

# *Inclusive Jet Production in Deep Inelastic Scattering at low and medium $Q^2$ at HERA*

*Artem Baghdasaryan*



*on behalf of the H1 Collaboration*

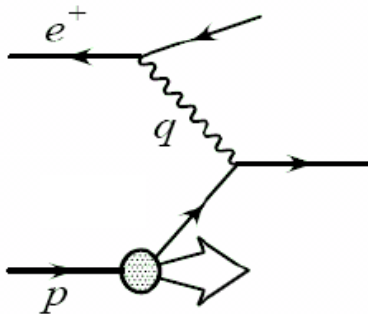


- **Motivation**
- **Event Selection**
- **Results**
- **Conclusion**

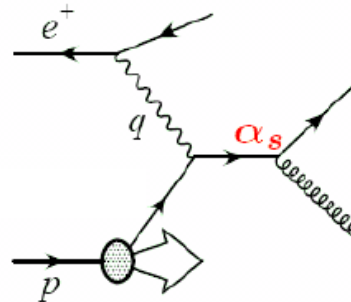
# Motivation

- High Statistics
- IR safety
- few non-perturbative complications

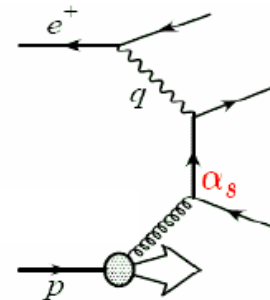
→ This investigation gives information on how low in  $Q^2$  and  $E_t$  we can use theory.



**Born Term**



**QCD Compton**



**Boson Gluon fusion**

# Jet Event Selection (Low $Q^2$ NC events)

## Data sample:

HERA-1 (1999-2000), Lumi=43.6 pb<sup>-1</sup>

## Phase Space

- $5 < Q^2 < 100 \text{ GeV}^2$
- $0.2 < y < 0.7$

## Jet Selection

- In the Breit reference frame. Inclusive  $k_t$  algorithm
- $E_t > 5 \text{ GeV}$  (in the Breit frame)
- $-1.0 < \eta_{(\text{lab})} < 2.5$  (in the lab frame)  
(range in which jets are well contained in the acceptance of the H1-LAr calorimeter)

**Total about 150.000 events**

# Control, Correction, Systematic

- **Monte Carlo files used for control & corrections**
  - DJANGO (CDM)
  - RAPGAP (ME + PS)
  - HERACLES for QED radiation correction
- **Bins chosen to have stability and purity  $\gtrsim 50\%$**
- **Bin-to-bin correction procedure for**
  - **Detector&QED: 1.3 – 1.9**
  - **Hadronization: 1.1 – 1.2**

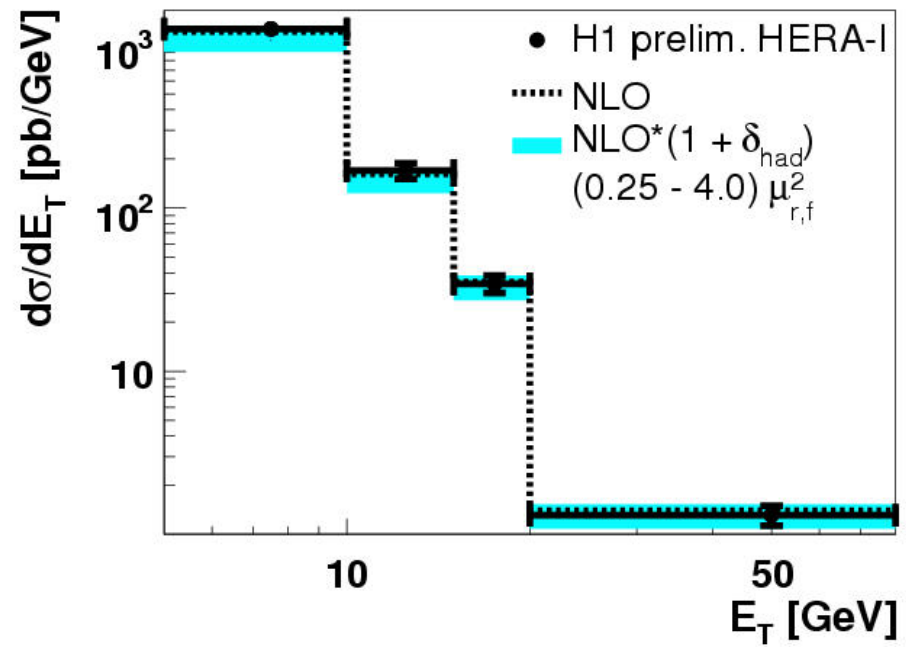
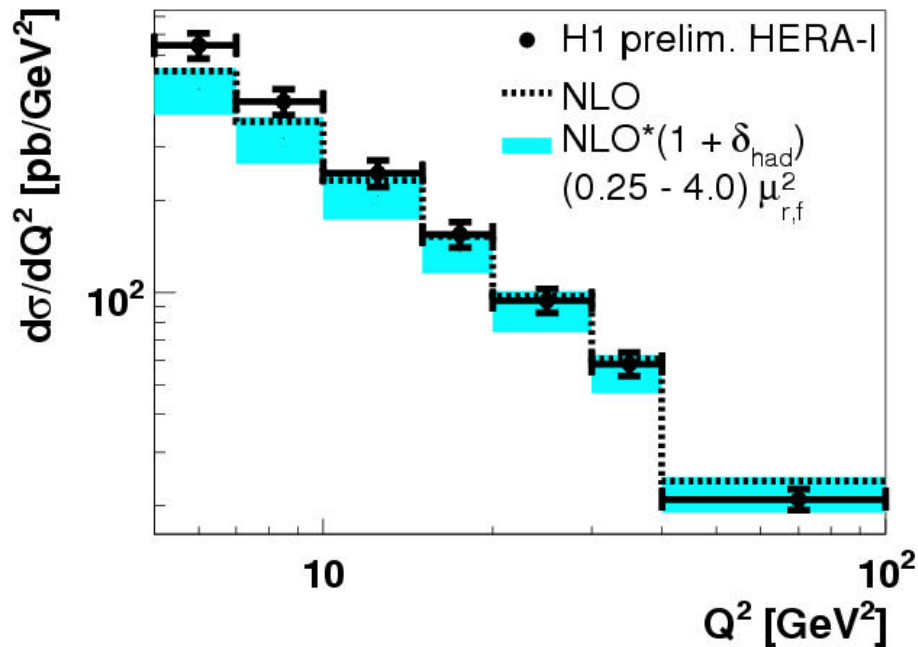
# Comparison with theory

- **Results compared with NLO pQCD**
  - NLOJet++ with CTEQ6.1M
  - $\overline{\text{MS}}$  scheme for five quarks flavours
- **Uncertainties on NLO predictions estimated from:**
  - **scale uncertainties: variation of factorization  $\mu_f=Q$  and renormalization  $\mu_r=E_t$  scales by factors 2 and  $1/2$**
  - **PDF uncertainties - use 40 eigenvectors of CTEQ6.1M**
  - **vary  $\alpha_s(M_z)$  from 0.116 to 0.120**

# Results

**Single and double differential cross sections vs.  $E_t$  and  $Q^2$  for inclusive jets are measured.**

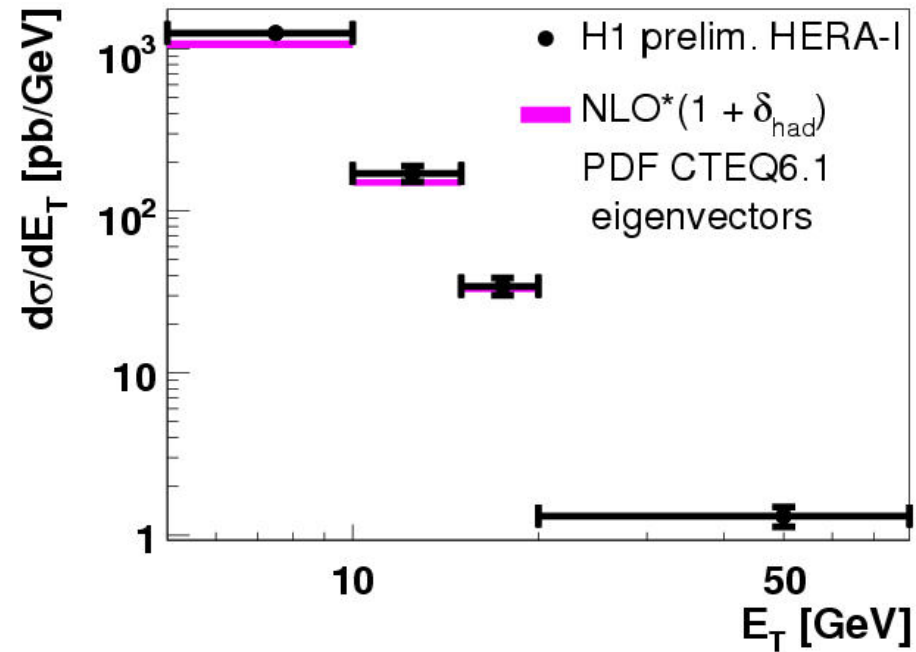
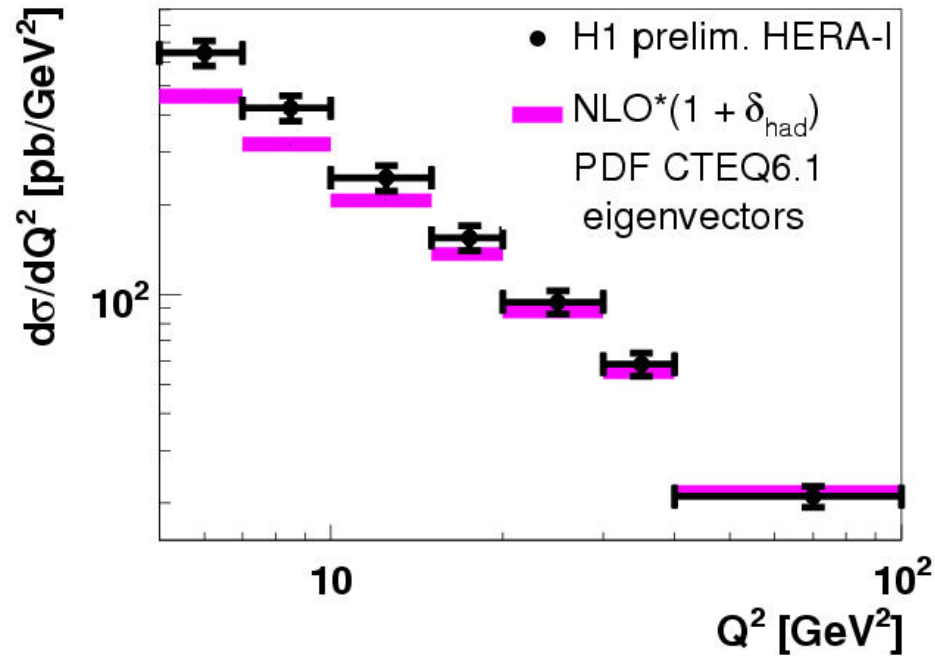
# H1 Inclusive Jet Cross Sections $\frac{d\sigma}{dQ^2}$ , $\frac{d\sigma}{dE_T}$



Factorization  $\mu_f=Q$  and renormalization  $\mu_r=E_t$  scales varied by factors 2 and  $\frac{1}{2}$  to estimate scale uncertainties  $\rightarrow \sim 20\%$ .

NLO describes well for  $Q^2 > 10 \text{ GeV}^2$  or  $E_t > 10 \text{ GeV}$  within uncertainties

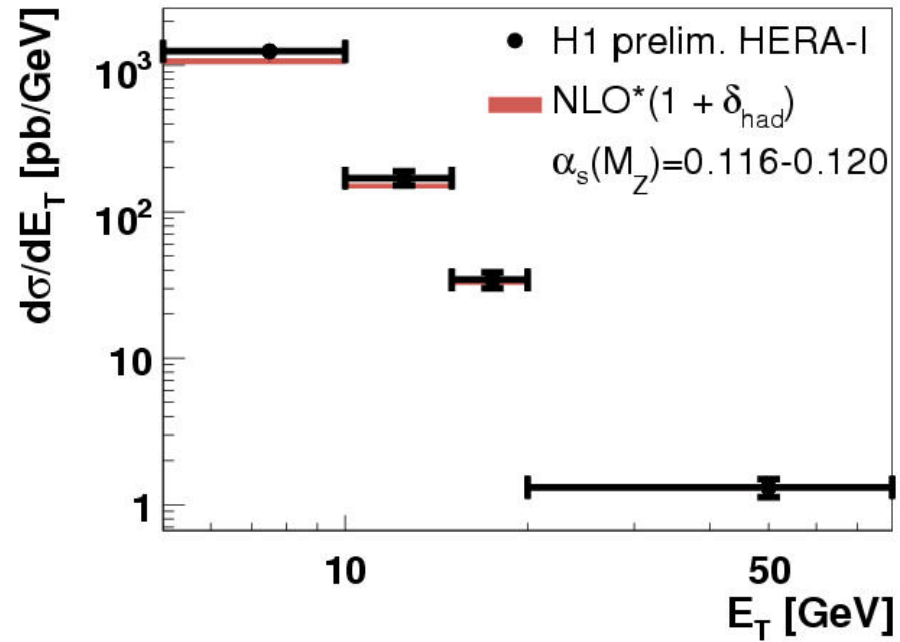
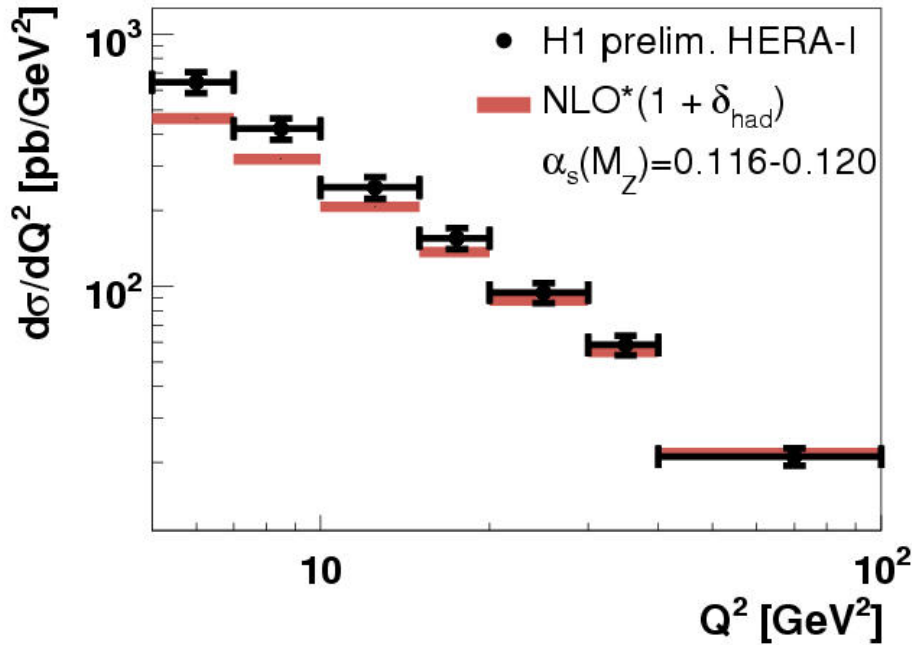
# H1 Inclusive Jet Cross Sections $\frac{d\sigma}{dQ^2}$ , $\frac{d\sigma}{dE_T}$



**Variation of 40 eigenvectors of CTEQ6.1M gives PDF uncertainties  $\rightarrow \sim 6\%$**



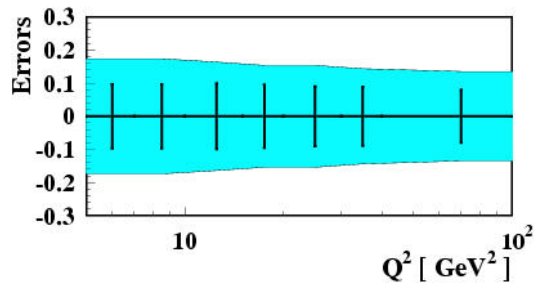
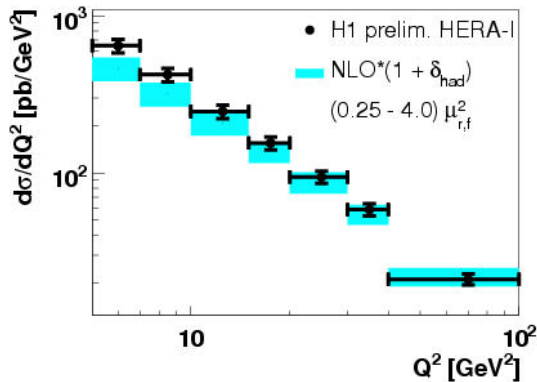
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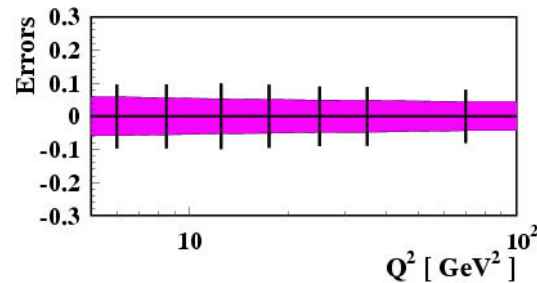
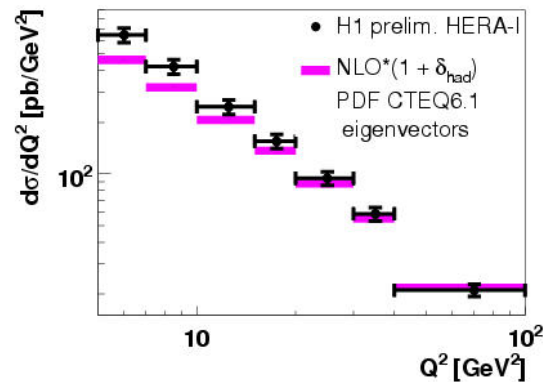
Variation of  $\alpha_s(M_Z)$  from 0.116 to 0.120 gives up to  $\rightarrow \sim 5\%$  uncertainties

# Inclusive cross-sections vs. $Q^2$ : compare experimental and theoretical uncertainties

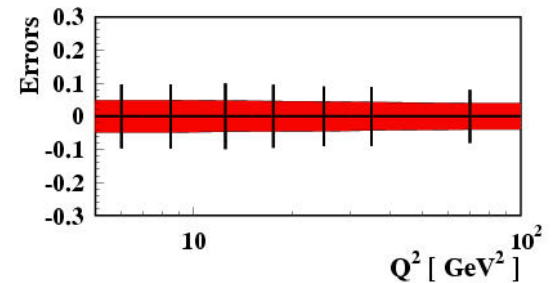
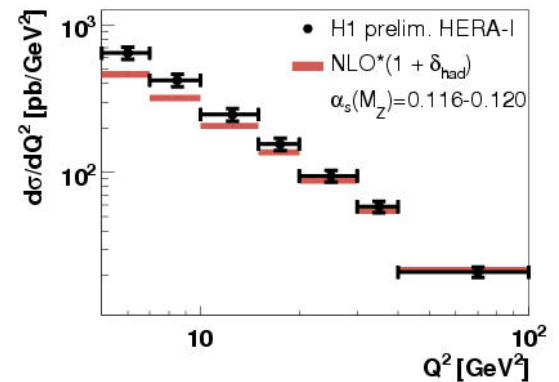
## H1 Inclusive Jet Cross Sections $\frac{d\sigma}{dQ^2}$



scale+hadronization



PDF

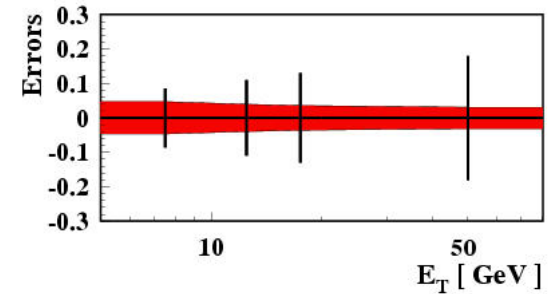
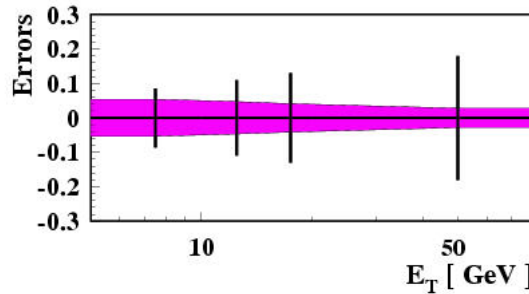
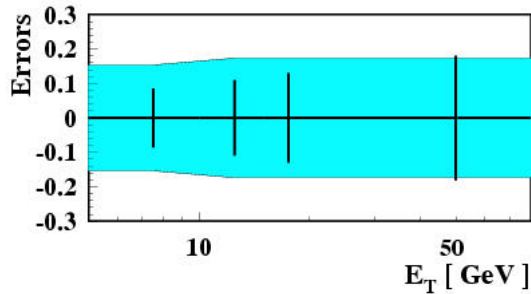
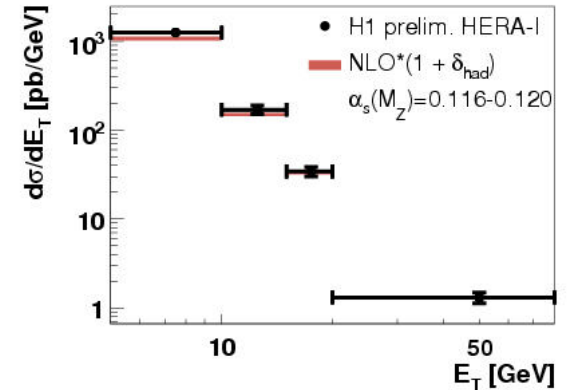
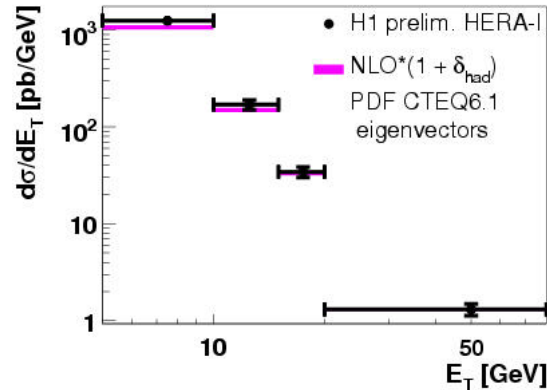
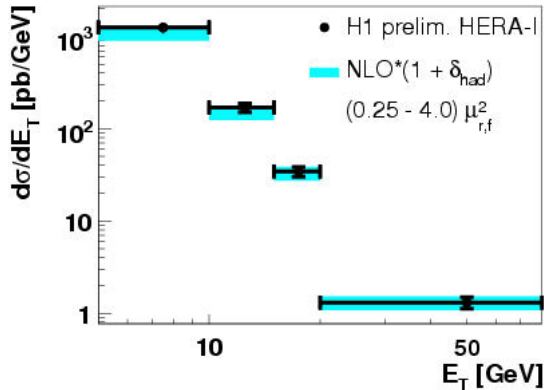


$\alpha_s(M_Z)$

Main uncertainties in NLO are from scale variation.

# Inclusive cross-sections vs. $E_T$ : compare experimental and theoretical uncertainties

## H1 Inclusive Jet Cross Sections $\frac{d\sigma}{dE_T}$



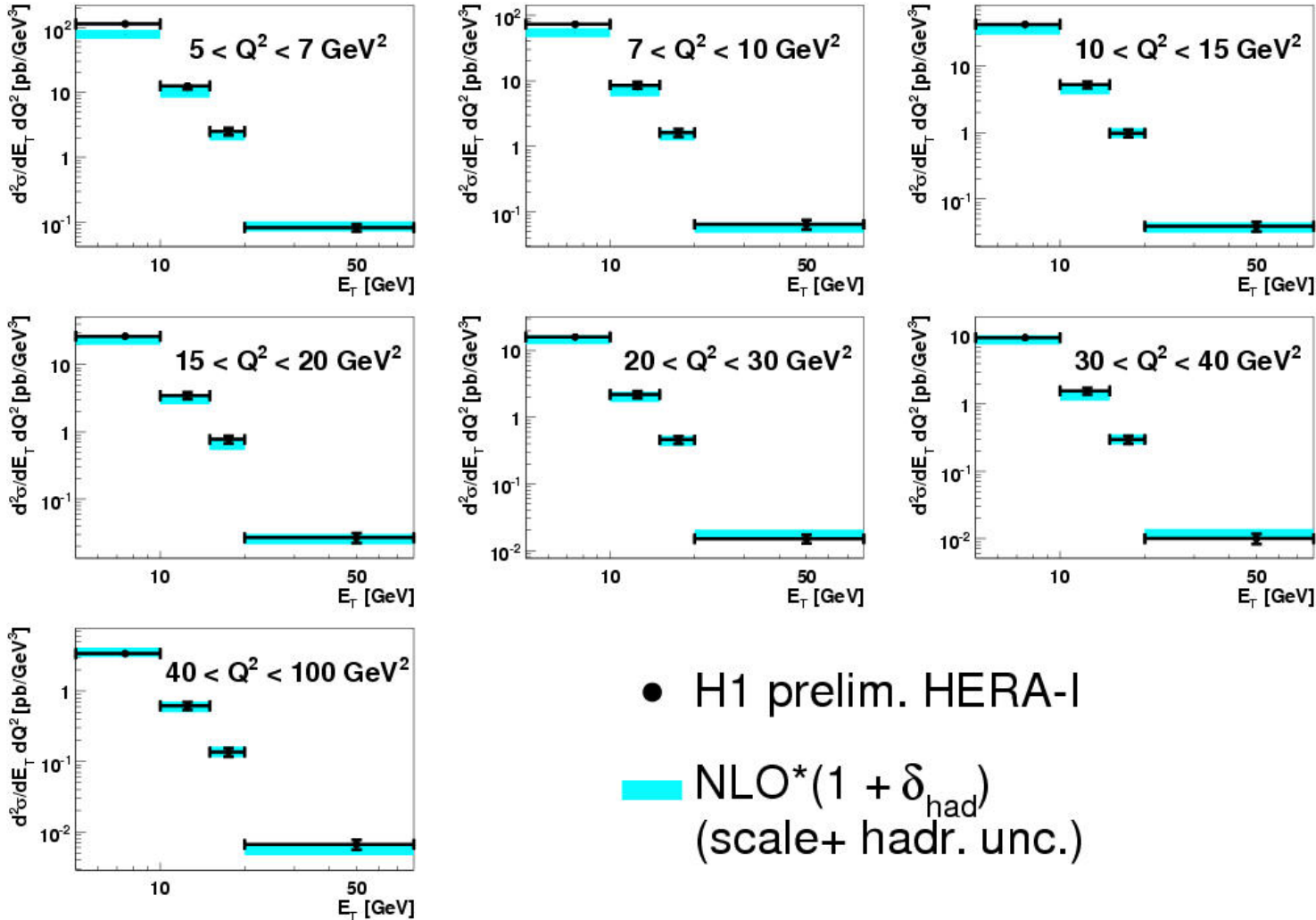
scale+hadronization

PDF

$\alpha_s(M_Z)$

Main uncertainties in NLO are from scale variation.

# H1 Inclusive Jet Cross Sections $\frac{d^2\sigma}{dQ^2 dE_T}$



NLO describes well if  $Q^2$  or  $E_T$  not too small

# Conclusion

- New measurements of inclusive jet cross sections at low  $Q^2$  with reduced statistical and systematic uncertainties are presented
- Good agreement with NLO pQCD calculations for inclusive jet cross sections at  $Q^2 > 10 \text{ GeV}^2$  or  $E_{\text{T}} > 10 \text{ GeV}$
- Uncertainties are dominated by scale variation effects  $\rightarrow$  need for next order of pQCD calculations (NNLO)