ZAF Meeting

Inclusive jet production in DIS using ZEUS data and NNLO QCD analysis in precision determination of $\alpha_s(M_Z)$

PhD project plan update

Florian Lorkowski

January 21, 2020

General procedure

Reminder

Goal: precision analysis of inclusive jet production

- Low and high Q^2 ($10 - 20\,000\,\mathrm{GeV}^2$)
- Sinistra and EM for electron reconstruction
- Massive jets using k_t algorithm

Electron:

- Low Q^2 ($\approx 10 - 1\,000\,\mathrm{GeV}^2$)
  - Sinistra reconstruction
  - Electron method for kinematics
- High Q^2 ($\approx 100 - 20\,000\,\mathrm{GeV}^2$)
  - EM reconstruction
  - Double angle method for kinematics

Electron:

- Low Q^2 ($\approx 10 - 1\,000\,\mathrm{GeV}^2$)
  - Sinistra reconstruction
  - Electron method for kinematics
- High Q^2 ($\approx 100 - 20\,000\,\mathrm{GeV}^2$)
  - EM reconstruction
  - Double angle method for kinematics

Jets:

- ZUFOs and CAL

Selected cuts
DIS selection

Phase space:

- Momentum transfer: Low Q^2: $10\,\text{GeV}^2 < Q^2 < 1000\,\text{GeV}^2$
  High Q^2: $Q^2 > 125\,\text{GeV}^2$
- Inelasticity: $0.2 < y < 0.6$,[1,2,3,4] $y_{\text{el}} < 0.95$ [1,4]

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)
[5] PhD thesis F. Januschek (2011)

Selected cuts
DIS selection

Phase space:

- Momentum transfer: Low Q^2: $10\,\text{GeV}^2 < Q^2 < 1000\,\text{GeV}^2$
  High Q^2: $Q^2 > 125\,\text{GeV}^2$
- Inelasticity: $0.2 < y < 0.6$,[1,2,3,4] $y_{\text{el}} < 0.95$ [1,4]

Triggers:

- EVTake, MVDTake (for ZUFOs), POLTake
- FLT, SLT and TLT to be selected

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)
[5] PhD thesis F. Januschek (2011)

Selected cuts
DIS selection

Phase space:

- Momentum transfer: Low Q^2: $10\,\text{GeV}^2 < Q^2 < 1000\,\text{GeV}^2$
  High Q^2: $Q^2 > 125\,\text{GeV}^2$
- Inelasticity: $0.2 < y < 0.6$,[1,2,3,4] $y_{\text{el}} < 0.95$ [1,4]

Triggers:

- EVTake, MVDTake (for ZUFOs), POLTake
- FLT, SLT and TLT to be selected

Background reduction:

- Interaction vertex position: $|z| < 30\,\text{cm}$ [2,5]
- Longitudinal momentum imbalance: Low Q^2: $42\,\text{GeV} < E - p_z < 65\,\text{GeV}$ [2]
  High Q^2: $38\,\text{GeV} < E - p_z < 65\,\text{GeV}$ [1,3,4,5]
- Remove elastic QED Compton scattering (not well described by MC) [1,2,3,4,5]

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)
[5] PhD thesis F. Januschek (2011)

Selected cuts
DIS selection

Electron kinematics:

- Probability Sinistra > 0.9 [1,2,3,4]
  Probability EM > 0.001 [5]
- Electron energy $> 10\,\text{GeV}$ [1,2,3,4,5]
- Matching track (reject misidentified photons, for high Q^2) [1,3,4,5]
- Isolation (reject misidentified photons/hadrons) [1,2,3,4,5]

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)
[5] PhD thesis F. Januschek (2011)

Selected cuts
DIS selection

Electron kinematics:

- Probability Sinistra > 0.9 [1,2,3,4]
  Probability EM > 0.001 [5]
- Electron energy $> 10\,\text{GeV}$ [1,2,3,4,5]
- Matching track (reject misidentified photons, for high Q^2) [1,3,4,5]
- Isolation (reject misidentified photons/hadrons) [1,2,3,4,5]

Geometry (reject electrons in imperfect detector regions): [1,2,3,4,5]

- RCAL chimney
- Super crack
- RCAL radius

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)
[5] PhD thesis F. Januschek (2011)

Selected cuts
DIS selection

Validate primary vertex: [1,2,3,4,5]

- At least one track which has:
- Transverse momentum: $p_T > 0.2\,\text{GeV}$
- Passed through at least three CTD superlayers

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)
[5] PhD thesis F. Januschek (2011)

Selected cuts
DIS selection

Validate primary vertex: [1,2,3,4,5]

- At least one track which has:
- Transverse momentum: $p_T > 0.2\,\text{GeV}$
- Passed through at least three CTD superlayers

Other:

- Validity of QED predictions: $y(1-x)^2 > 0.004$ [1,3,4,5]
- Transverse momentum balance: $\frac{p_T}{\sqrt{E_T}} < 2.5\sqrt{\text{GeV}}$ [1,3,4]
- Projection of hadronic scattering angle on FCAL (not well described by MC) [1,3,4,5]

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)
[5] PhD thesis F. Januschek (2011)

Selected cuts

Inclusive jet selection

Jets: [1,2,3,4]

- Transverse momentum: $p_T^{\text{Breit}} > 8\,\text{GeV}$
  $p_T^{\text{lab}} > 3\,\text{GeV}$
- Pseudorapidity: $-1 < \eta^{\text{lab}} < 2.5$
- Electron jet distance: $(\Delta\phi)^2 + (\Delta\eta)^2 > 1$ (reject misidentified DIS electron)
- Jet veto: (reject misidentified photons)
  Low Q^2: No jet with $\eta^{\text{lab}} < -2$ [2]
  High Q^2: No jet with $\eta^{\text{lab}} < -1$ [1,3,4]

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)

Selected cuts
Inclusive jet selection

Jets: [1,2,3,4]

- Transverse momentum: $p_T^{\text{Breit}} > 8\,\text{GeV}$
  $p_T^{\text{lab}} > 3\,\text{GeV}$
- Pseudorapidity: $-1 < \eta^{\text{lab}} < 2.5$
- Electron jet distance: $(\Delta\phi)^2 + (\Delta\eta)^2 > 1$ (reject misidentified DIS electron)
- Jet veto: (reject misidentified photons)
  Low Q^2: No jet with $\eta^{\text{lab}} < -2$ [2]
  High Q^2: No jet with $\eta^{\text{lab}} < -1$ [1,3,4]

CAL cells:

- Minimum energy per cell (different for electromagnetic and hadronic cells) [1,3]
- Difference of two readouts per cell $< 90\%$ [1,2,3]

[1] PhD thesis J. Behr (2010)
[2] PhD thesis H. Perrey (2011)
[3] PhD thesis D. Lontkovskyi (2015)
[4] PhD thesis I. Makarenko (2017)