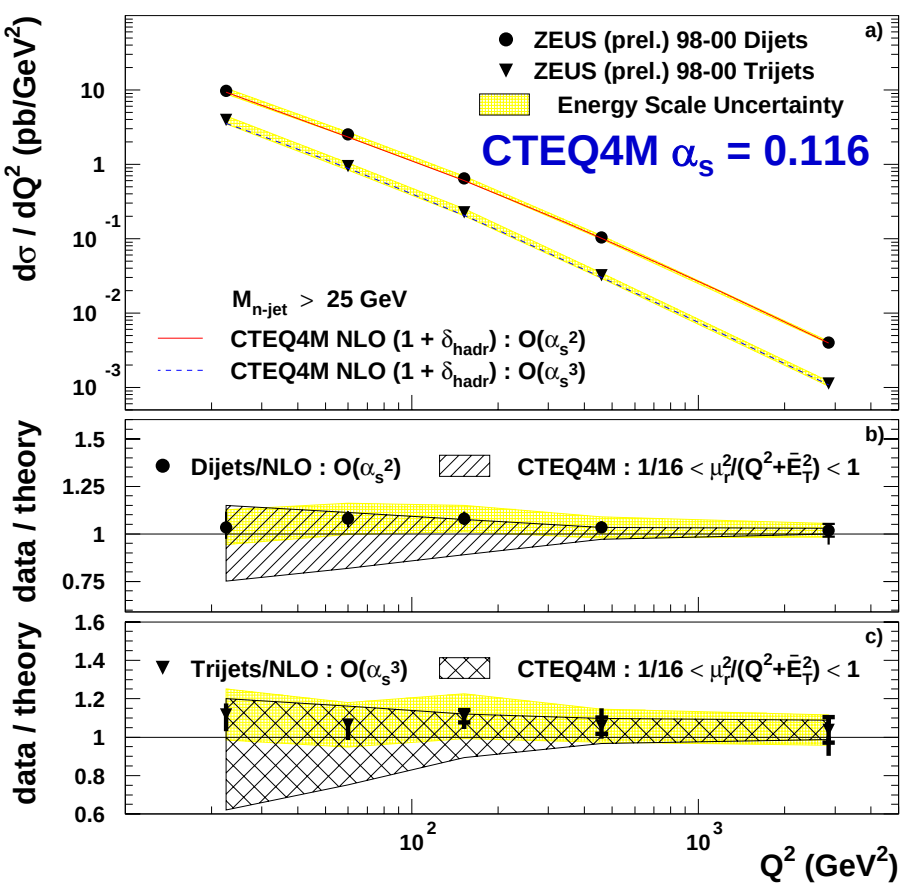


Scale $\mu_r = \mu_f = (\bar{E}_T^2 + Q^2)/4$

Results presented at DIS2004 showed that NLO describes data

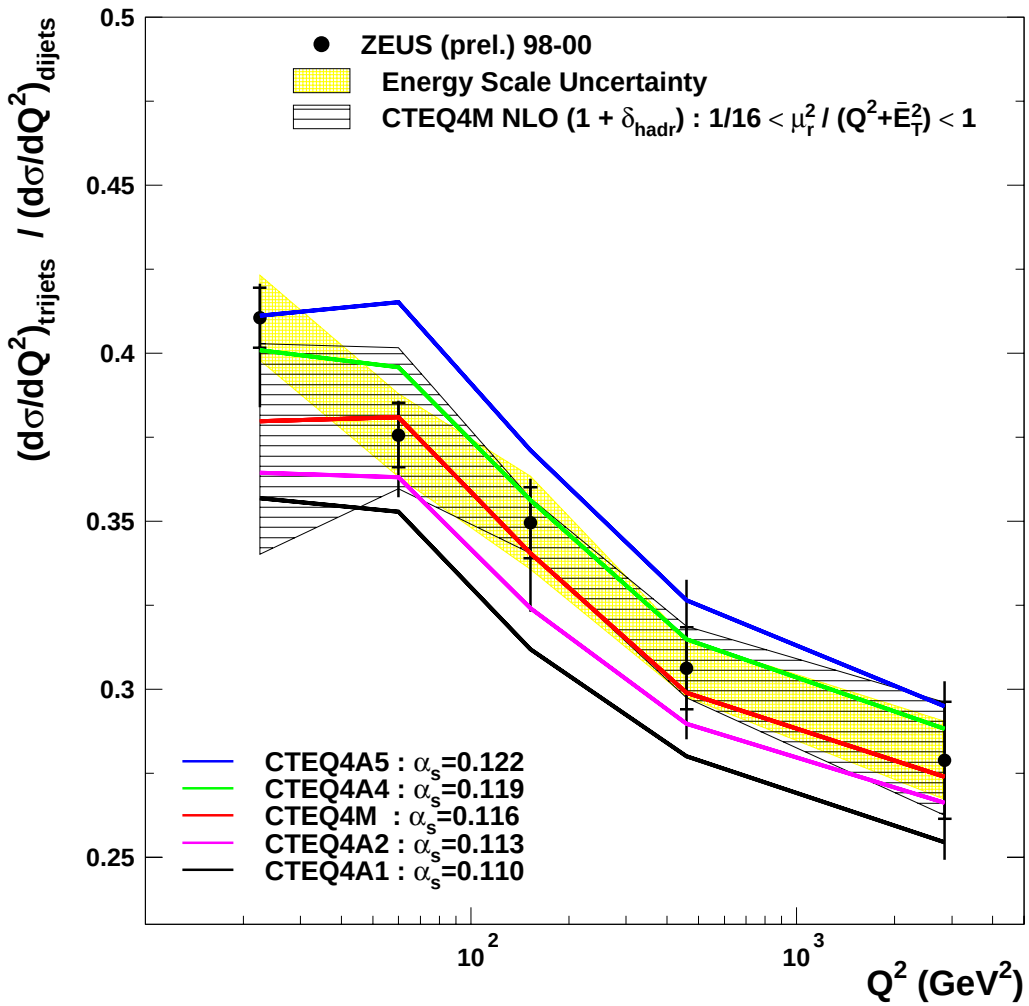
Compare Data vs. NLOJET : MRST99 and CTEQ4M PDF





Good description of both dijets and trijets over 3 orders of magnitude in Q^2 for both PDFs

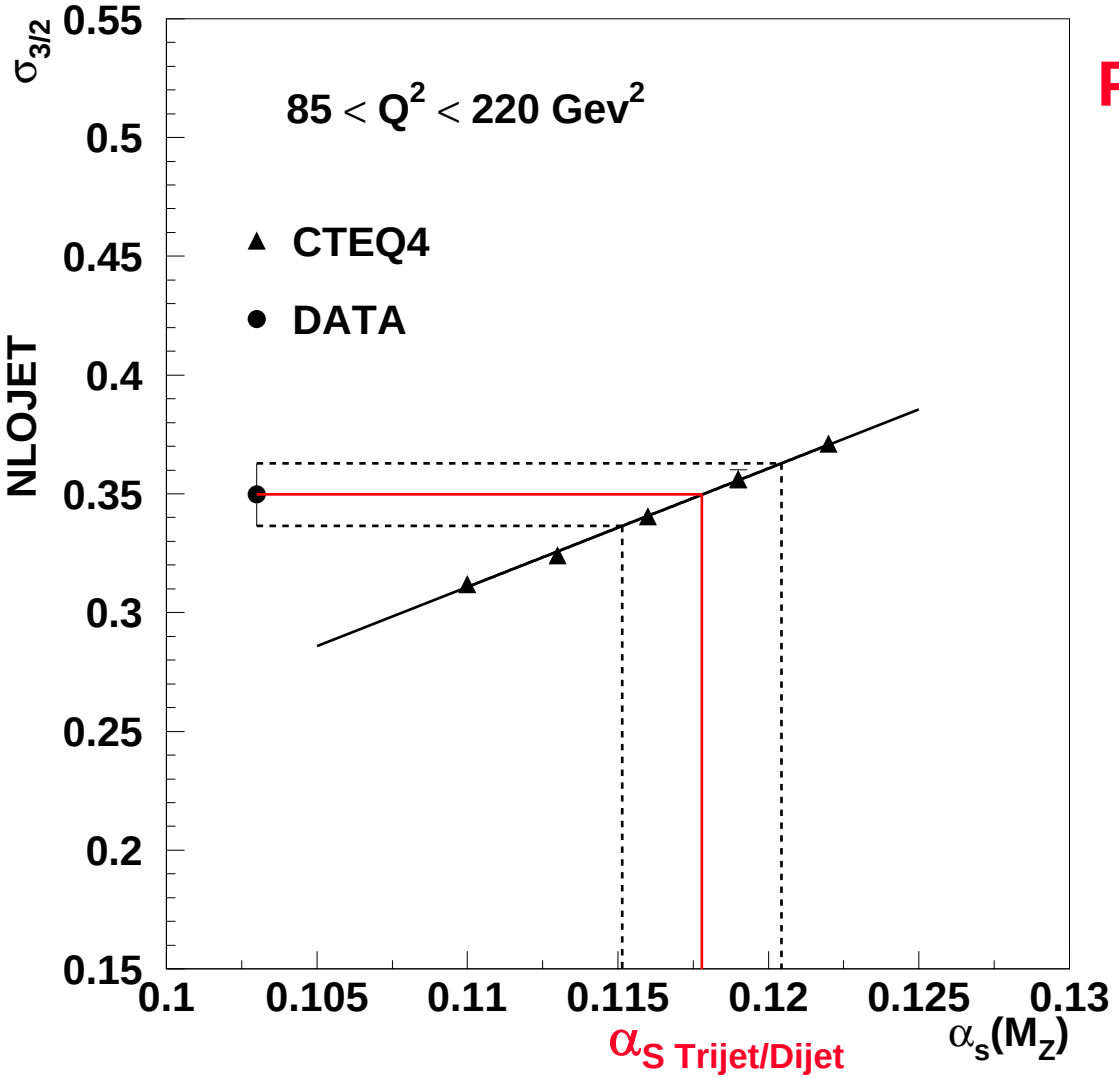
Trijet to Dijet Cross Section Ratio $R_{3/2}$: CTEQ4 with Different α_s value



$R_{3/2}=\sigma_{trijet}/\sigma_{dijet}$

- As expected, predictions within one PDF are sensitive to α_s
- Potential to extract α_s

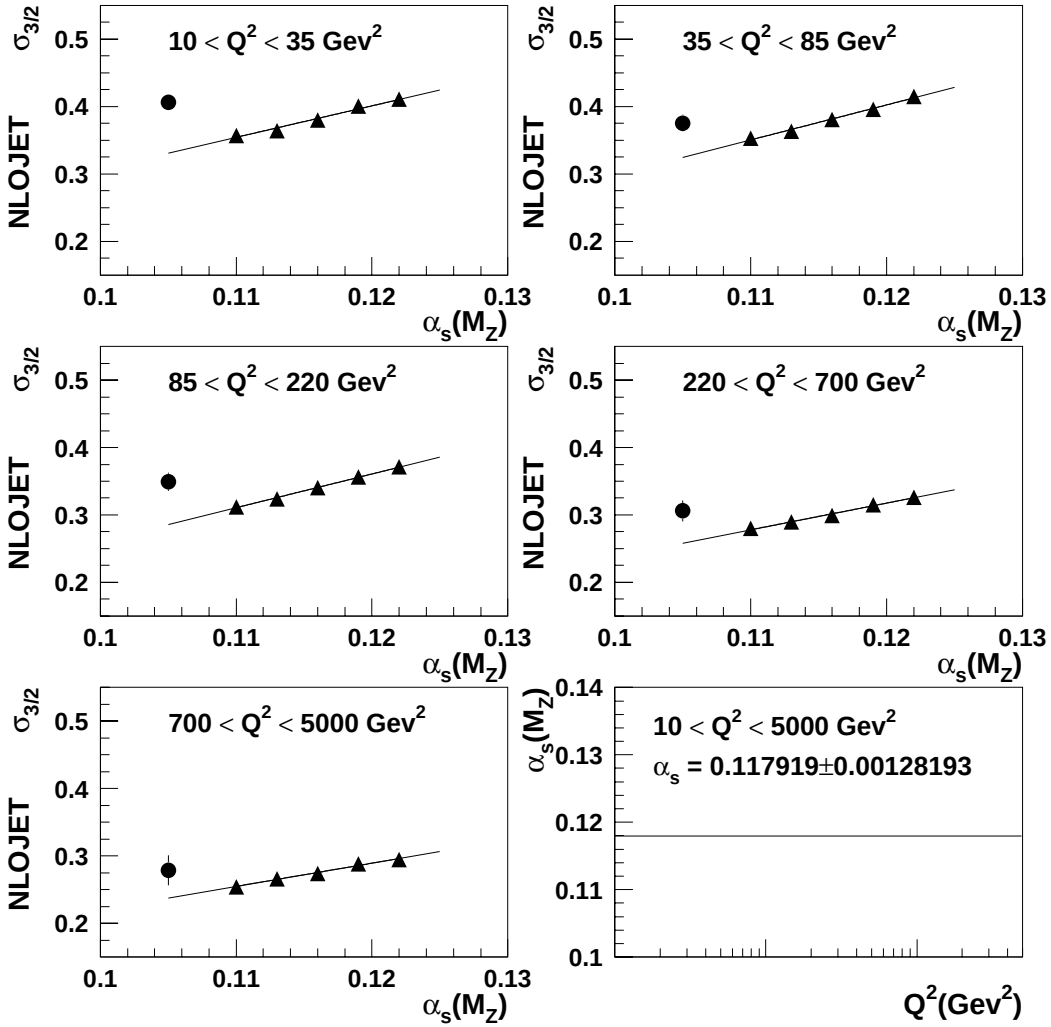
Parametrisation of $R_{3/2}$ with the value of $\alpha_s(M_z)$



Procedures:

- **Run NLOJET with several α_S values and fit through a linear function for each Q^2 bin**
- **Use this function to associate $R_{3/2}$ measurements with $\alpha_S(M_z)$**
- **Extract α_S for each Q^2 bin and a combined value with a χ^2-fit.**

Extraction of α_s with CTEQ4 PDF



- **Data**
- **▲CTEQ4**

- **CTEQ4 allows more variations in $\alpha_s(M_z)$ than other PDF available (MRST99)**

Systematic uncertainties next page

$$\alpha_S(M_Z) = 0.1179 \pm 0.0013(\text{stat.}) \; {}^{+0.0028}_{-0.0046} \; (\text{syst.}) \; {}^{+0.0061}_{-0.0047} \; (\text{th.})$$

Systematic Uncertainties

Experimental (maximal change)

- Jet pseudo-rapidity cut: 1%
- Use of different LO MC model: 2%
- Jet transverse energy and invariant mass cuts: 2%
- The absolute energy scale of the CAL: 2.5%
- Other sources which have negligible effects
  - Un-reweighted MC
  - Z_{Vertex} cuts
  - Y_{JB} cut
  - E-P_Z cut
  - Cosγ_{had} cut

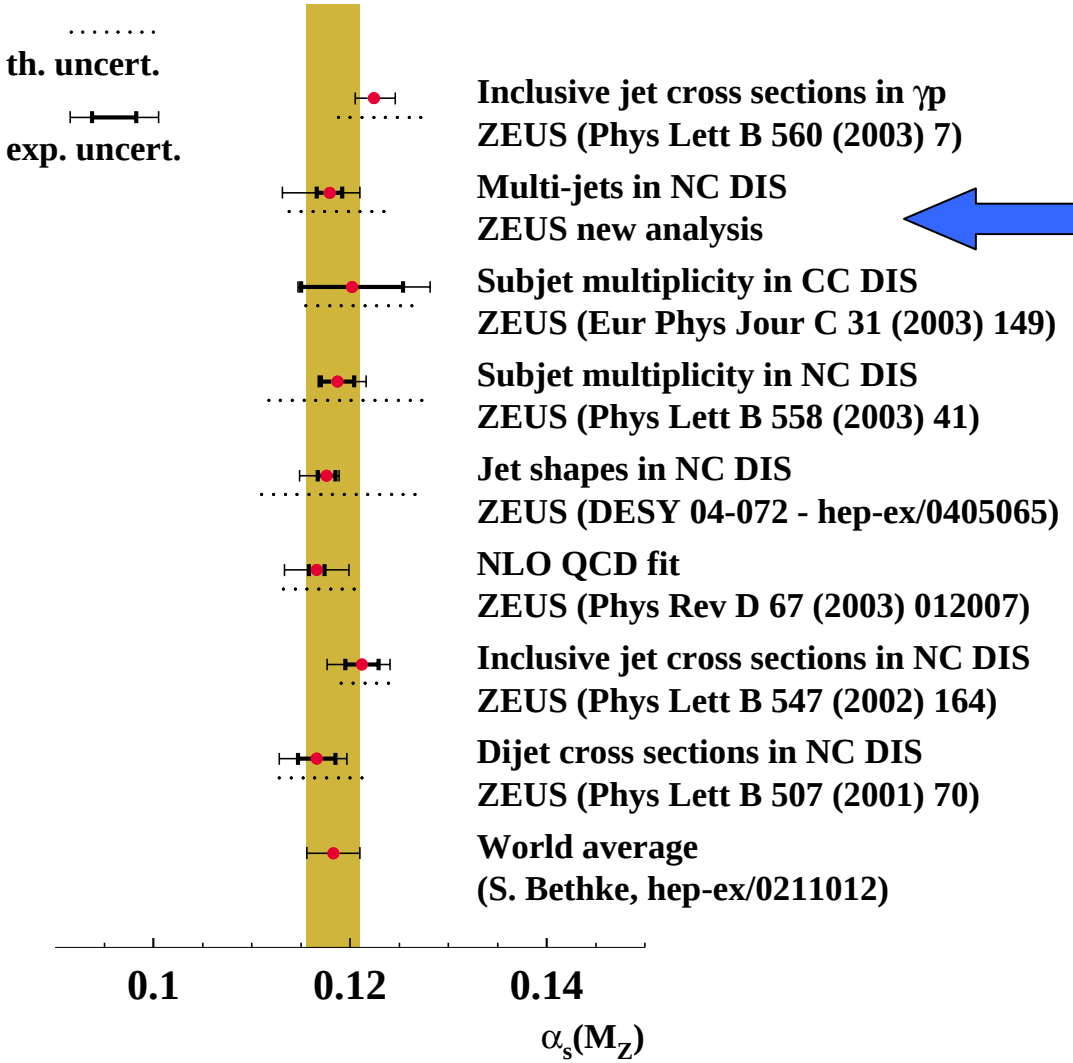
$$\Delta\alpha_S(M_Z) = {}^{+0.0028}_{-0.0046}$$

Theoretical (maximal change)

- Hadronisation correction factors: 2%
- Terms beyond NLO: 5%
- Uncertainties in the proton PDFs: to be included

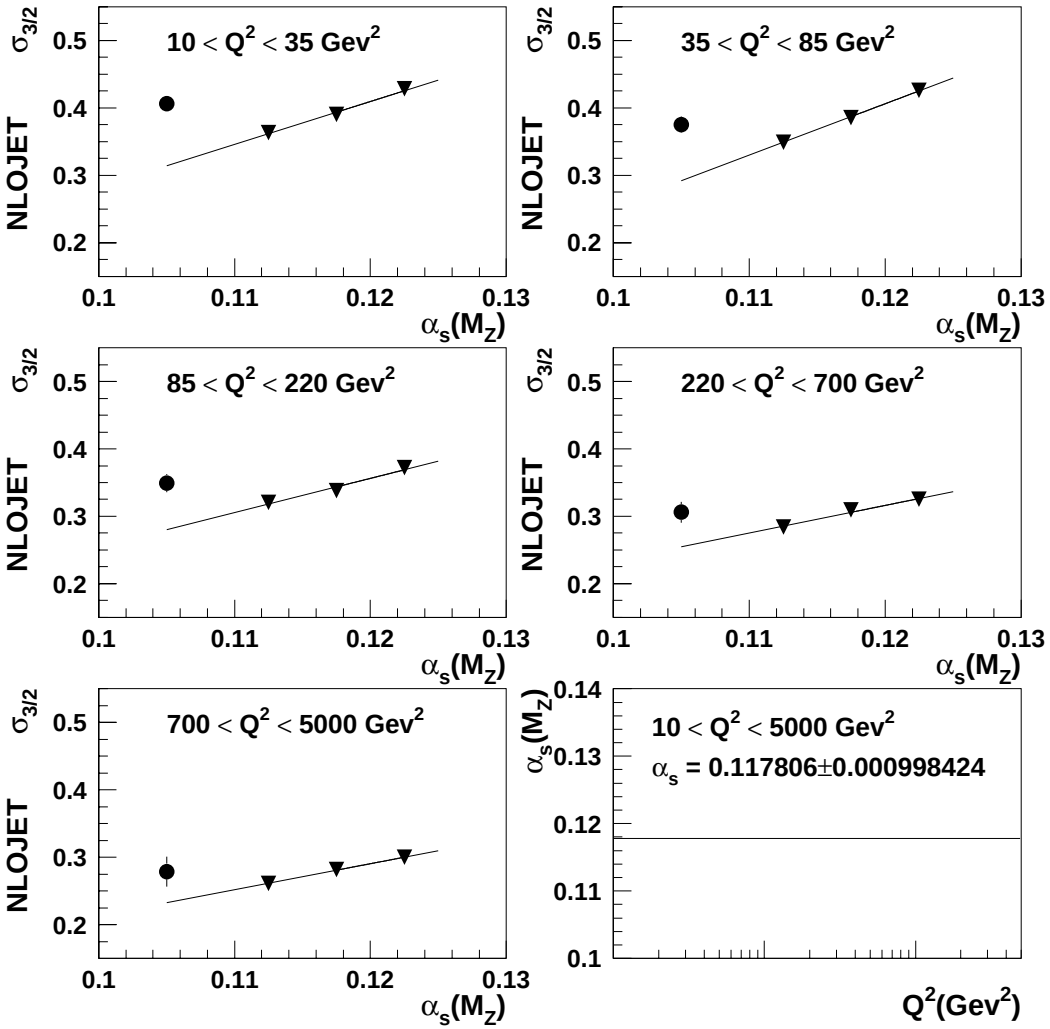
$$\Delta\alpha_S(M_Z) = {}^{+0.0061}_{-0.0047}$$

Other α_s measurements



- Errors competitive
- PDF uncertainty not yet included
- But see comparison with different PDF next page

Extraction of α_s with MRST99 PDF

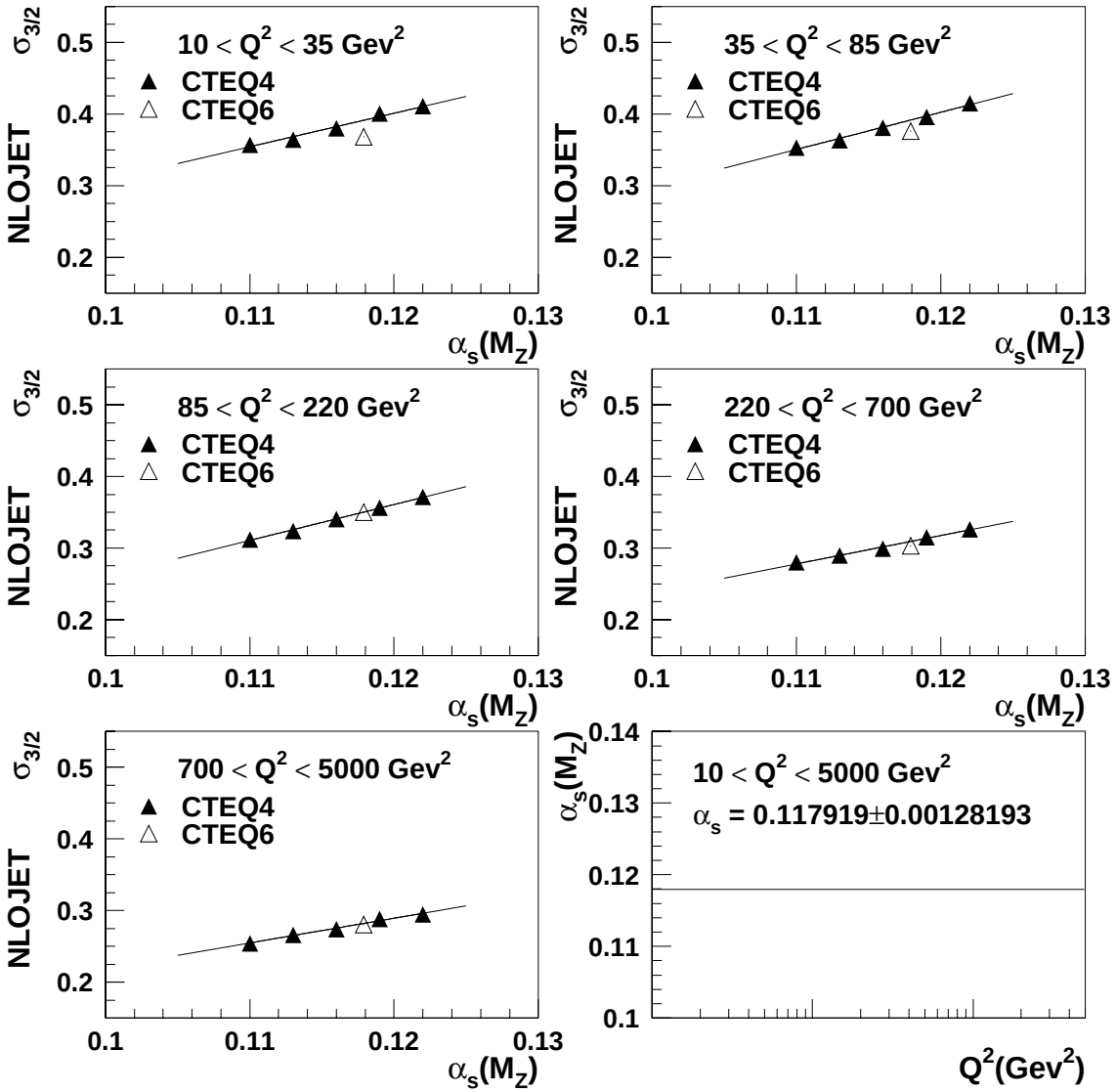


- Data
- ▼MRST99

Excellent agreement between CTEQ4M and MRST99 PDF

$$\alpha_S(M_Z) = 0.1178 \pm 0.0010(\text{stat.}) \; {}^{+0.0021}_{-0.0035} \; (\text{syst.}) \; {}^{+0.0048}_{-0.0034} \; (\text{th.})$$

Compare CTEQ4M vs. CTEQ6



- Good agreement
- Small difference observed at low Q^2 which can be explained by the difference between CTEQ4 and CTEQ6 PDF (confirmed by CTEQ group)

Summary and Outlook

- Extracted α_s value in good agreement with world average
- PDF uncertainty study underway
- Paper draft

Compare MRST99 vs. CTEQ6