

Parton distribution benchmarking with LHC data

Catalog of Plots

Richard Ball, Stefano Carrazza, Luigi Del Debbio, Stefano Forte, Nathan P. Hartland,
Joey Huston, Pavel Nadolsky, Jun Gao, Juan Rojo, Daniel Stump, Robert Thorne, C.-P. Yuan

November 26, 2012

References

- [1] R. Ball, S. Carrazza, L. Del Debbio, S. Forte, N. P. Hartland, J. Huston, P. Nadolsky, J. Gao, J. Rojo, D. Stump, R. Thorne, C.-P. Yuan, “Parton distribution benchmarking with LHC data”, arXiv:1211.5142 [hep-ph].

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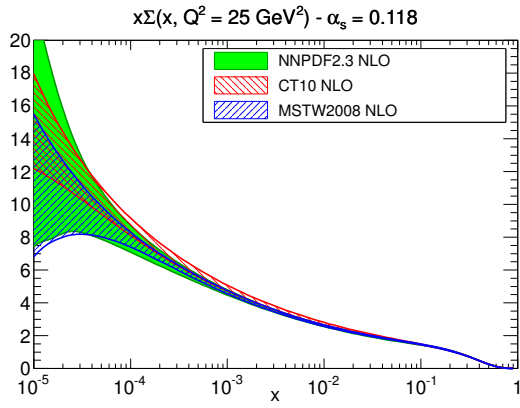
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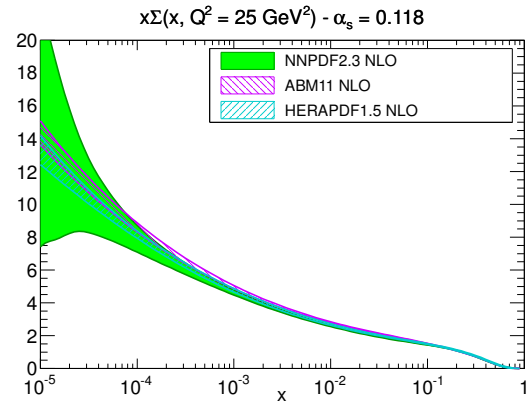
1 PDFs comparison at $\alpha_s = 0.118$

1.1 NLO at $Q^2 = 25 \text{ GeV}^2$

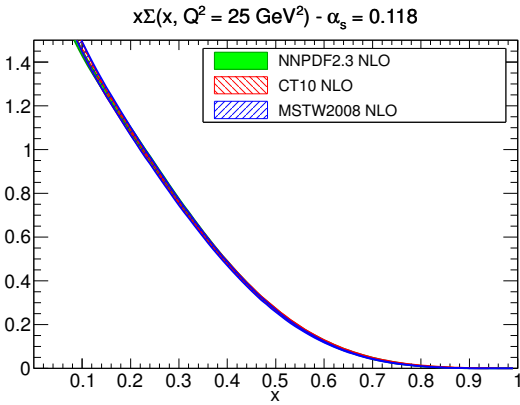
1.1.1 Evolution basis



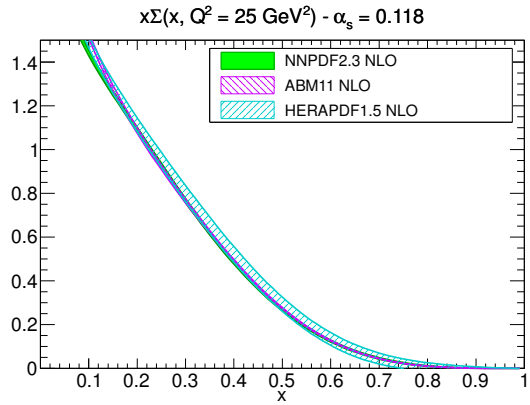
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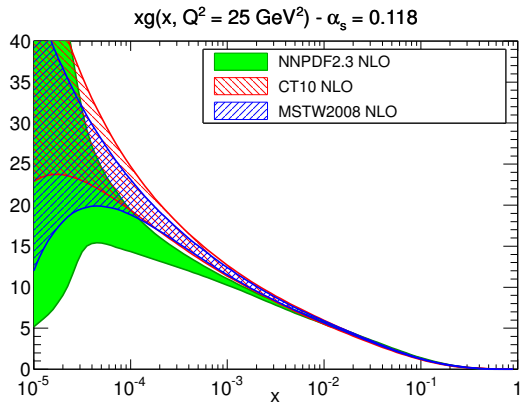
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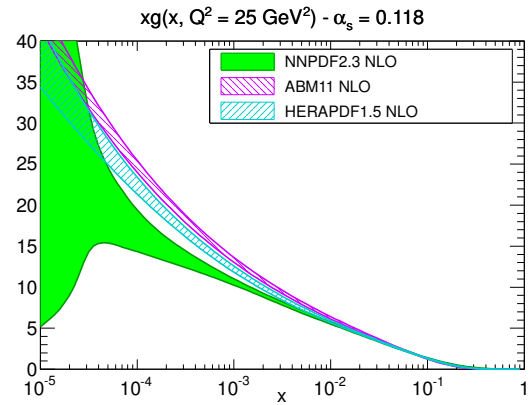
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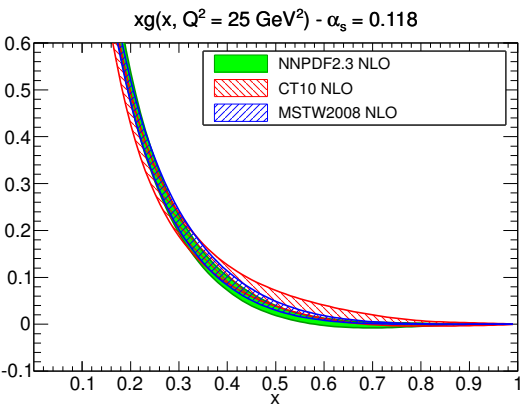
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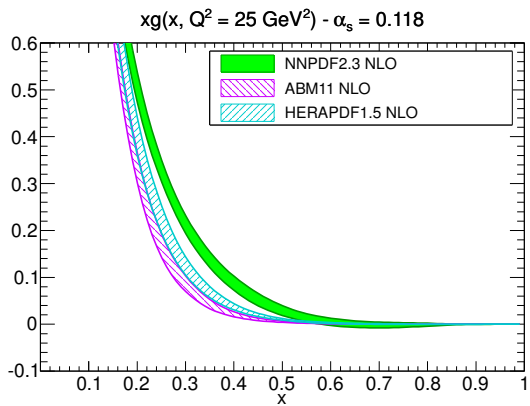
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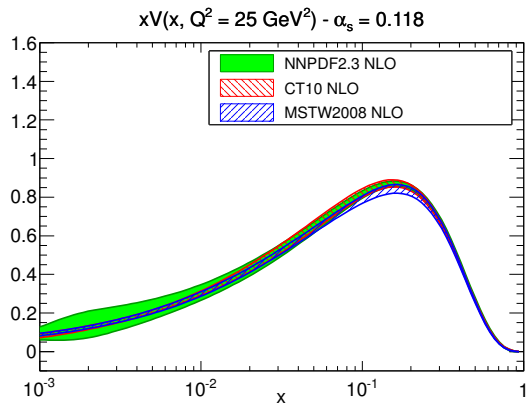


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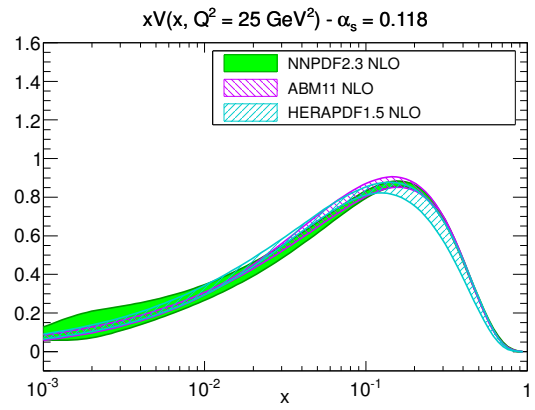


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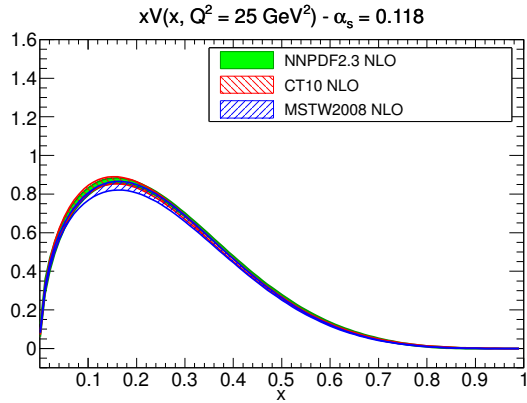
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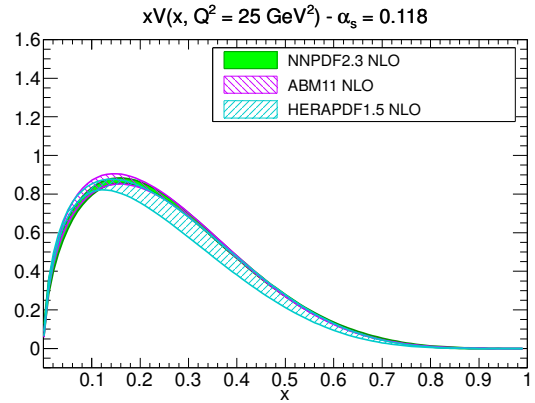
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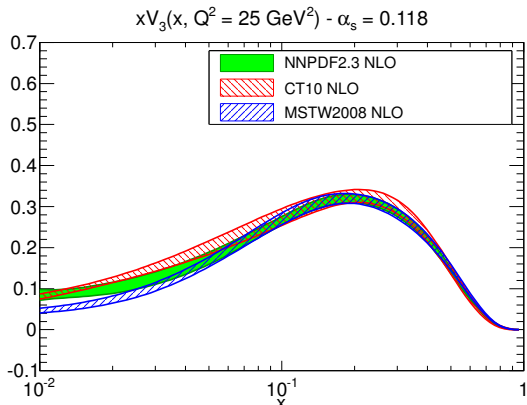
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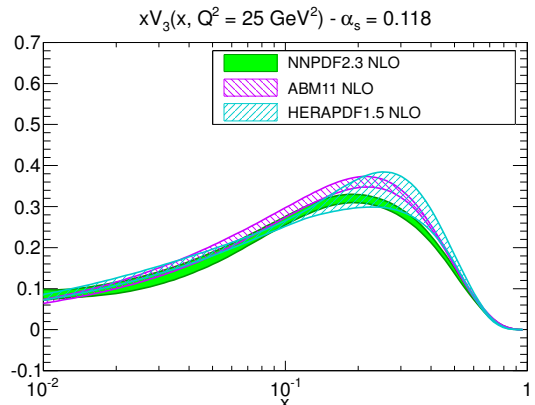
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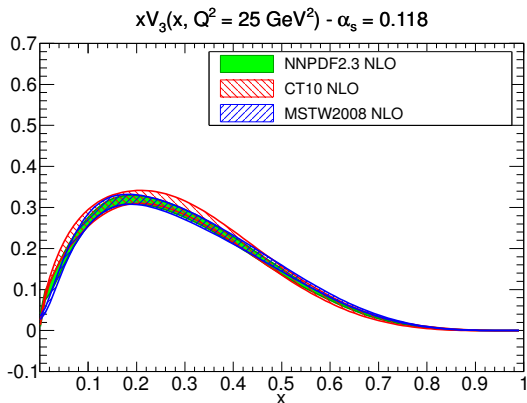
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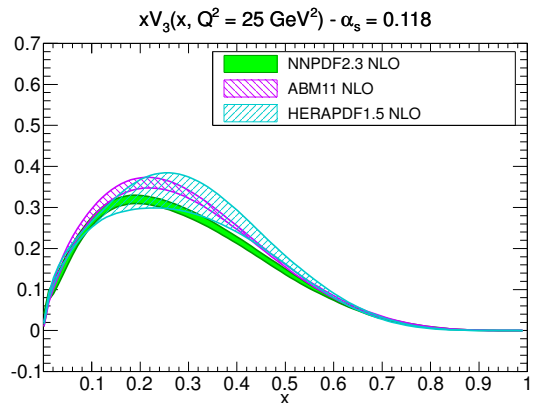
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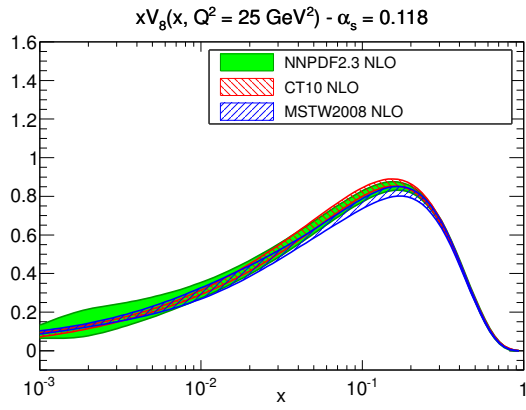


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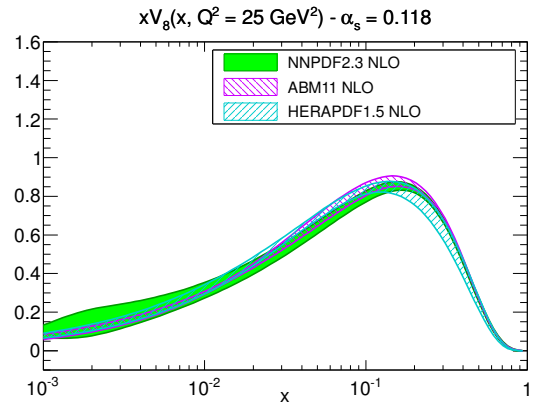


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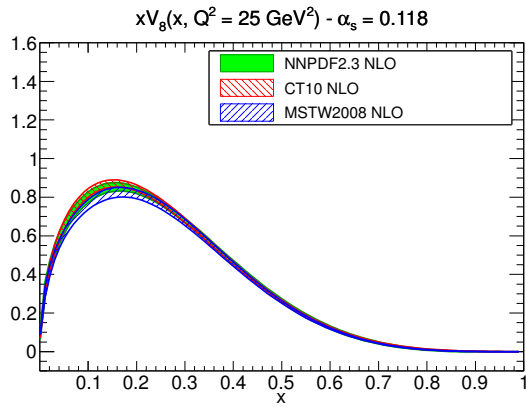
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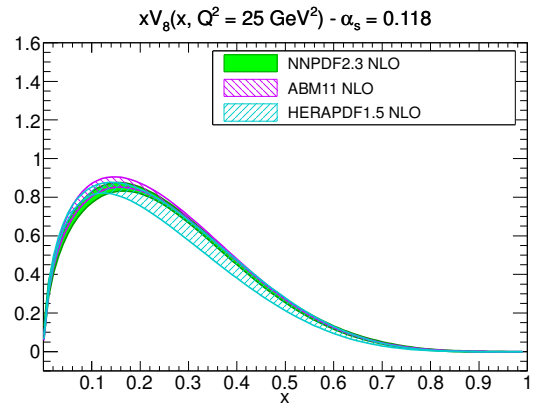
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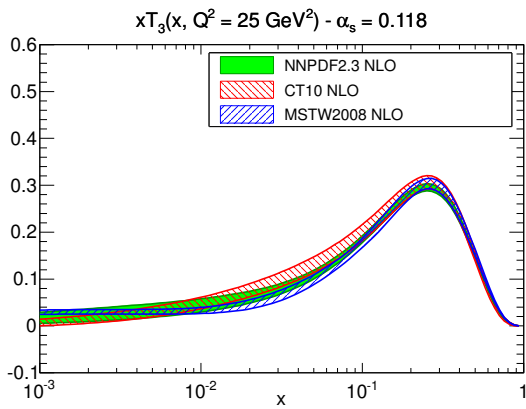
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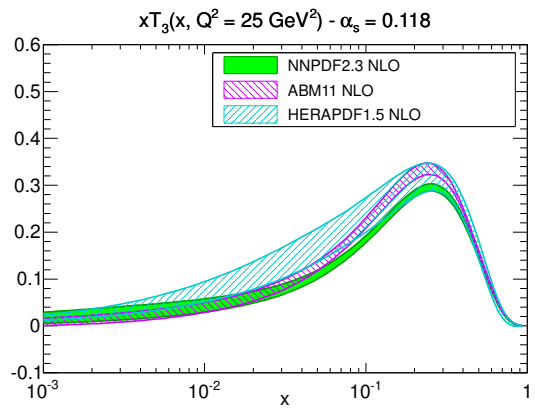
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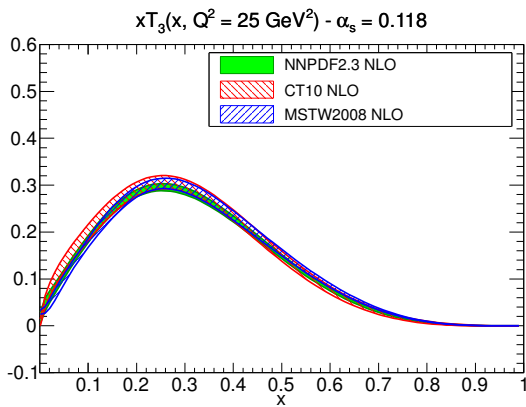
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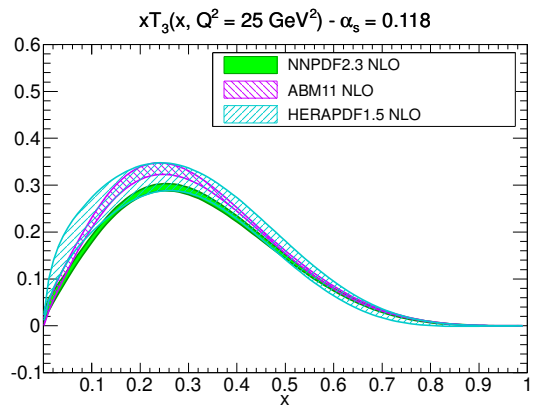
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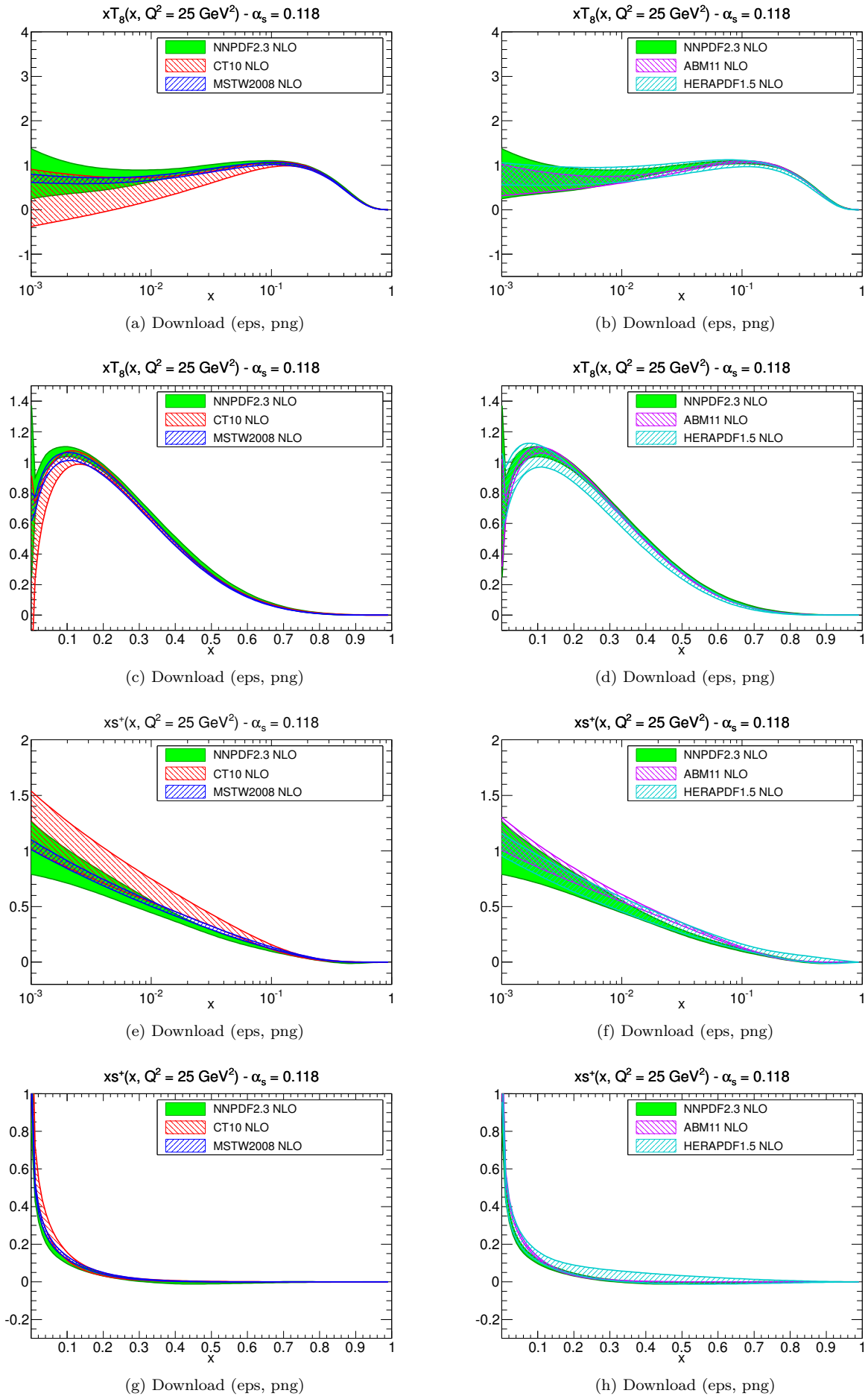
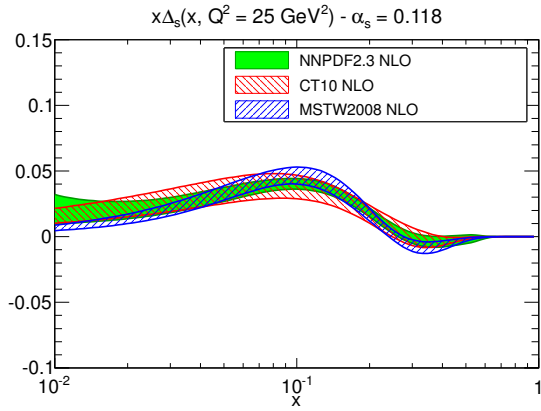
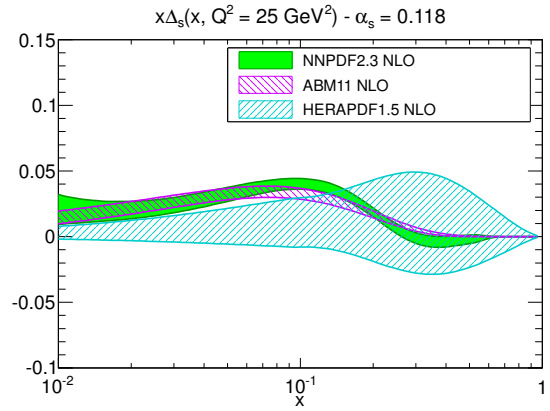


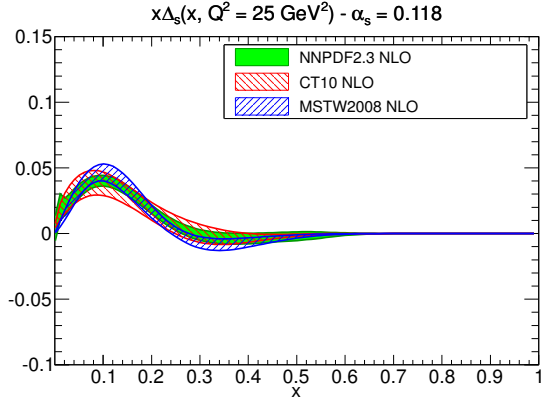
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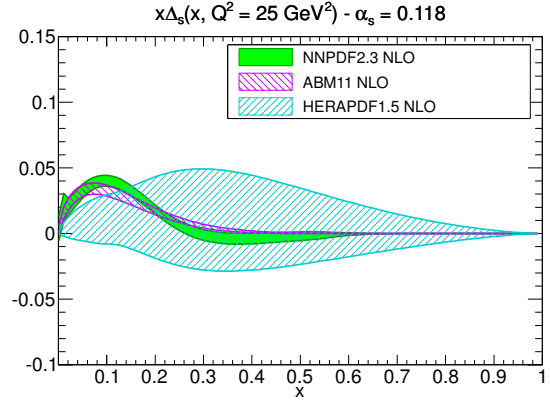
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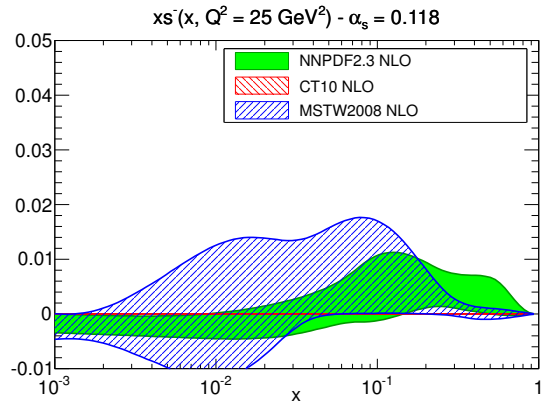
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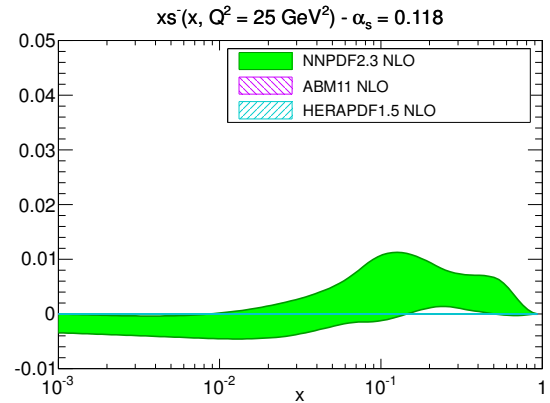
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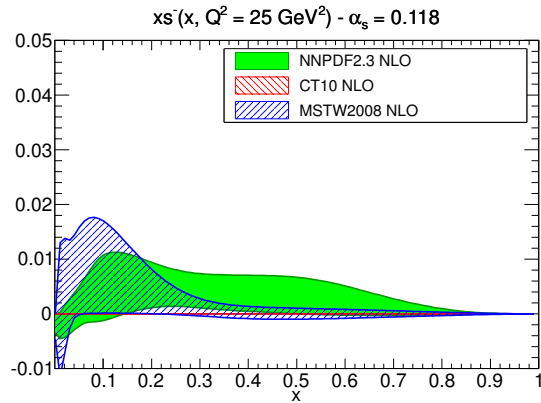
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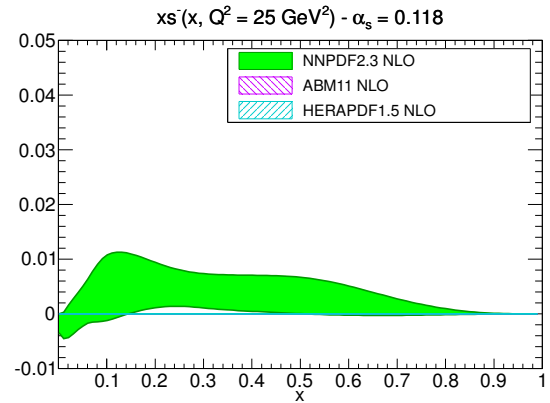
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Figure 5

1.1.2 Flavor basis

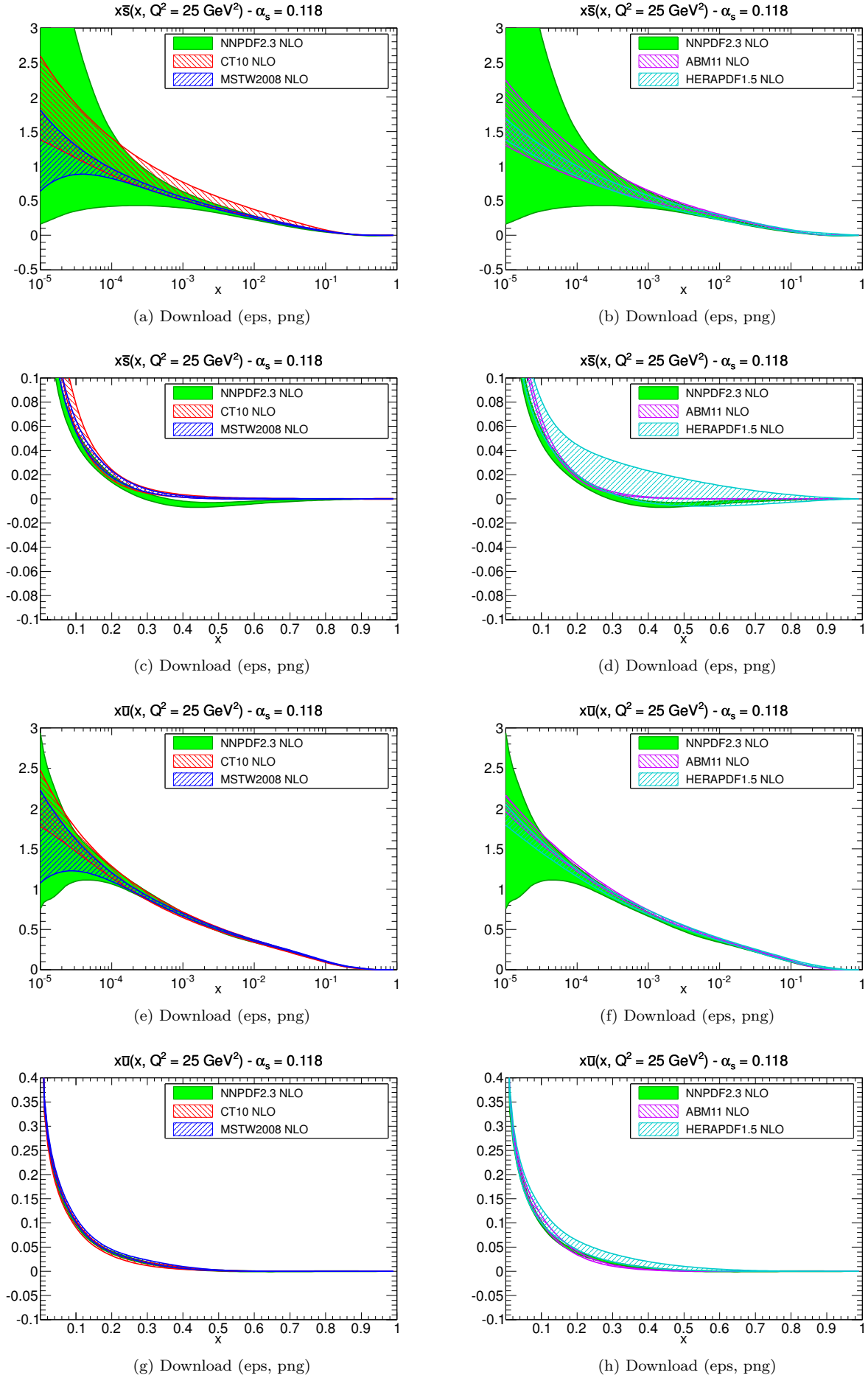


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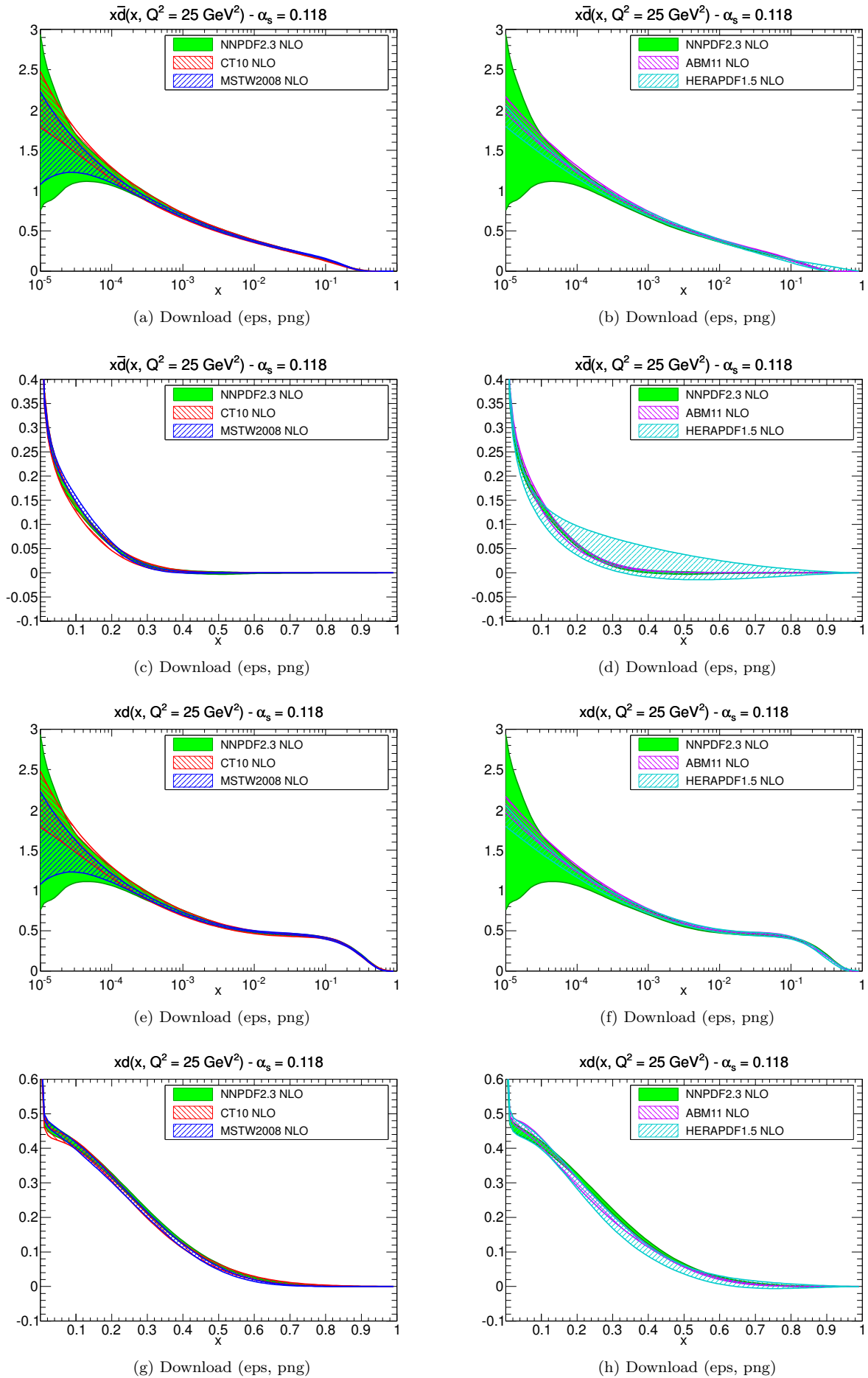


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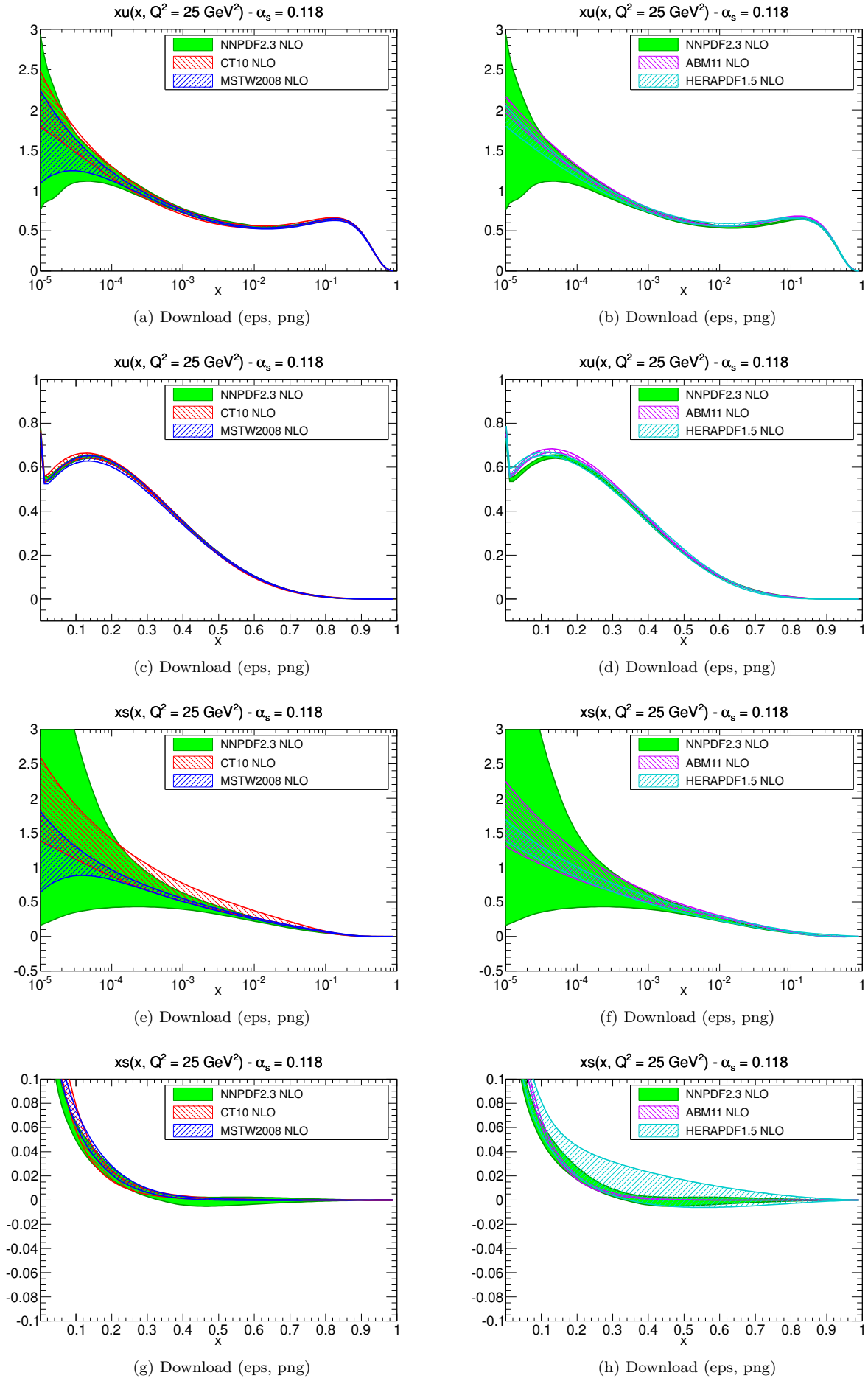


Figure 8

1.2 NNLO at $Q^2 = 25 \text{ GeV}^2$

1.2.1 Evolution basis

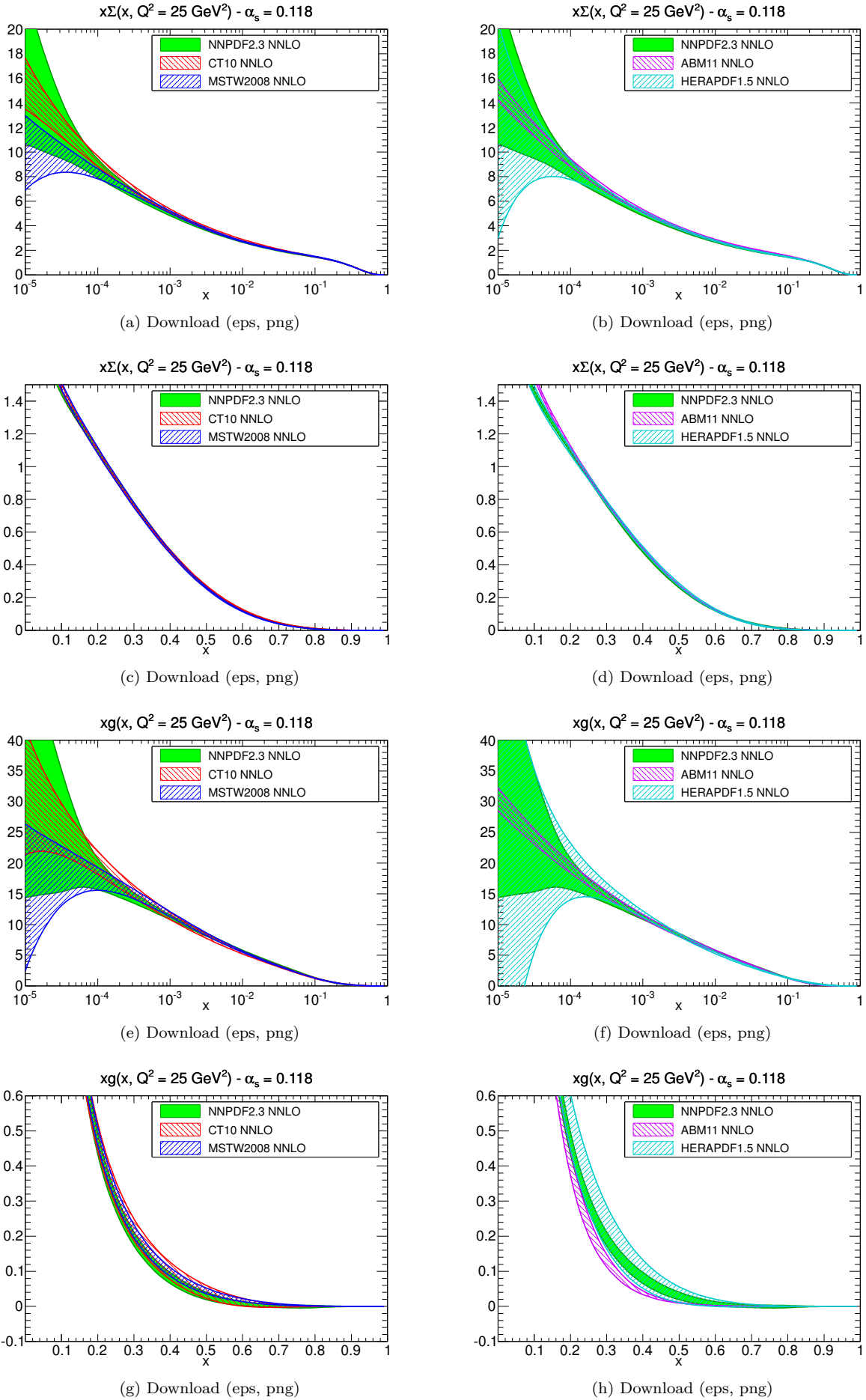
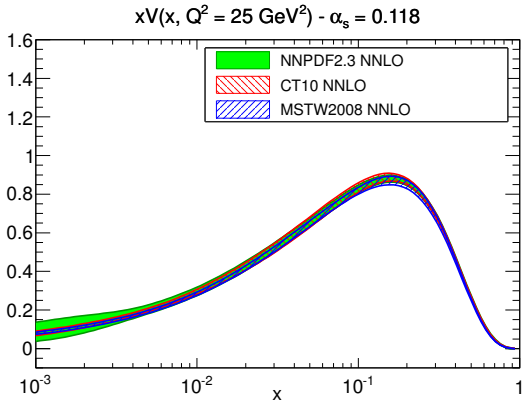
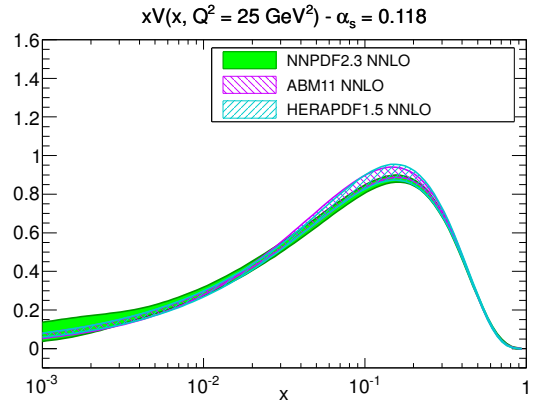


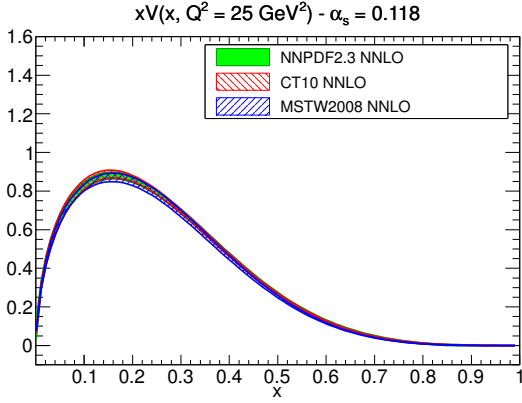
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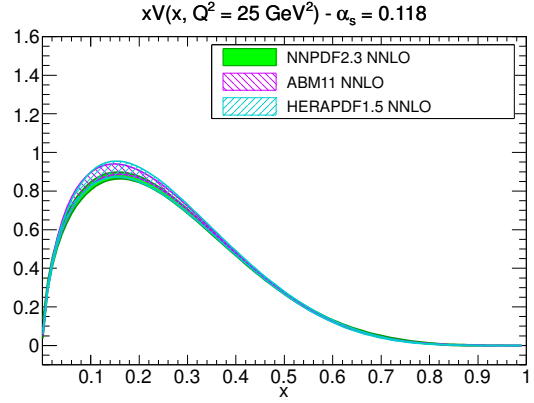
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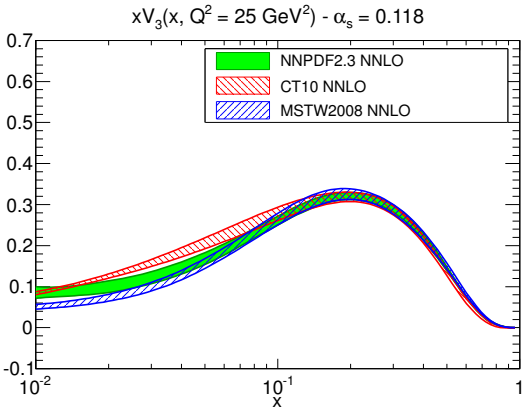
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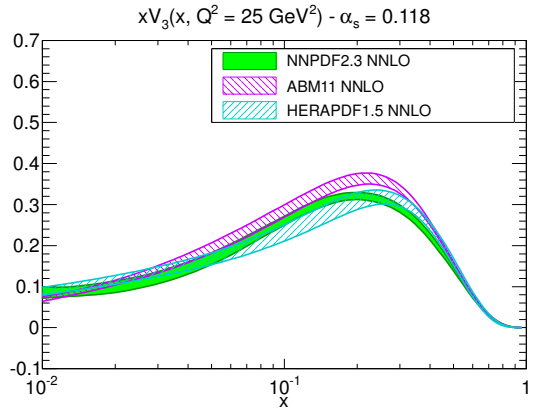
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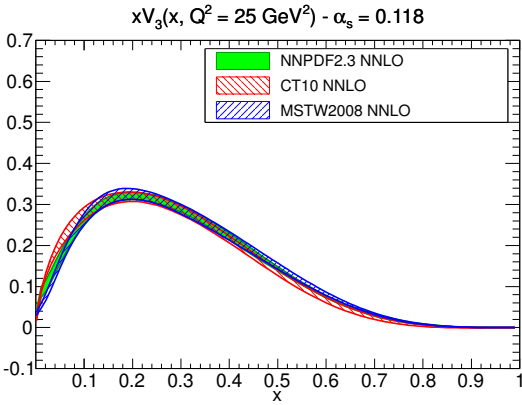
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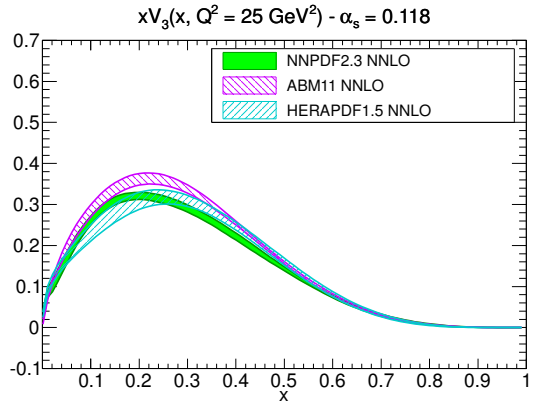
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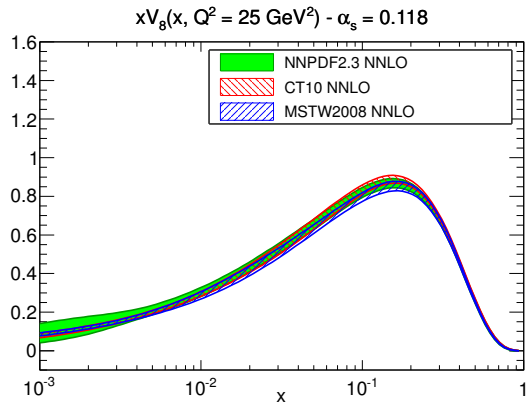


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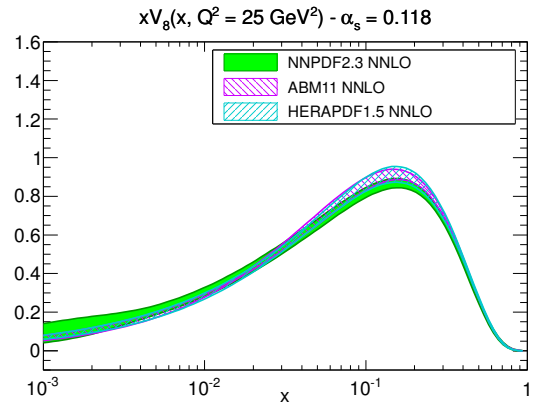


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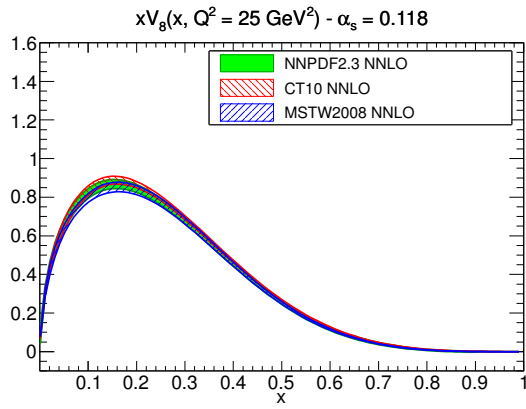
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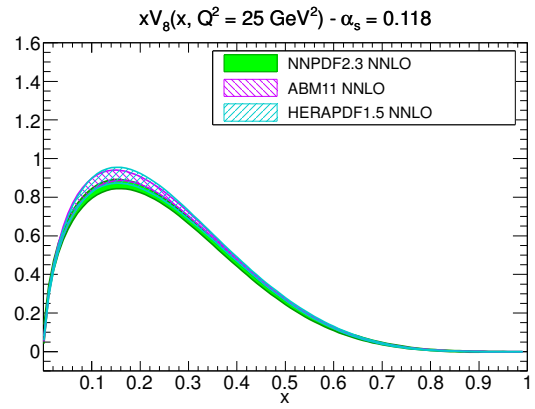
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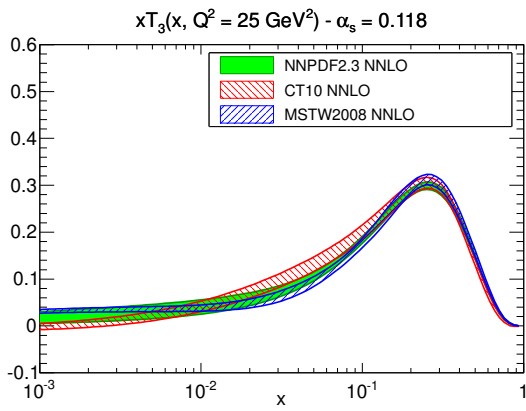
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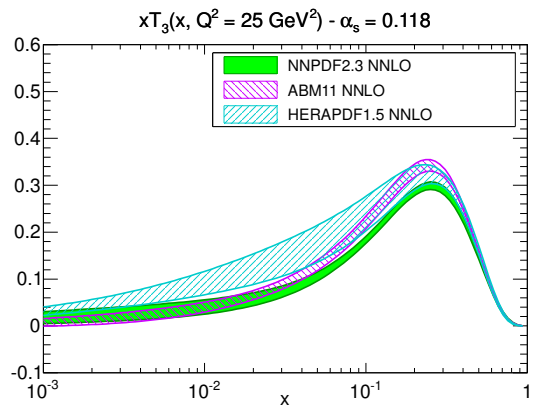
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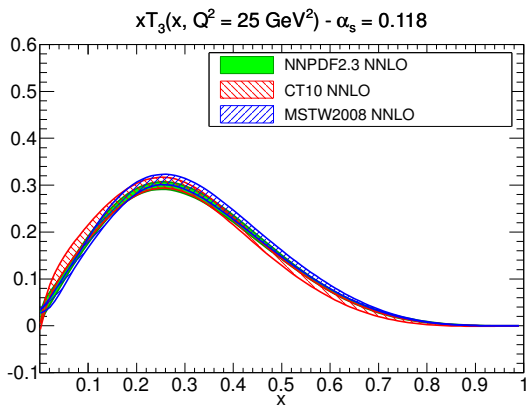
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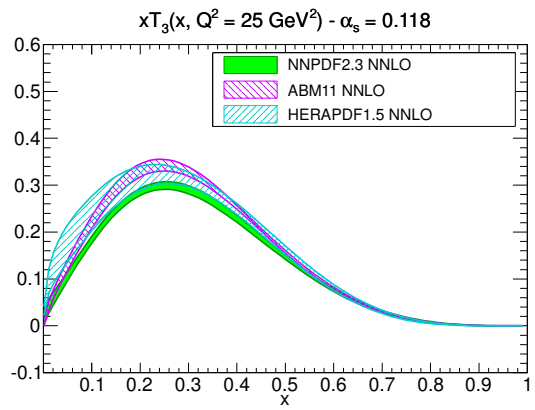
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Figure 11

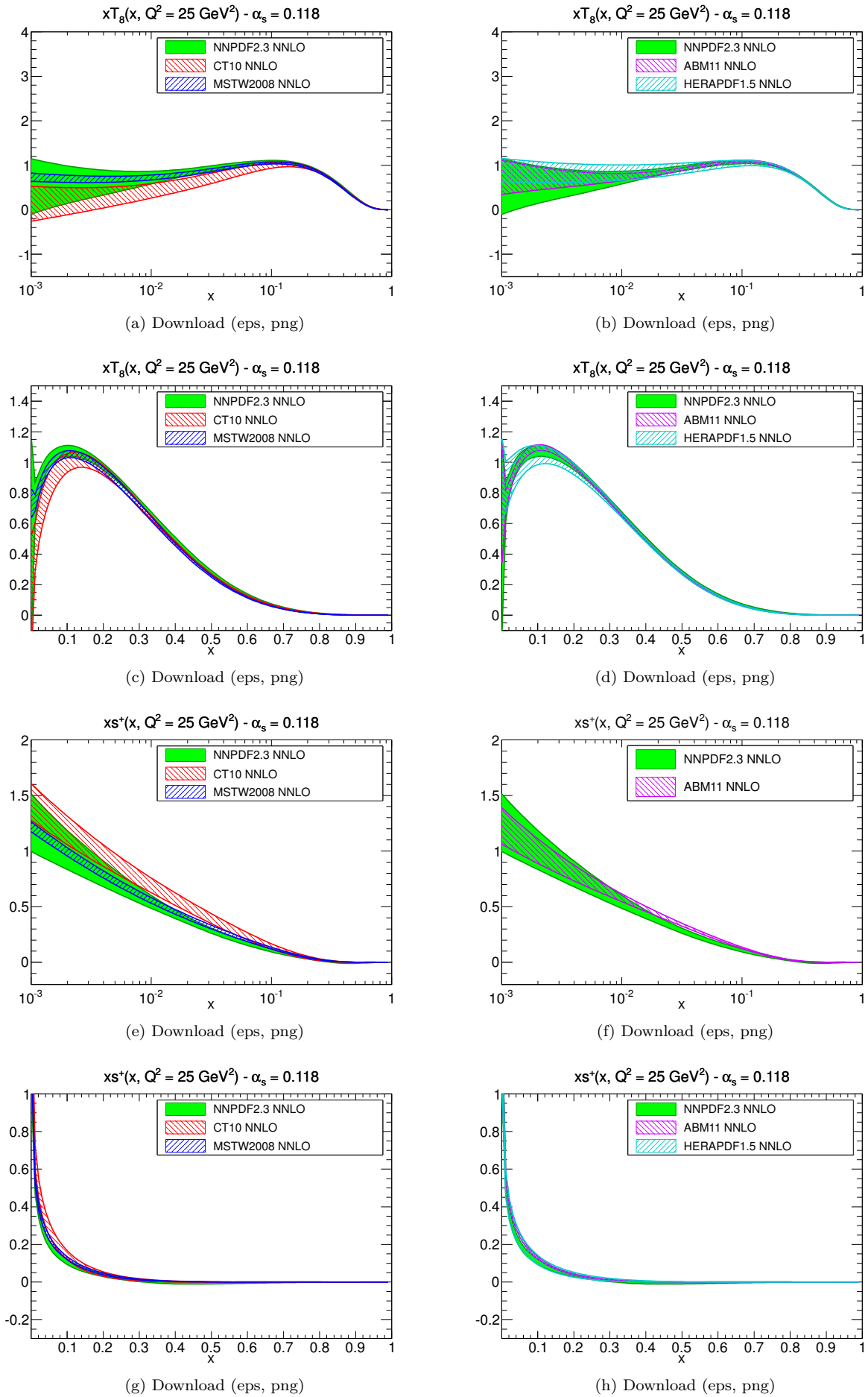
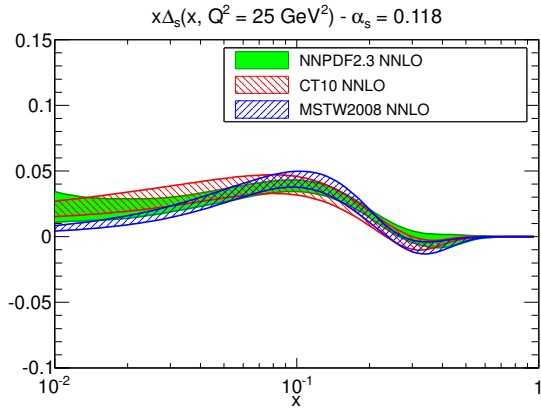
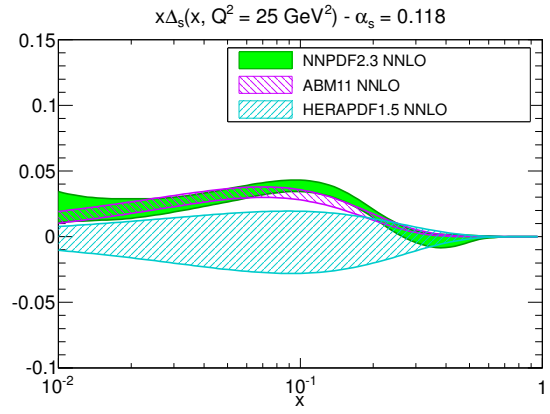


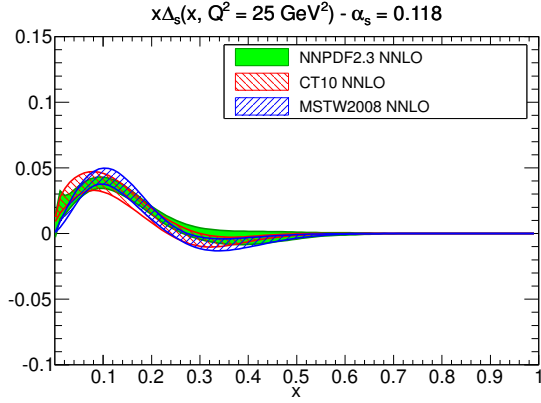
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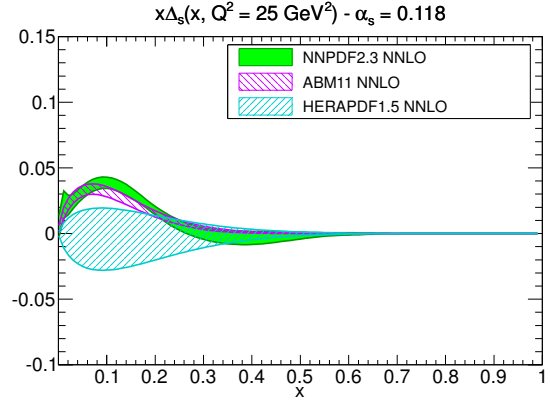
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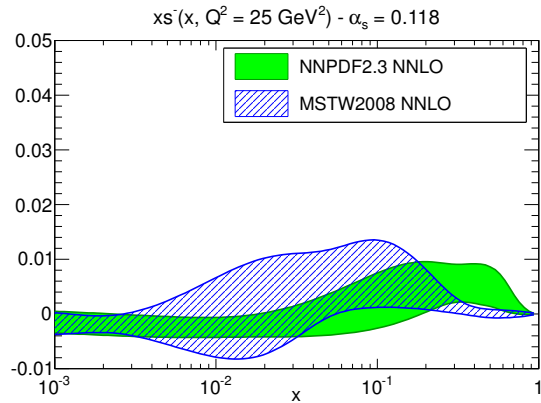
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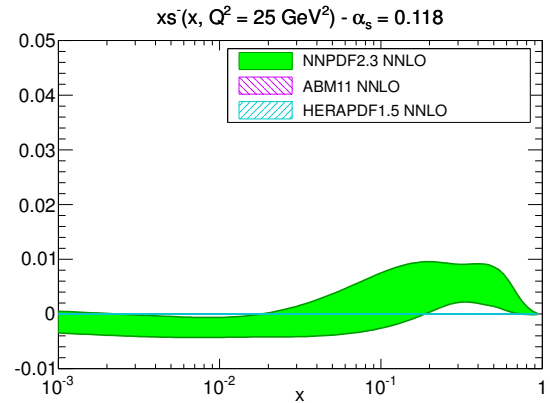
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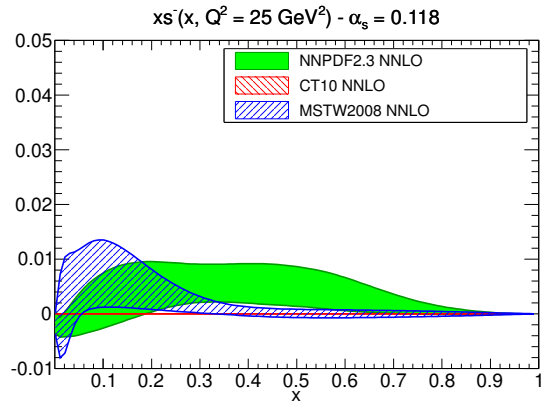
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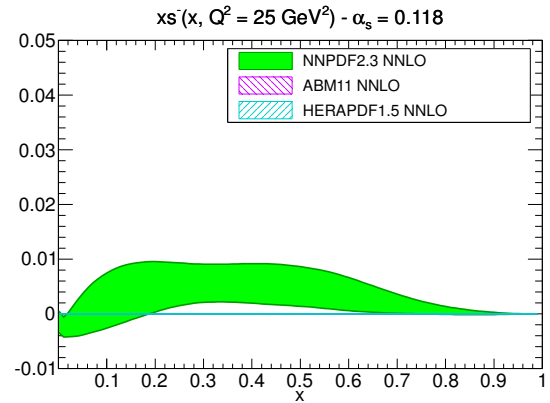
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Figure 13

1.2.2 Flavor basis

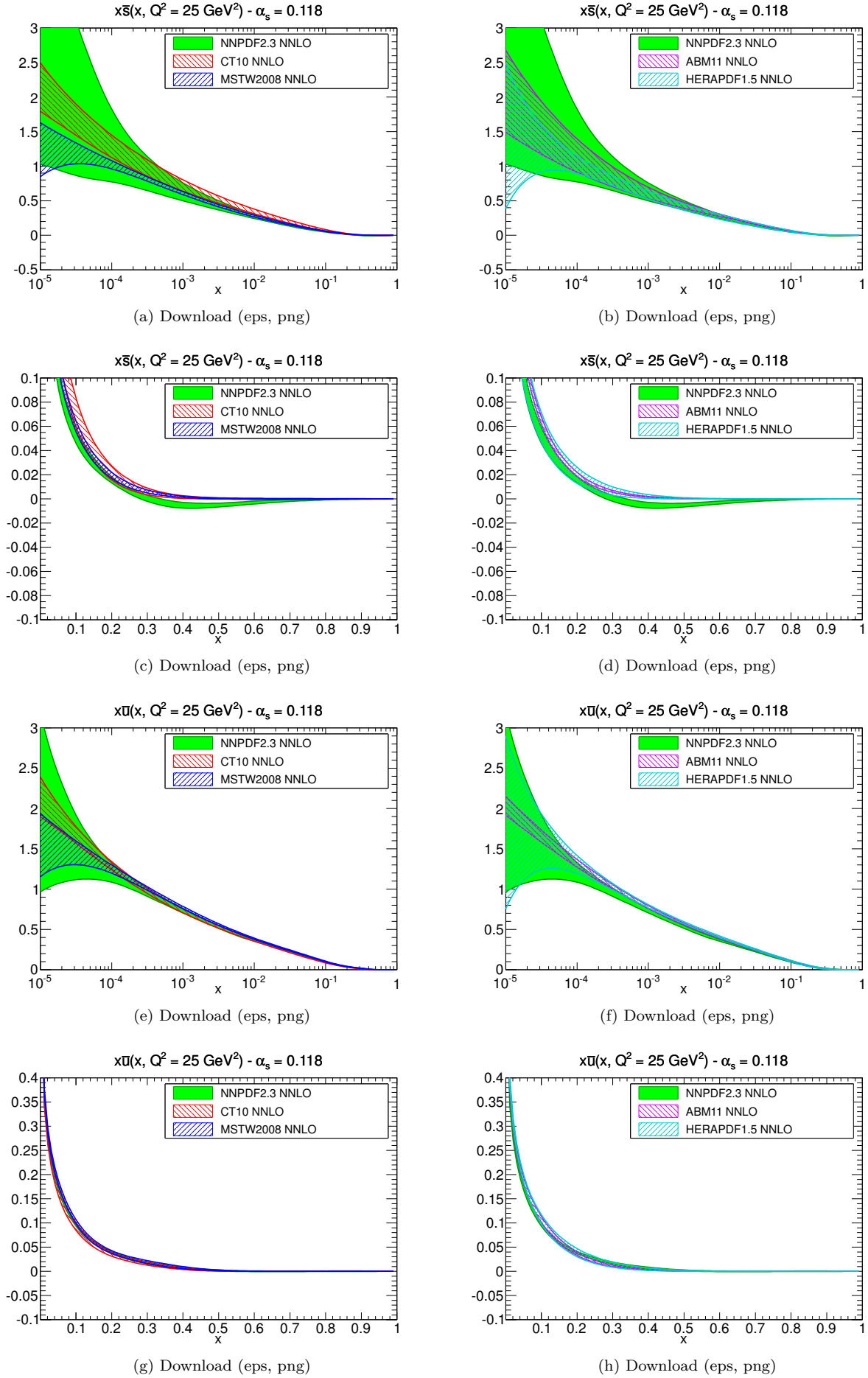


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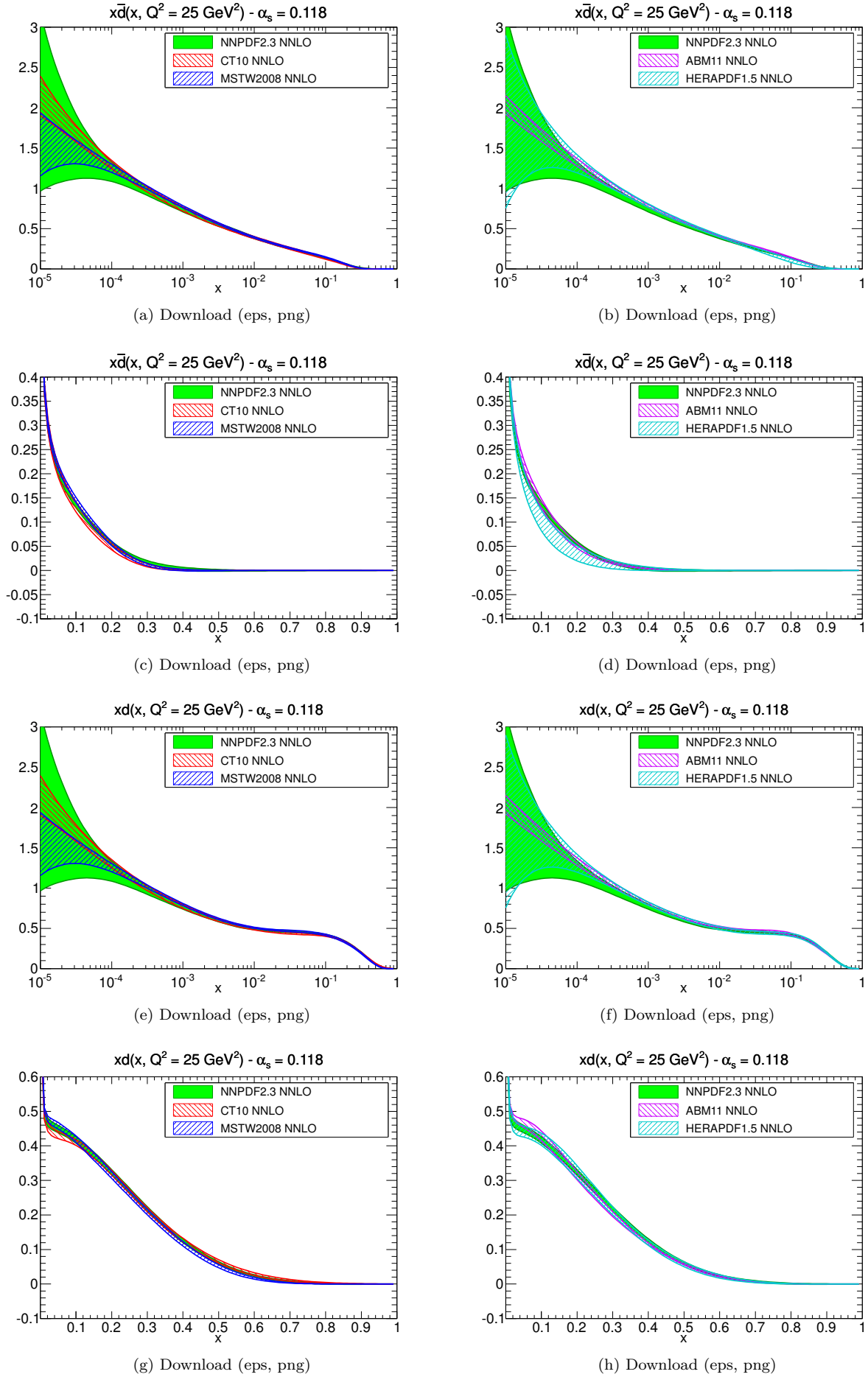


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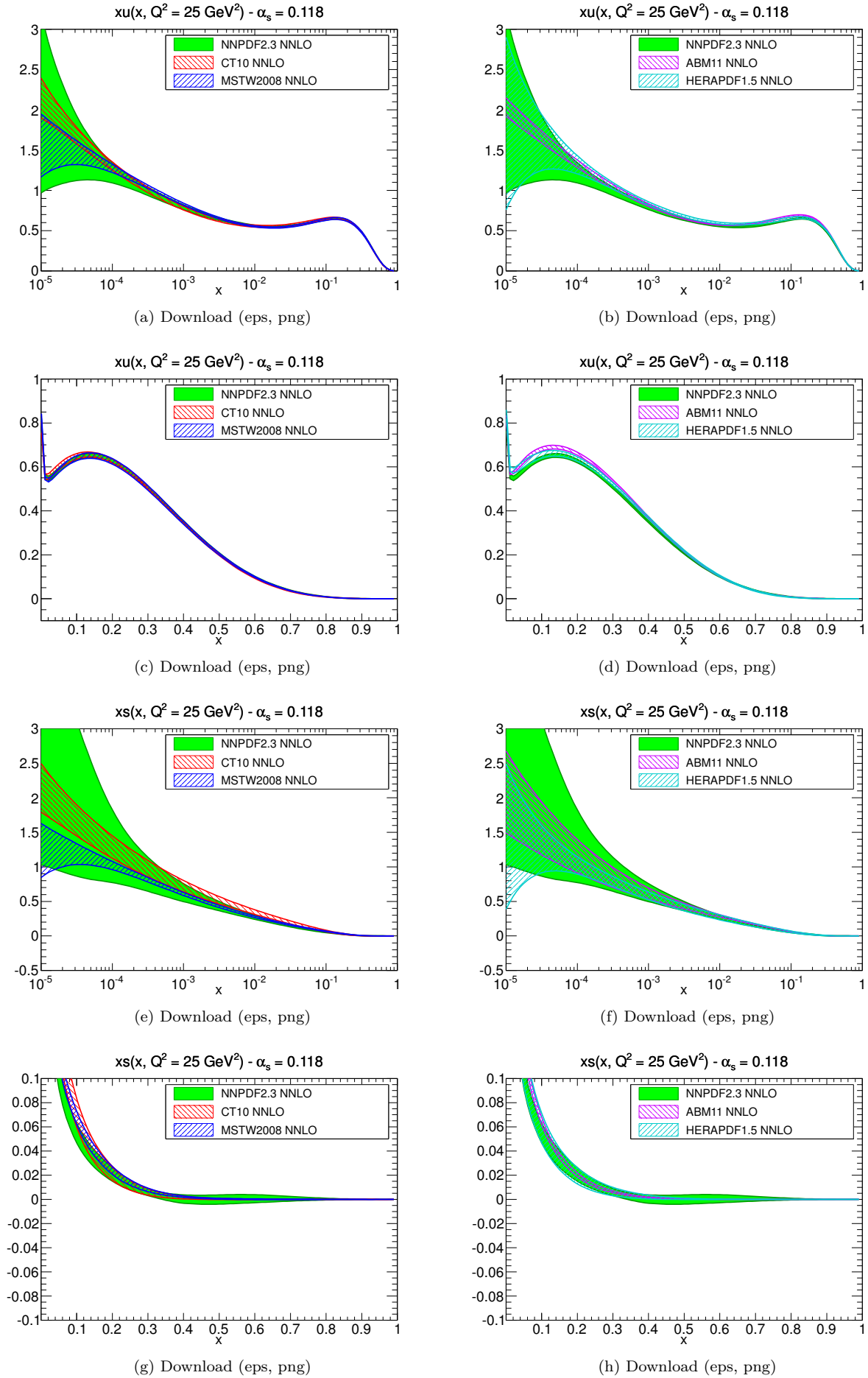


Figure 16

1.3 NNLO ratios at $Q^2 = 10^4 \text{ GeV}^2$

1.3.1 Evolution basis

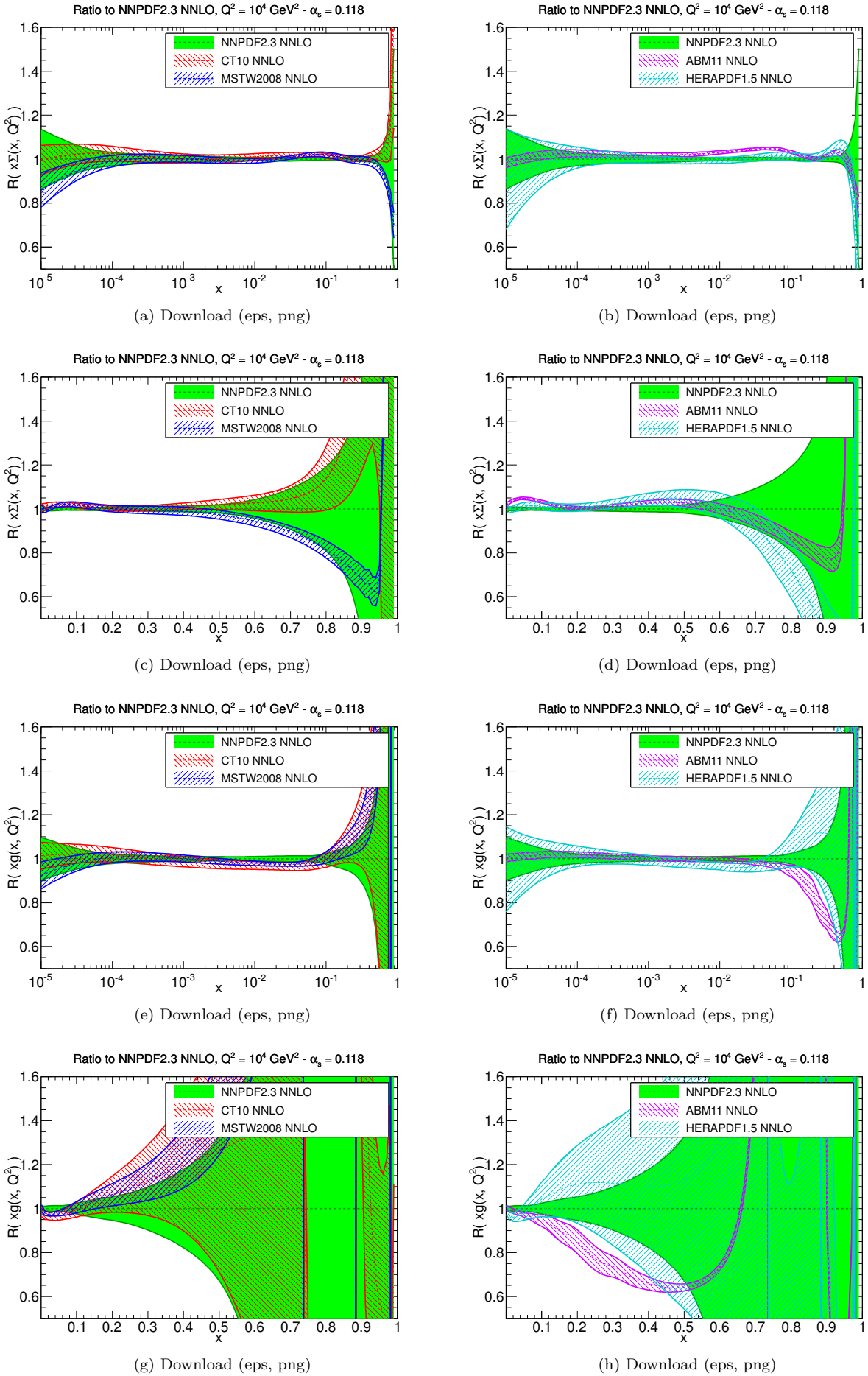


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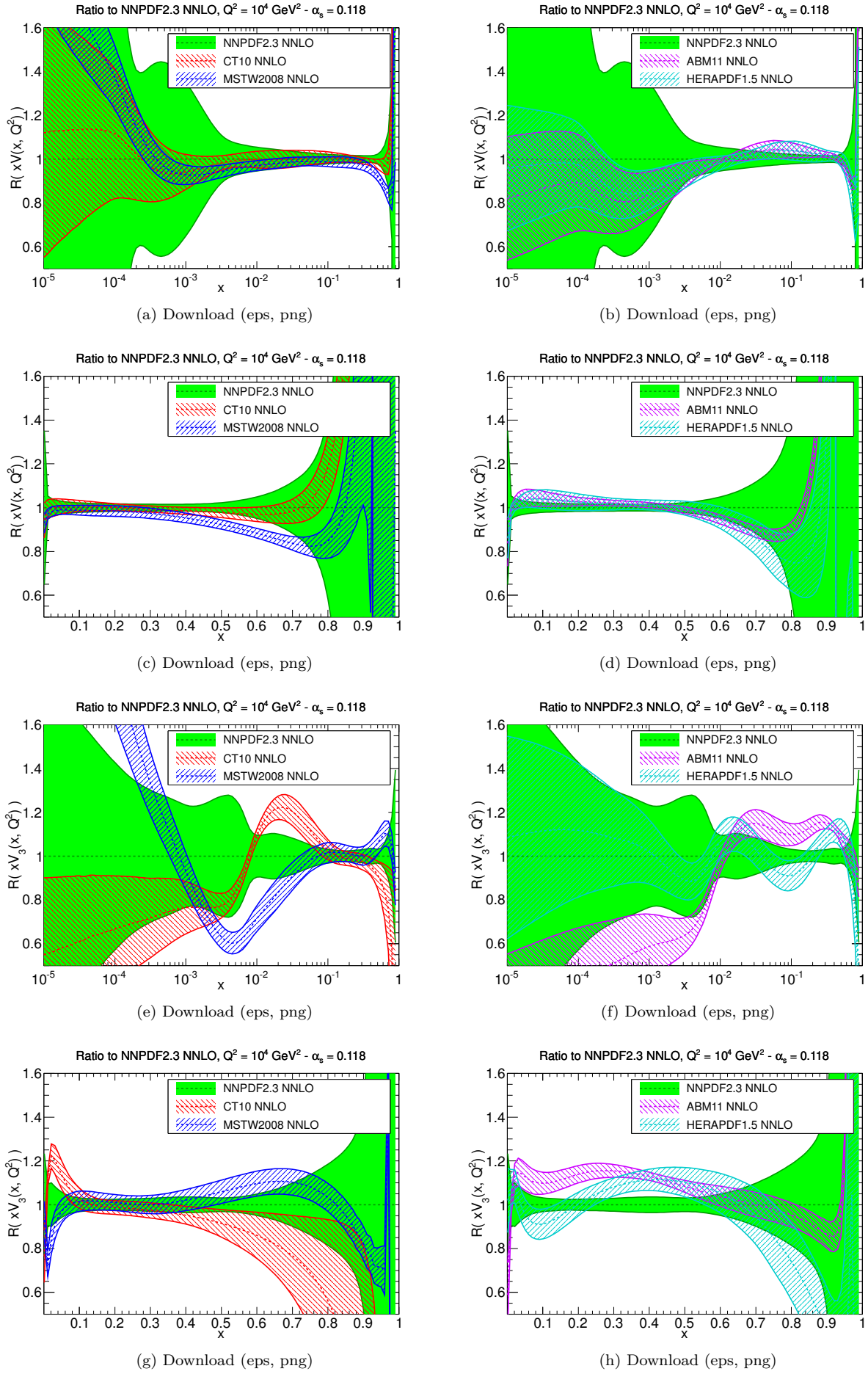


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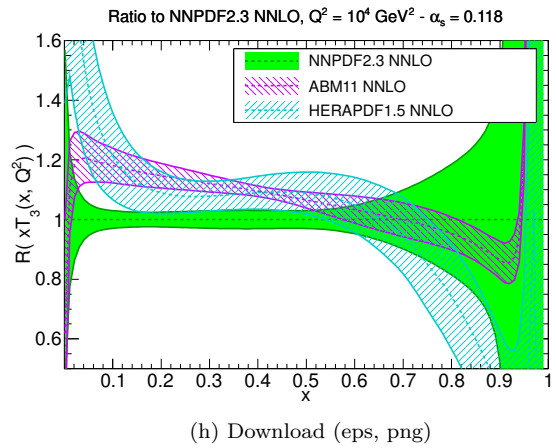
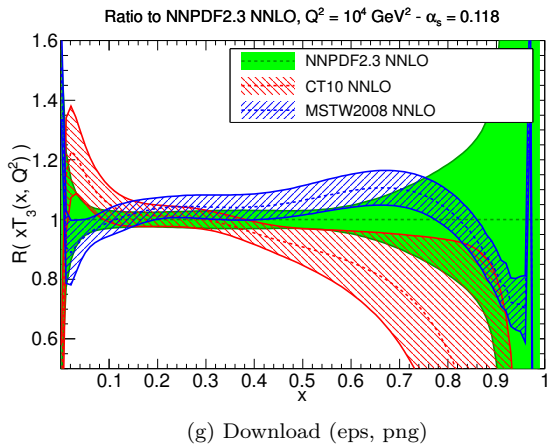
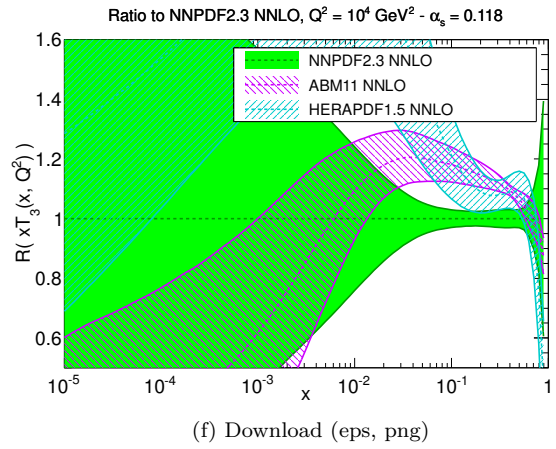
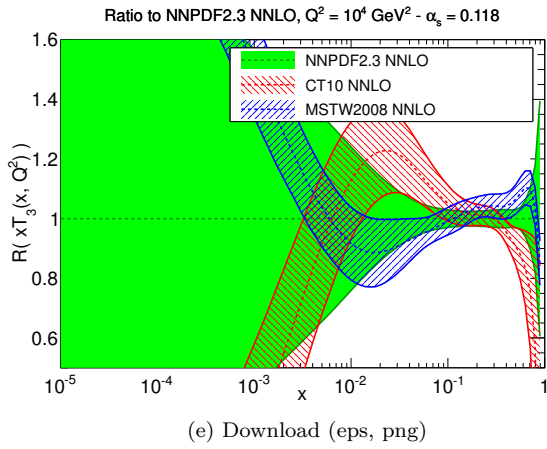
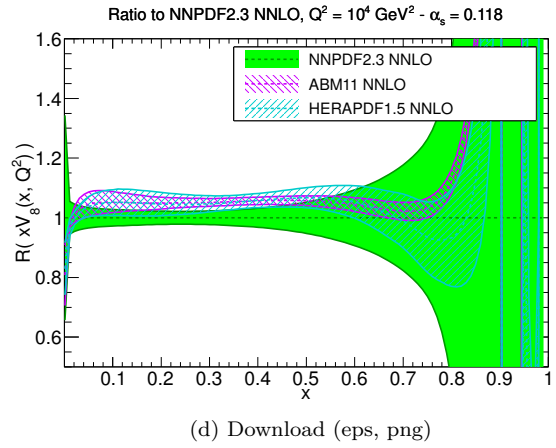
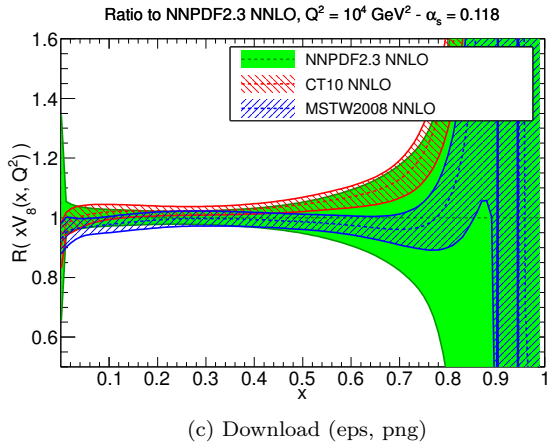
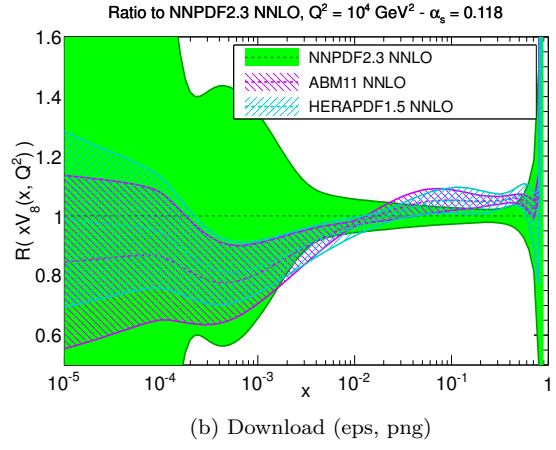
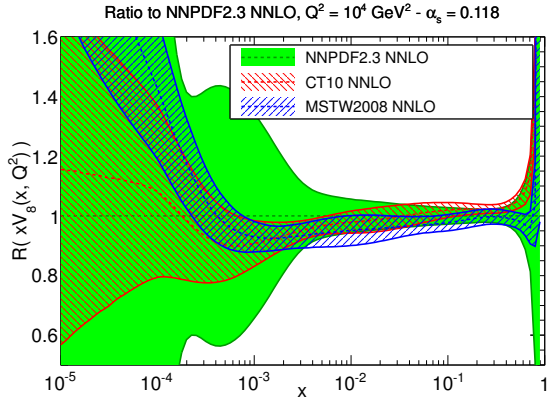


Figure 19

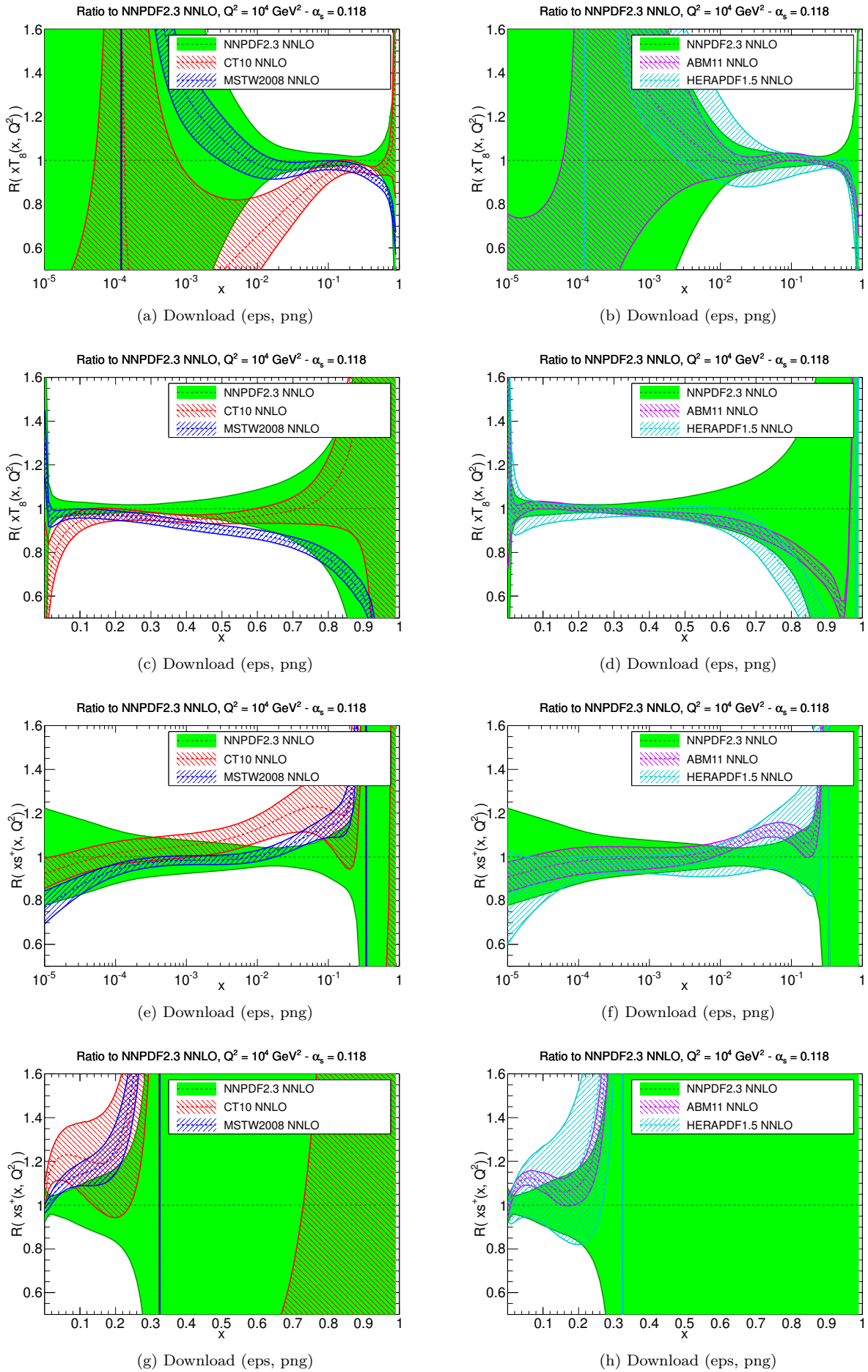
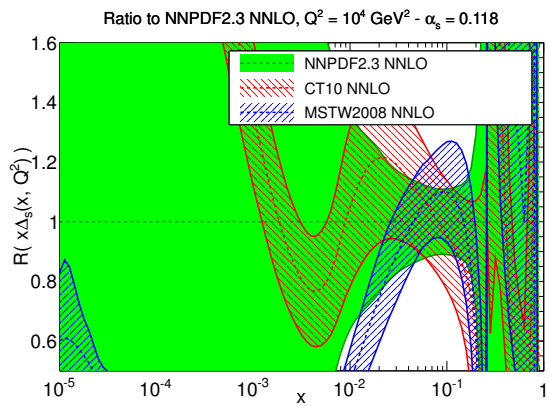
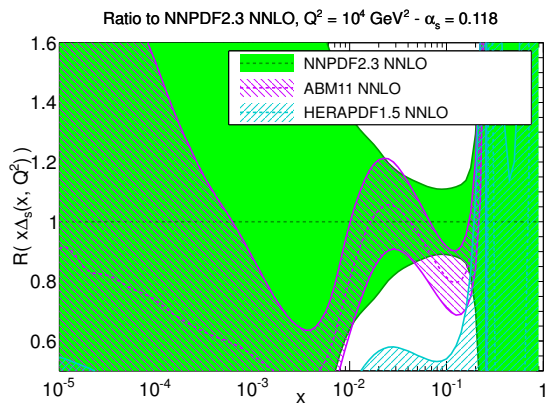


Figure 20



(a) Download (eps, png)



(b) Download (eps, png)

Figure 21

1.3.2 Flavor basis

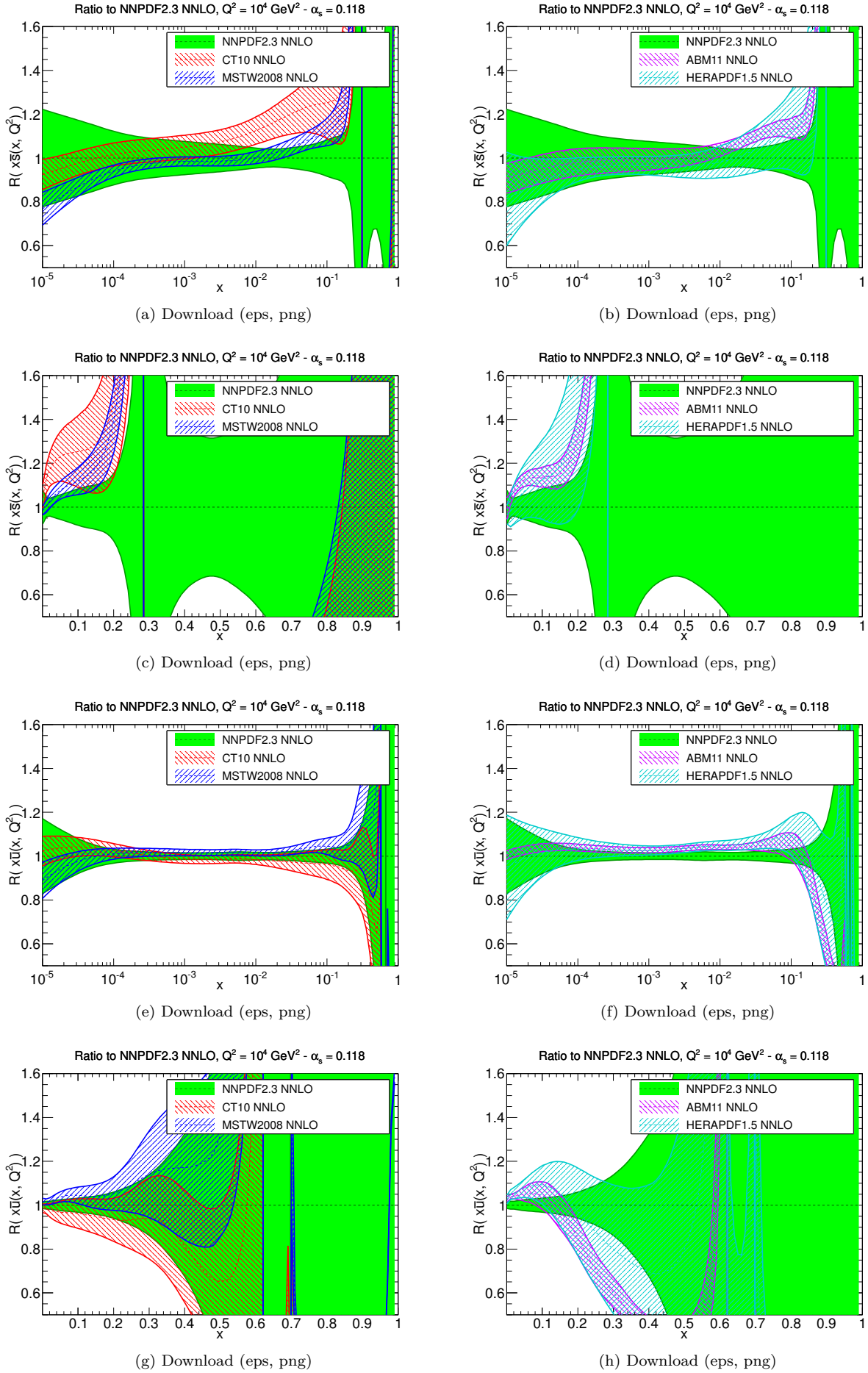
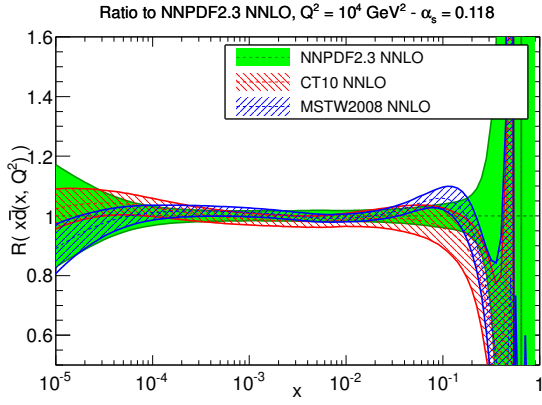
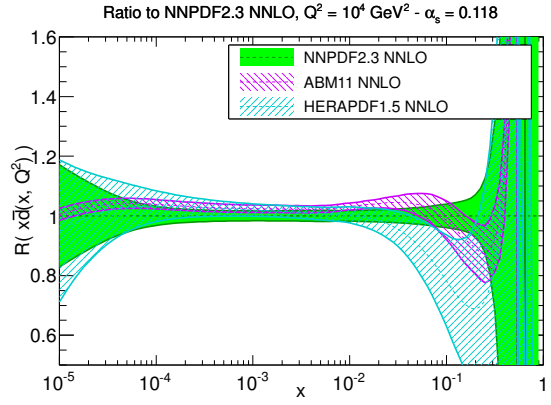


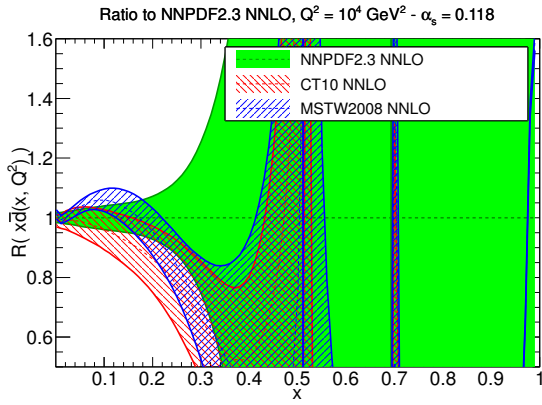
Figure 22



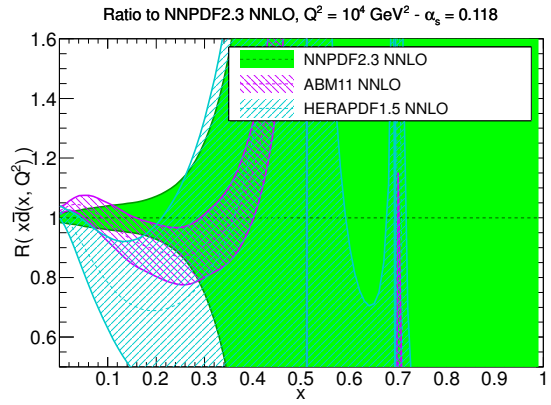
(a) Download (eps, png)



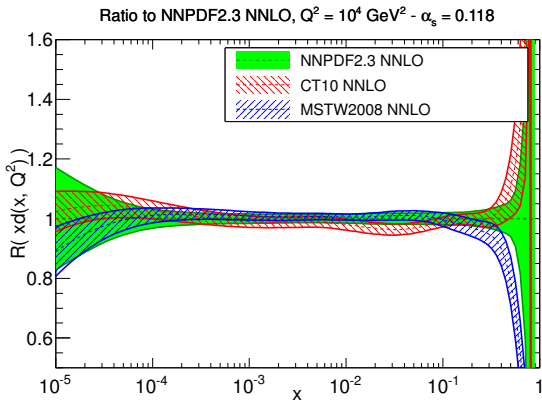
(b) Download (eps, png)



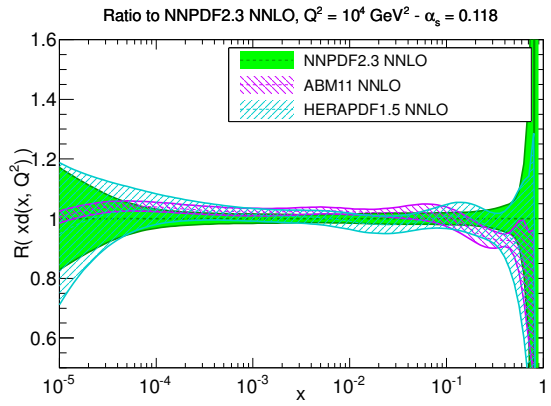
(c) Download (eps, png)



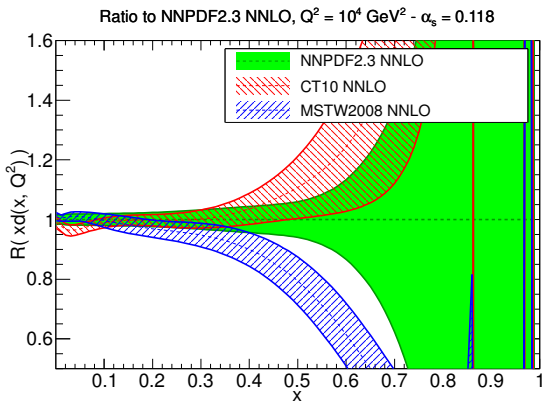
(d) Download (eps, png)



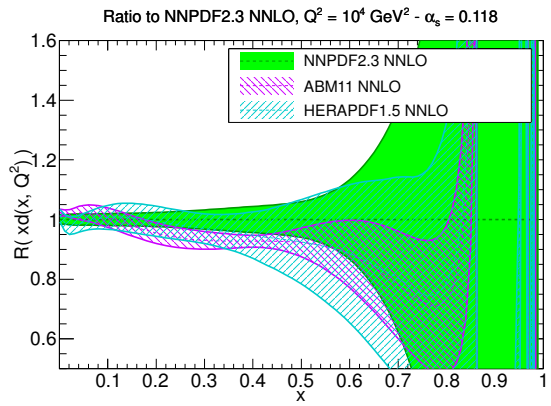
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 23

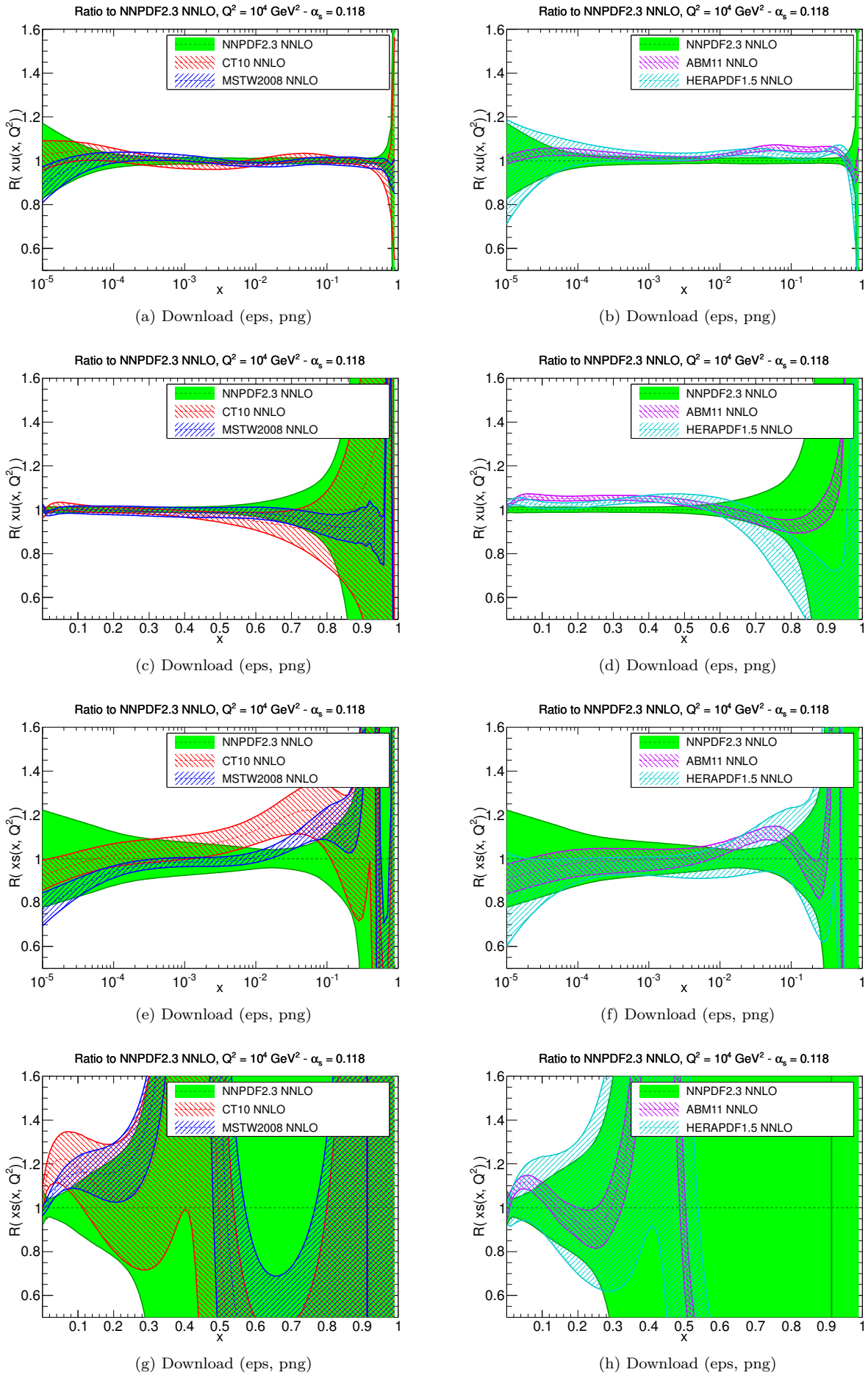


Figure 24

2 PDFs comparison at $\alpha_s = 0.119$

2.1 NLO at $Q^2 = 2 \text{ GeV}^2$

2.1.1 Evolution basis

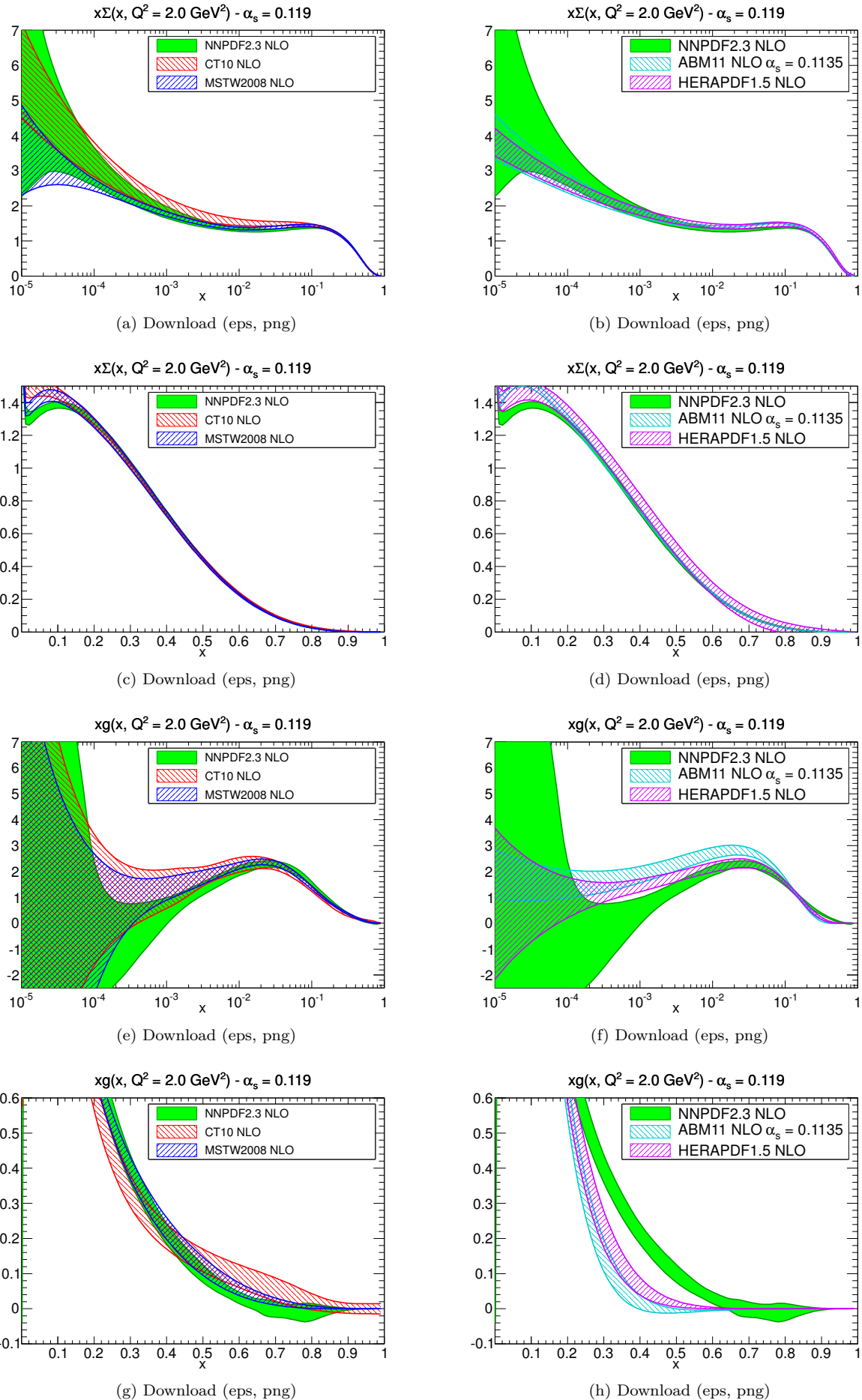
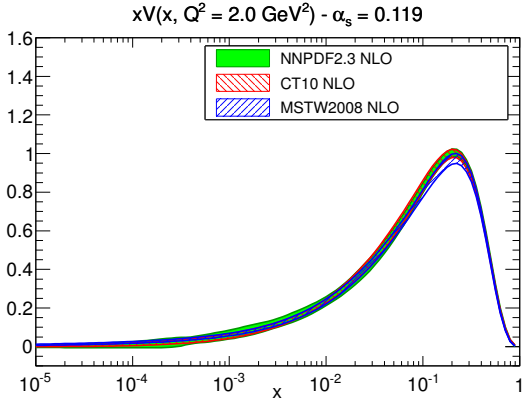
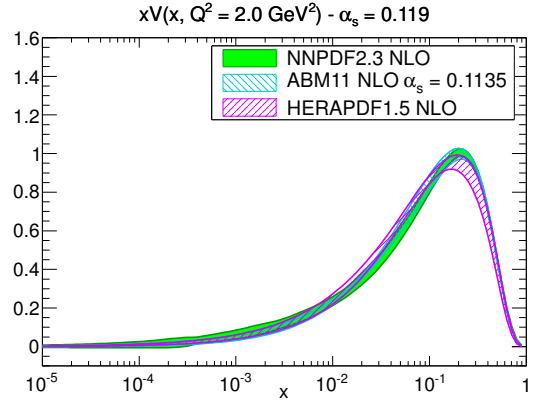


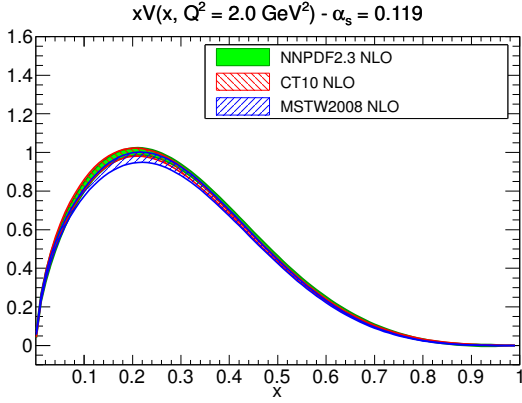
Figure 25
29



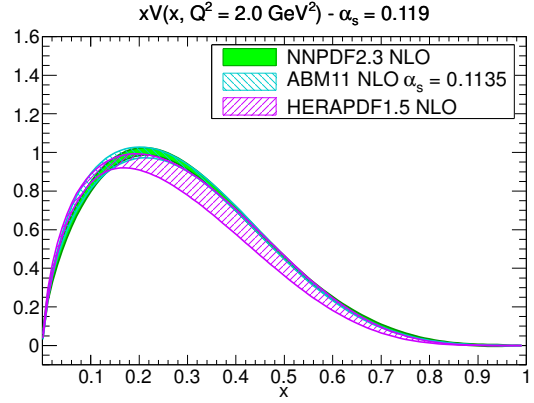
(a) Download (eps, png)



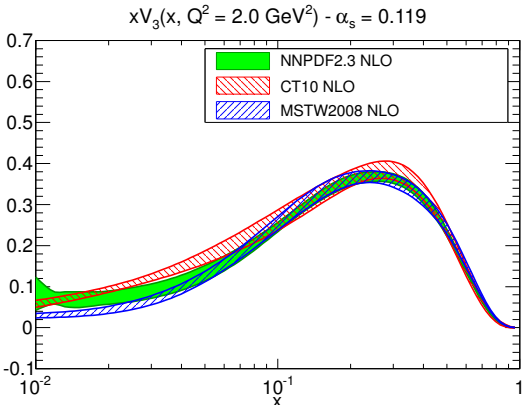
(b) Download (eps, png)



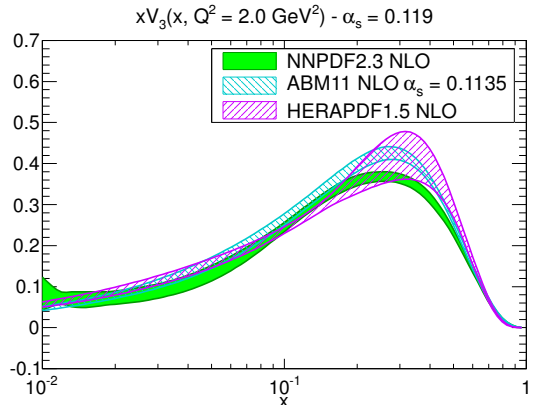
(c) Download (eps, png)



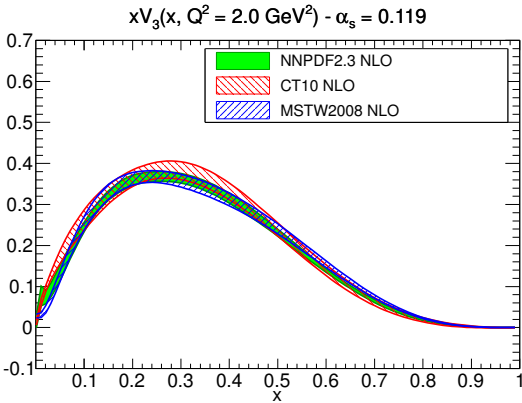
(d) Download (eps, png)



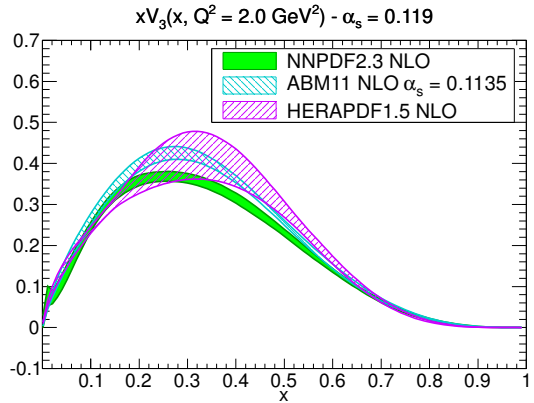
(e) Download (eps, png)



(f) Download (eps, png)

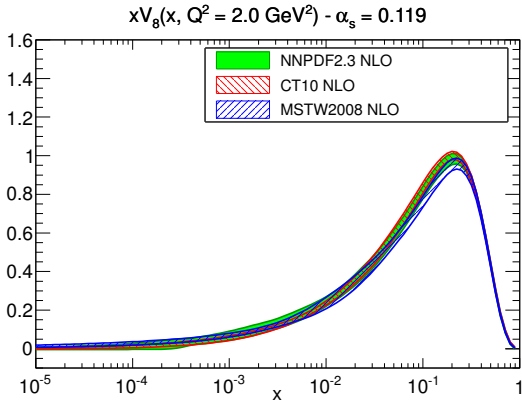


(g) Download (eps, png)

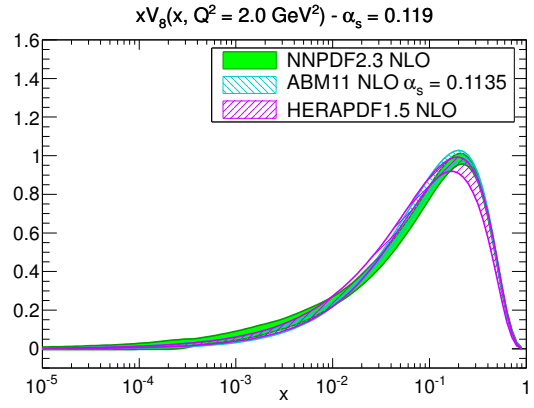


(h) Download (eps, png)

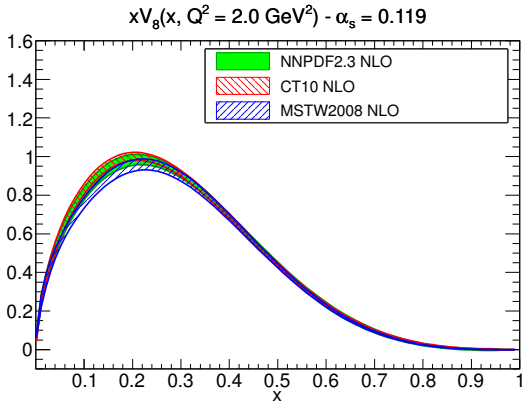
Figure 26



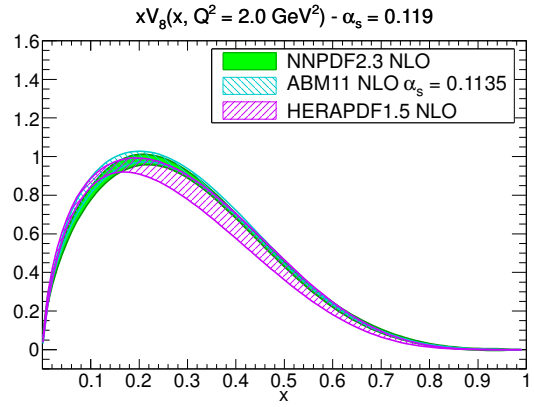
(a) Download (eps, png)



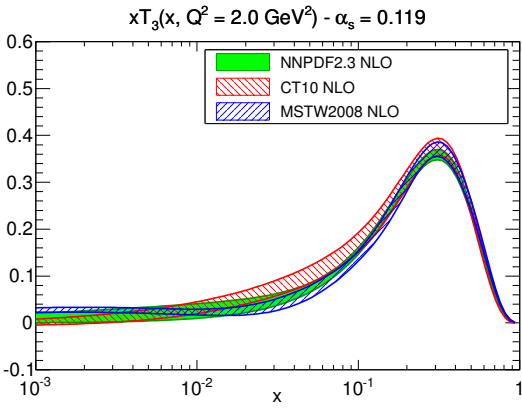
(b) Download (eps, png)



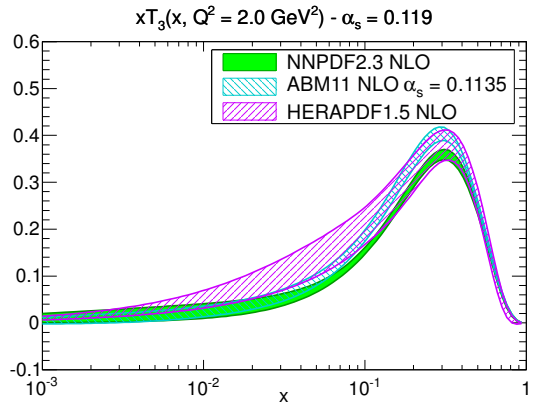
(c) Download (eps, png)



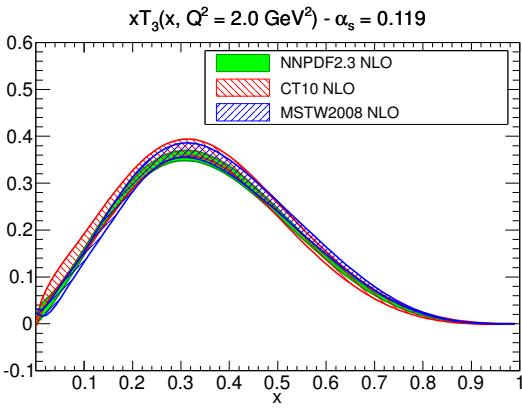
(d) Download (eps, png)



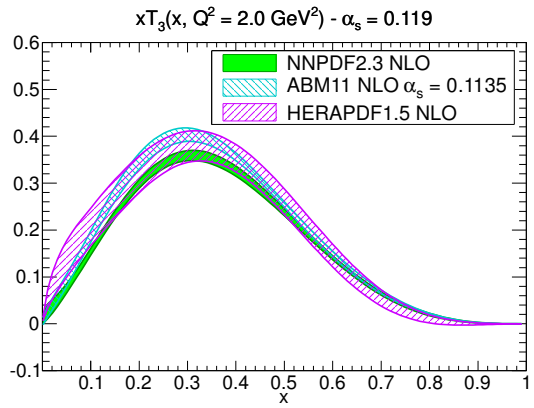
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 27

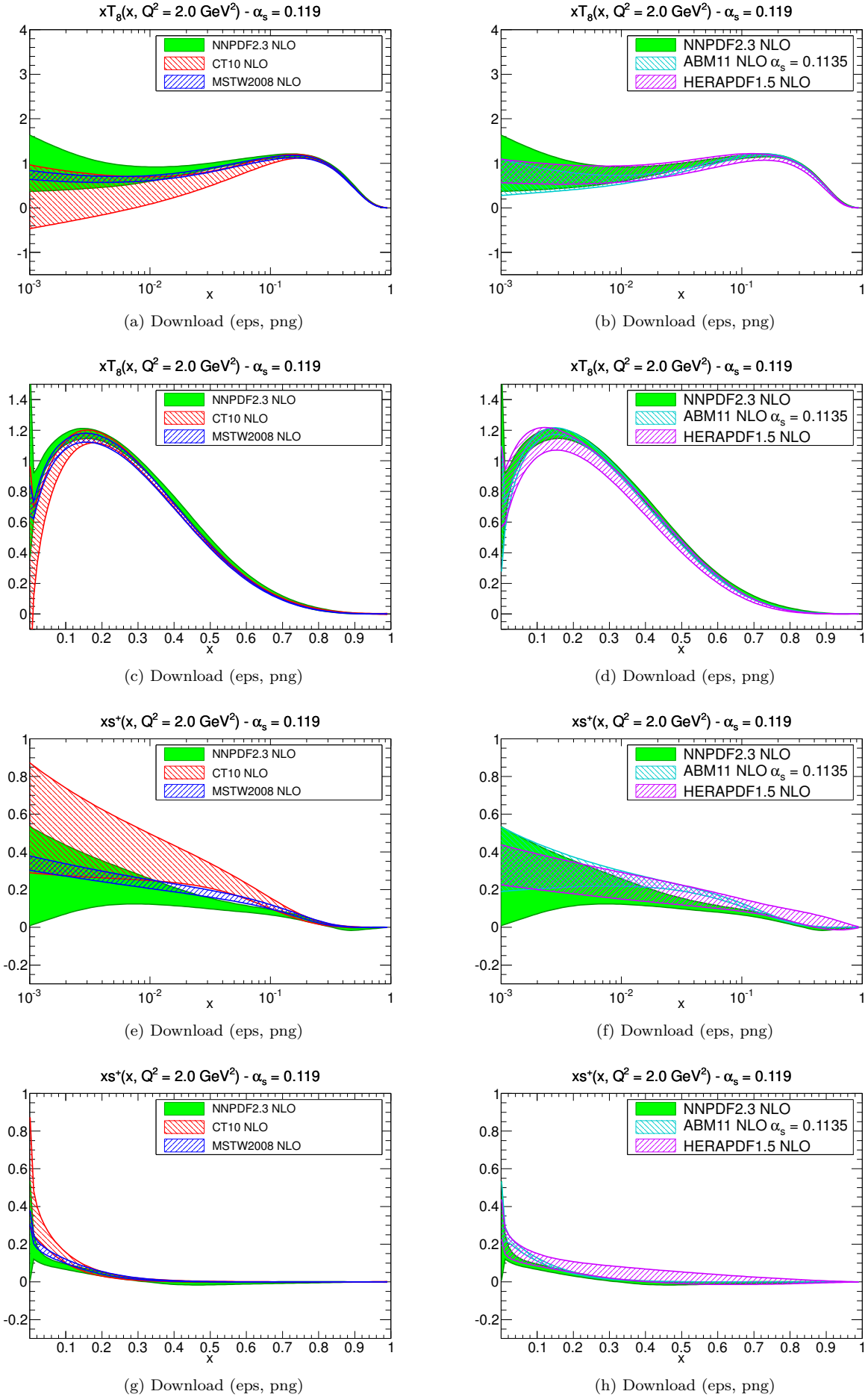
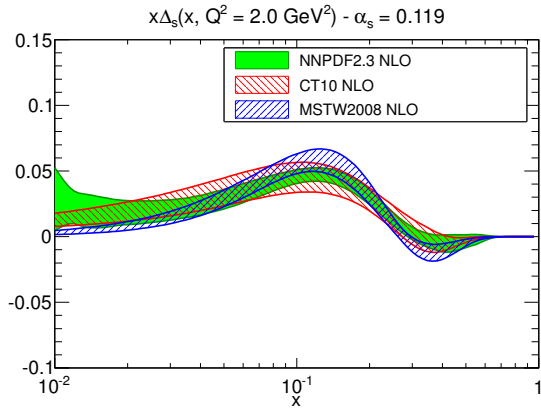
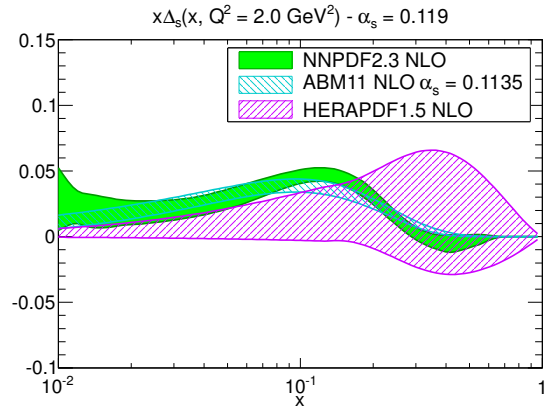


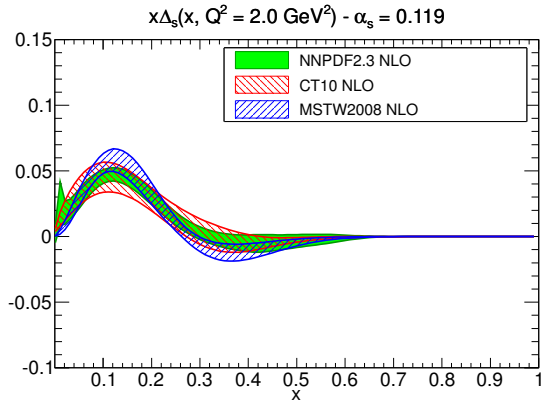
Figure 28



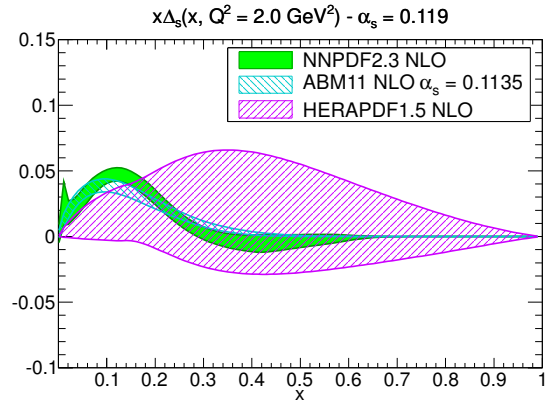
(a) Download (eps, png)



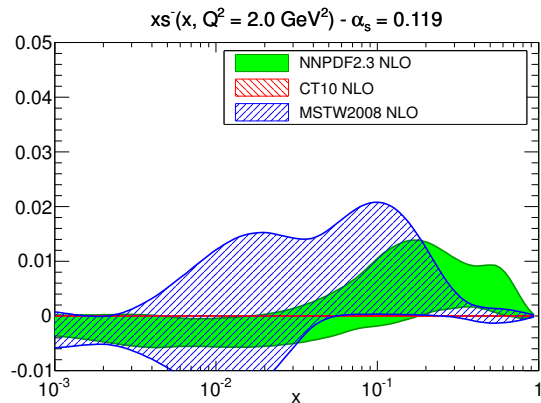
(b) Download (eps, png)



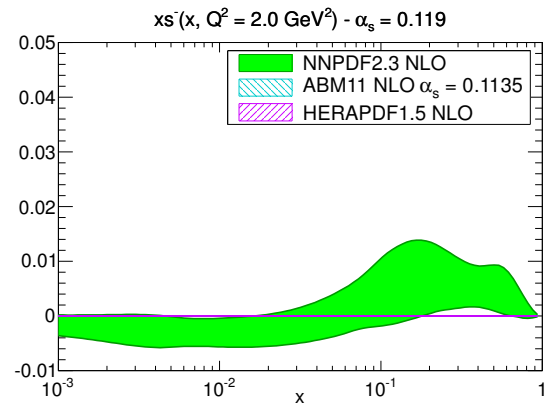
(c) Download (eps, png)



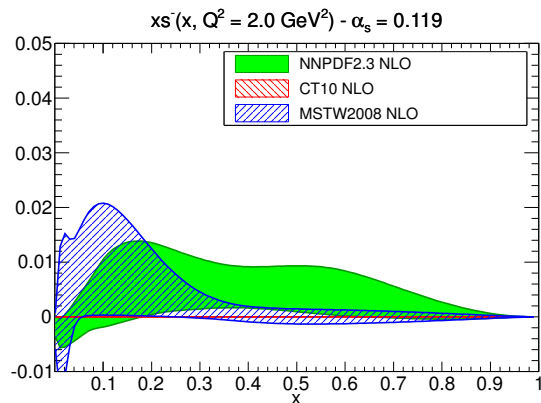
(d) Download (eps, png)



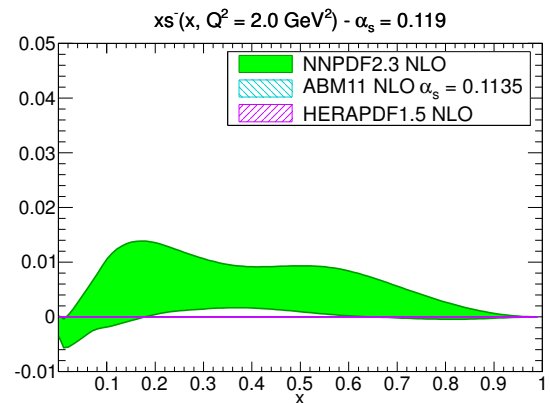
(e) Download (eps, png)



(f) Download (eps, png)



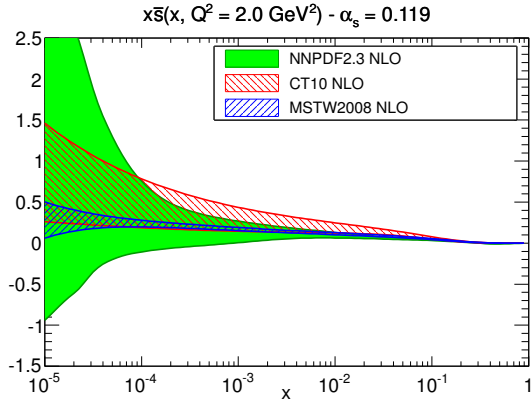
(g) Download (eps, png)



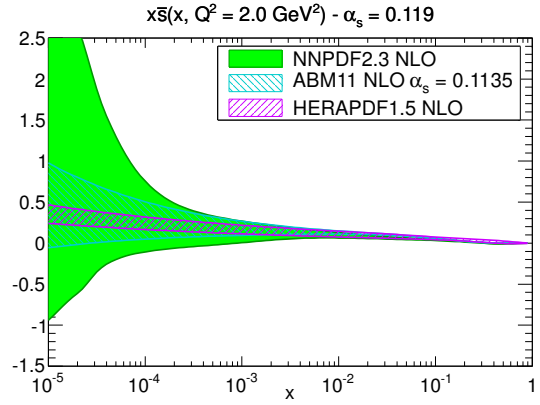
(h) Download (eps, png)

Figure 29

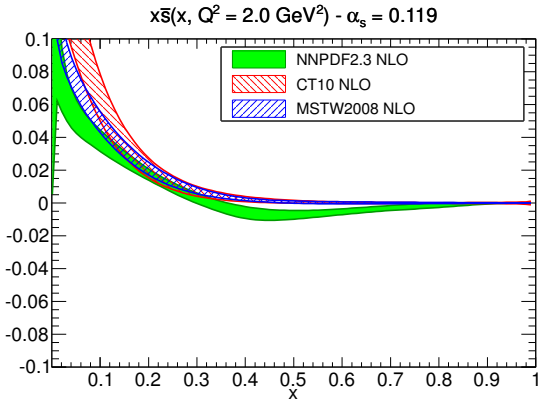
2.1.2 Flavor basis



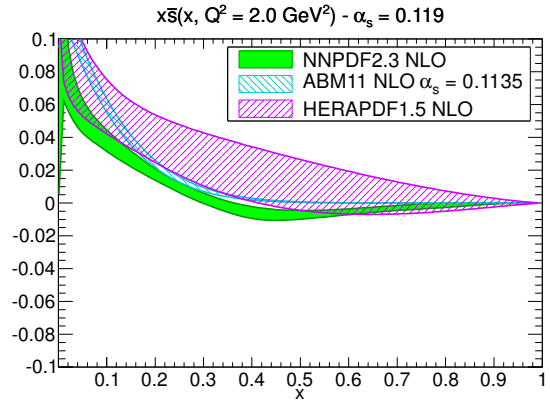
(a) Download (eps, png)



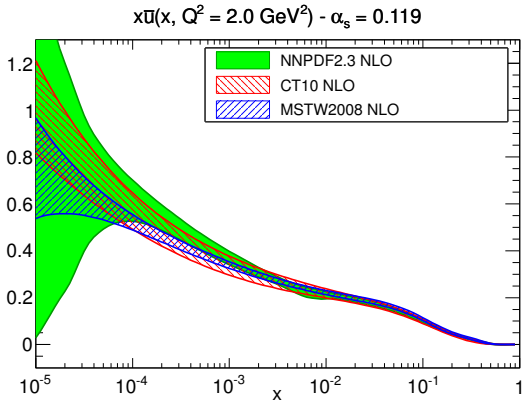
(b) Download (eps, png)



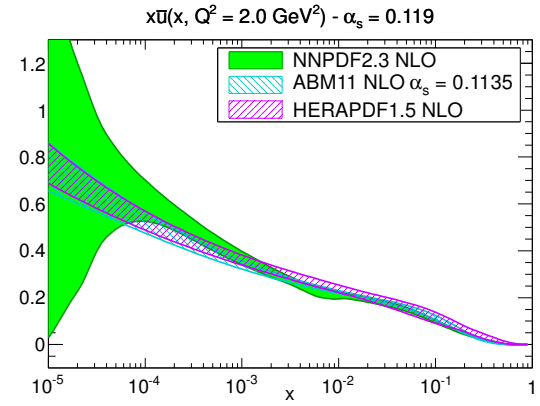
(c) Download (eps, png)



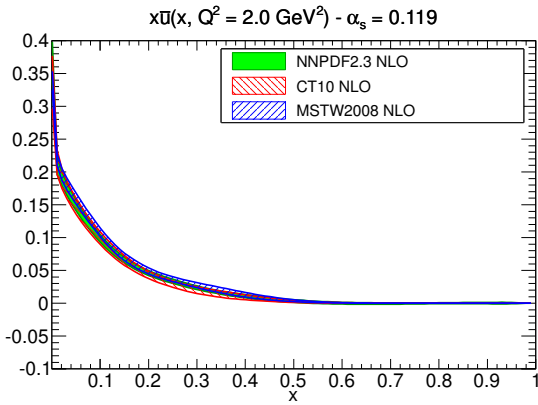
(d) Download (eps, png)



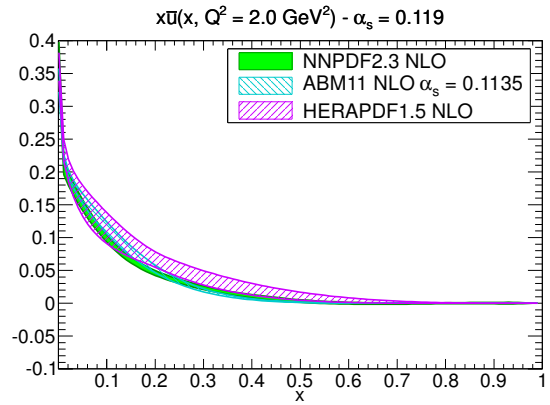
(e) Download (eps, png)



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(g) Download (eps, png)



(h) Download (eps, png)

Figure 30

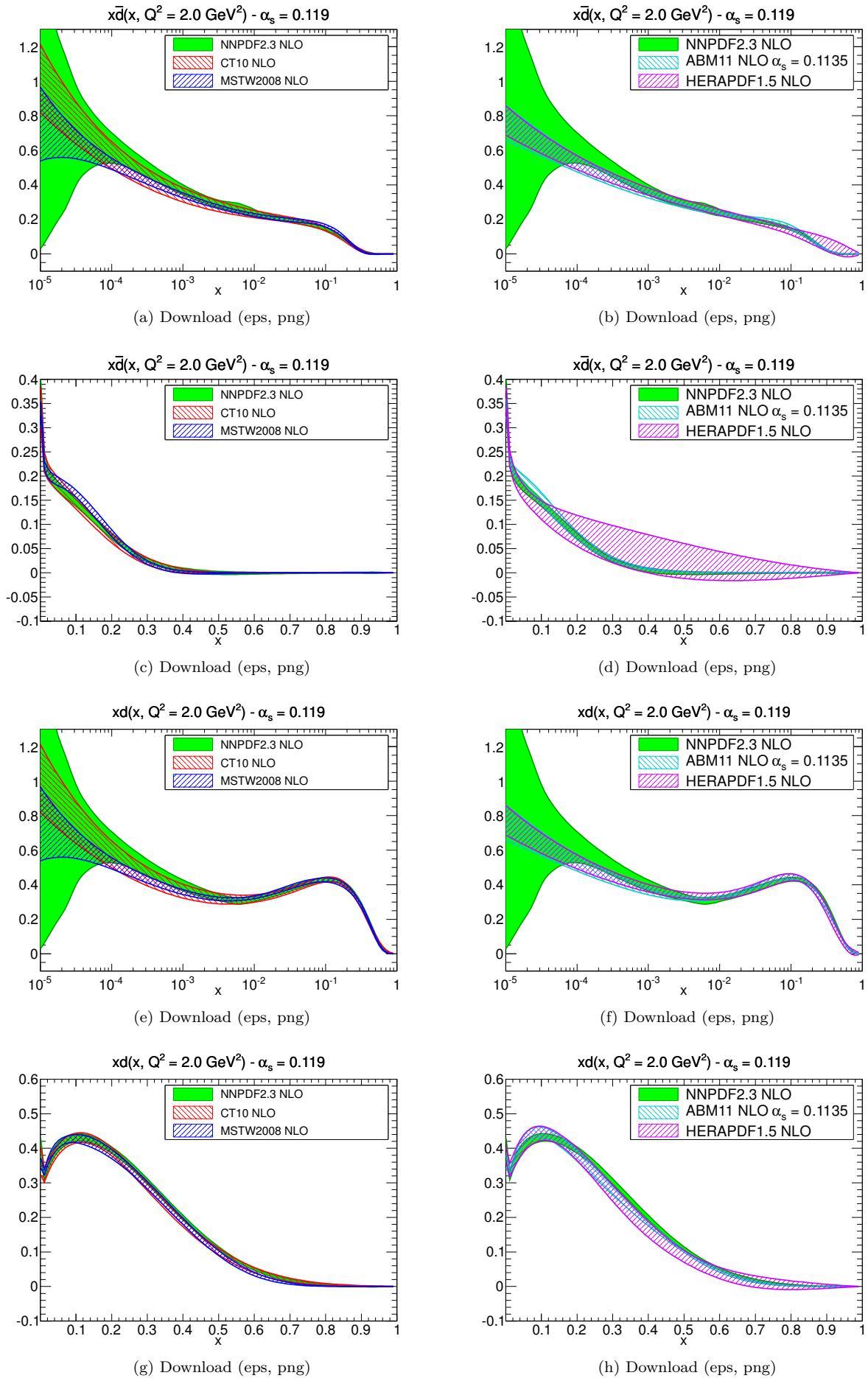


Figure 31

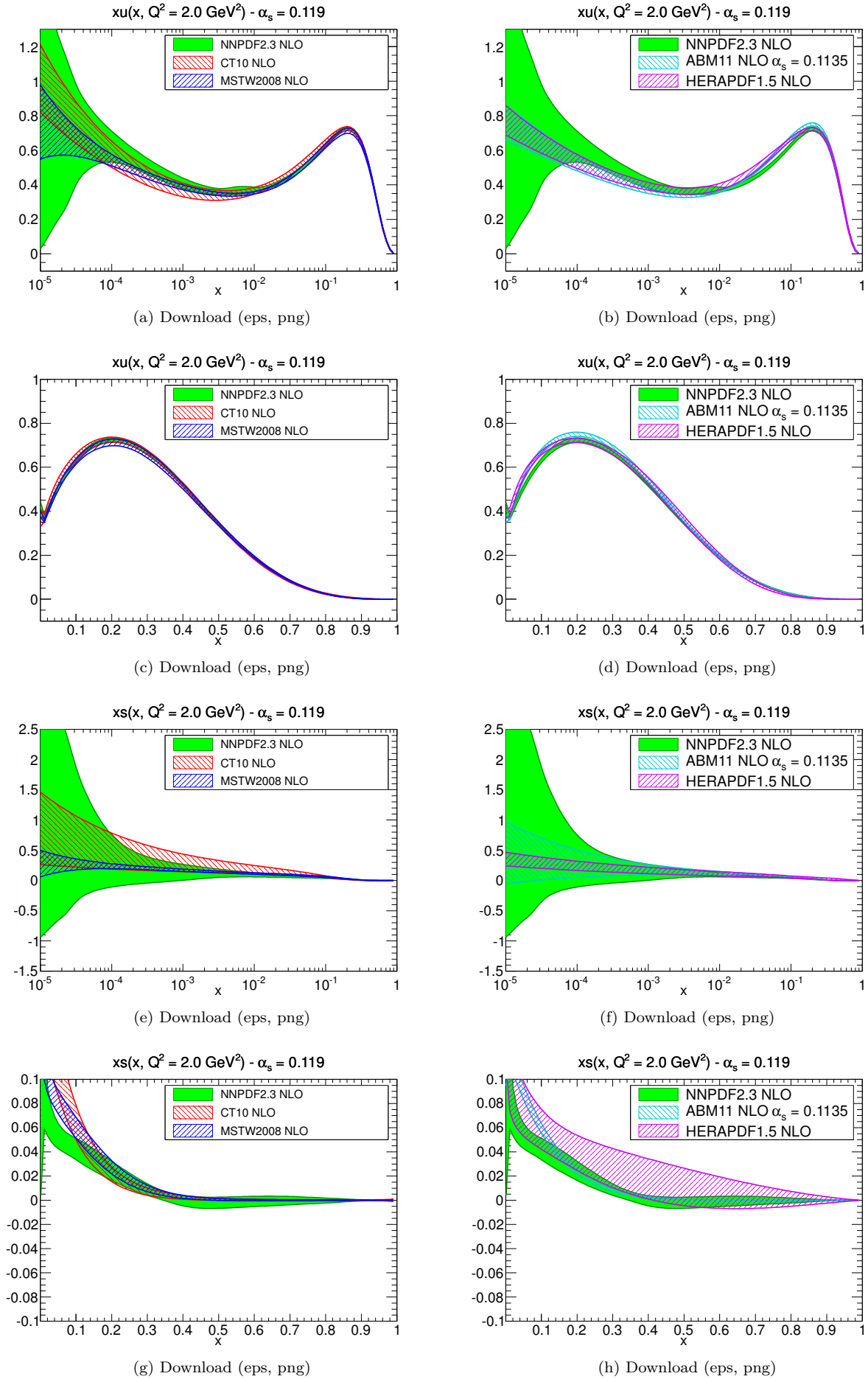


Figure 32

2.2 NNLO at $Q^2 = 2 \text{ GeV}^2$

2.2.1 Evolution basis

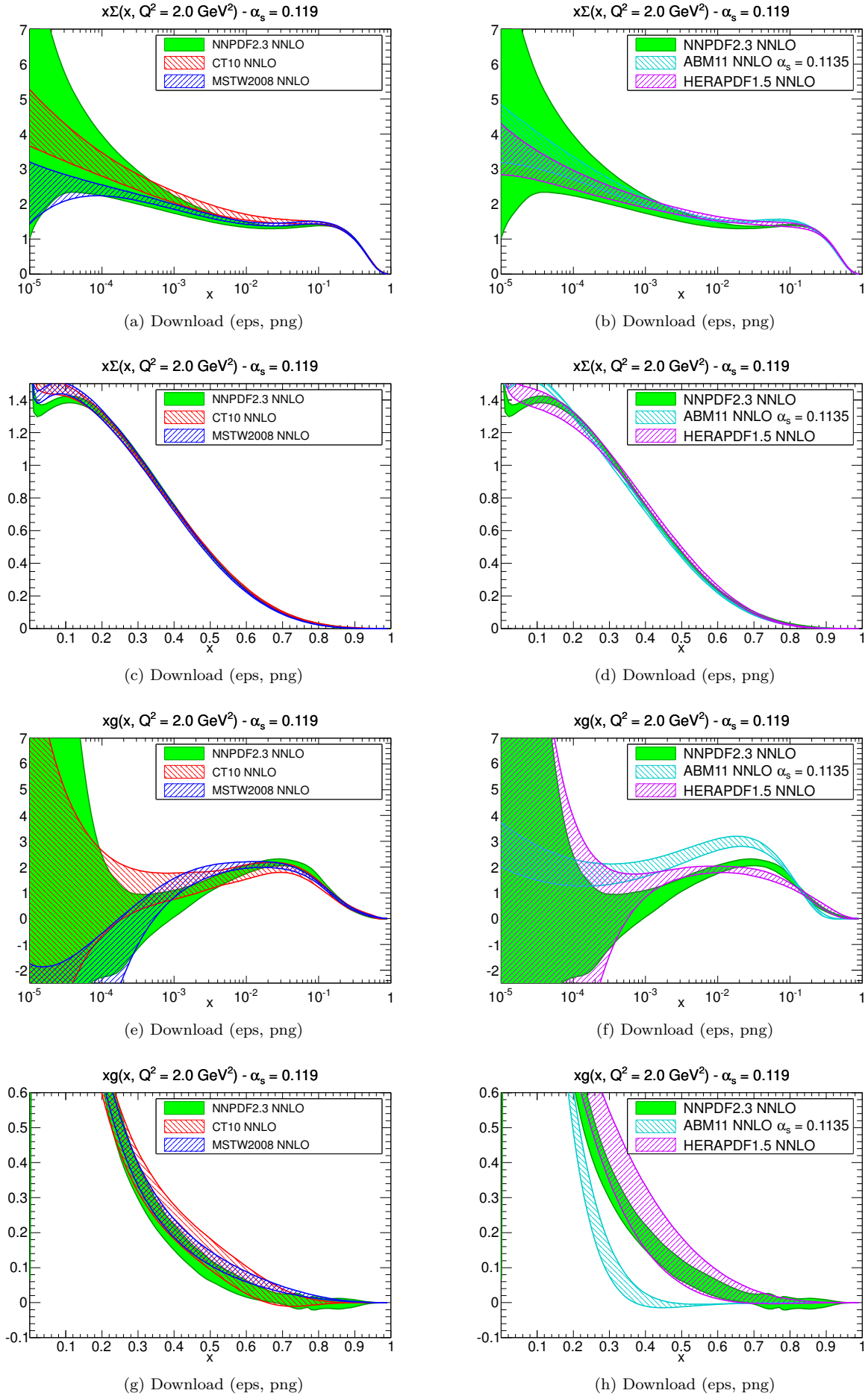
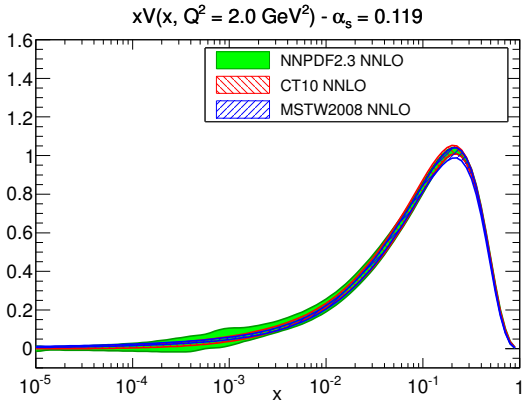
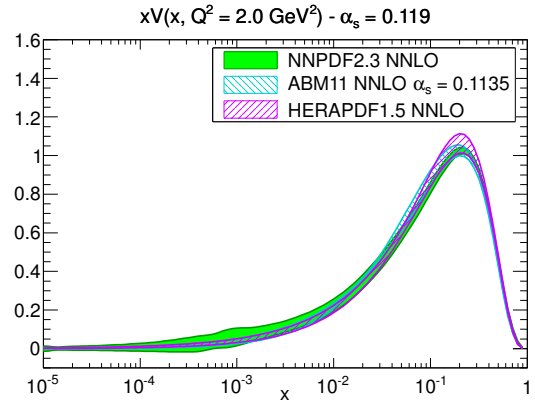


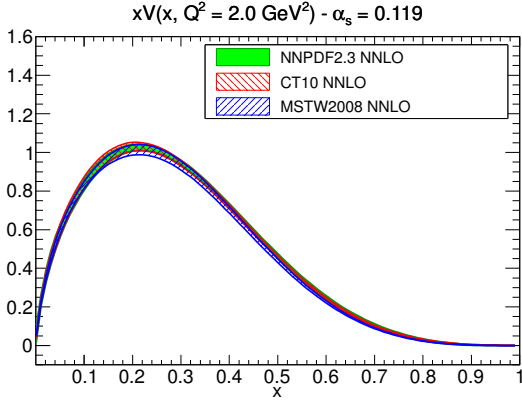
Figure 33



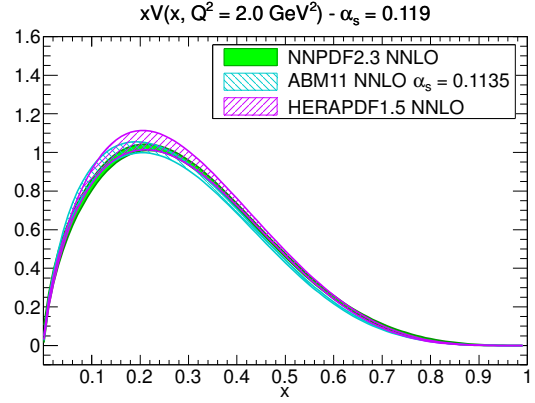
(a) Download (eps, png)



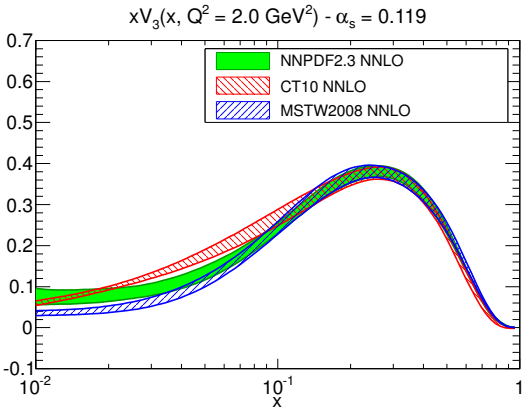
(b) Download (eps, png)



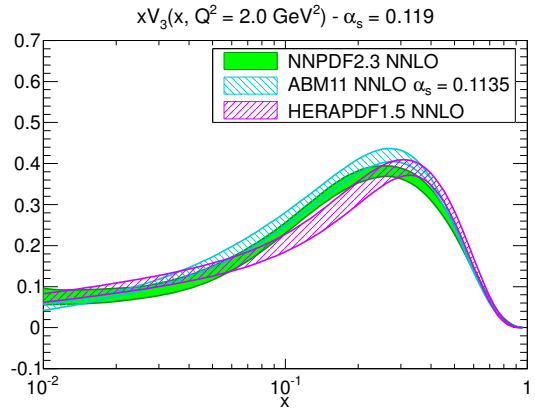
(c) Download (eps, png)



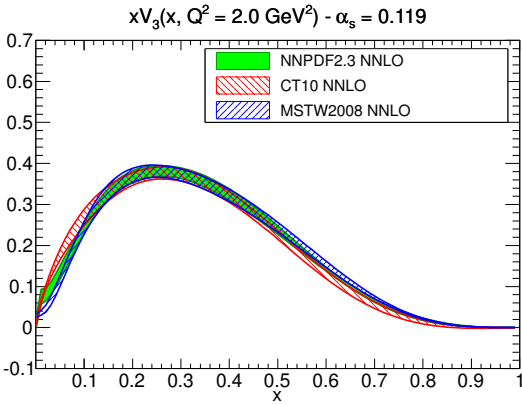
(d) Download (eps, png)



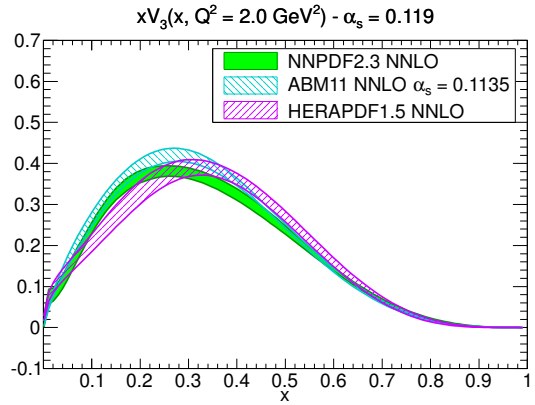
(e) Download (eps, png)



(f) Download (eps, png)

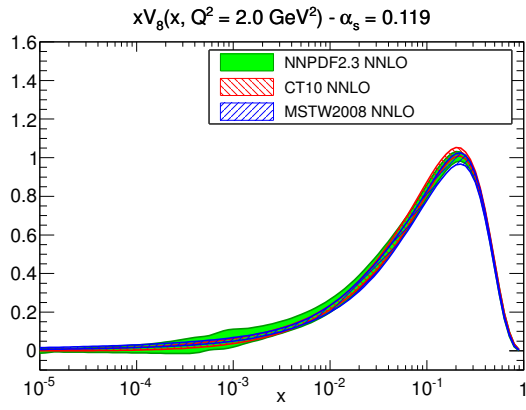


(g) Download (eps, png)

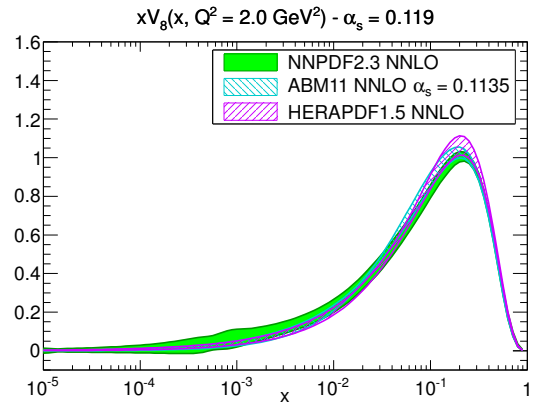


(h) Download (eps, png)

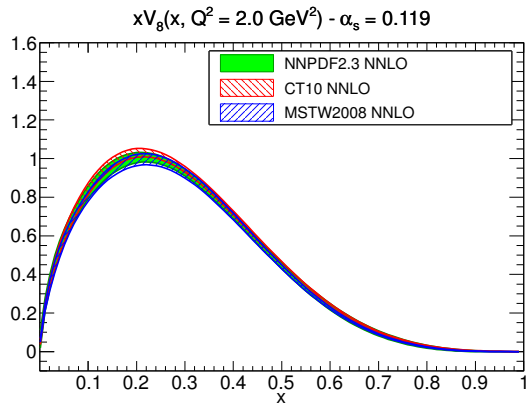
Figure 34



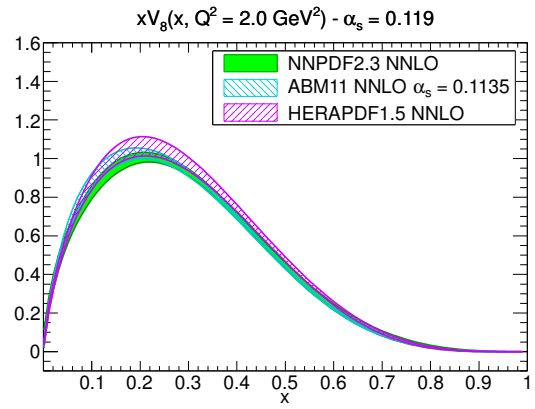
(a) Download (eps, png)



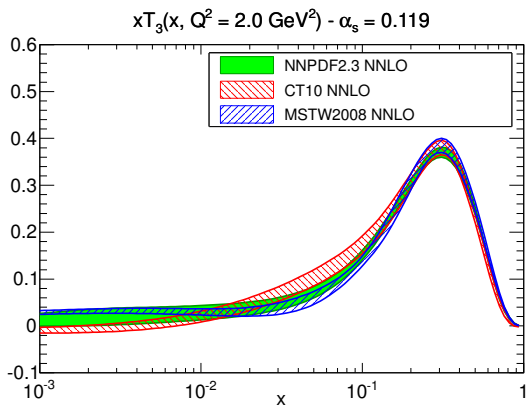
(b) Download (eps, png)



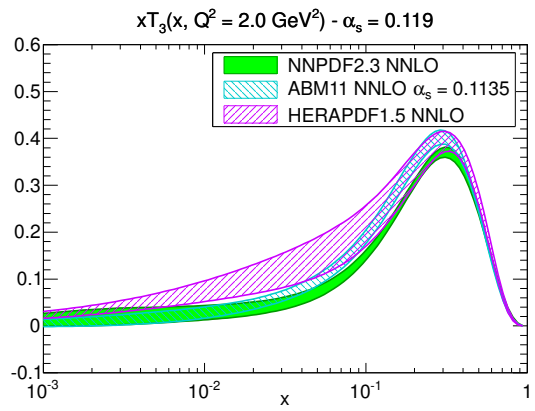
(c) Download (eps, png)



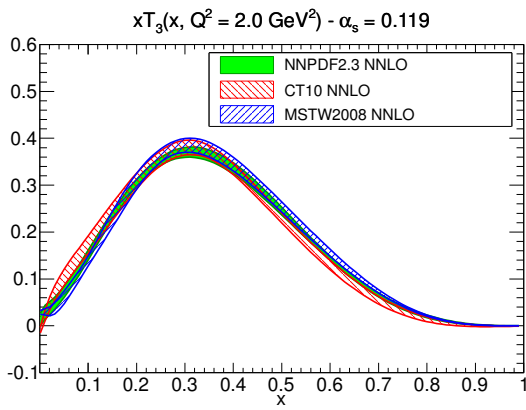
(d) Download (eps, png)



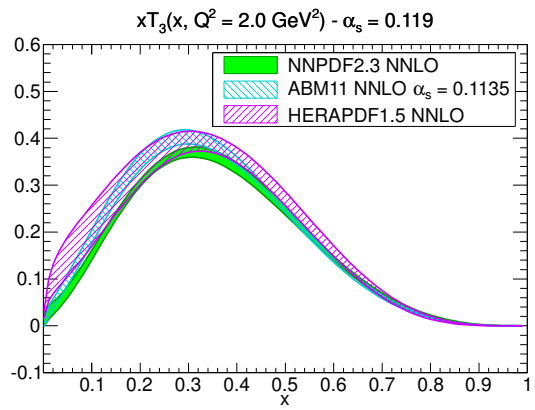
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 35

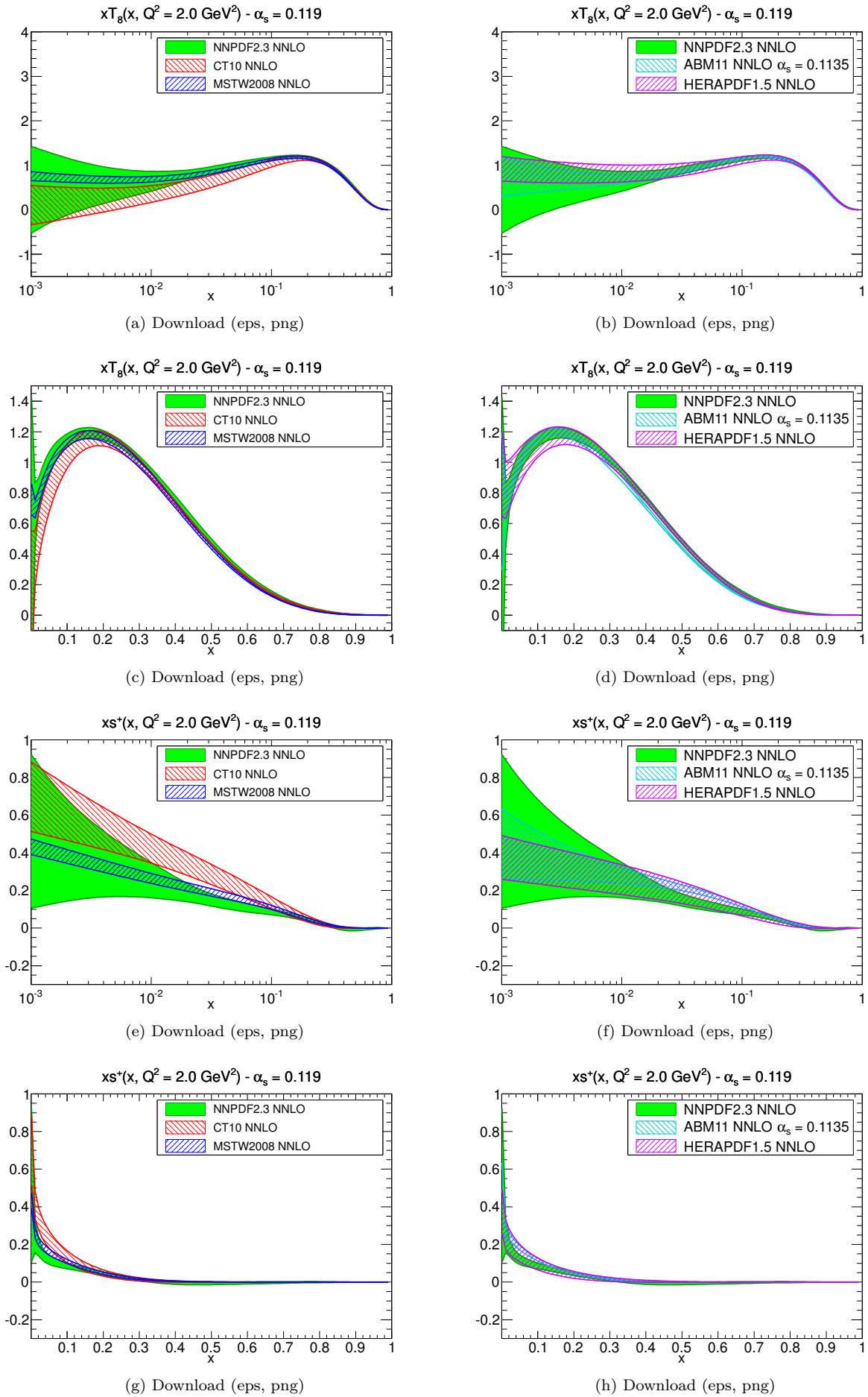
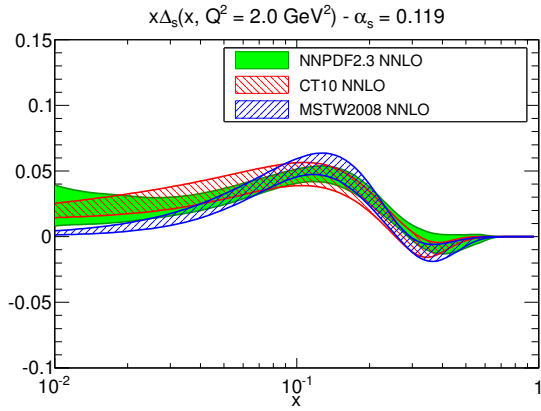
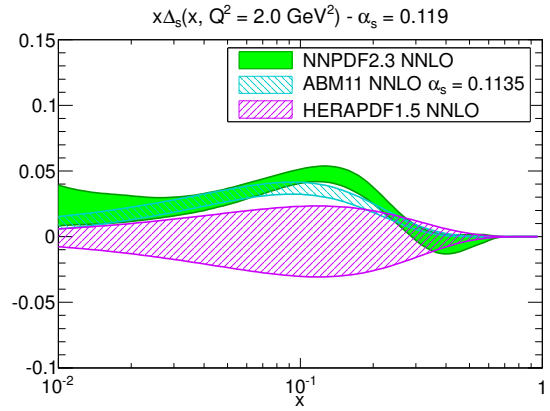


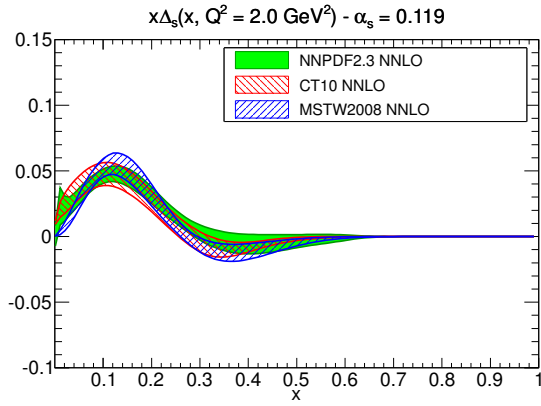
Figure 36



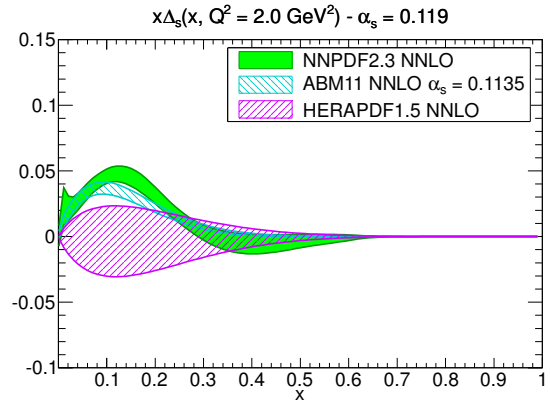
(a) Download (eps, png)



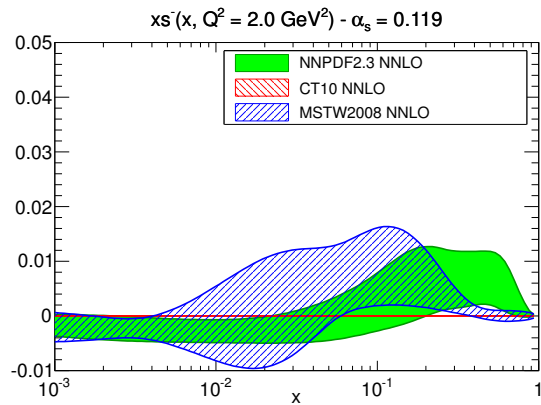
(b) Download (eps, png)



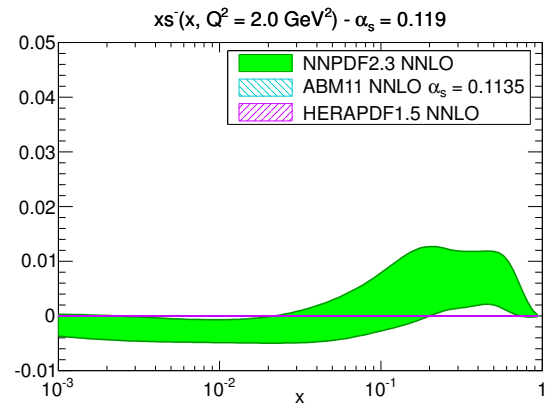
(c) Download (eps, png)



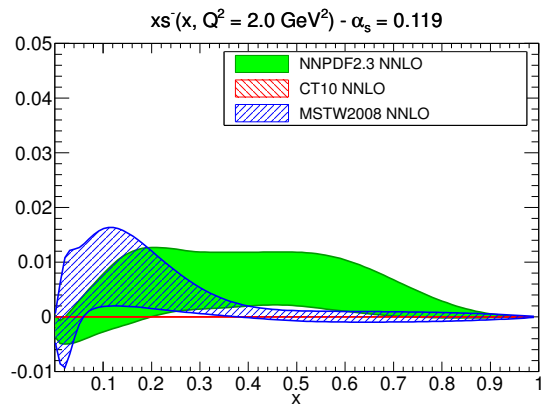
(d) Download (eps, png)



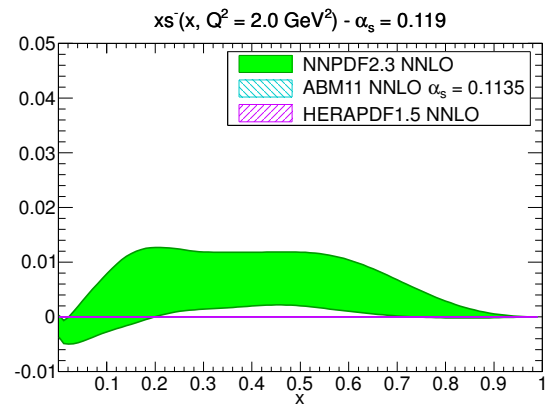
(e) Download (eps, png)



(f) Download (eps, png)



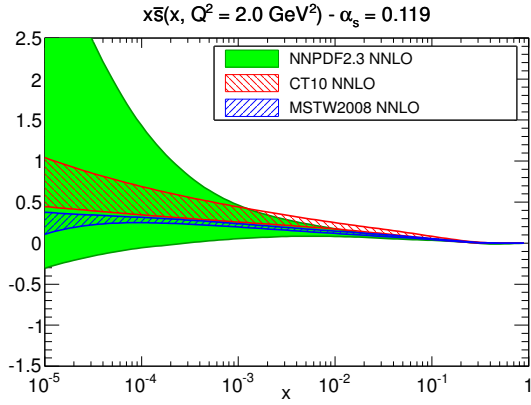
(g) Download (eps, png)



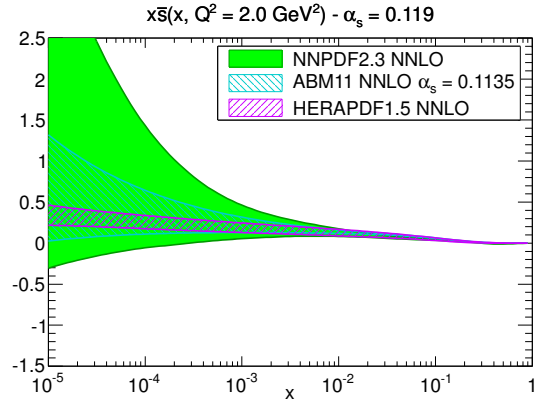
(h) Download (eps, png)

Figure 37

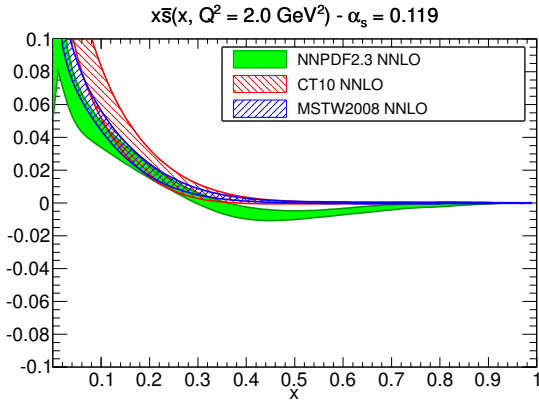
2.2.2 Flavor basis



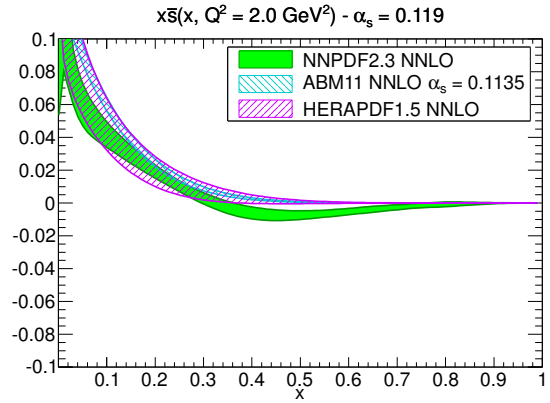
(a) Download (eps, png)



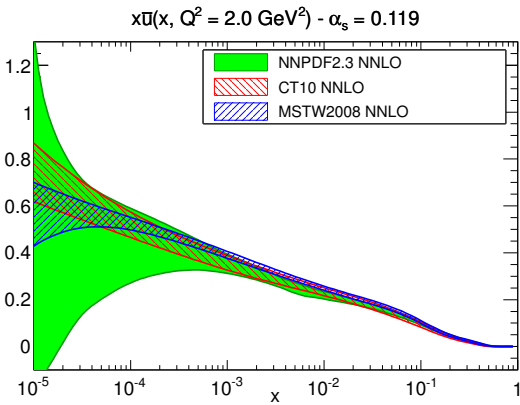
(b) Download (eps, png)



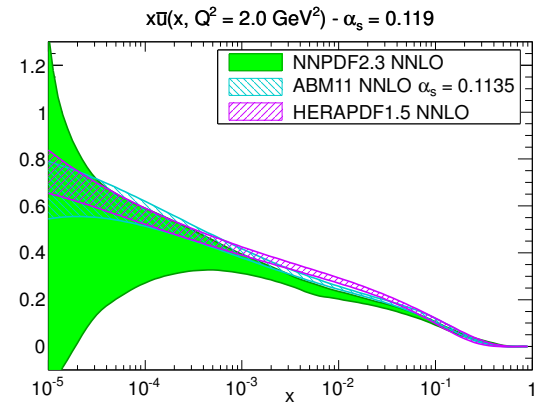
(c) Download (eps, png)



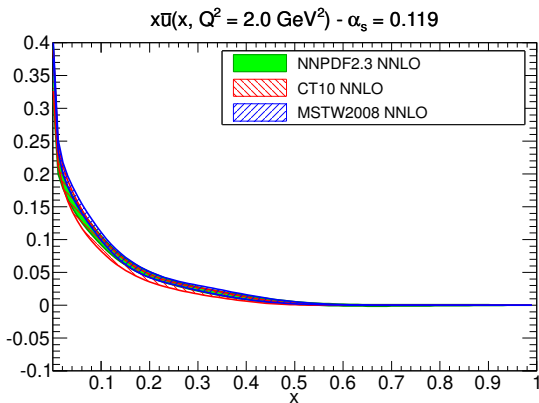
(d) Download (eps, png)



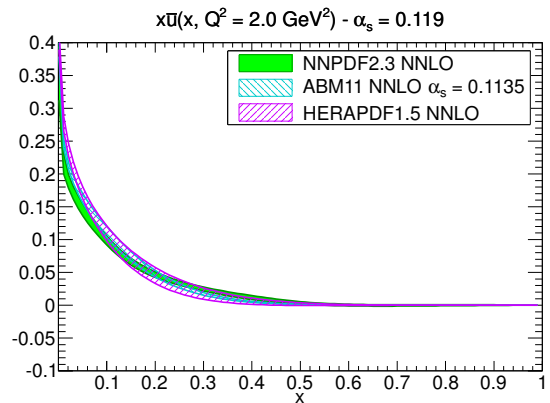
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 38

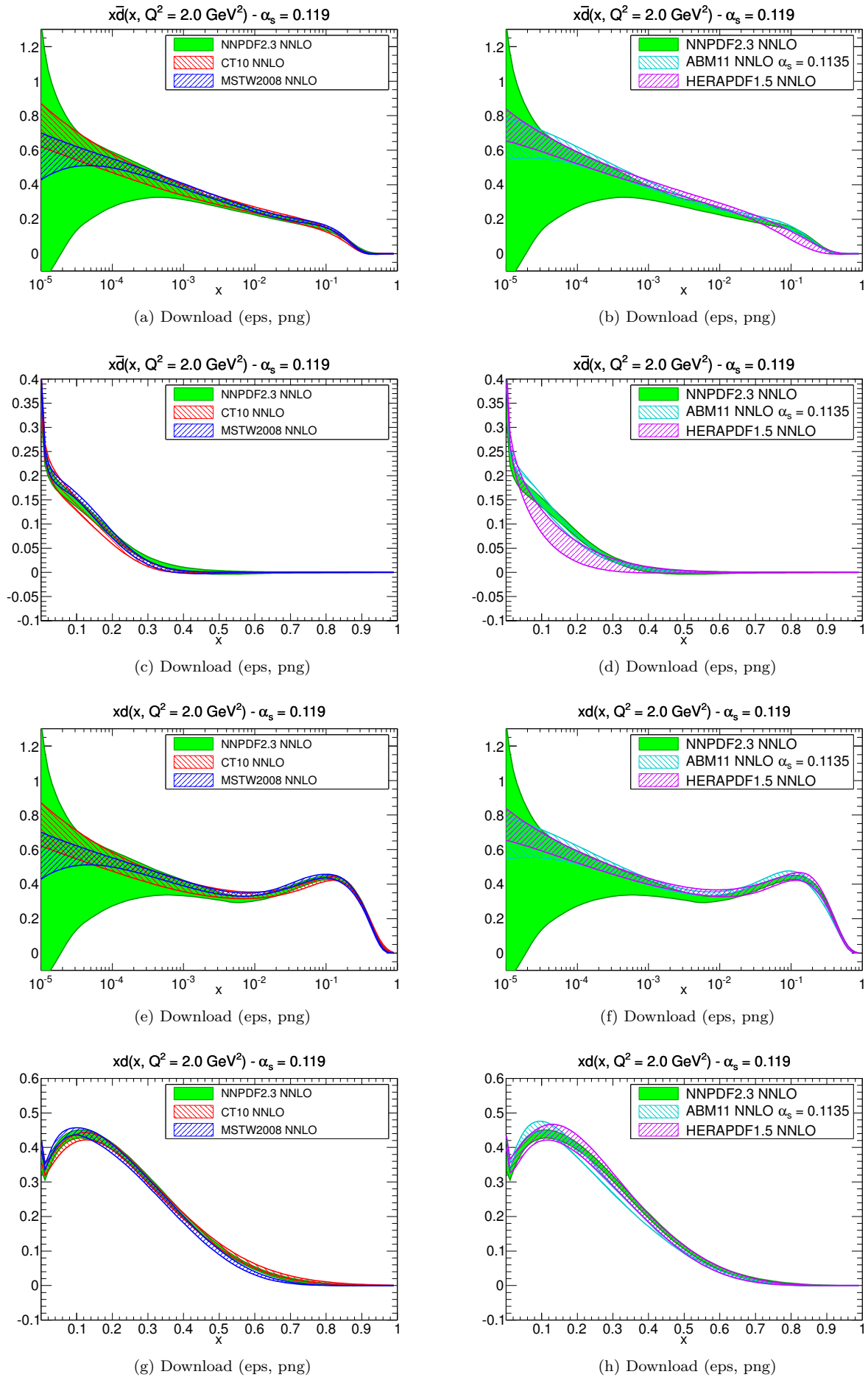


Figure 39

2.3 NNLO ratios at $Q^2 = 10^4 \text{ GeV}^2$

2.3.1 Evolution basis

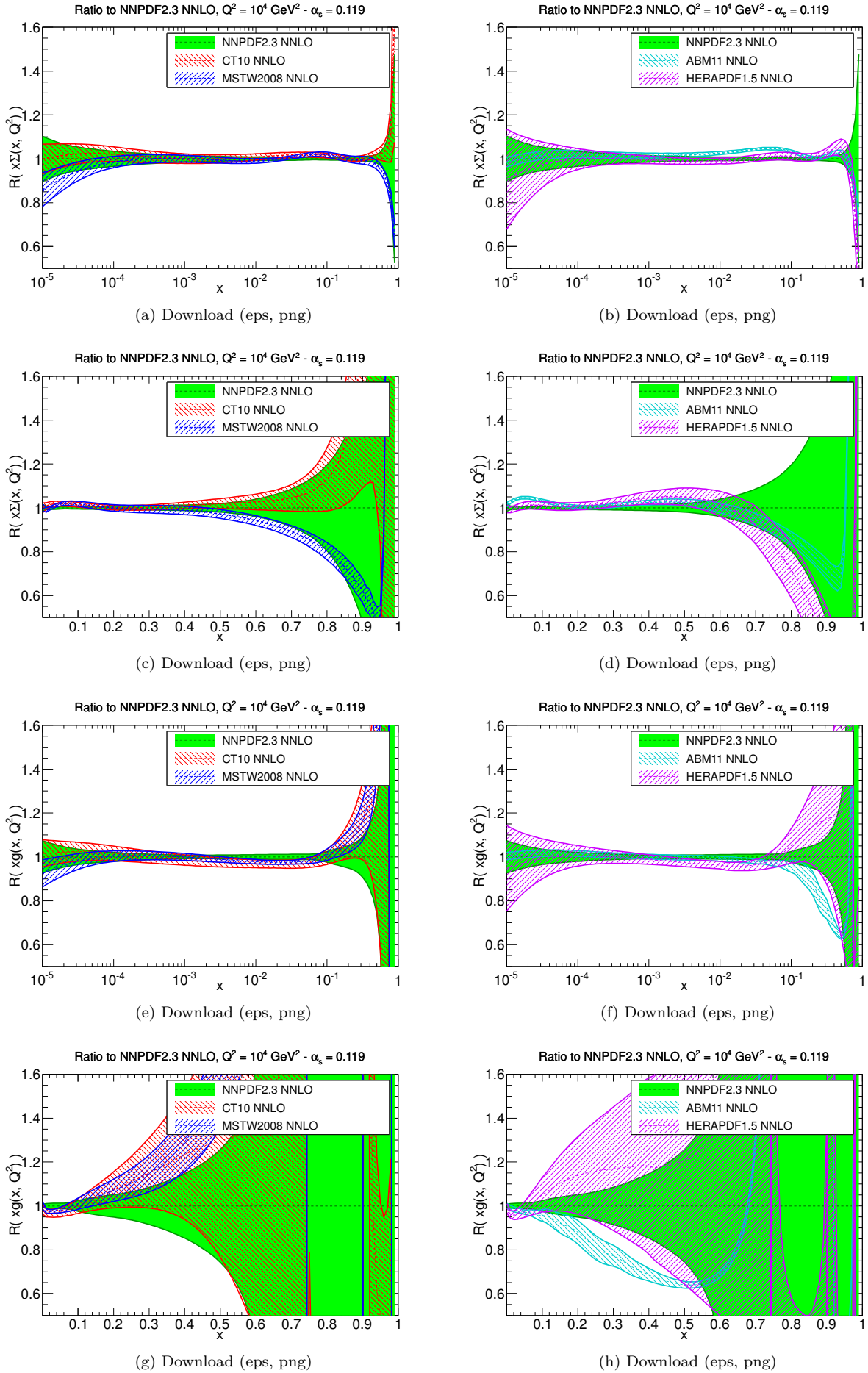


Figure 41

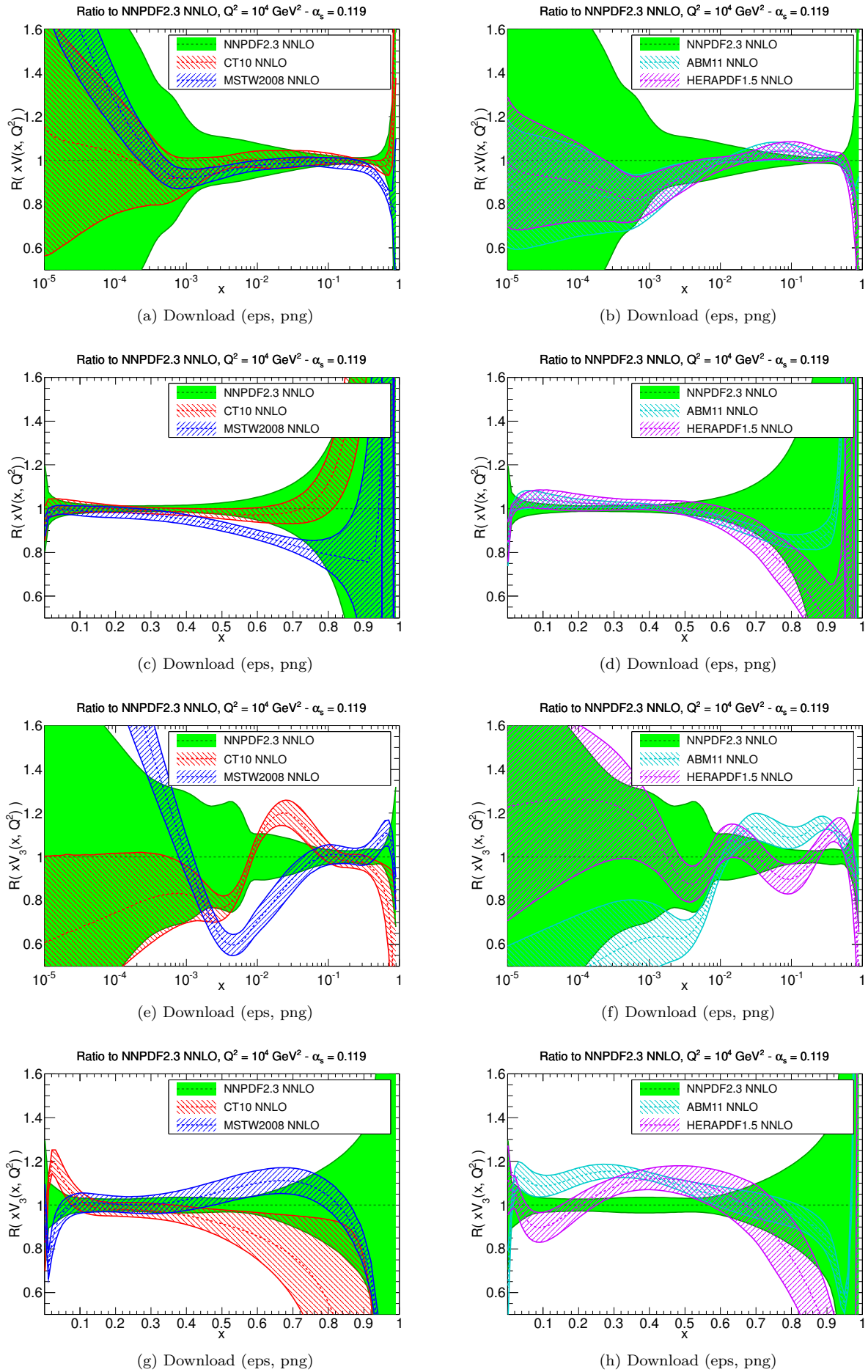


Figure 42

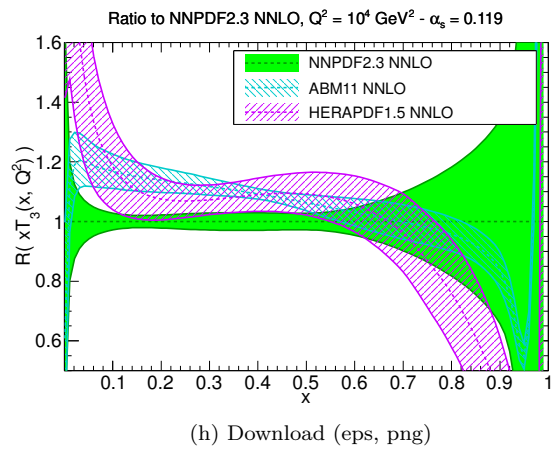
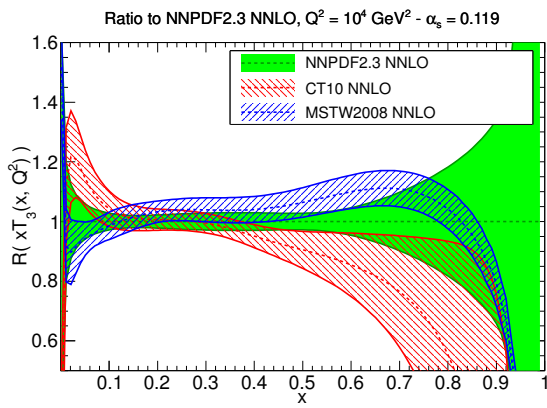
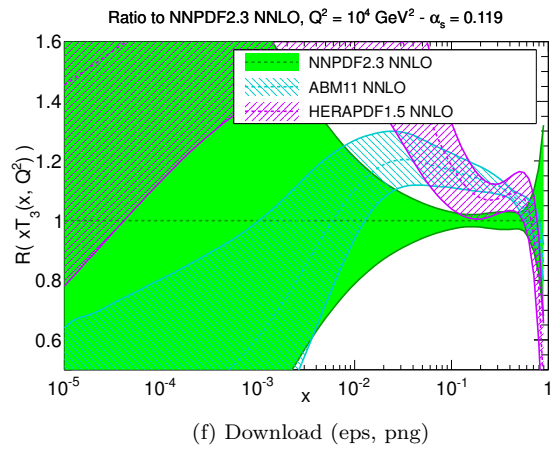
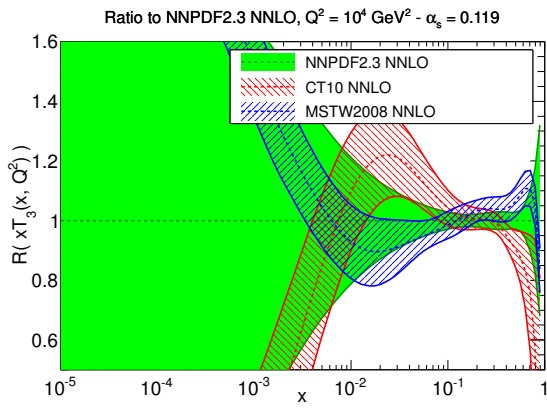
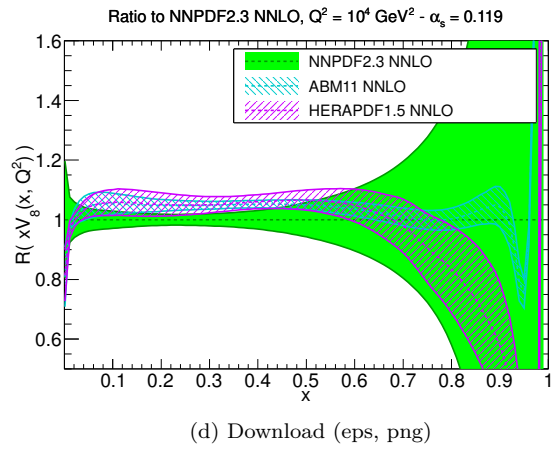
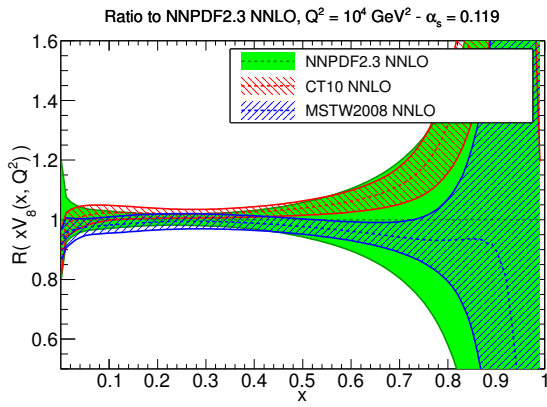
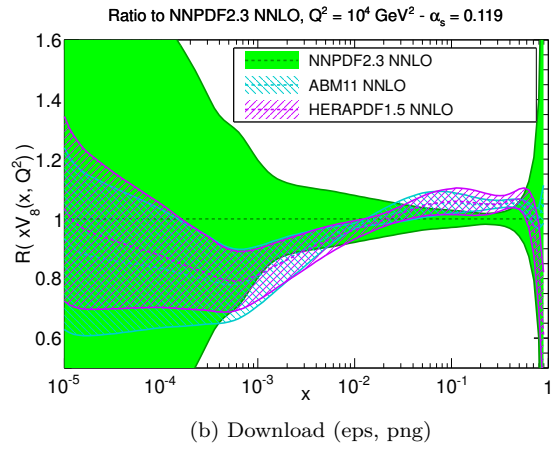
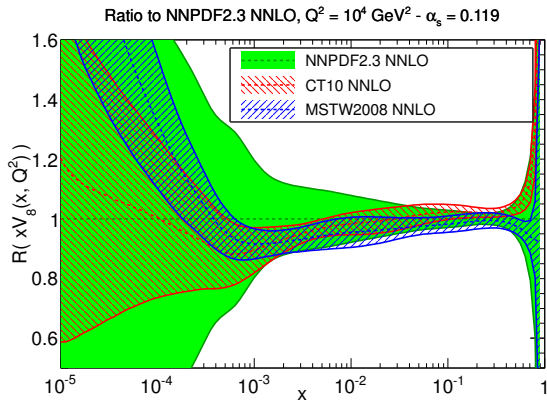


Figure 43

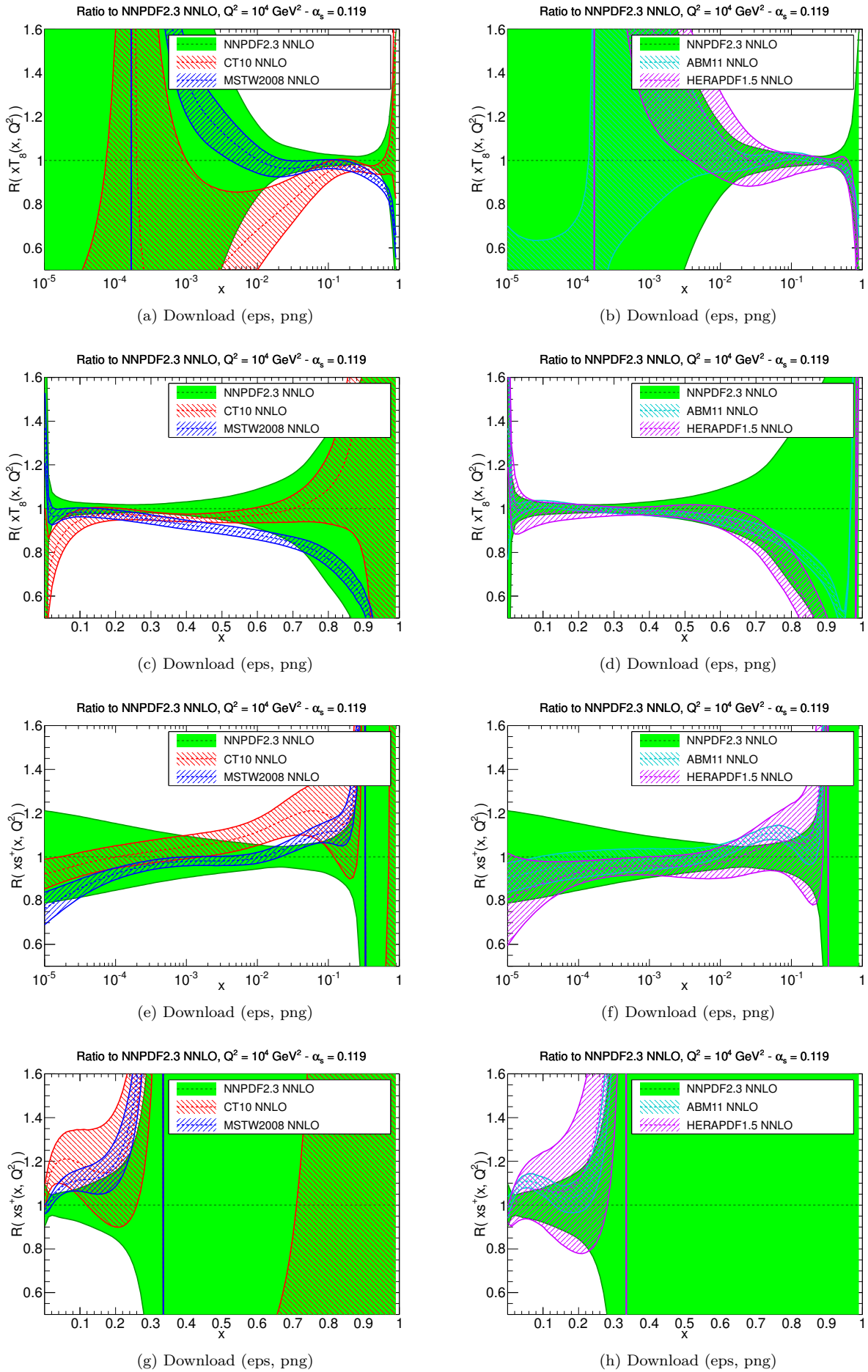
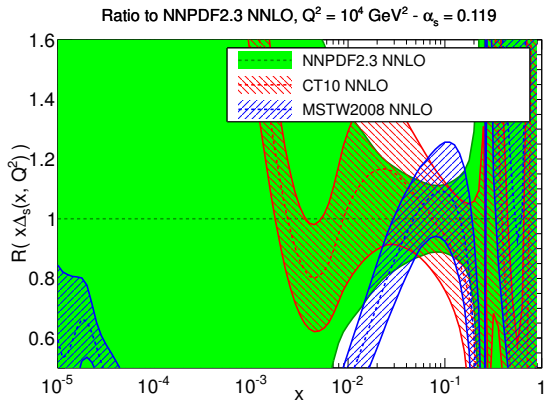
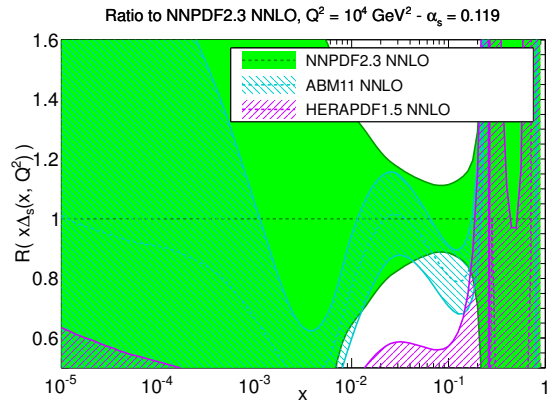


Figure 44



(a) Download (eps, png)



(b) Download (eps, png)

Figure 45

2.3.2 Flavor basis

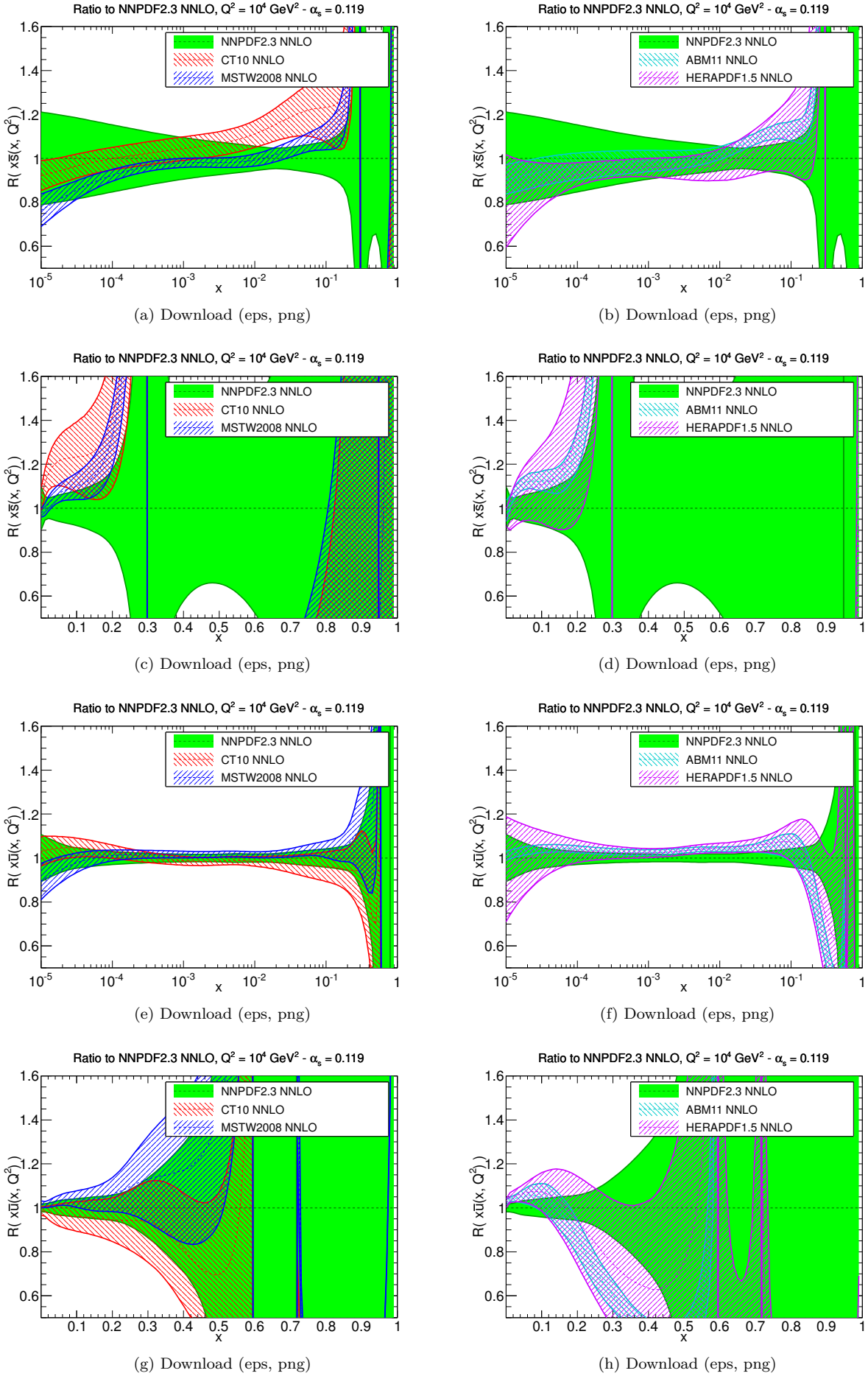
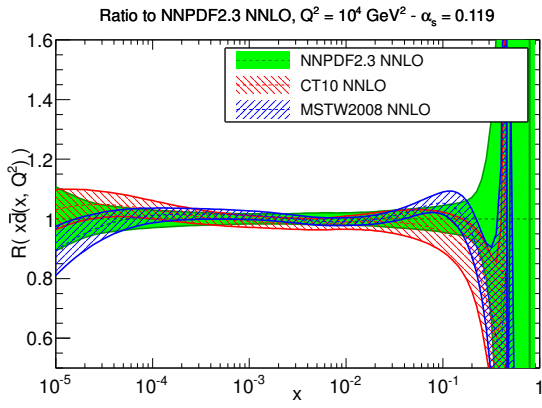
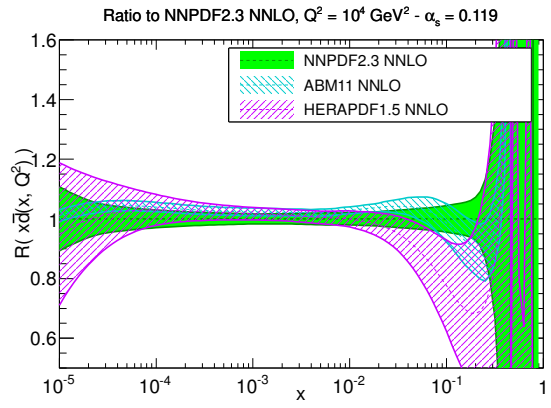


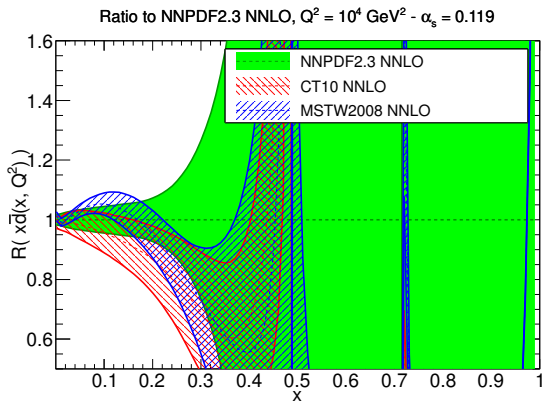
Figure 46



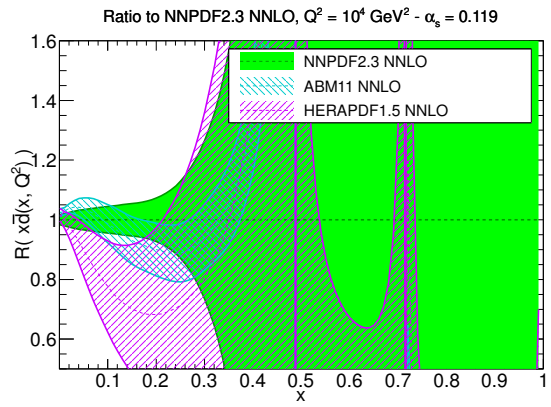
(a) Download (eps, png)



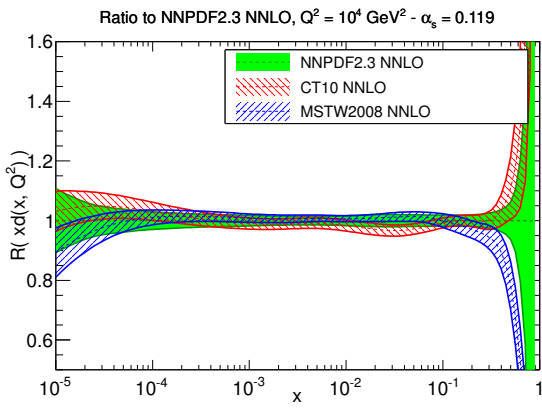
(b) Download (eps, png)



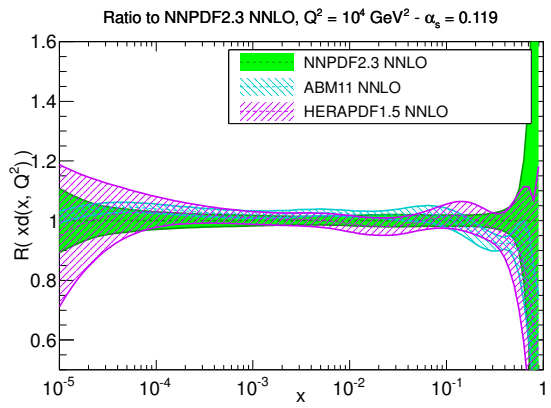
(c) Download (eps, png)



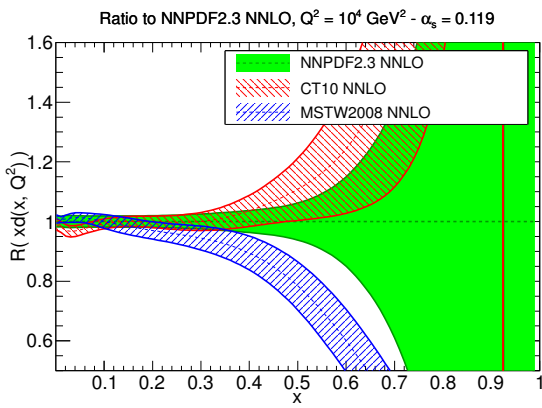
(d) Download (eps, png)



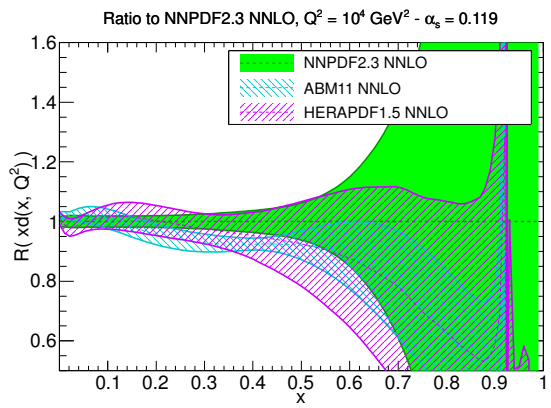
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 47

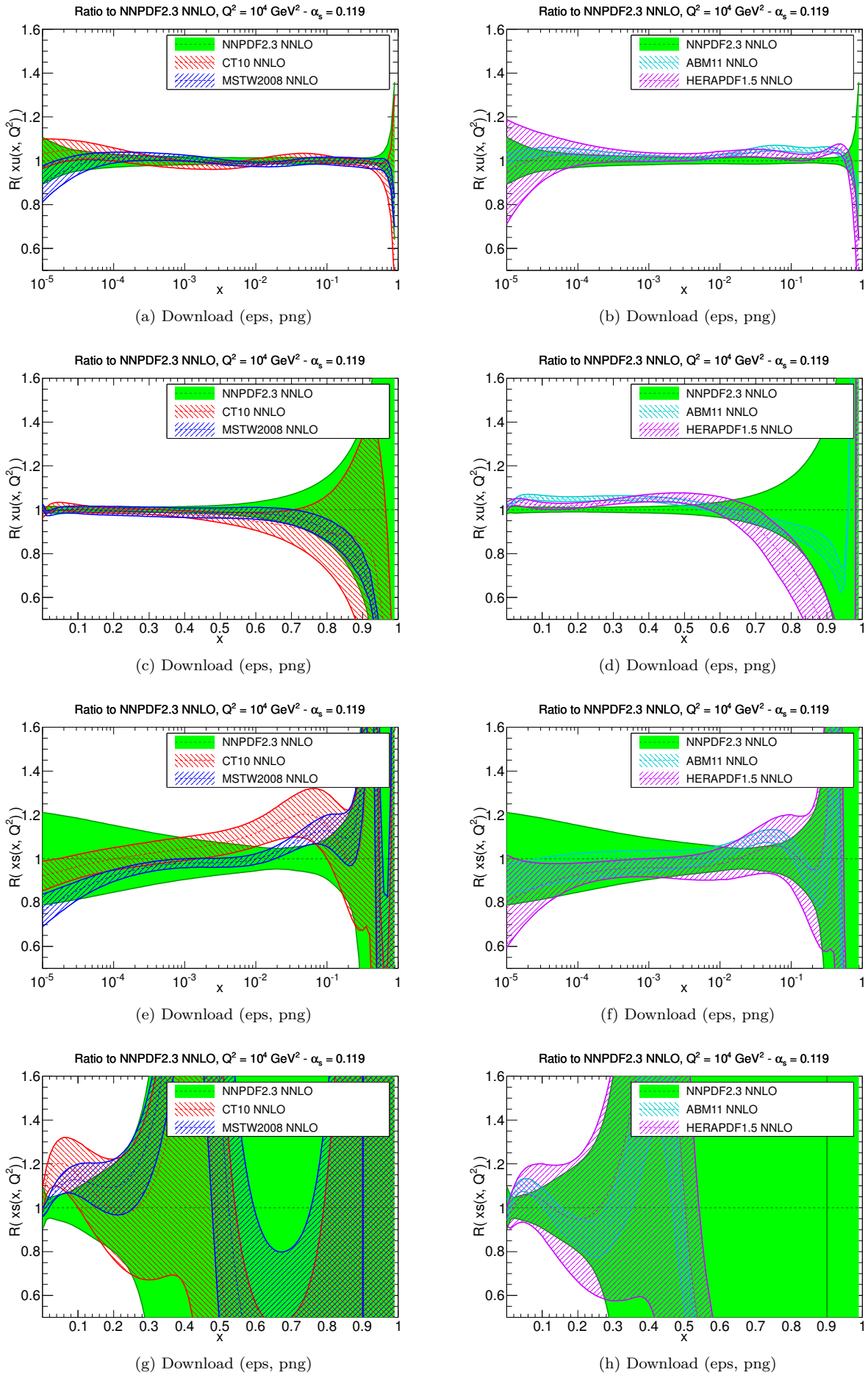


Figure 48

3 PDFs comparison at $\alpha_s = 0.117$

3.1 NLO at $Q^2 = 2 \text{ GeV}^2$

3.1.1 Evolution basis

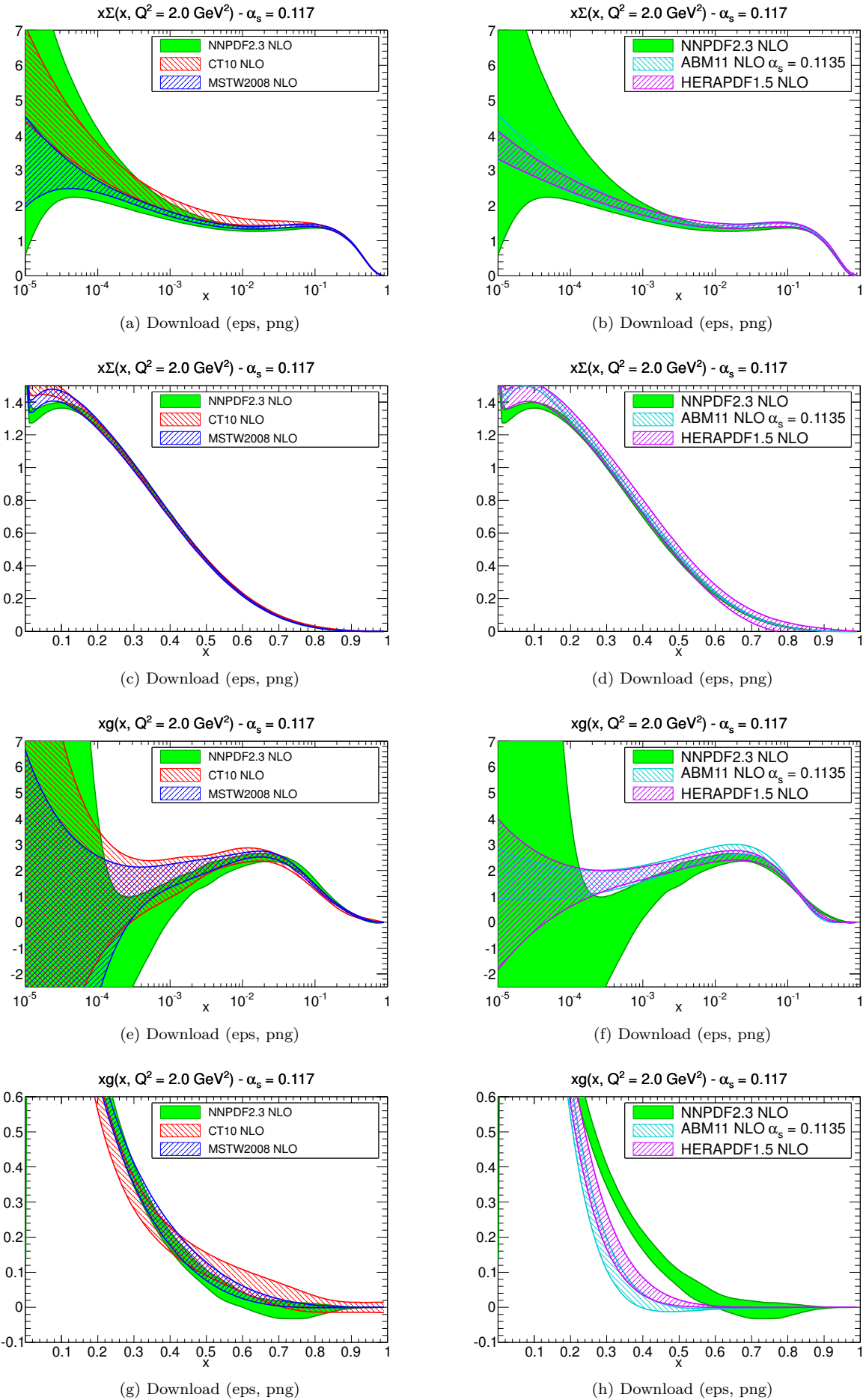
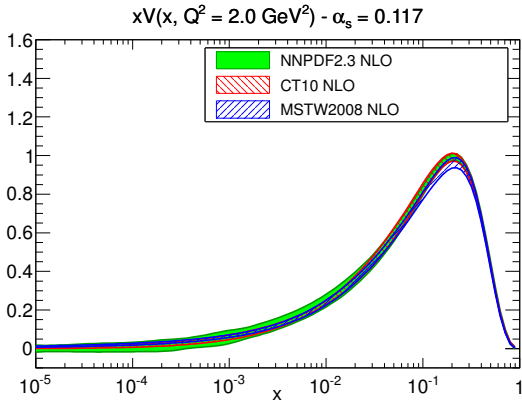
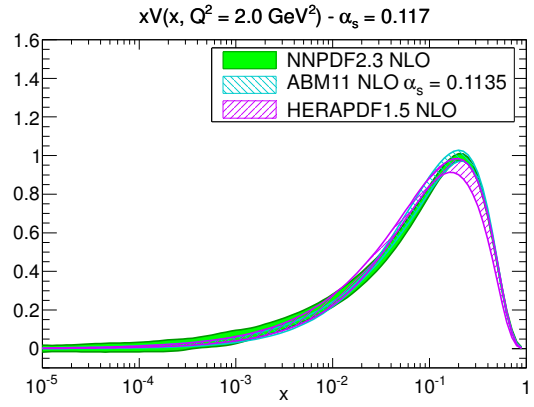


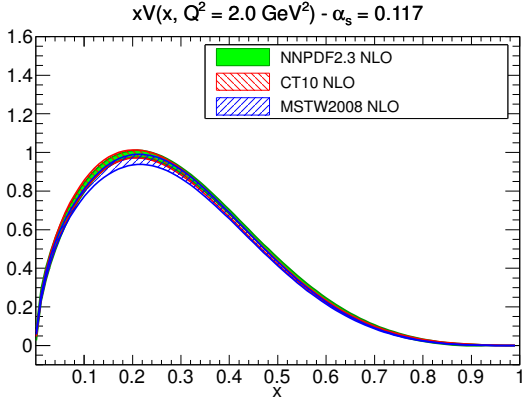
Figure 49



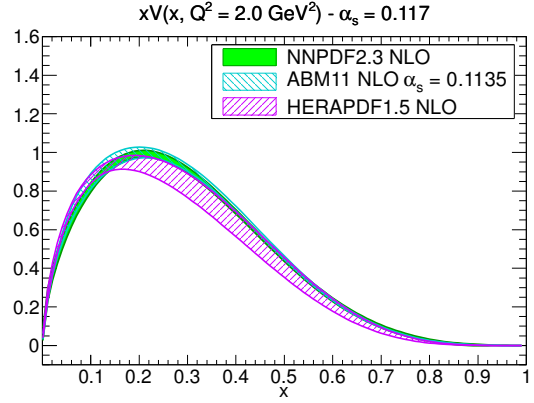
(a) Download (eps, png)



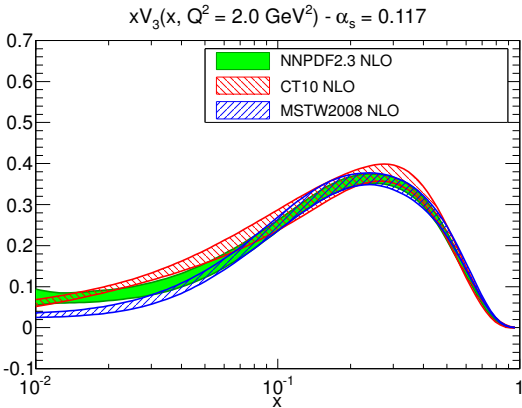
(b) Download (eps, png)



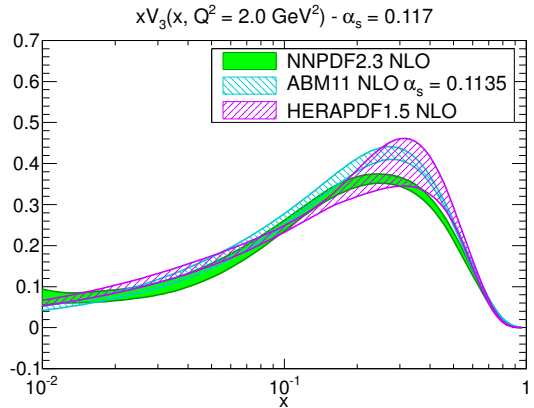
(c) Download (eps, png)



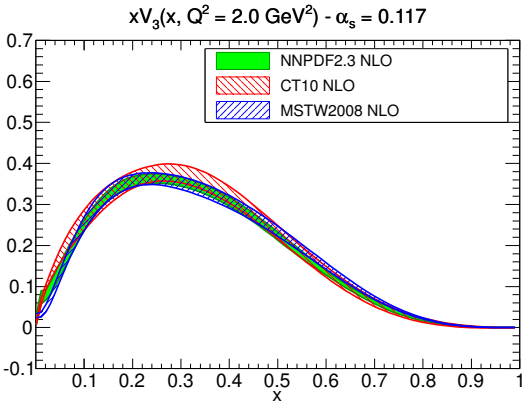
(d) Download (eps, png)



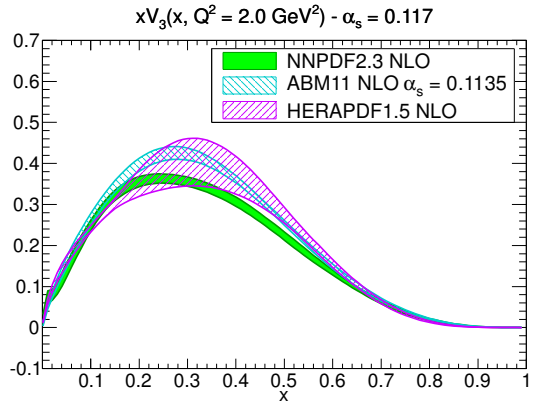
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 50

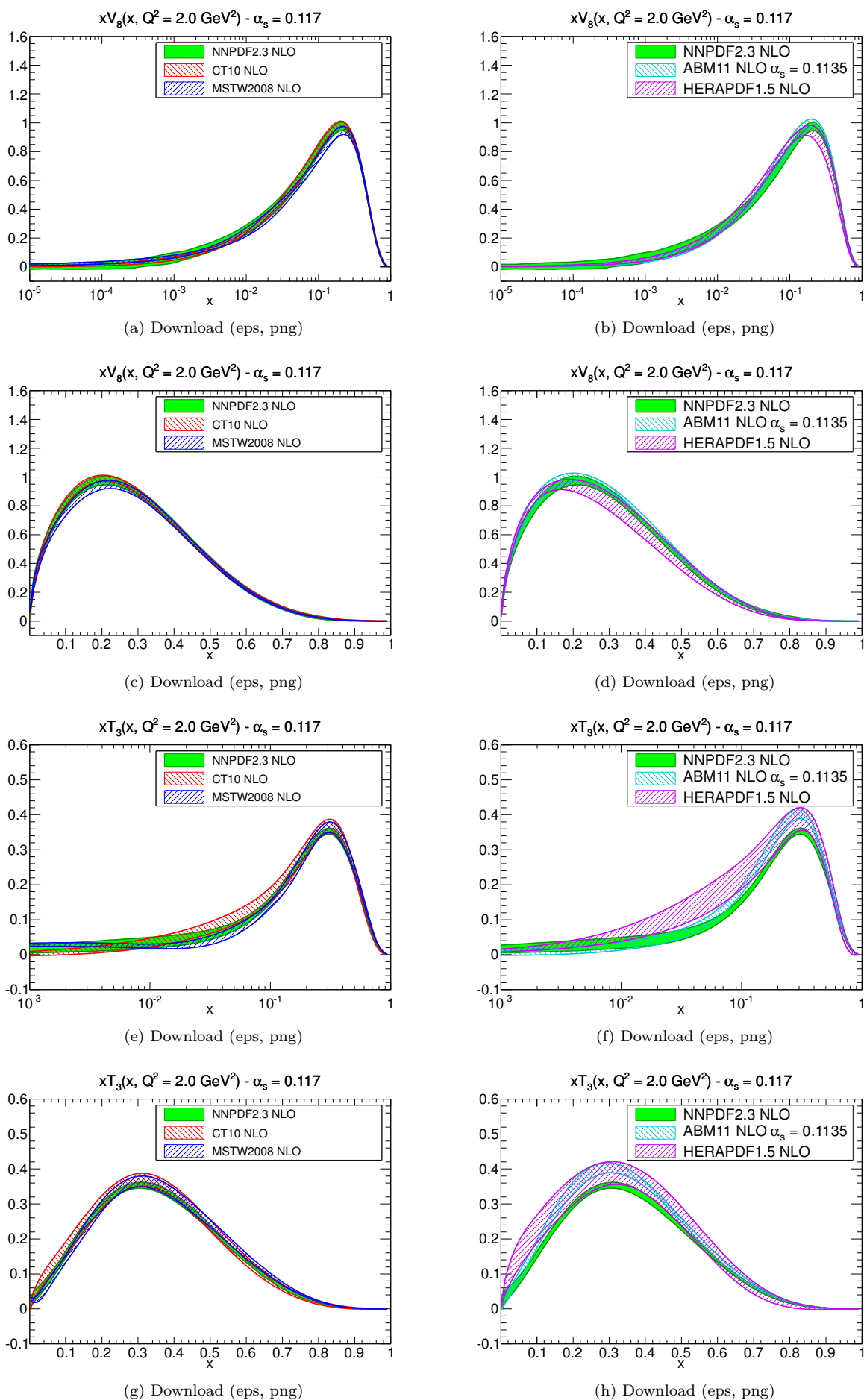


Figure 51

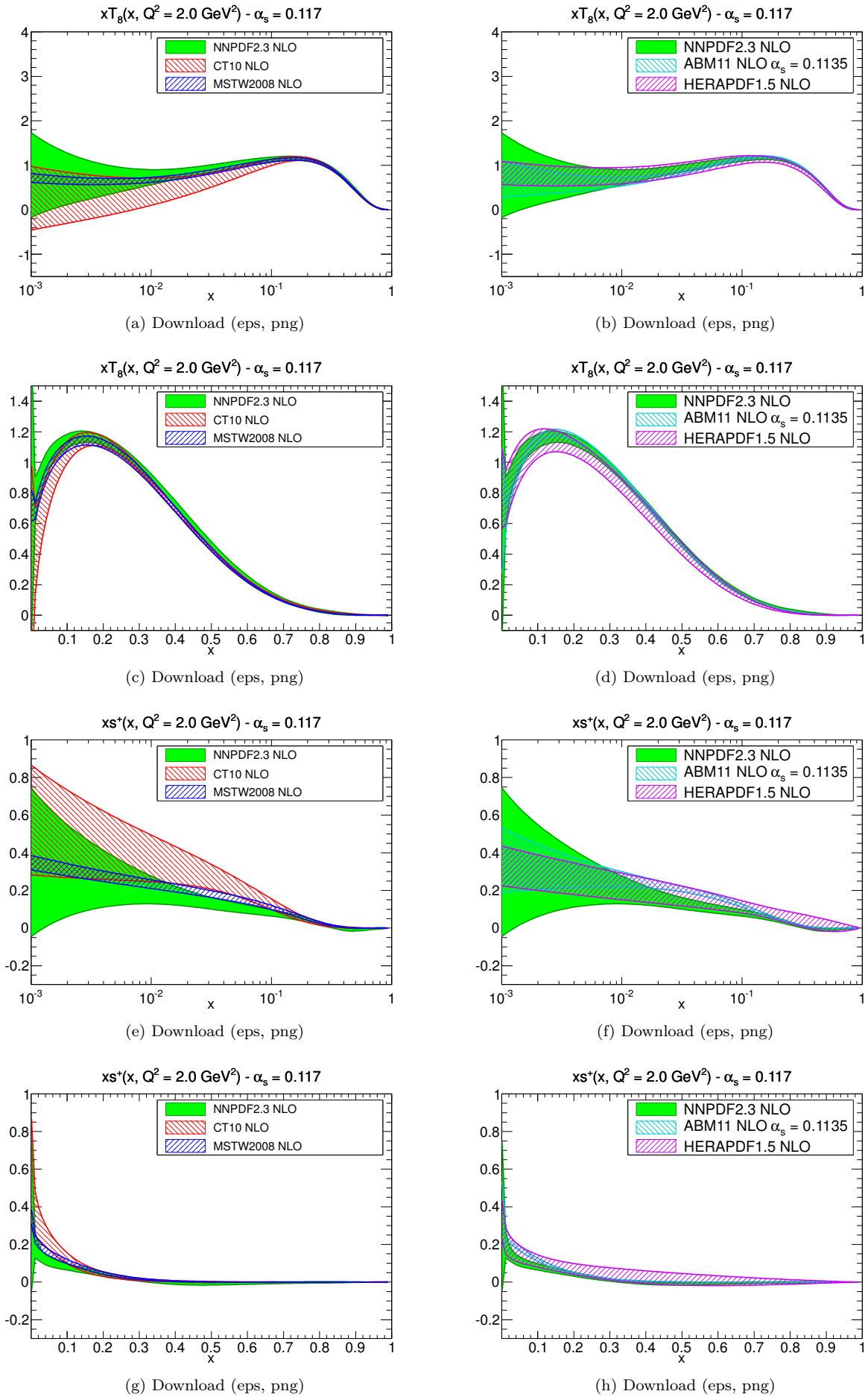
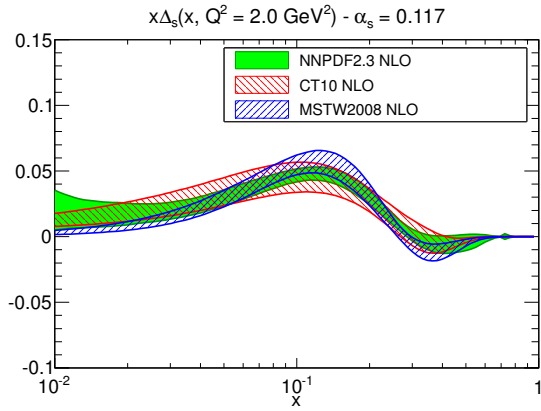
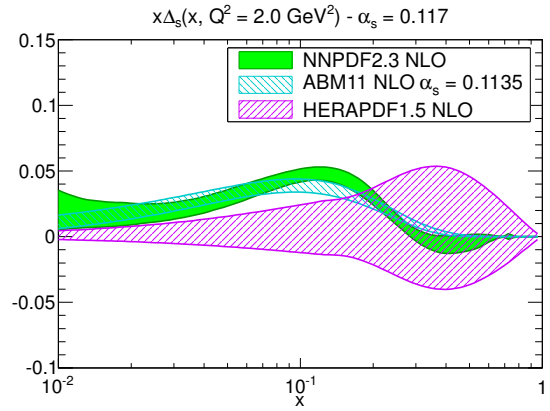


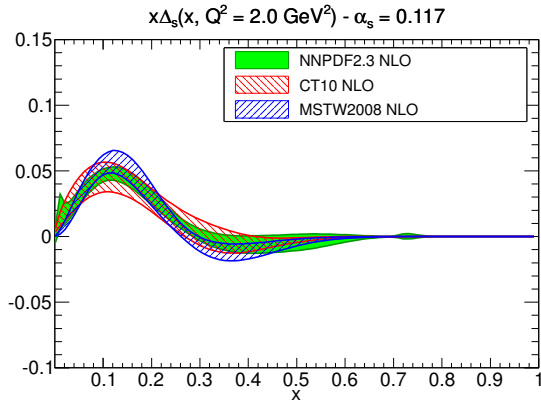
Figure 52



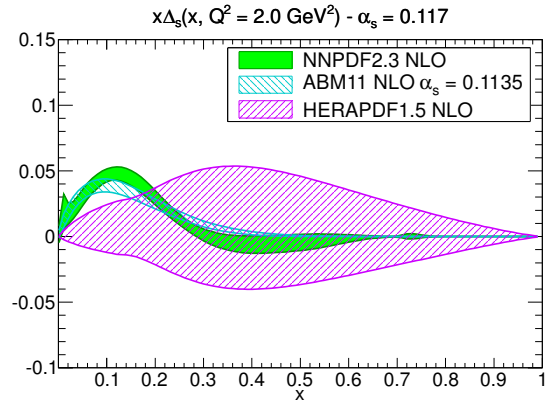
(a) Download (eps, png)



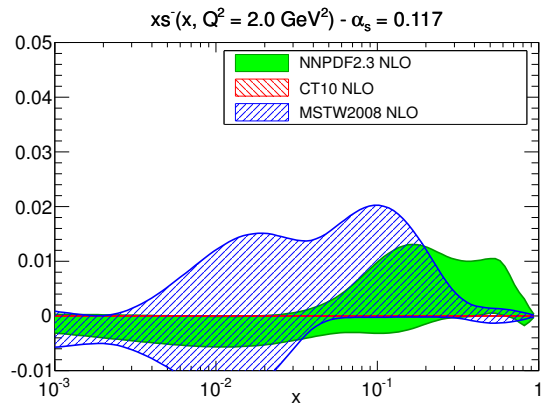
(b) Download (eps, png)



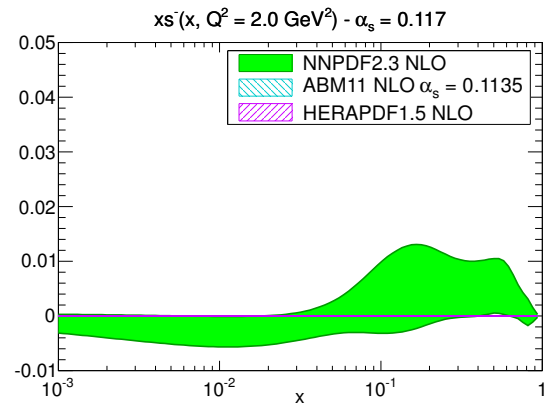
(c) Download (eps, png)



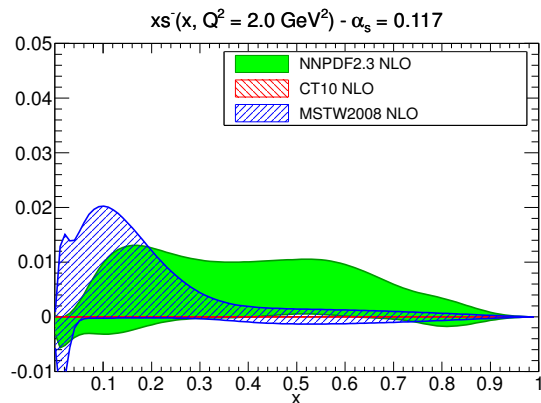
(d) Download (eps, png)



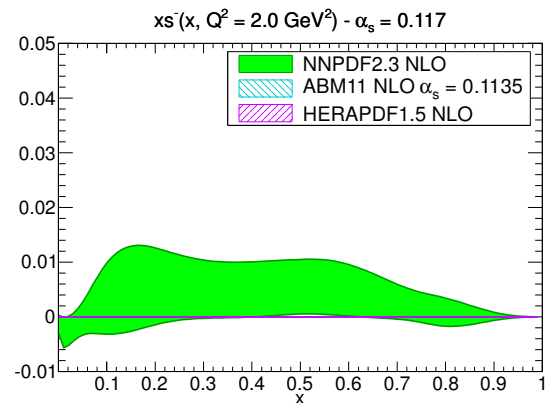
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 53

3.1.2 Flavor basis

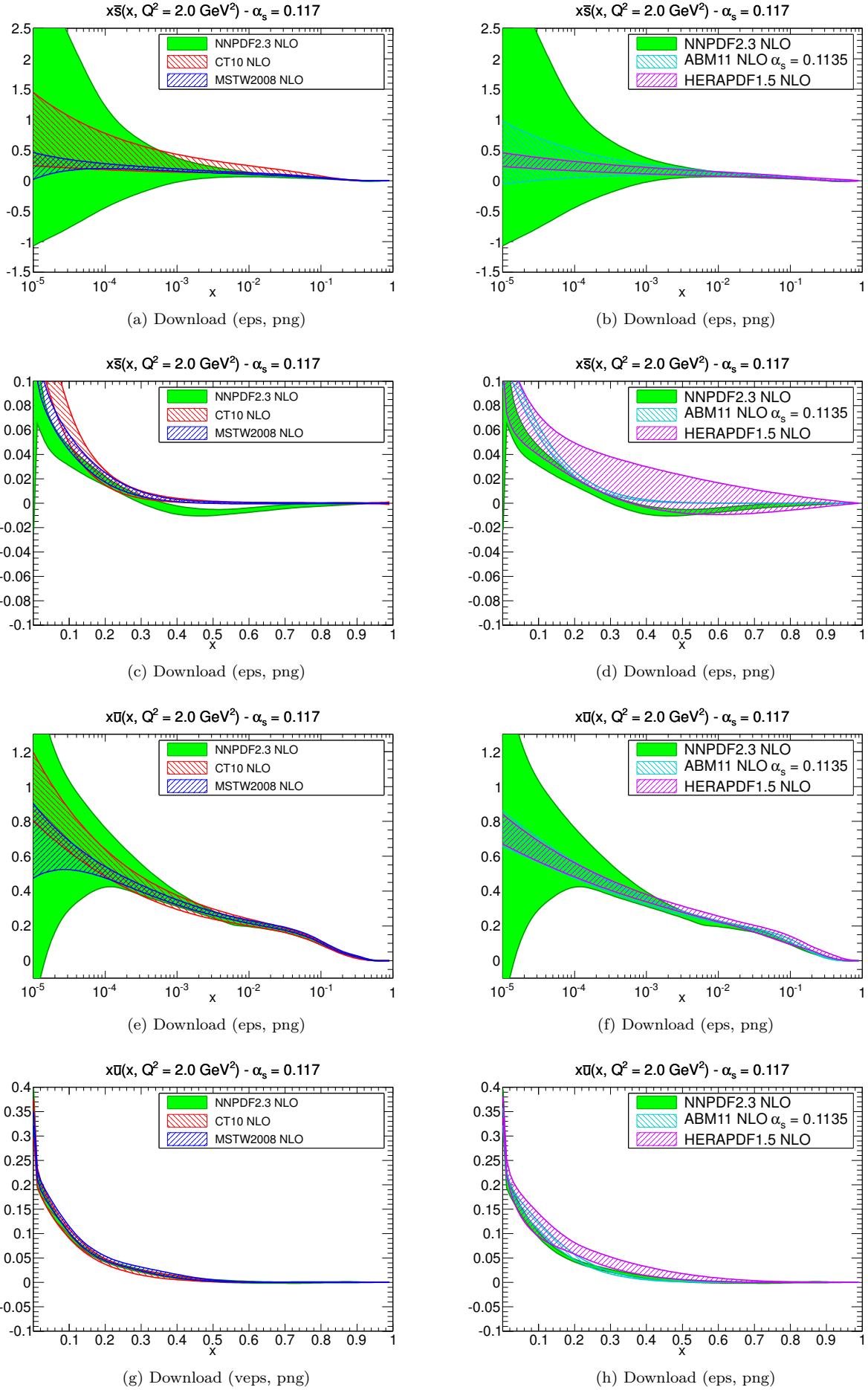


Figure 54

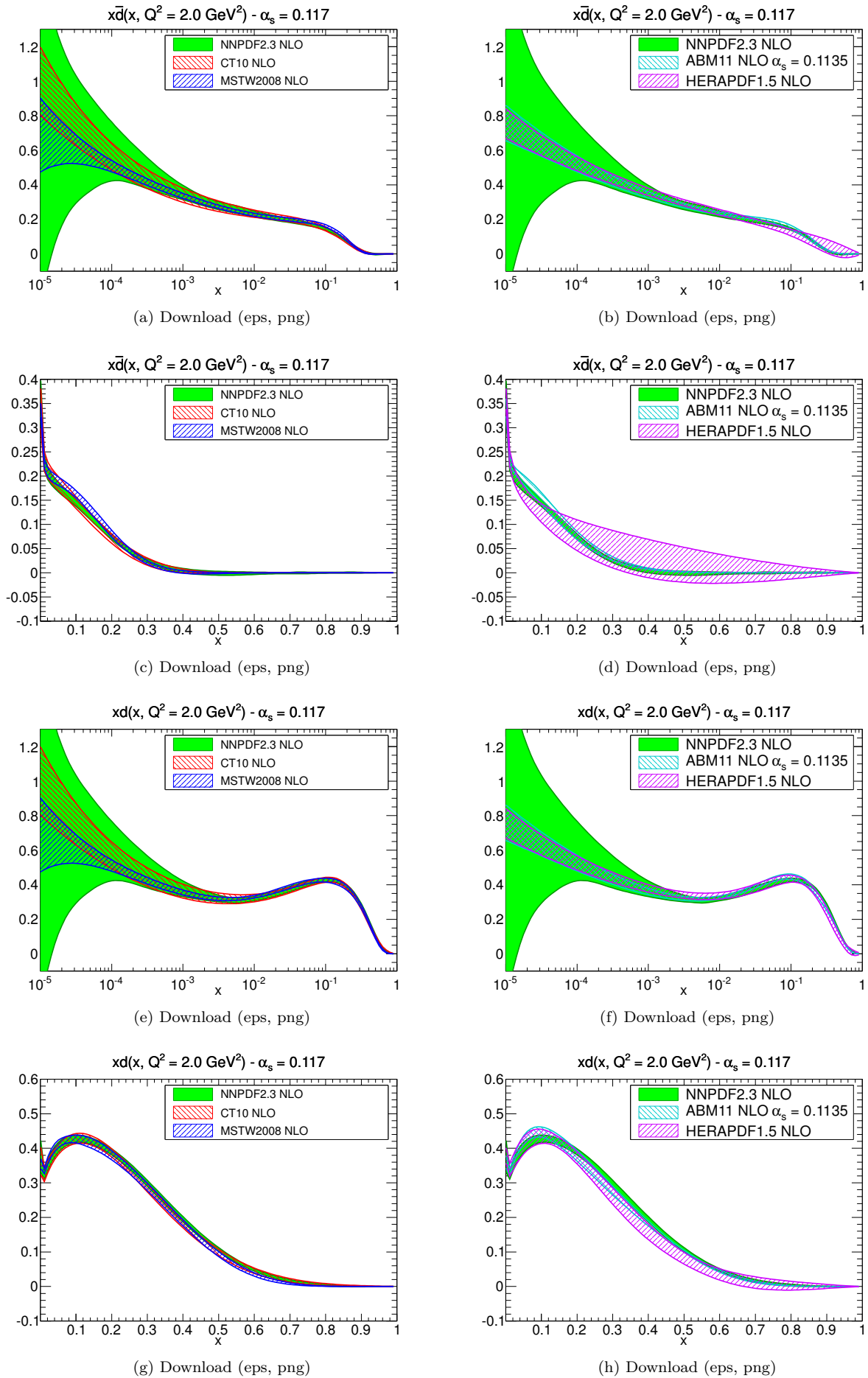


Figure 55

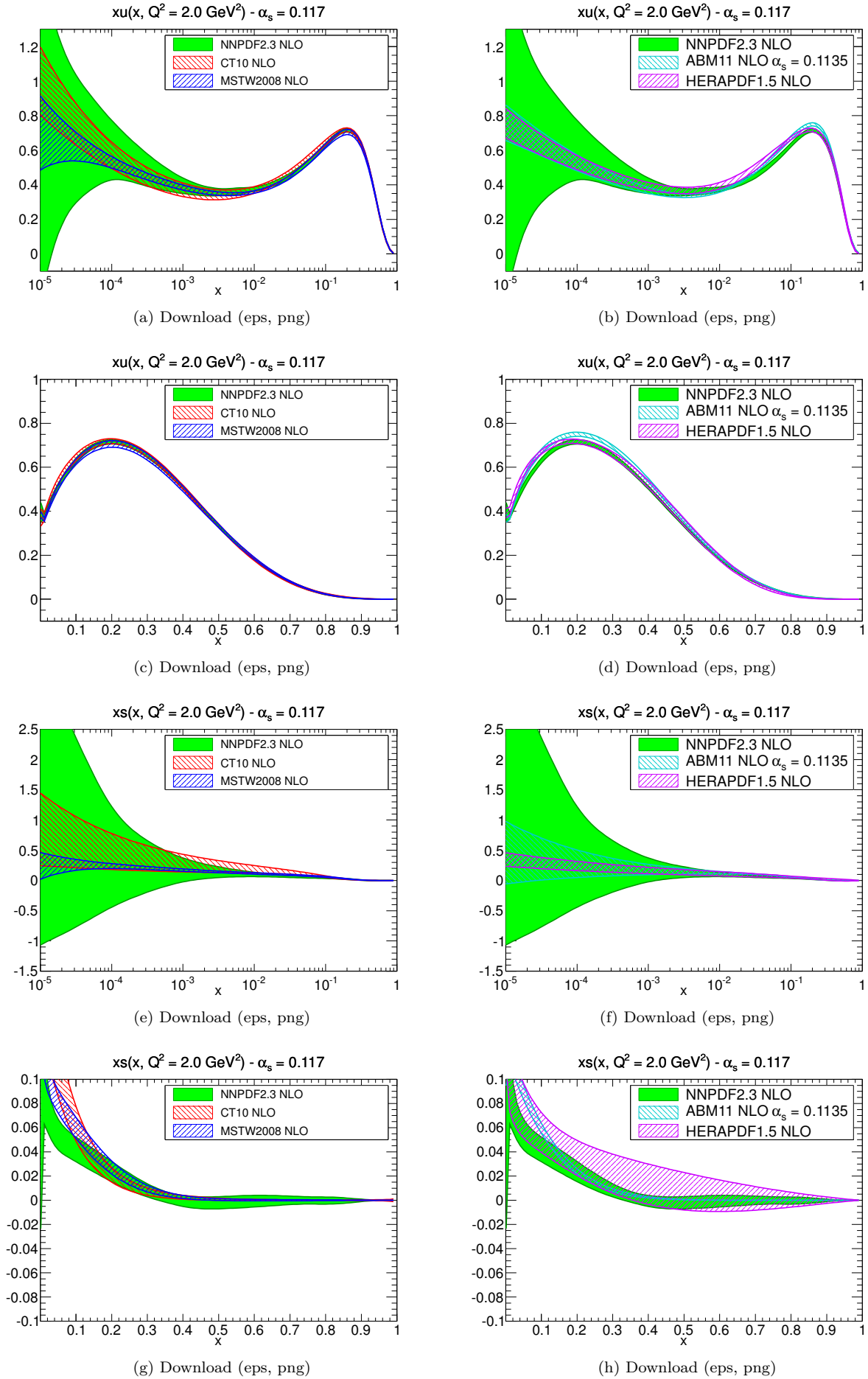


Figure 56

3.2 NNLO at $Q^2 = 2 \text{ GeV}^2$

3.2.1 Evolution basis

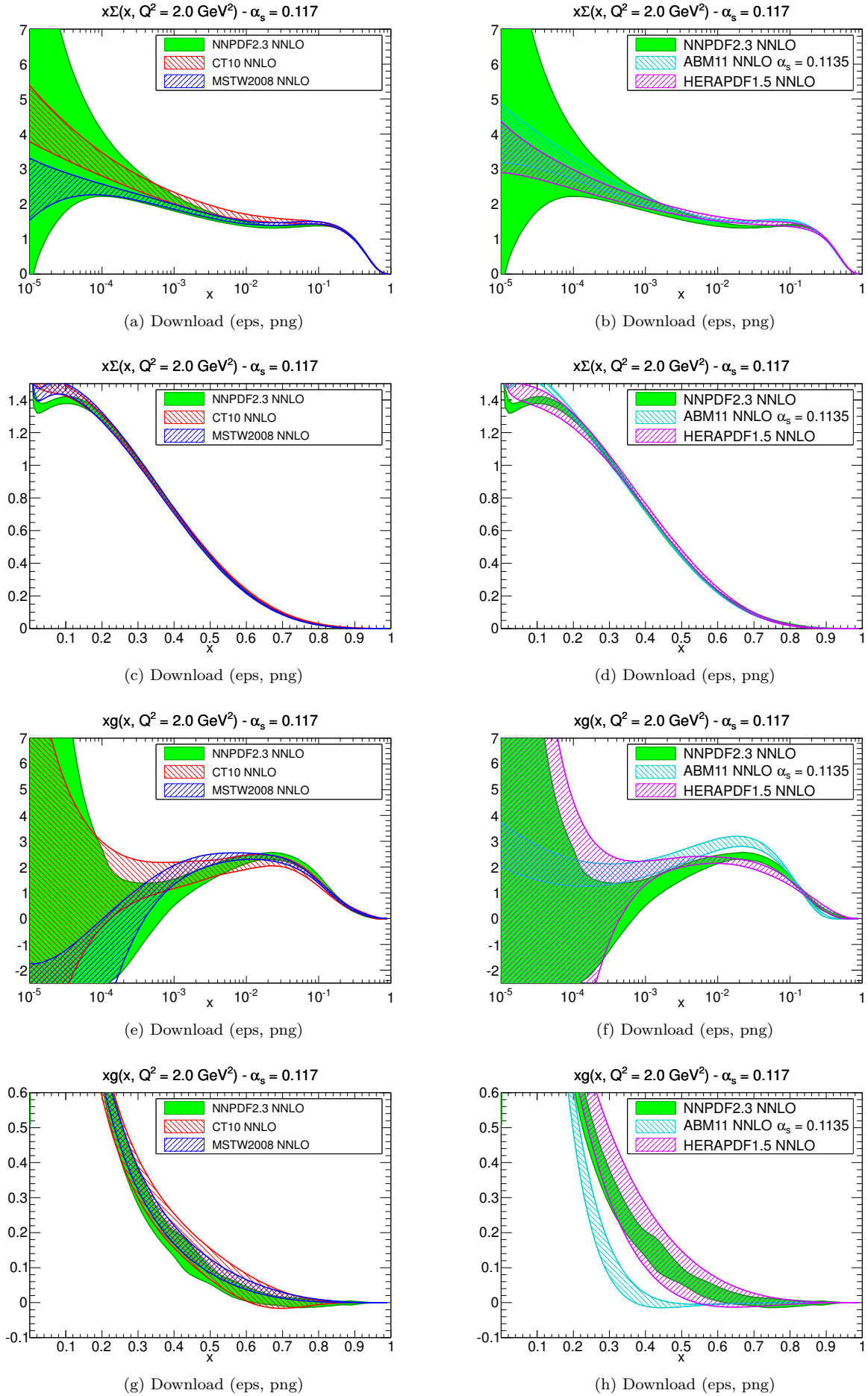
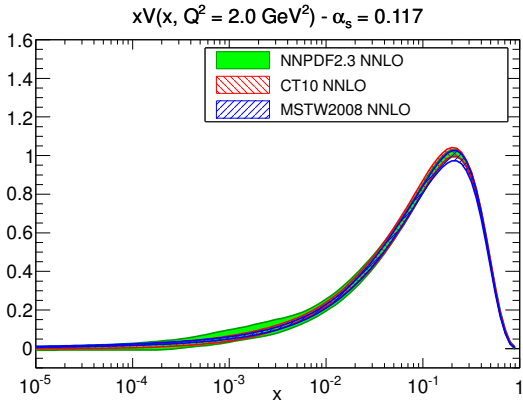
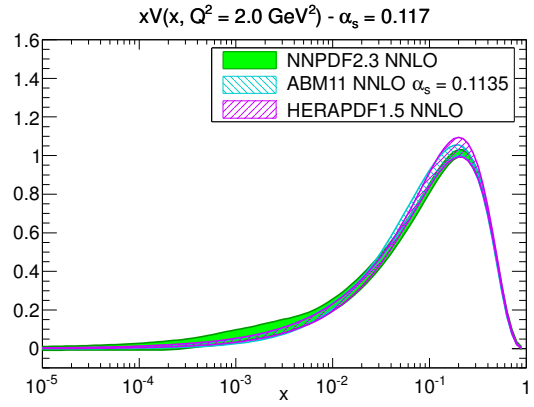


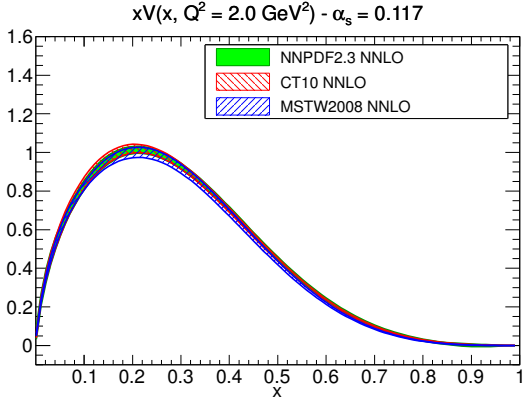
Figure 57



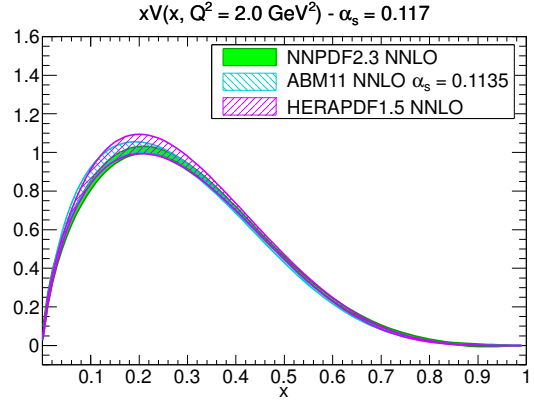
(a) Download (eps, png)



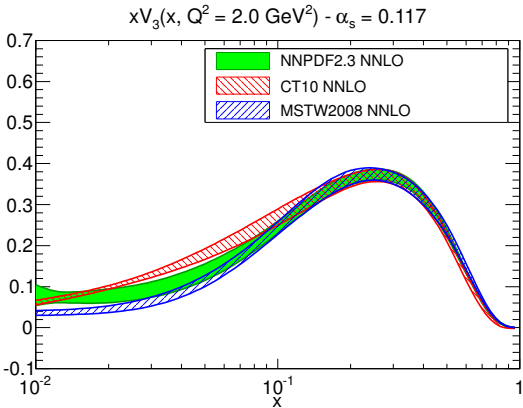
(b) Download (eps, png)



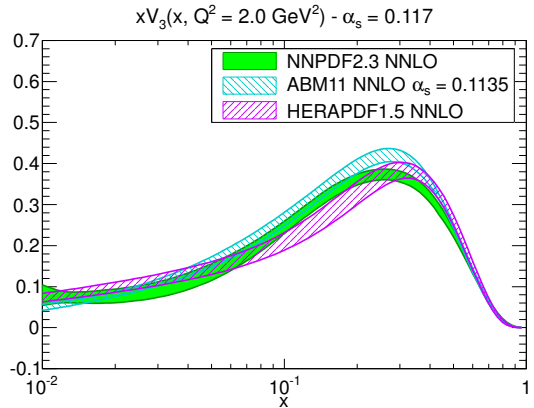
(c) Download (eps, png)



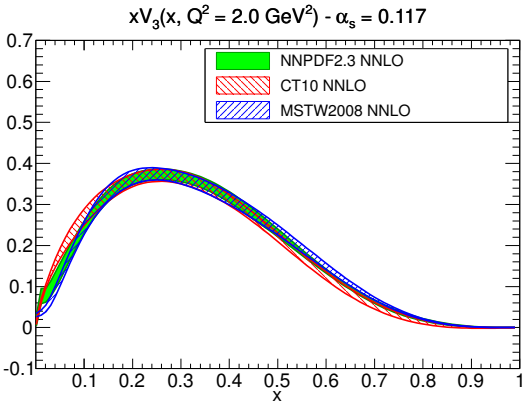
(d) Download (eps, png)



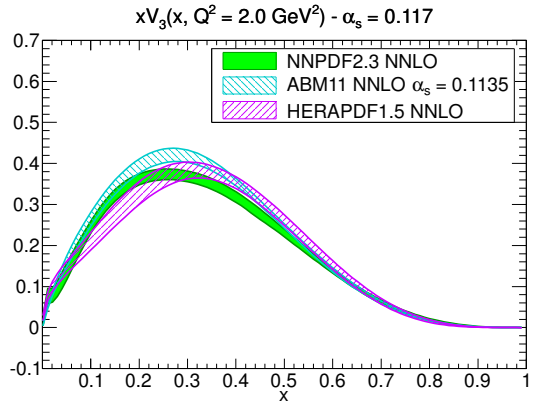
(e) Download (eps, png)



(f) Download (eps, png)

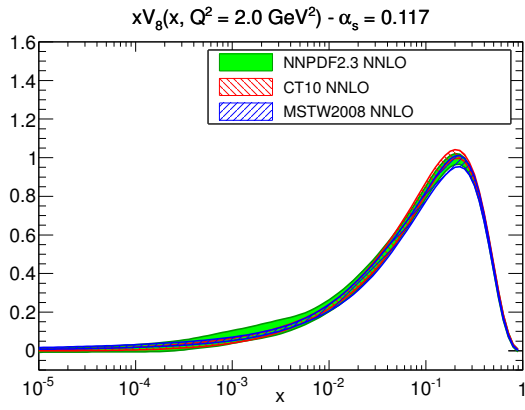


(g) Download (eps, png)

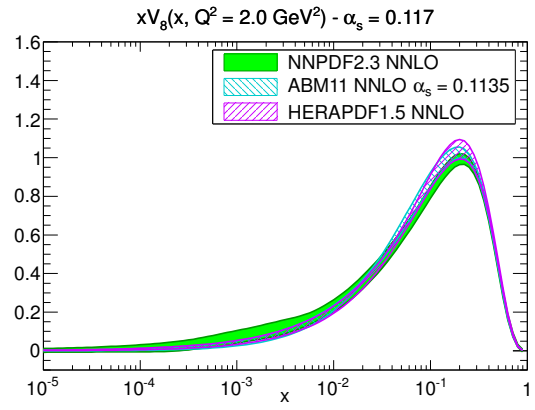


(h) Download (eps, png)

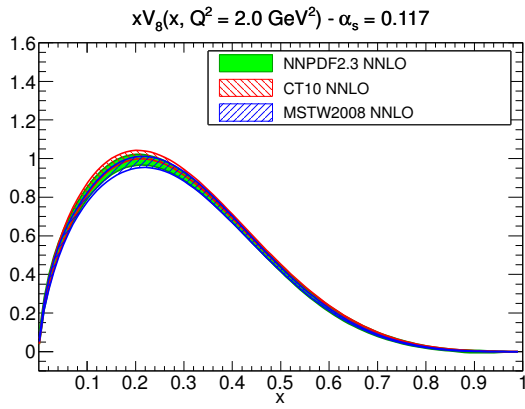
Figure 58



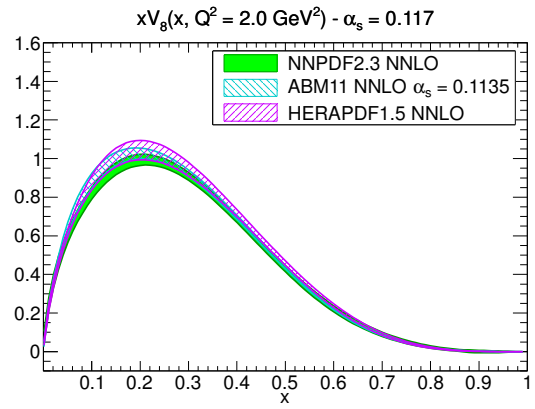
(a) Download (eps, png)



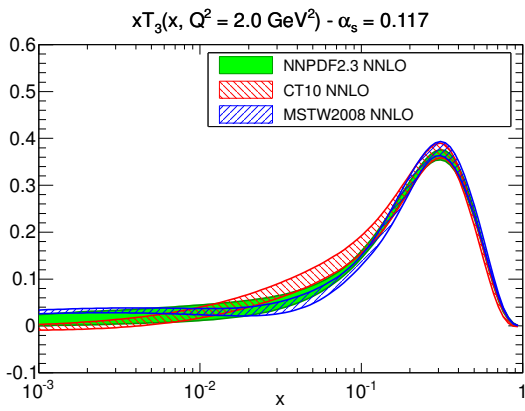
(b) Download (eps, png)



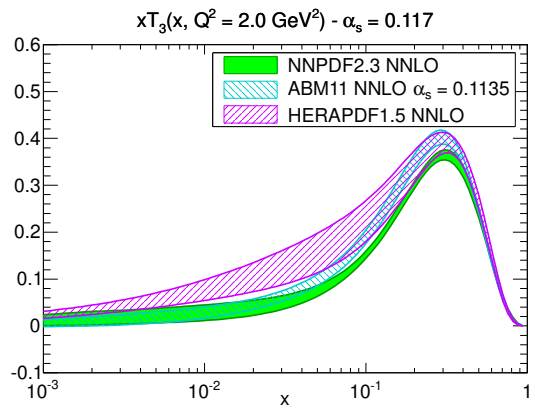
(c) Download (eps, png)



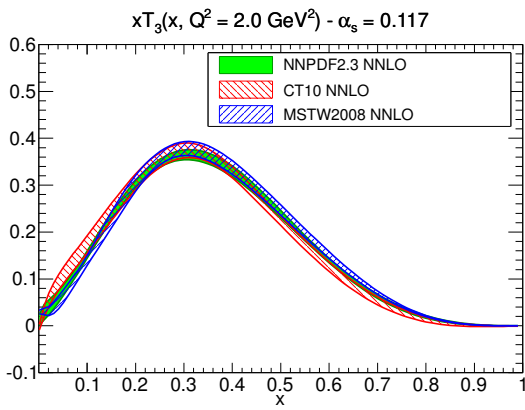
(d) Download (eps, png)



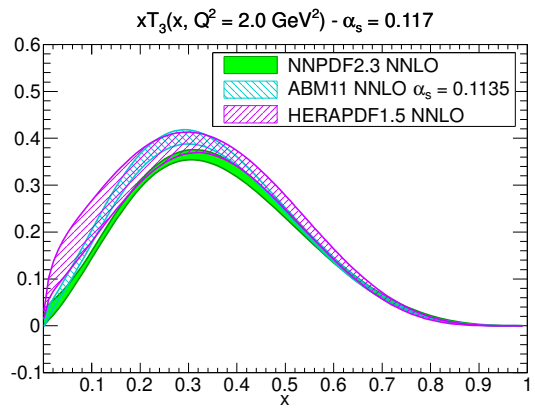
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 59

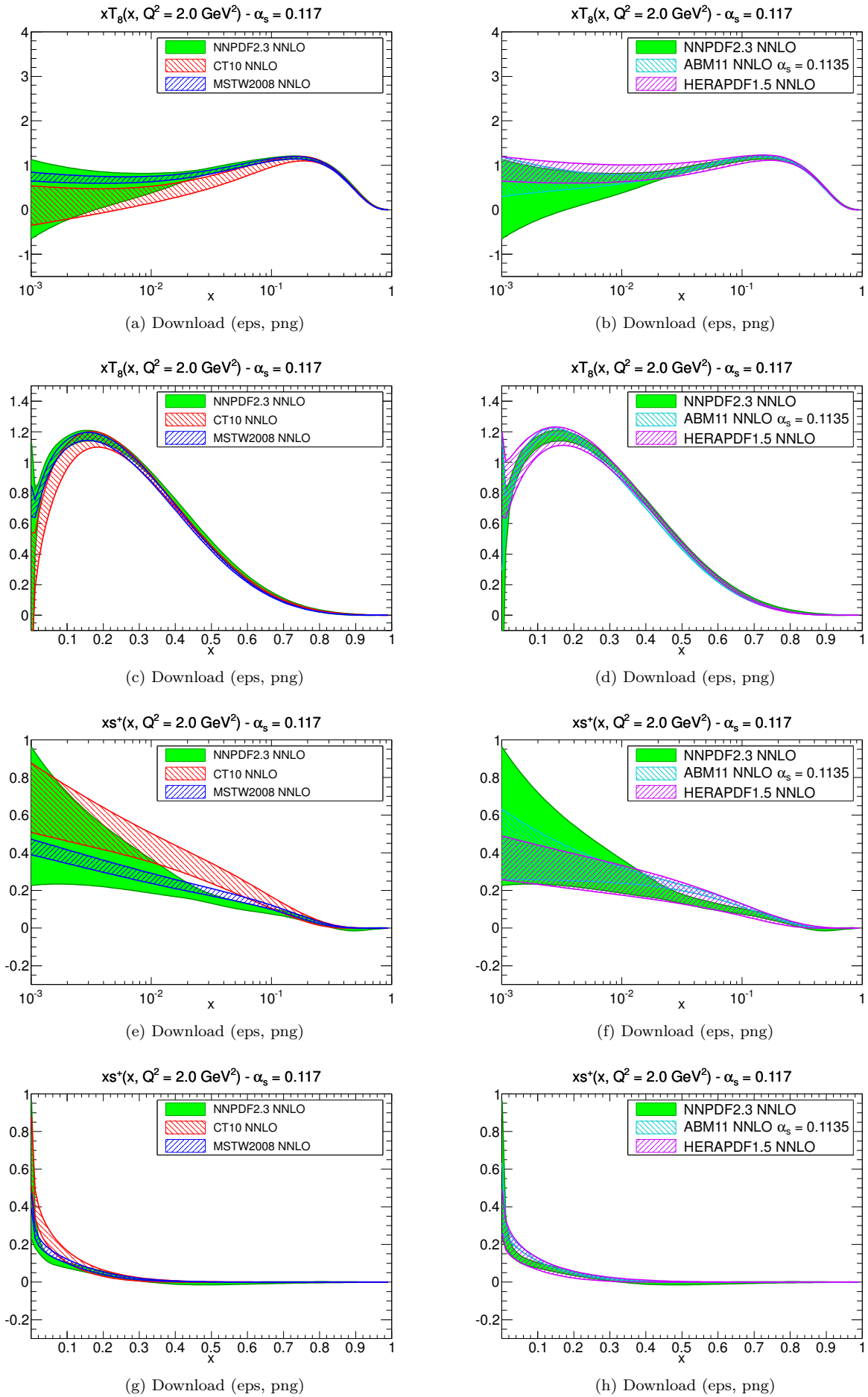
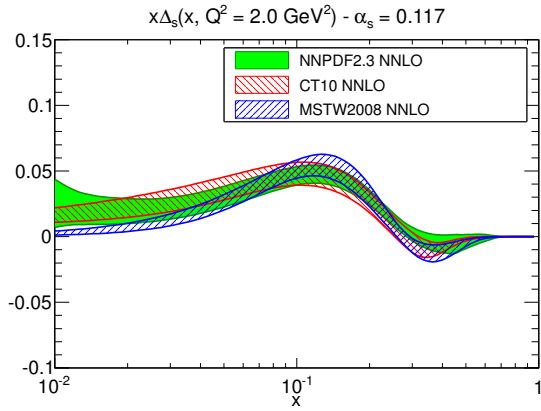
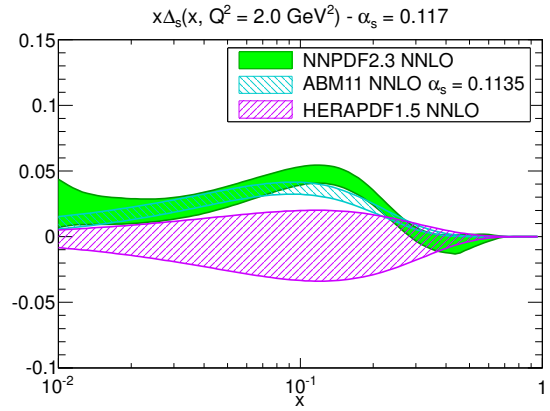


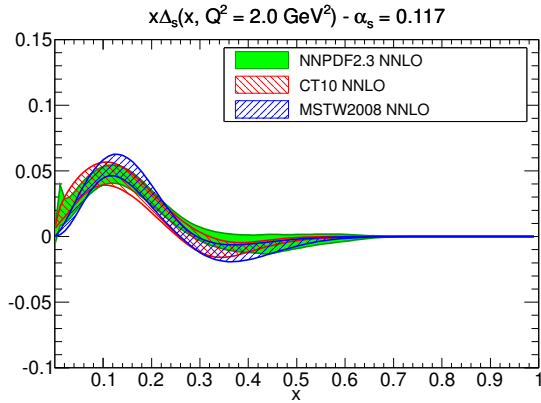
Figure 60



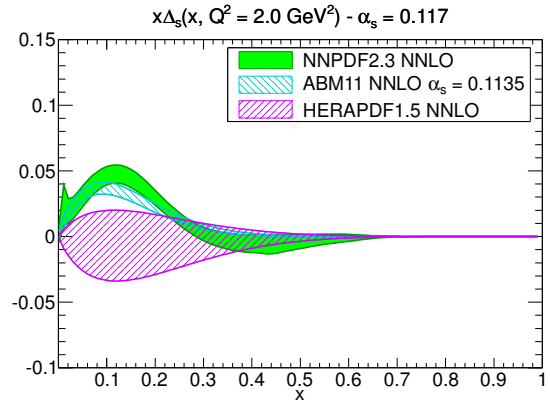
(a) Download (eps, png)



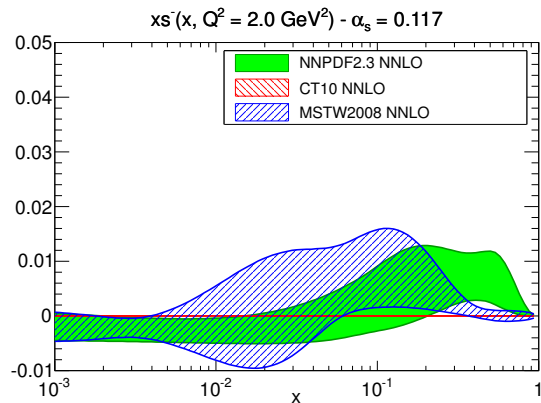
(b) Download (eps, png)



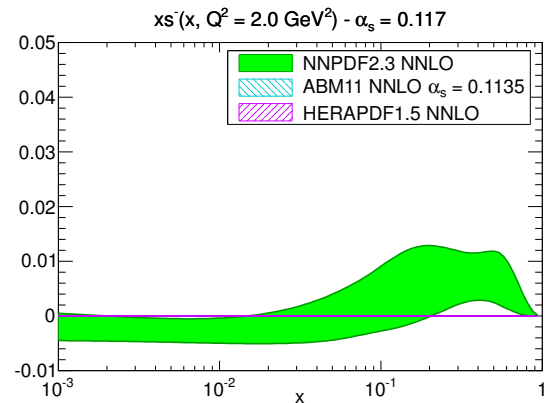
(c) Download (eps, png)



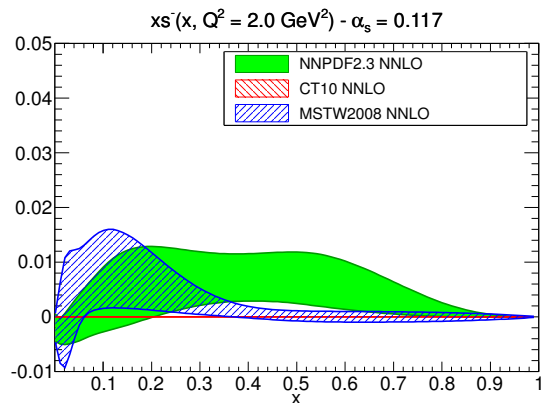
(d) Download (eps, png)



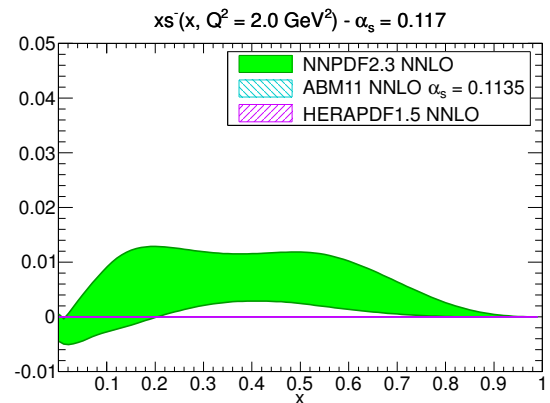
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 61

3.2.2 Flavor basis

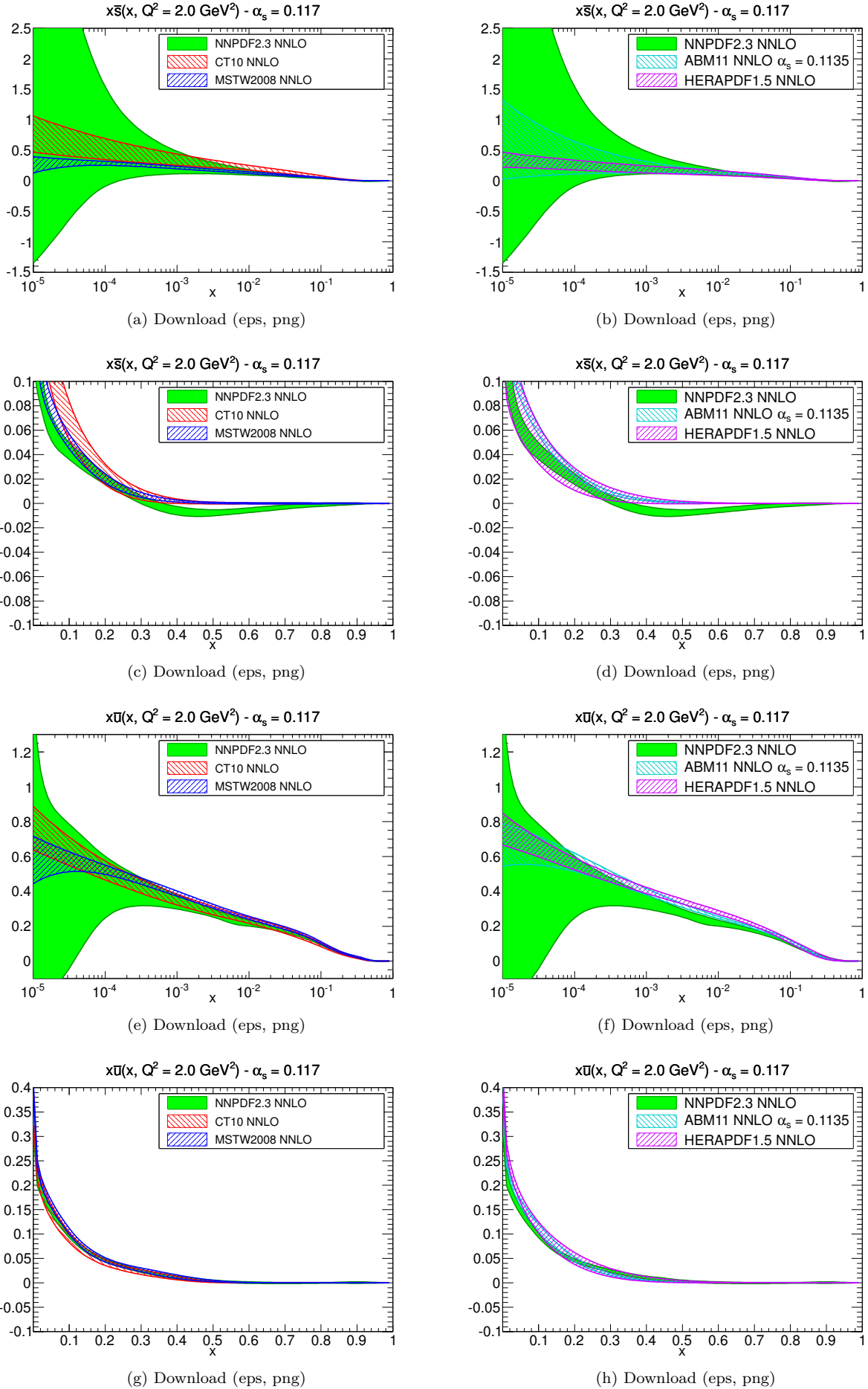


Figure 62

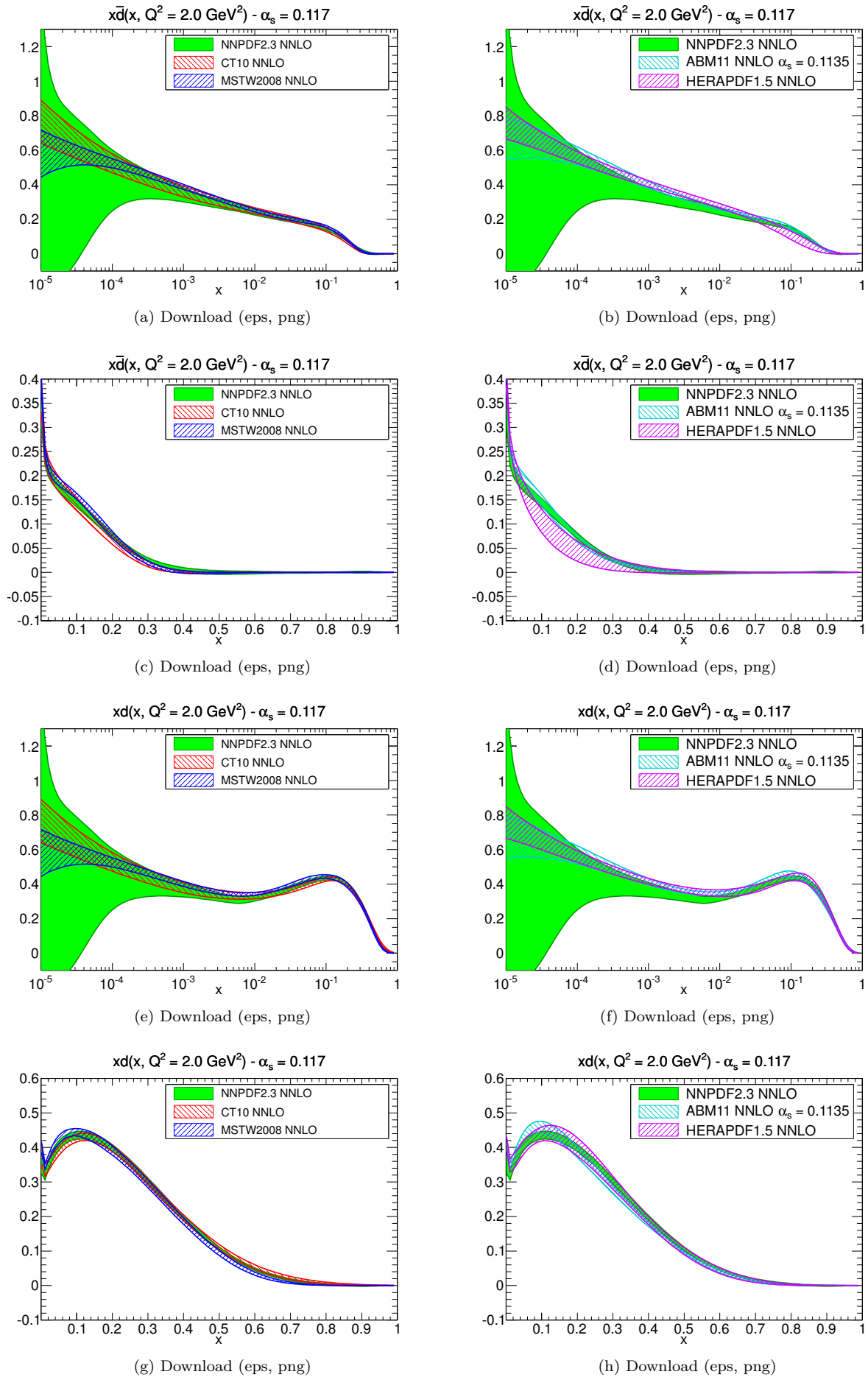


Figure 63

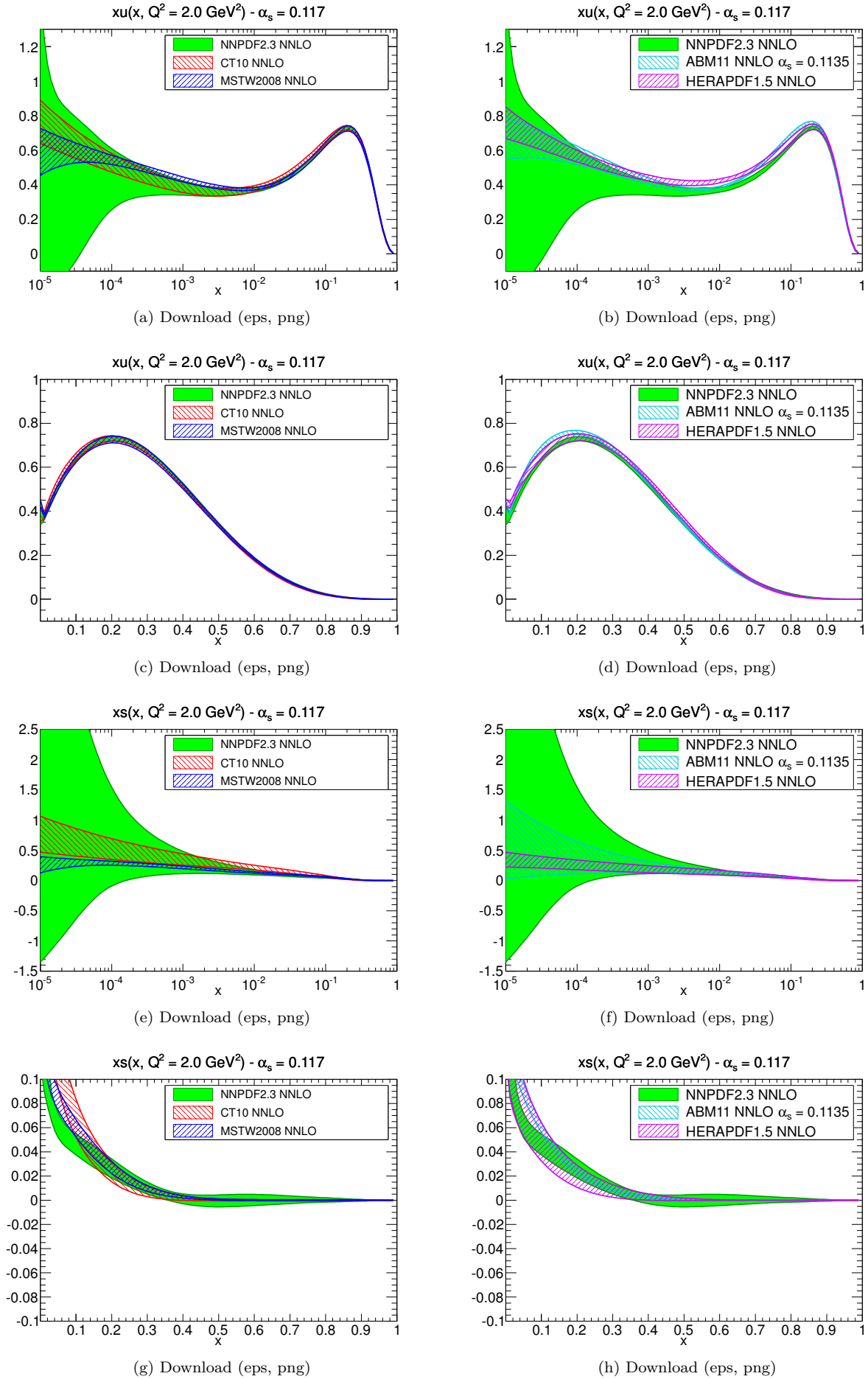


Figure 64

3.3 NNLO ratios at $Q^2 = 10^4 \text{ GeV}^2$

3.3.1 Evolution basis

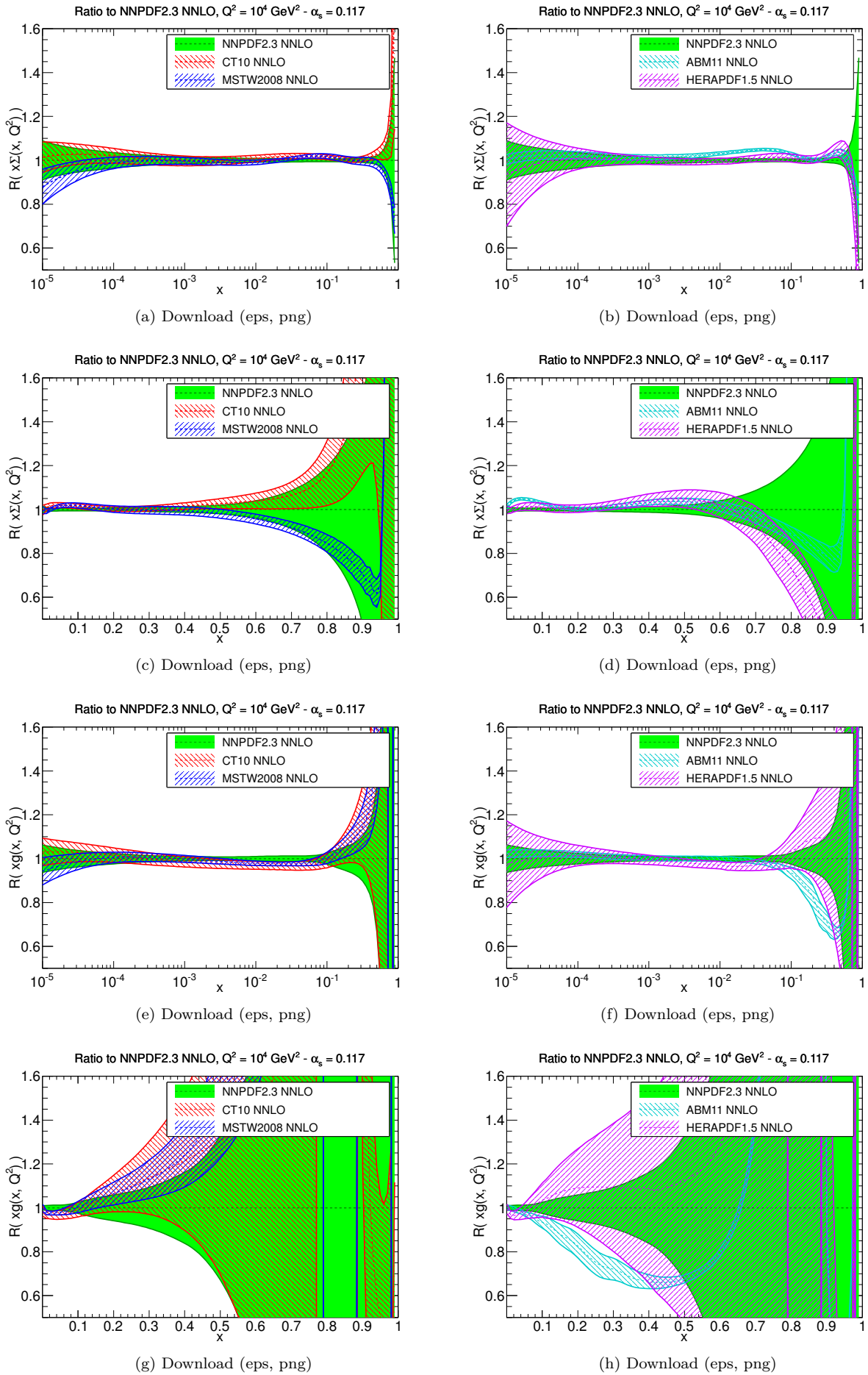


Figure 65

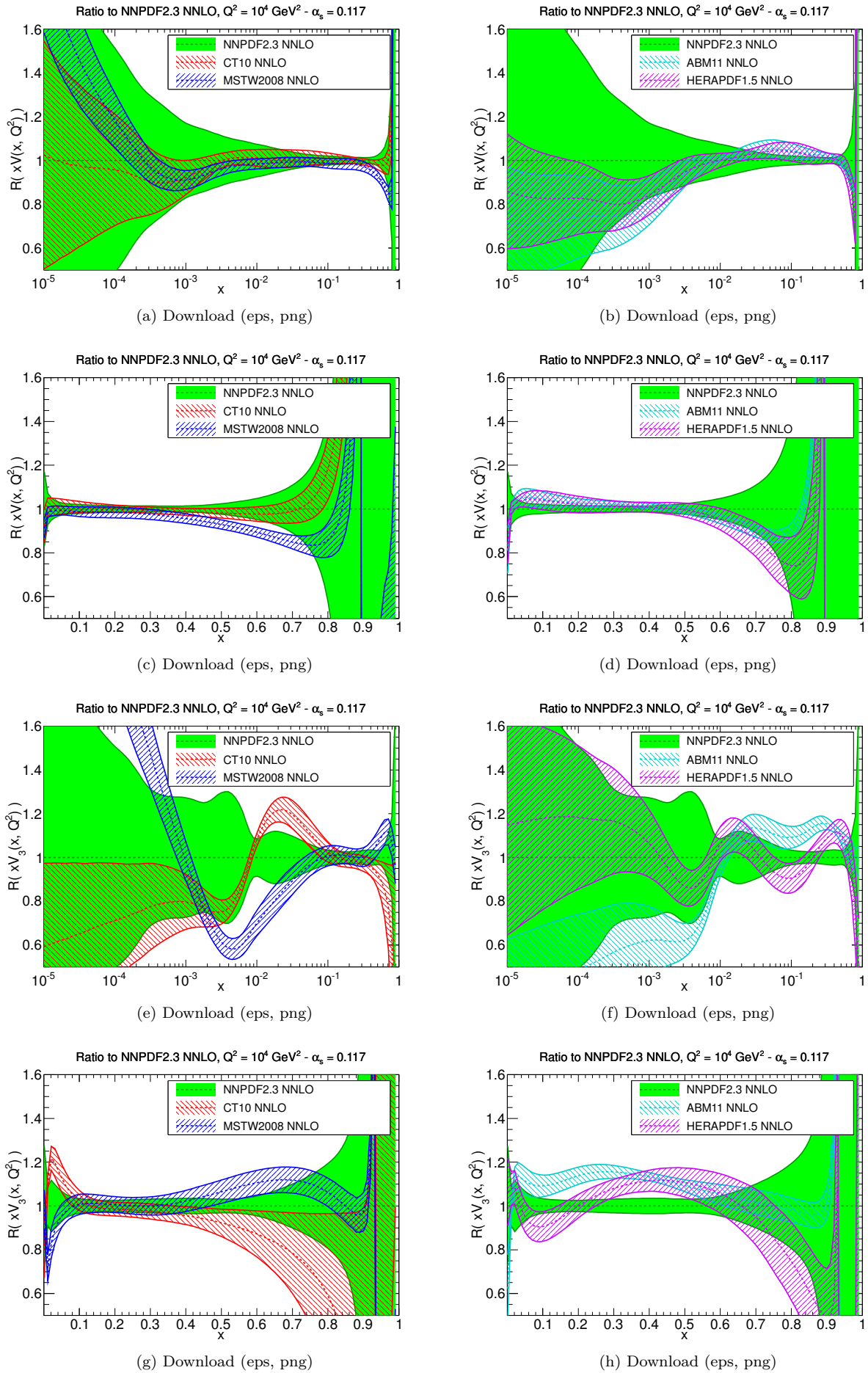
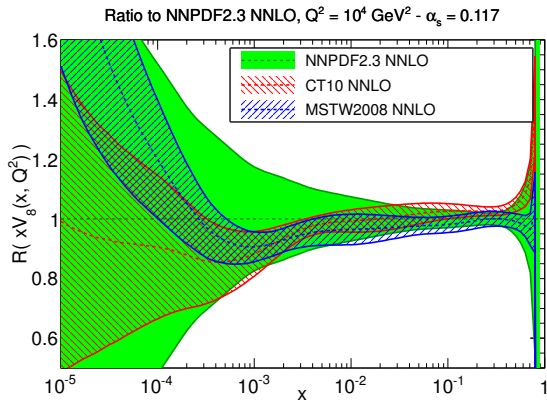
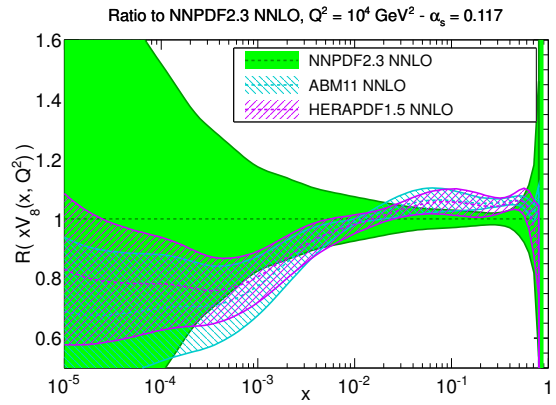


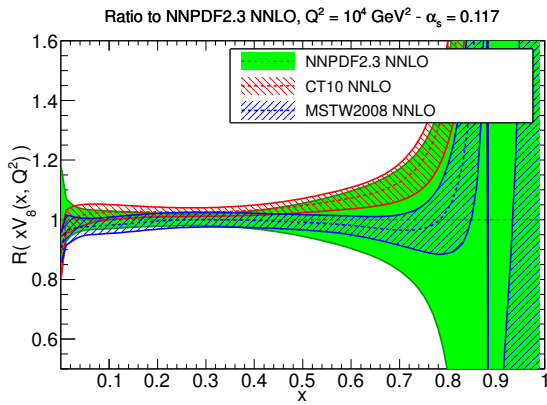
Figure 66



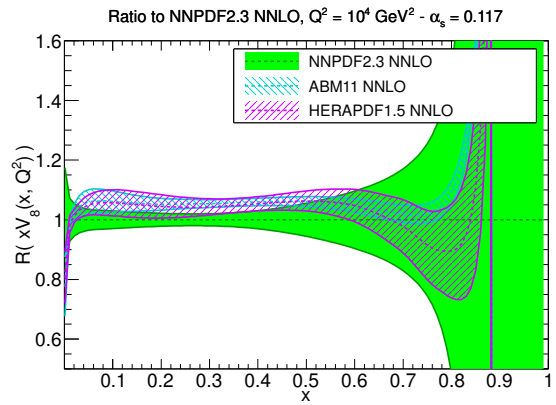
(a) Download (eps, png)



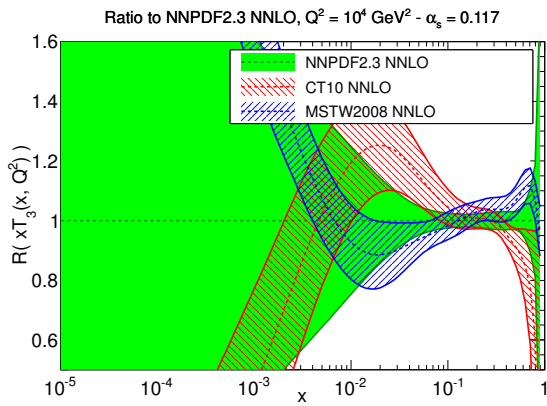
(b) Download (eps, png)



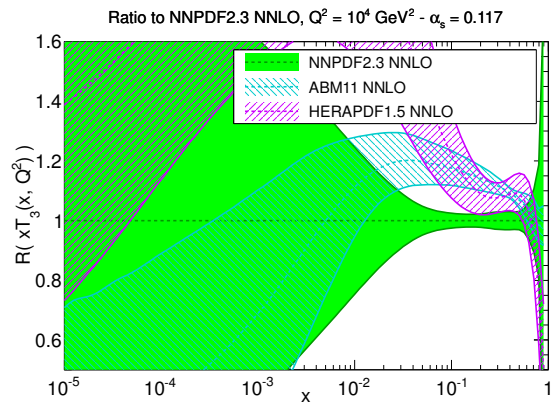
(c) Download (eps, png)



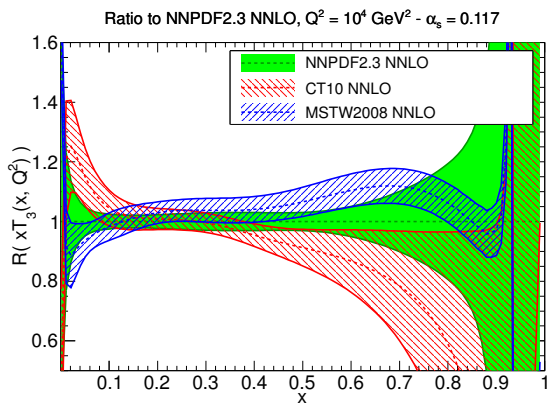
(d) Download (eps, png)



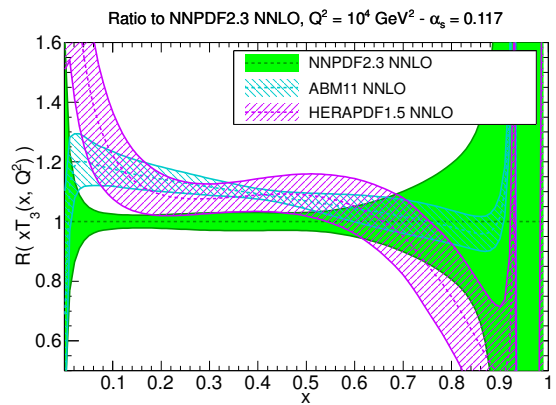
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 67

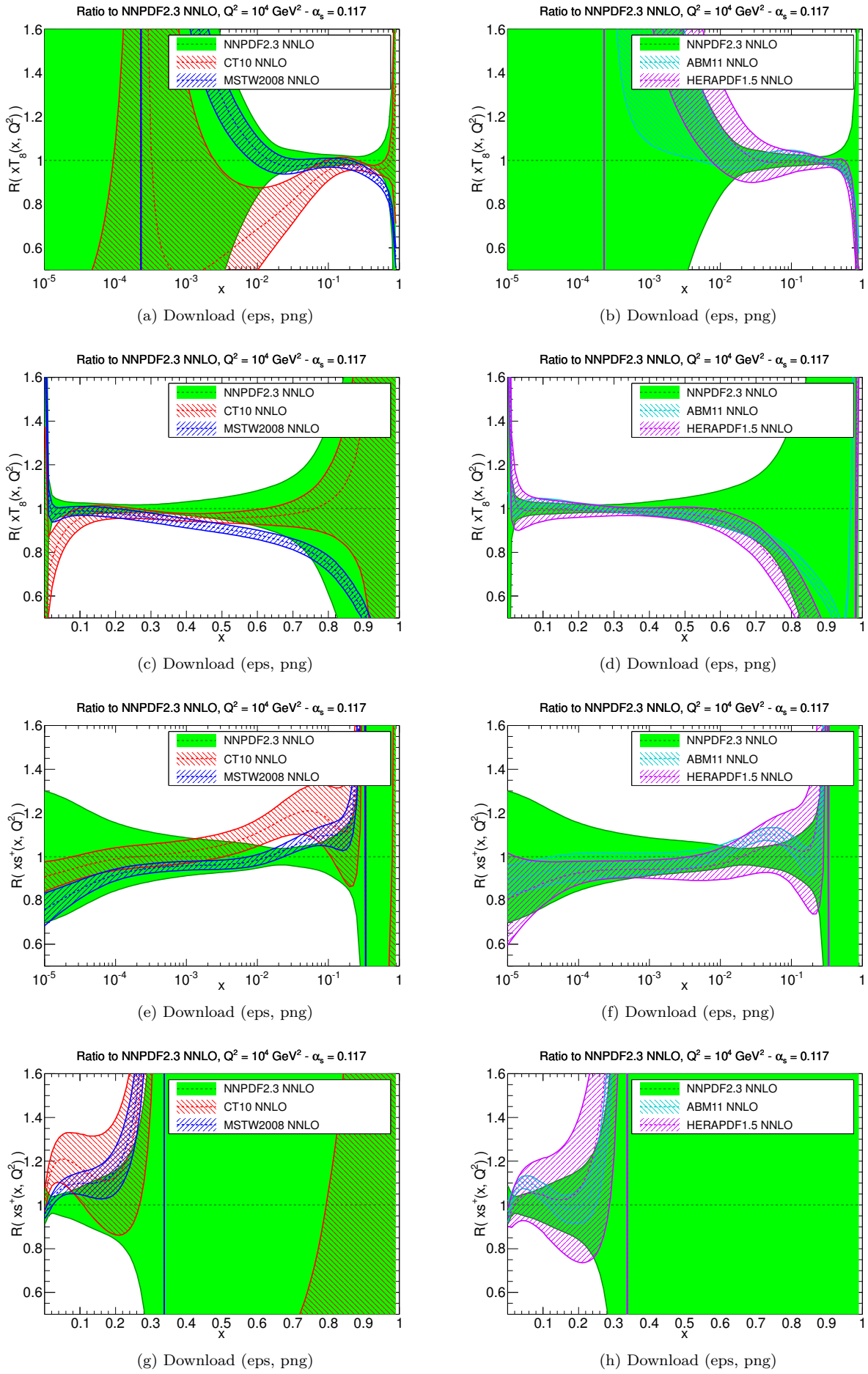
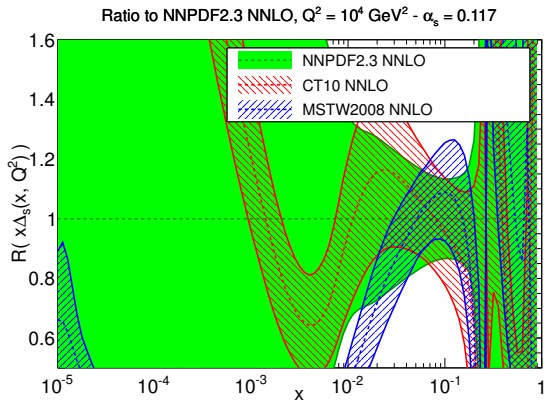
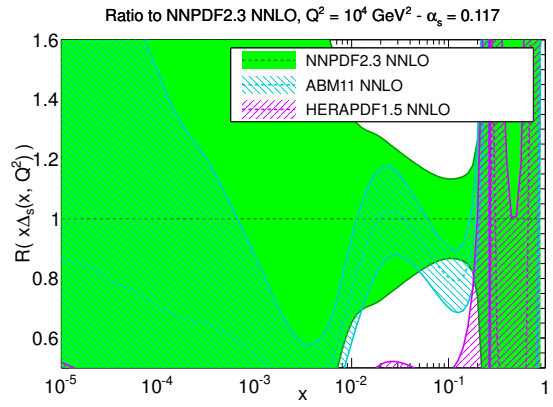


Figure 68



(a) Download (eps, png)



(b) Download (eps, png)

Figure 69

3.3.2 Flavor basis

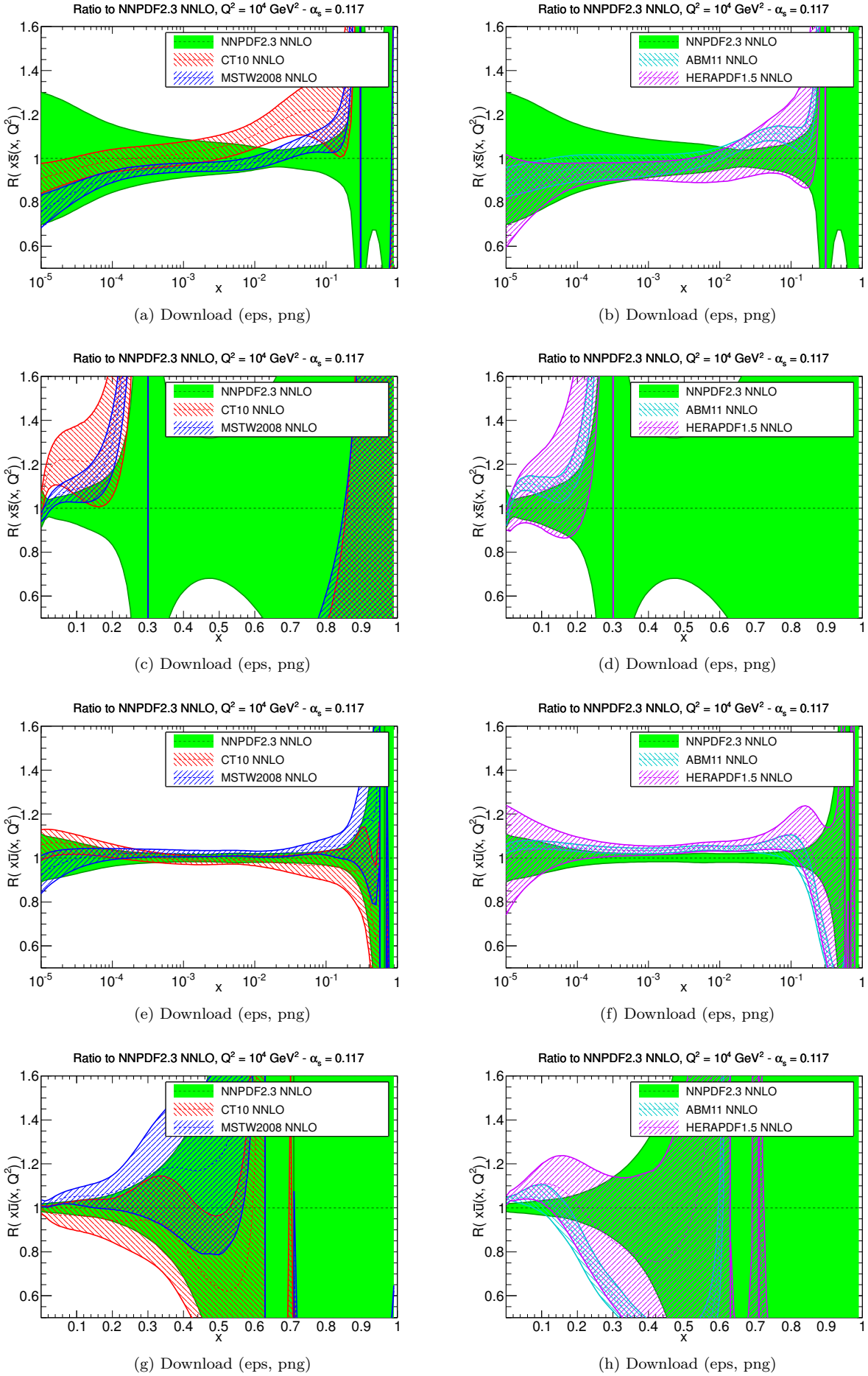
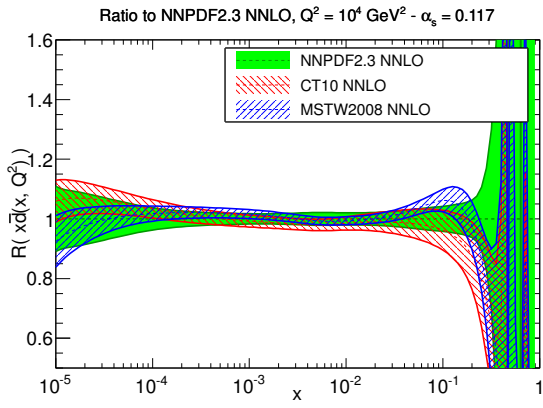
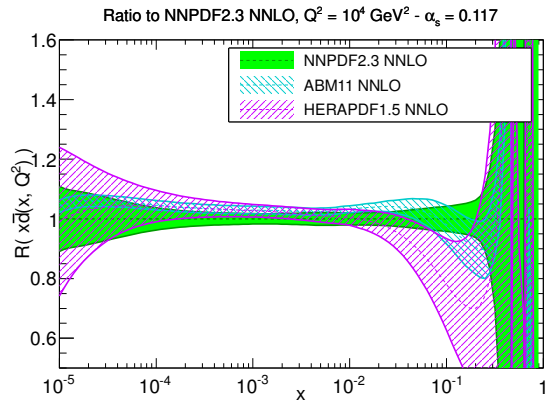


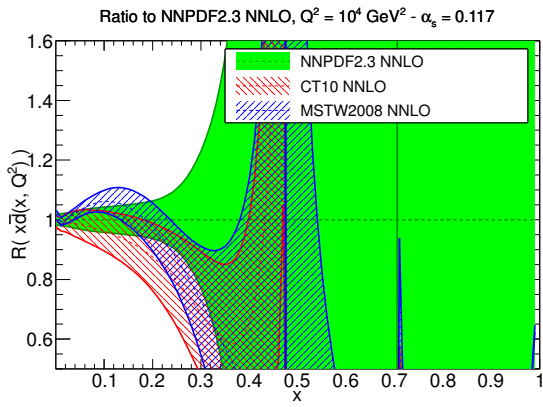
Figure 70



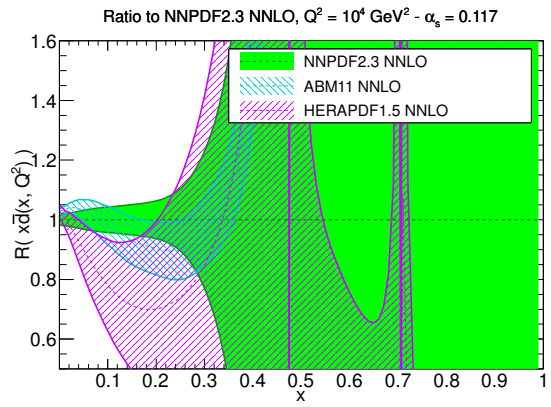
(a) Download (eps, png)



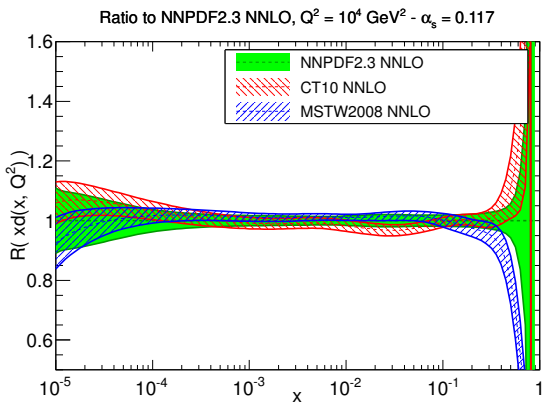
(b) Download (eps, png)



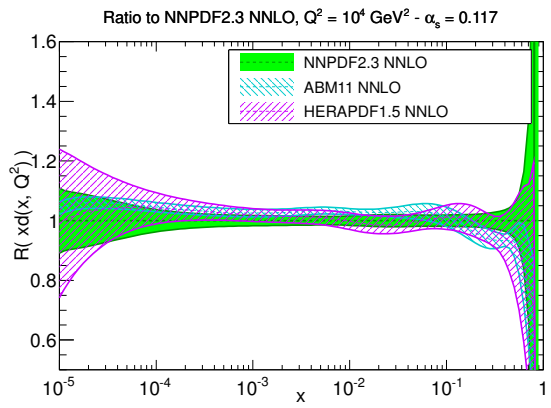
(c) Download (eps, png)



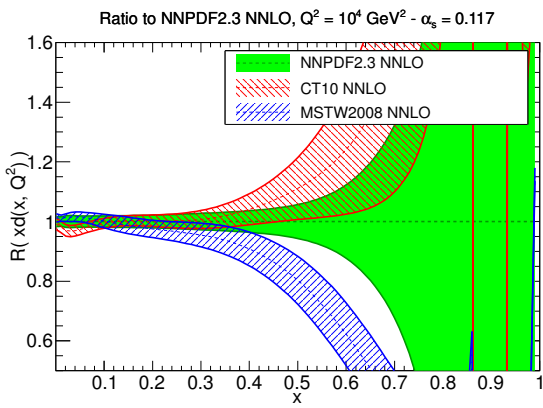
(d) Download (eps, png)



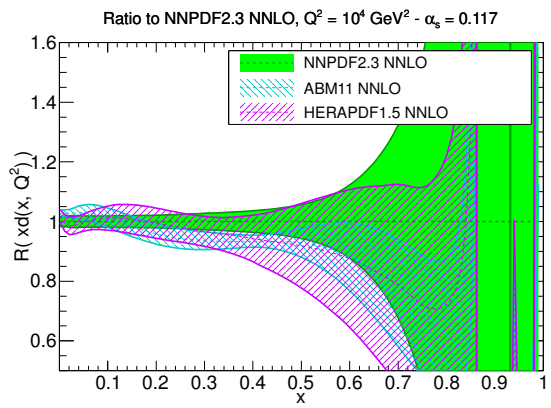
(e) Download (eps, png)



(f) Download (eps, png)

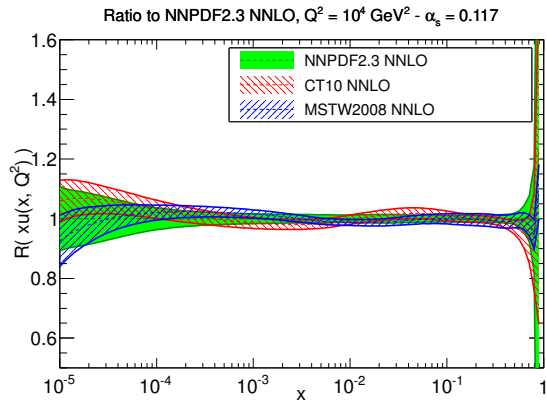


(g) Download (eps, png)

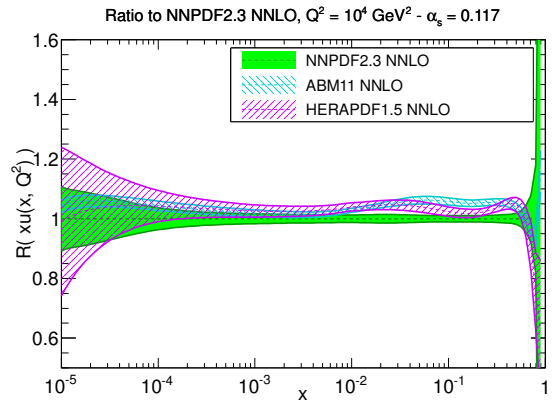


(h) Download (eps, png)

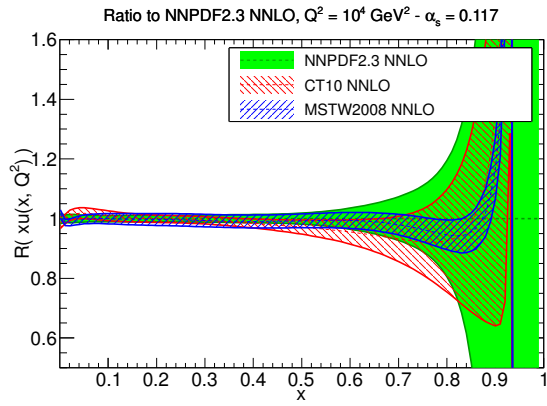
Figure 71



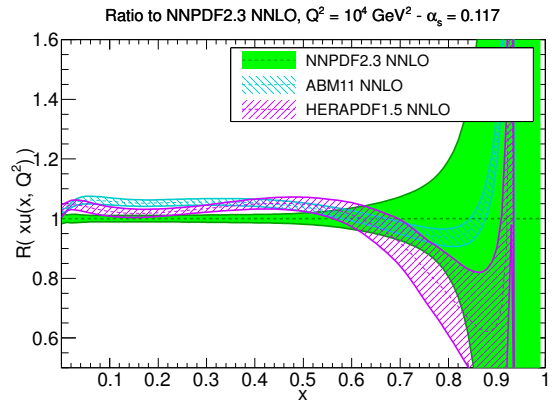
(a) Download (eps, png)



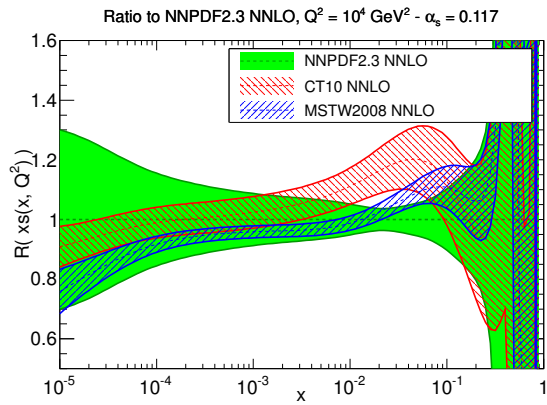
(b) Download (eps, png)



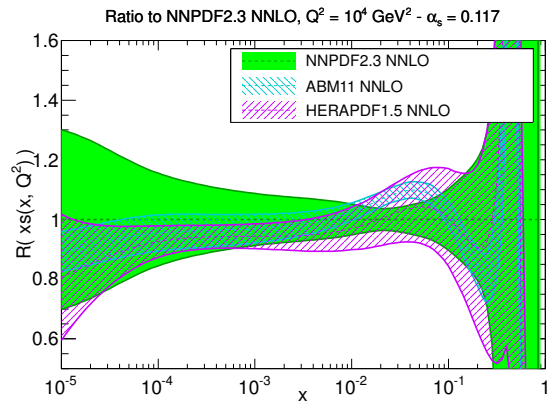
(c) Download (eps, png)



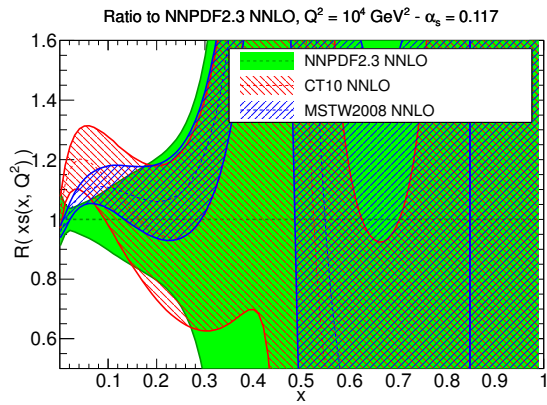
(d) Download (eps, png)



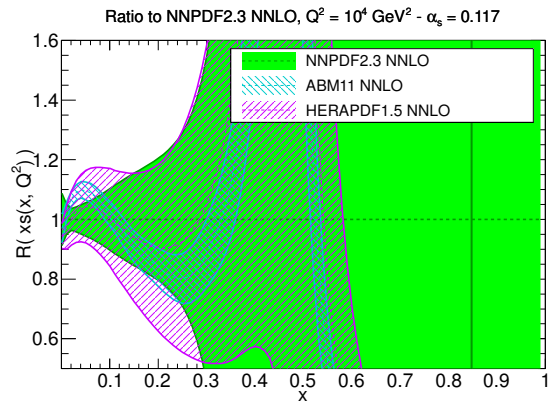
(e) Download (eps, png)



(f) Download (eps, png)



(g) Download (eps, png)



(h) Download (eps, png)

Figure 72

4 Parton luminosities

4.1 At $\alpha_s = 0.119$

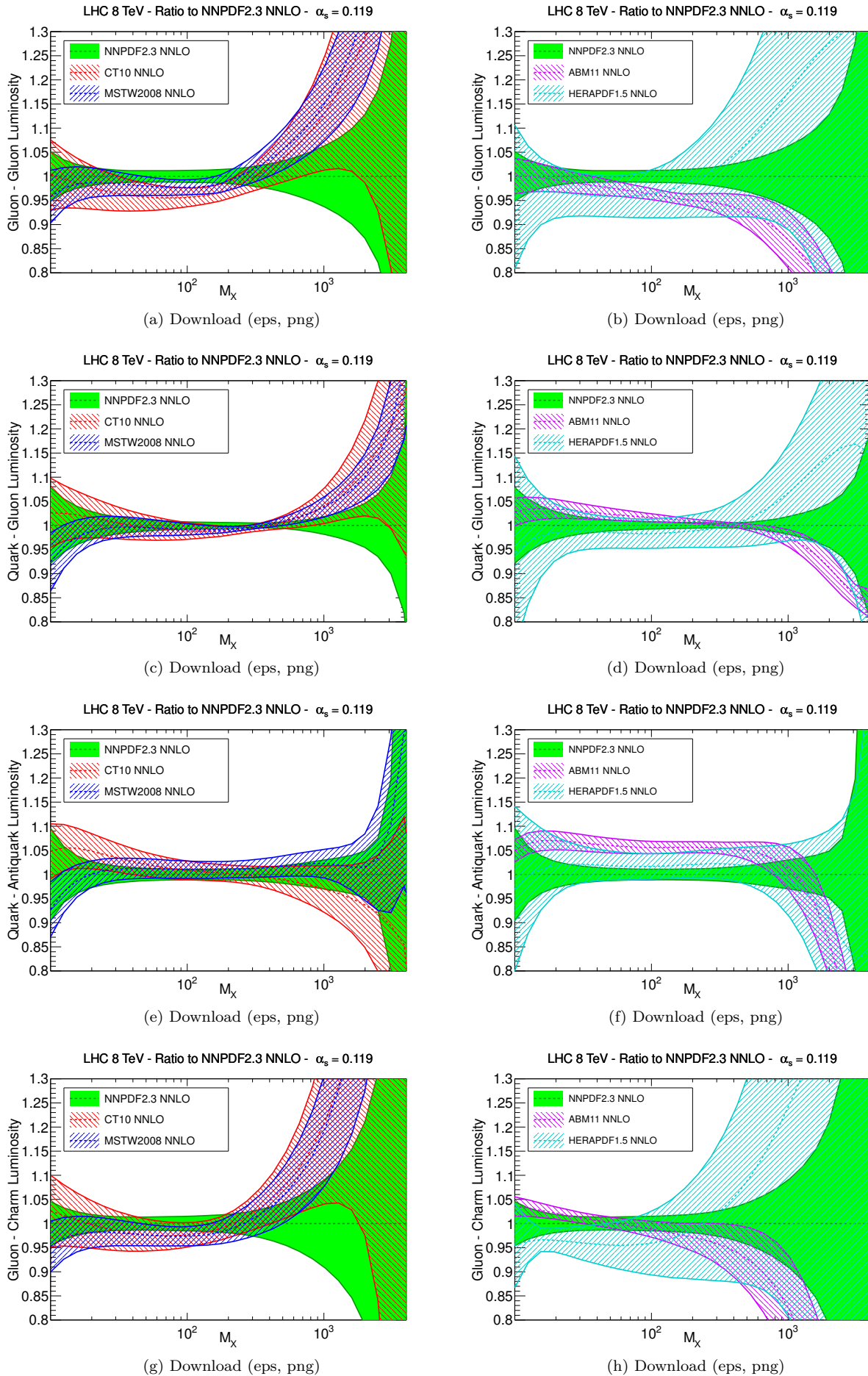


Figure 73

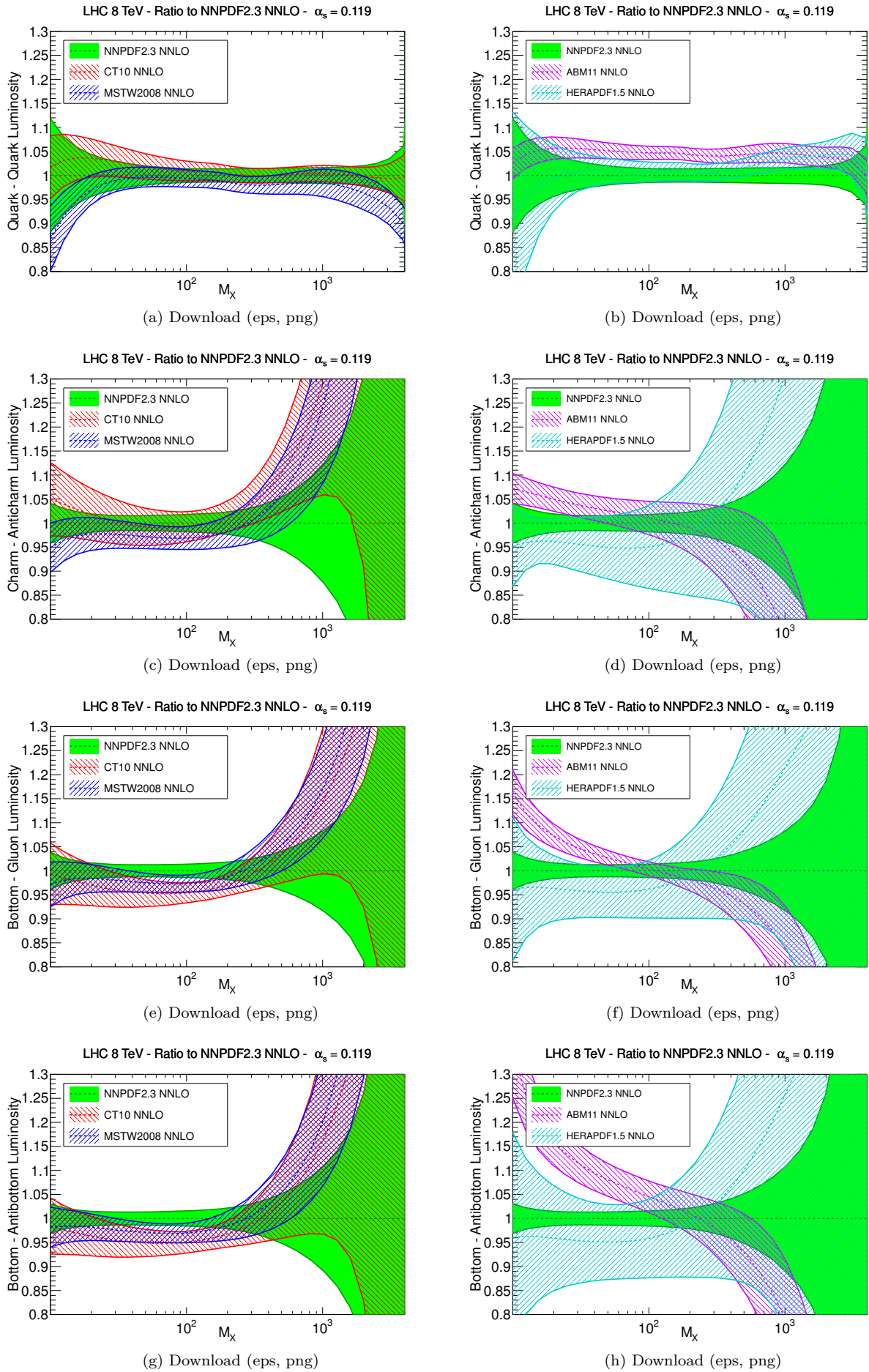


Figure 74

4.2 At $\alpha_s = 0.118$

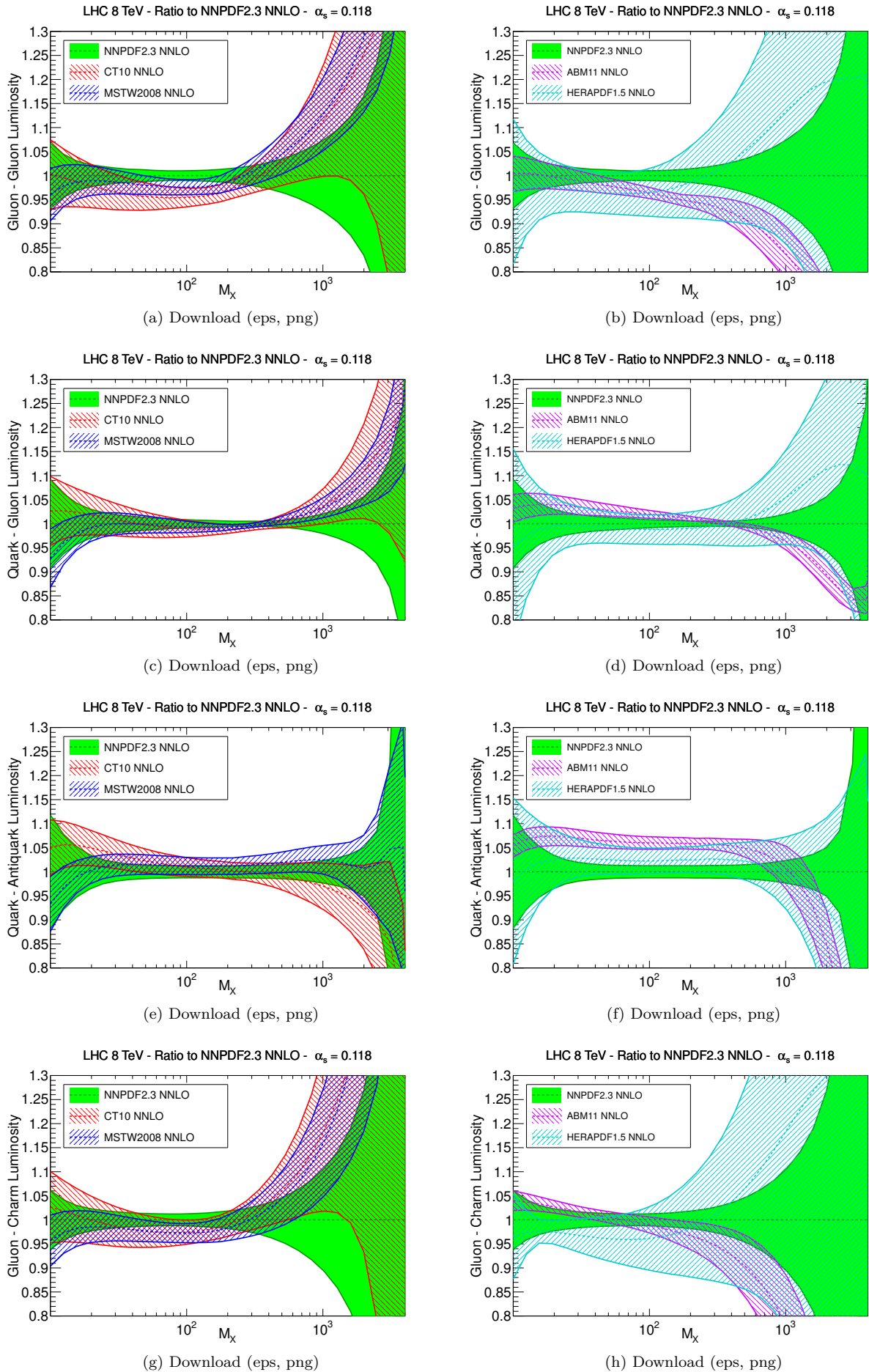


Figure 75

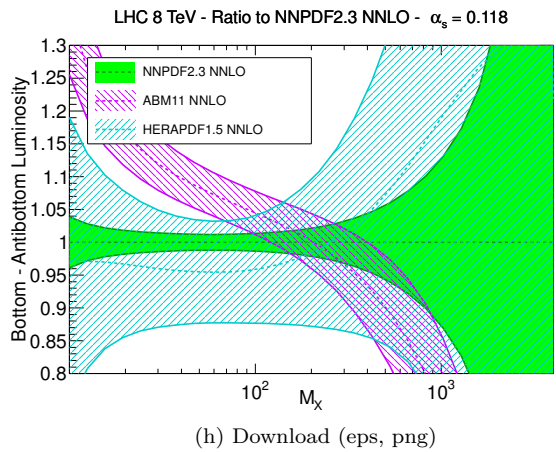
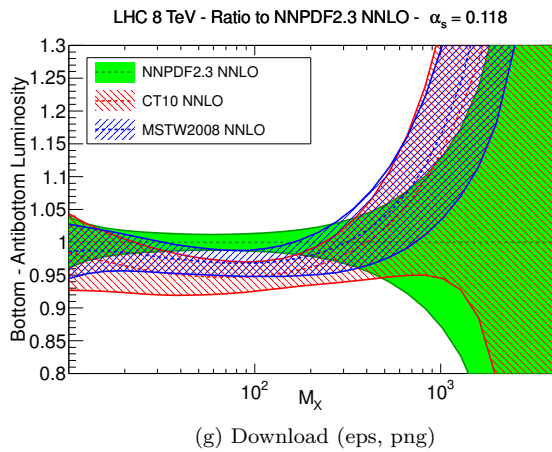
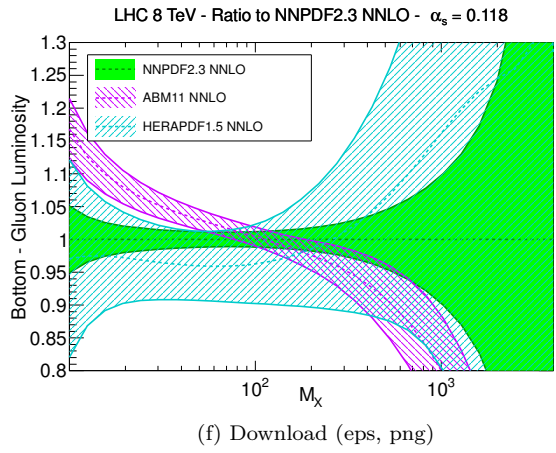
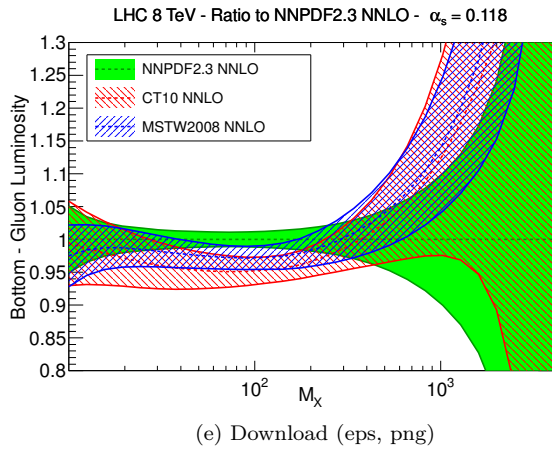
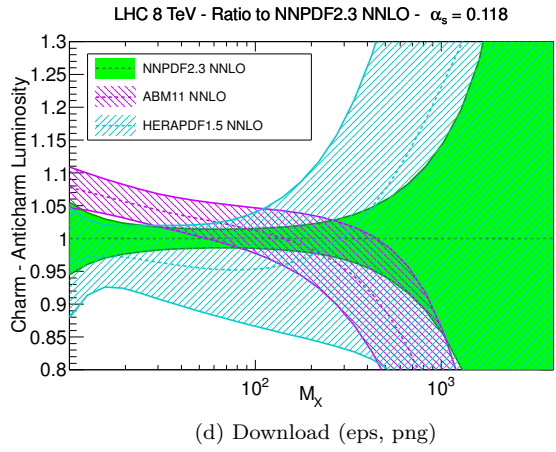
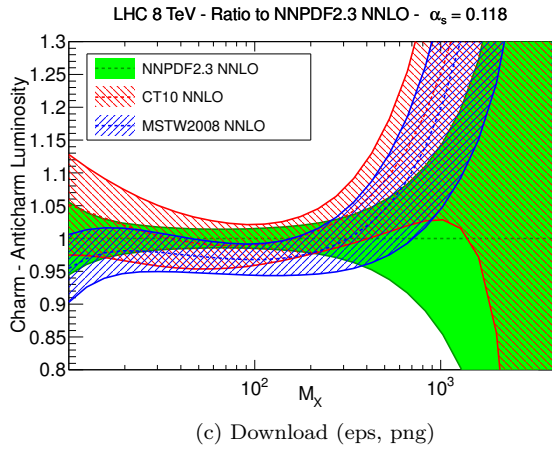
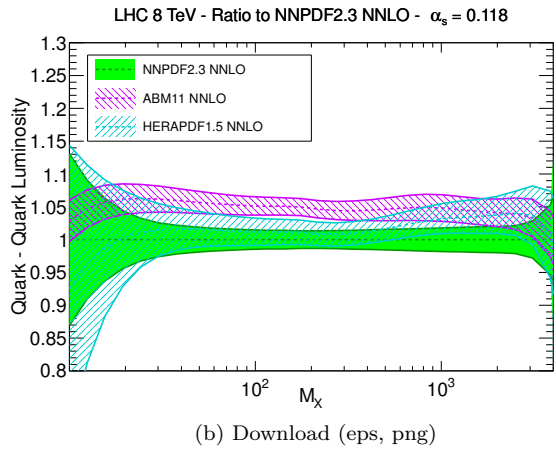
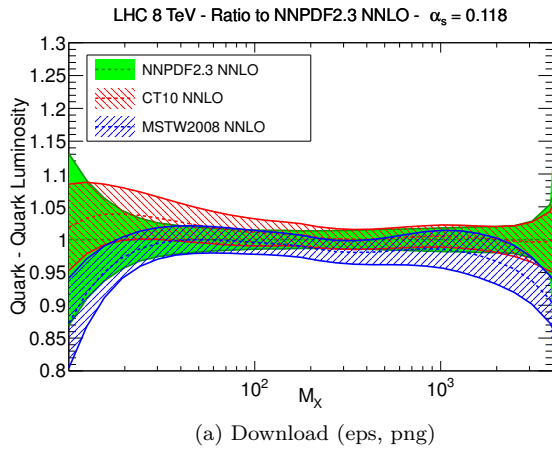


Figure 76

4.3 At $\alpha_s = 0.117$

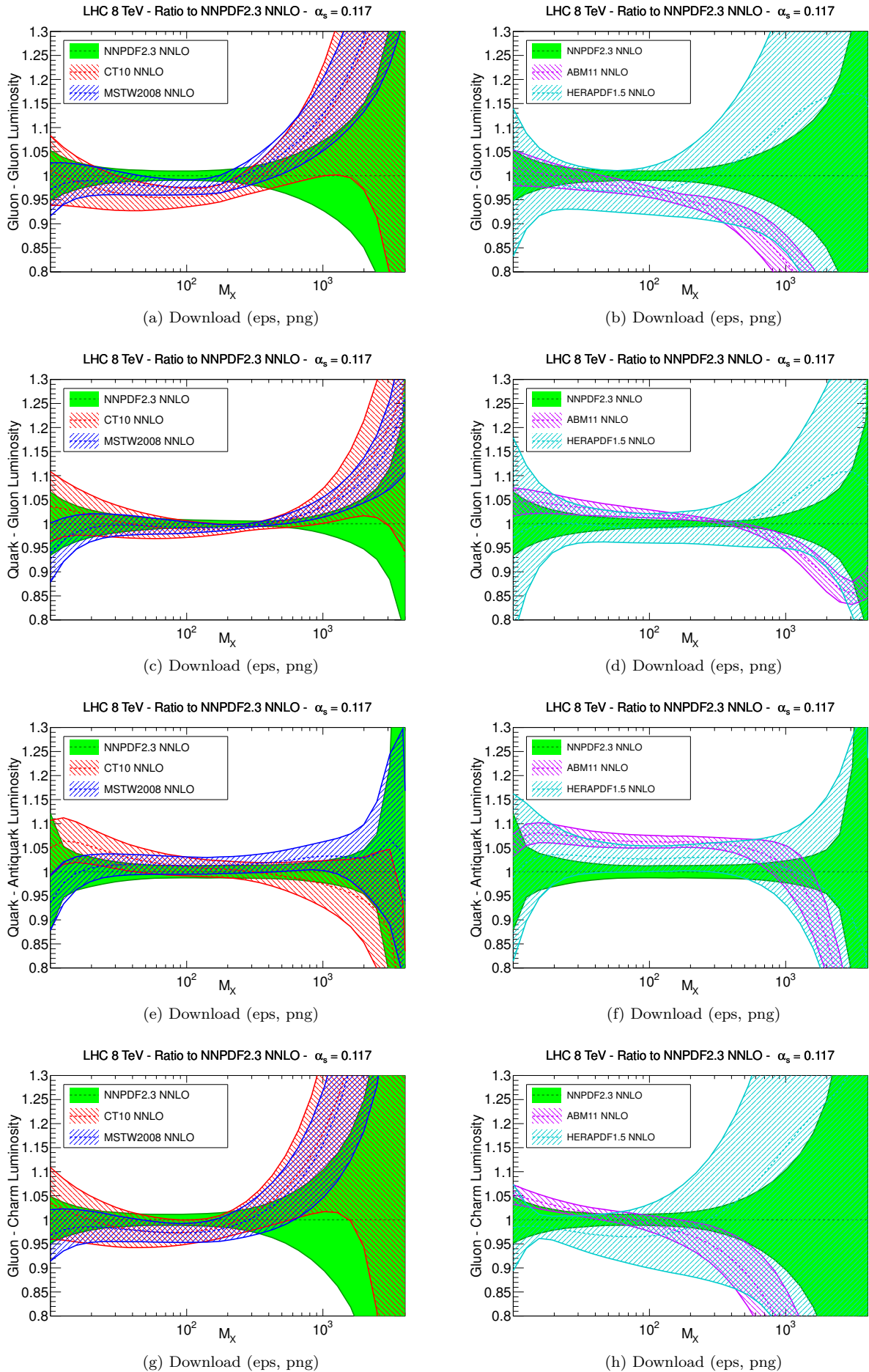


Figure 77

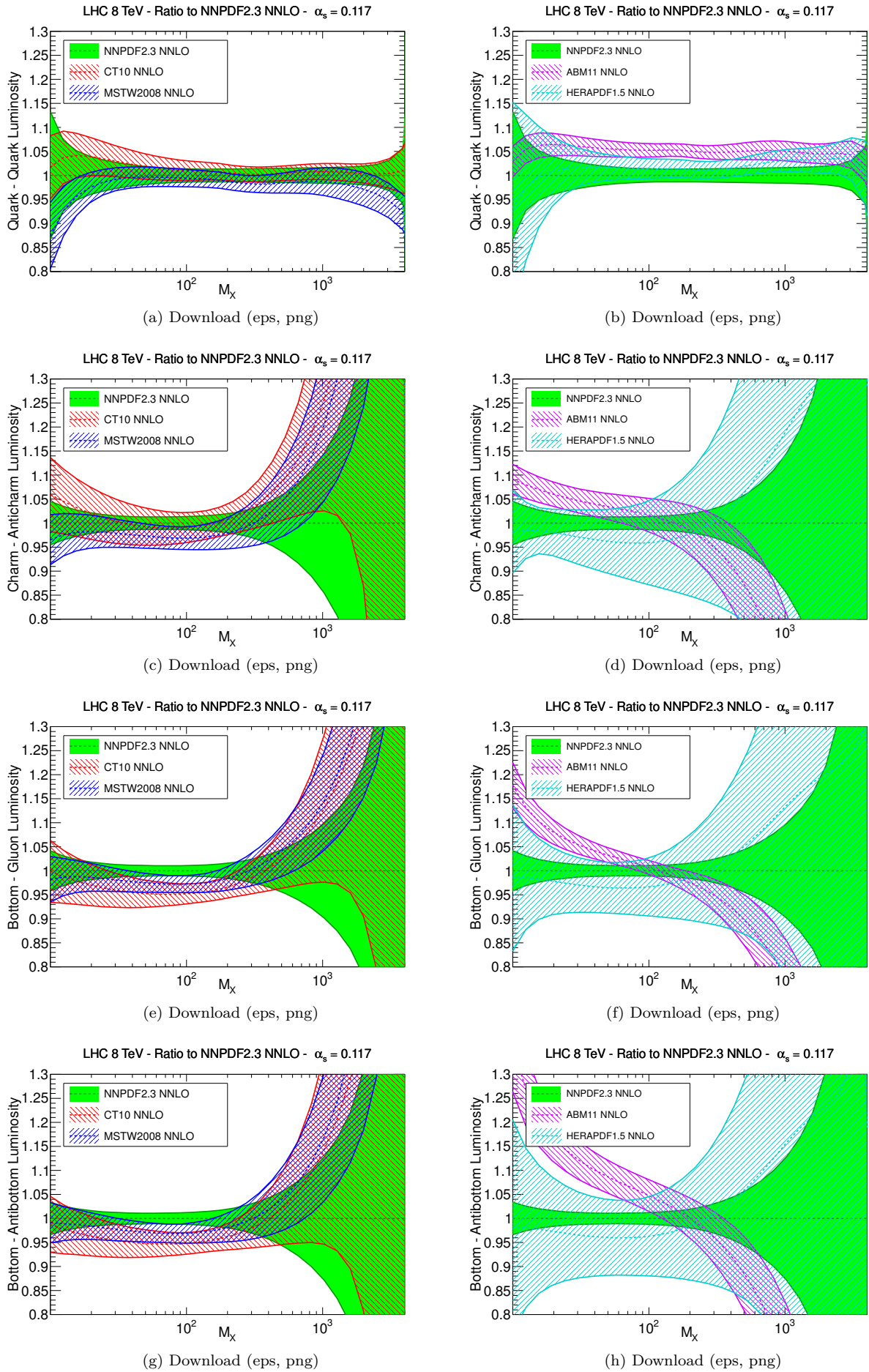


Figure 78

4.4 At default α_s

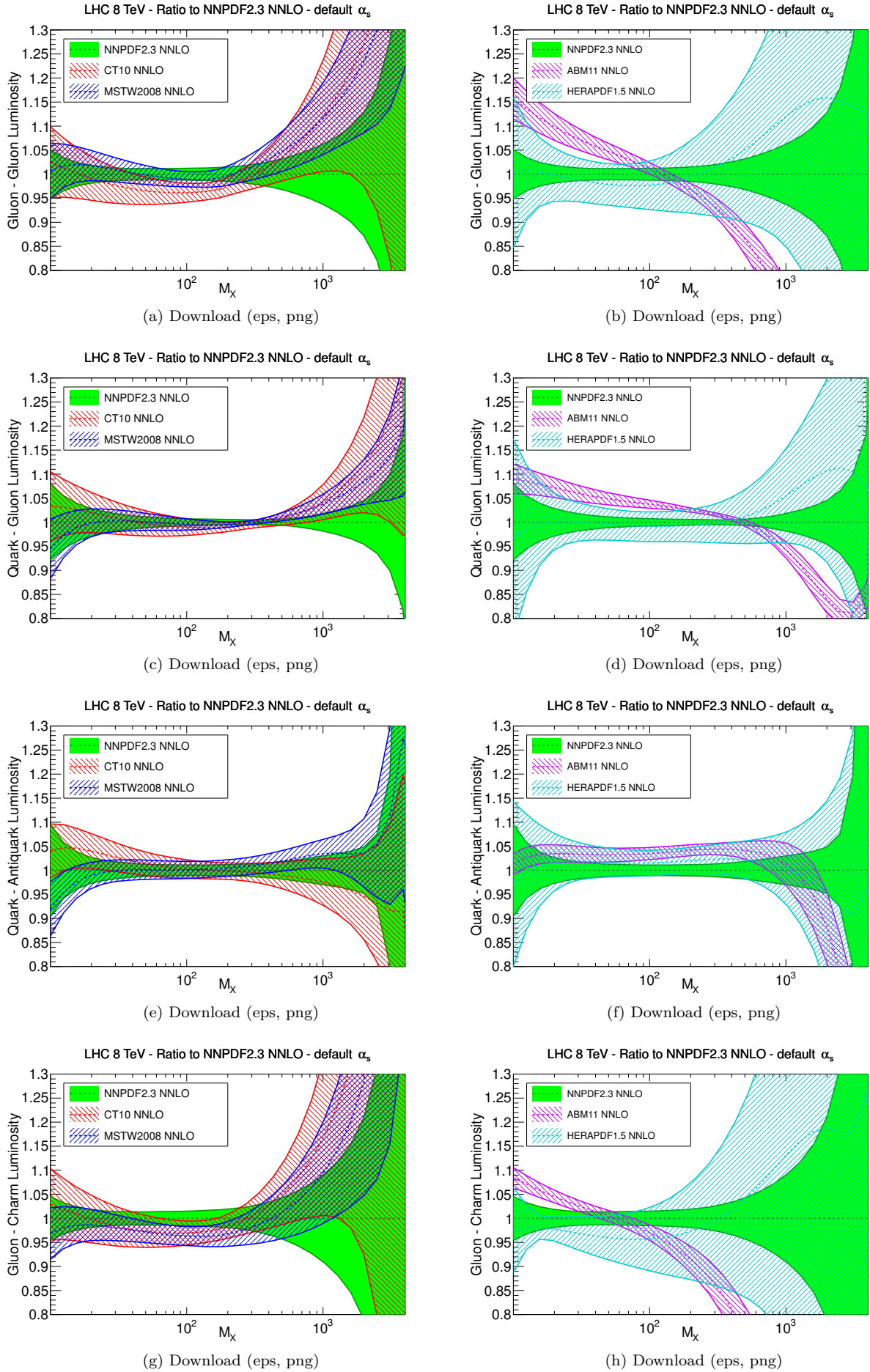


Figure 79

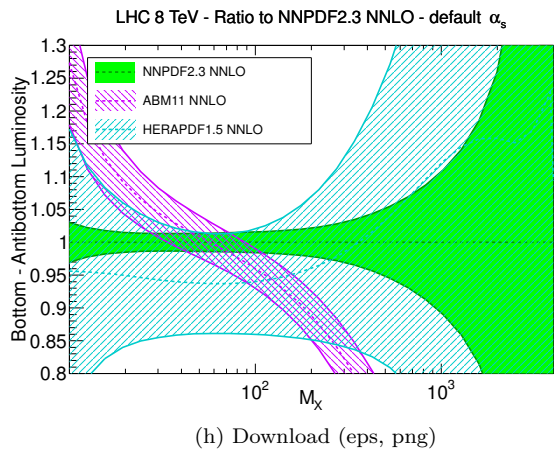
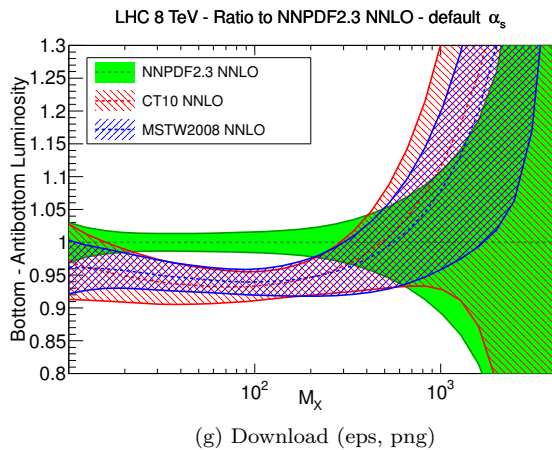
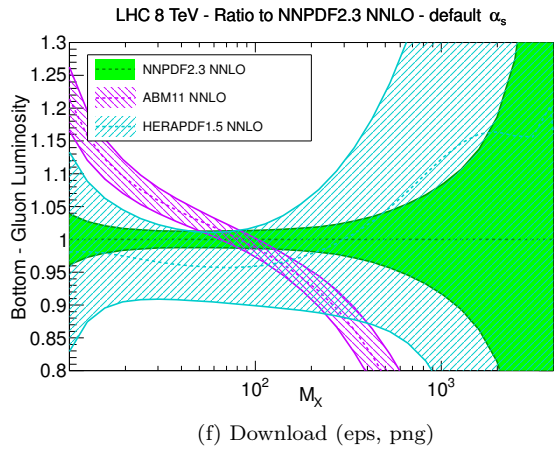
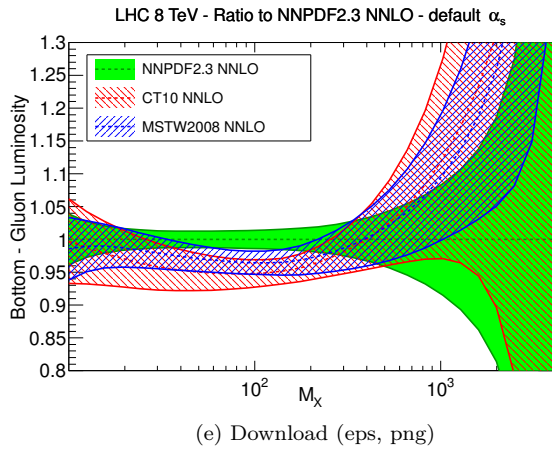
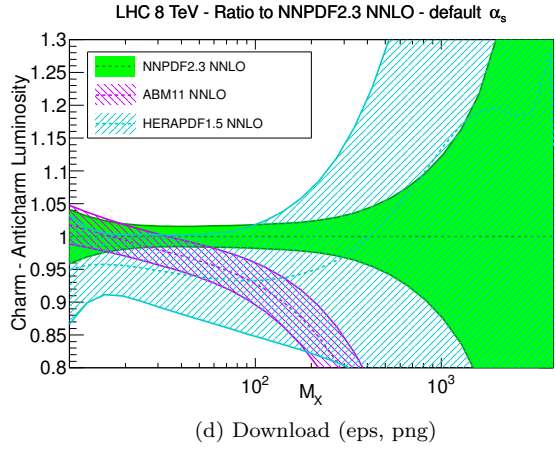
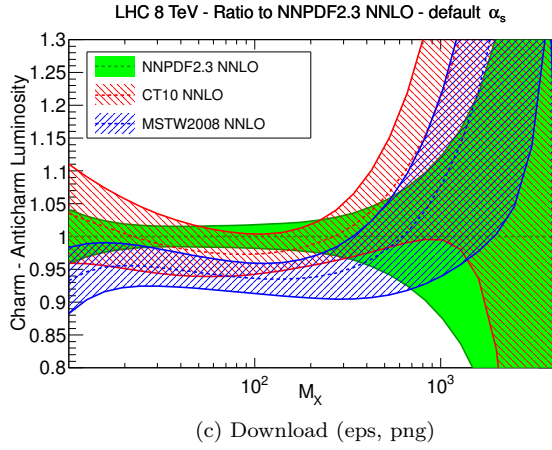
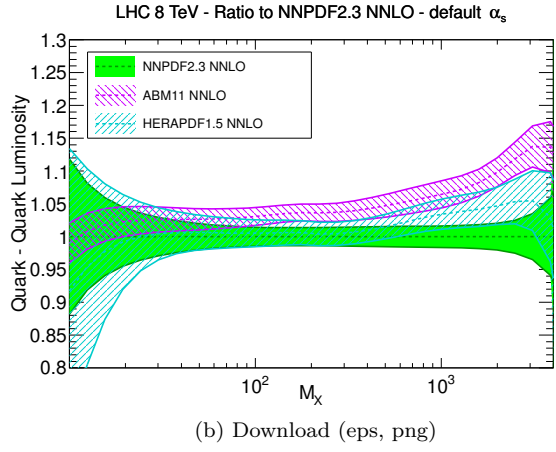
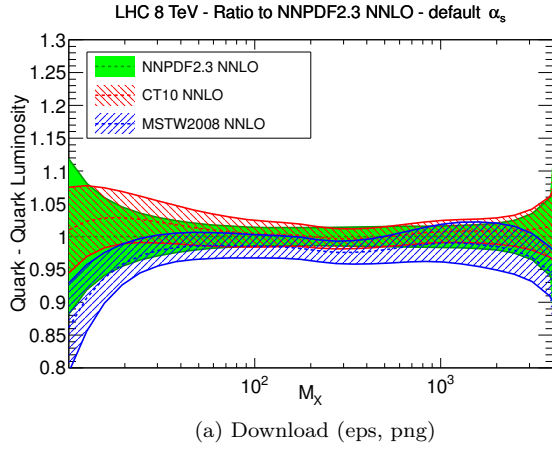


Figure 80

4.5 Relative PDF uncertainty

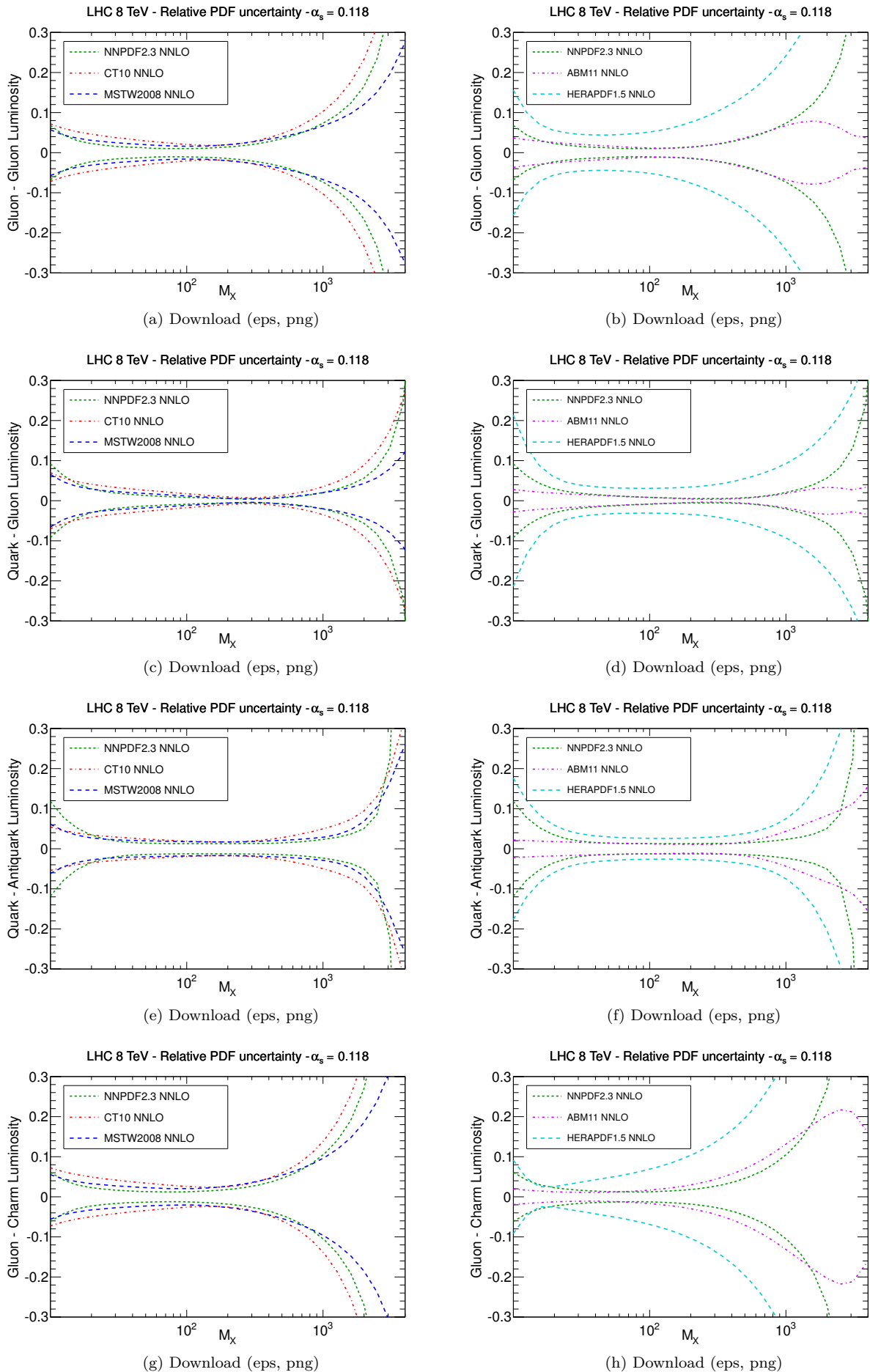


Figure 81

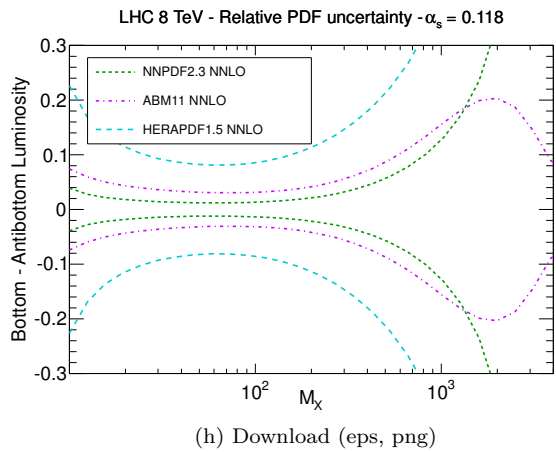
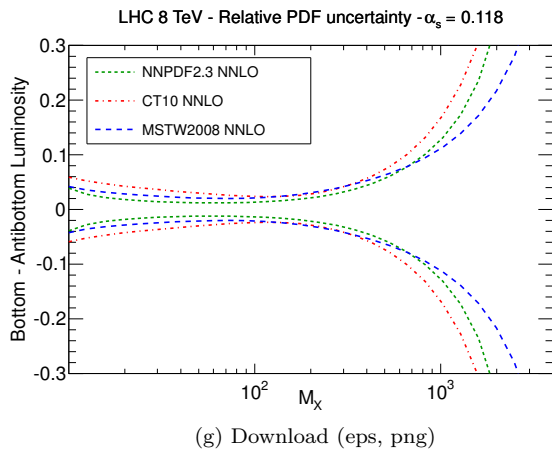
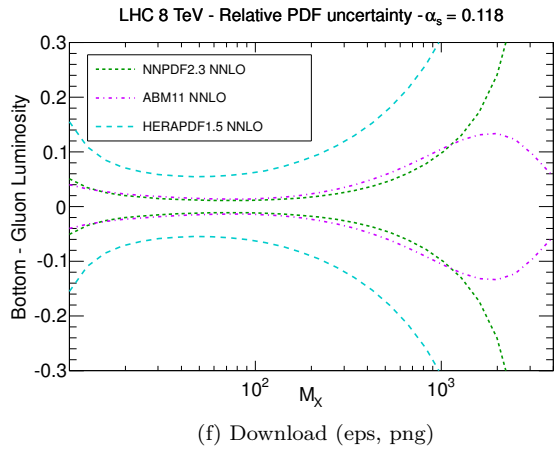
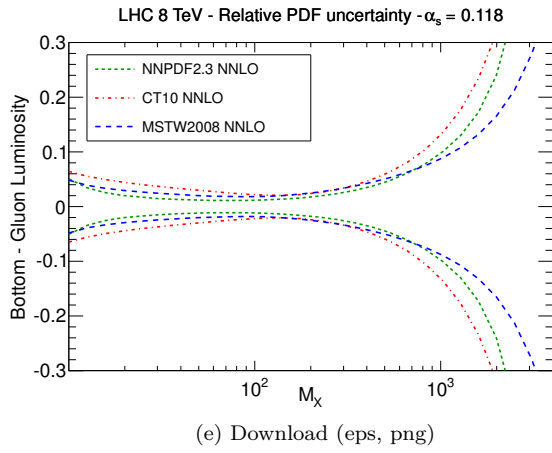
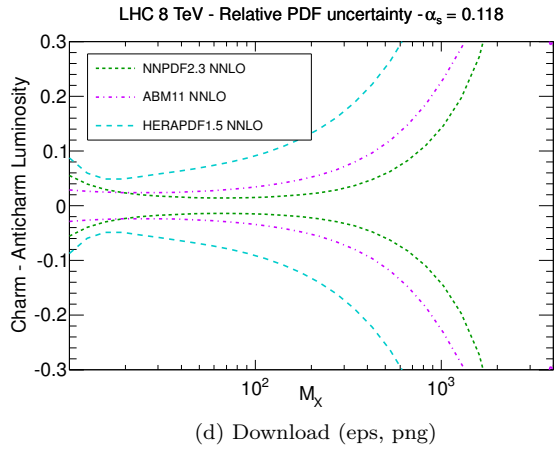
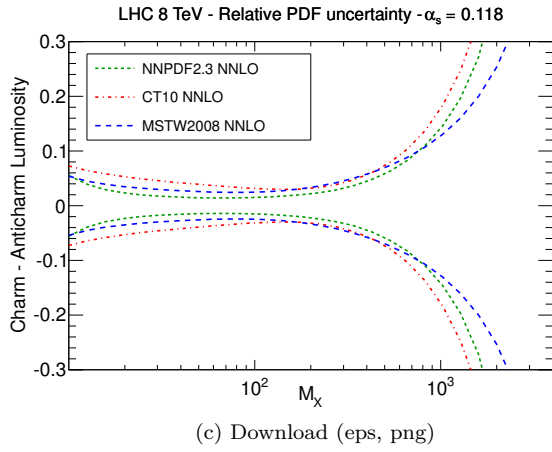
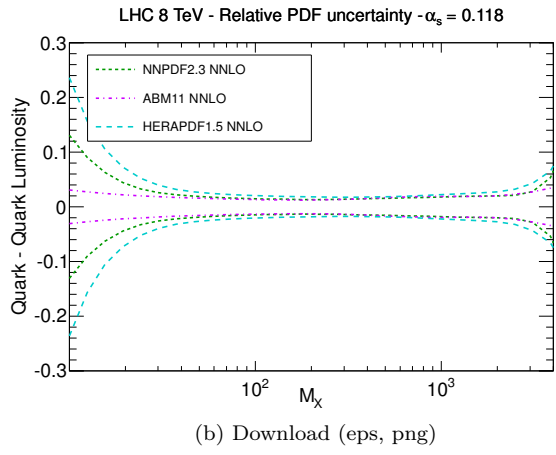
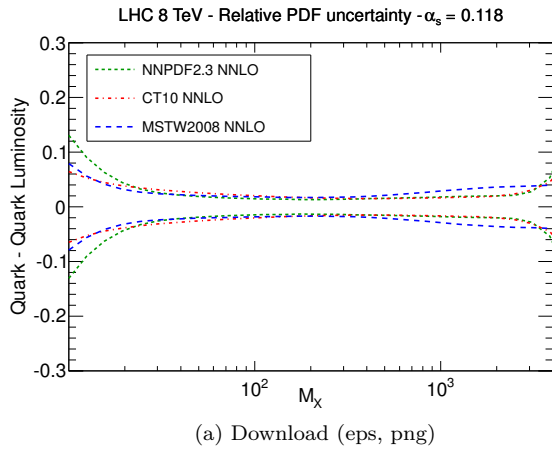


Figure 82

5 The LHC data

5.1 Predictions at $\alpha_s = 0.119$

5.1.1 ATLAS inclusive jet data with predictions

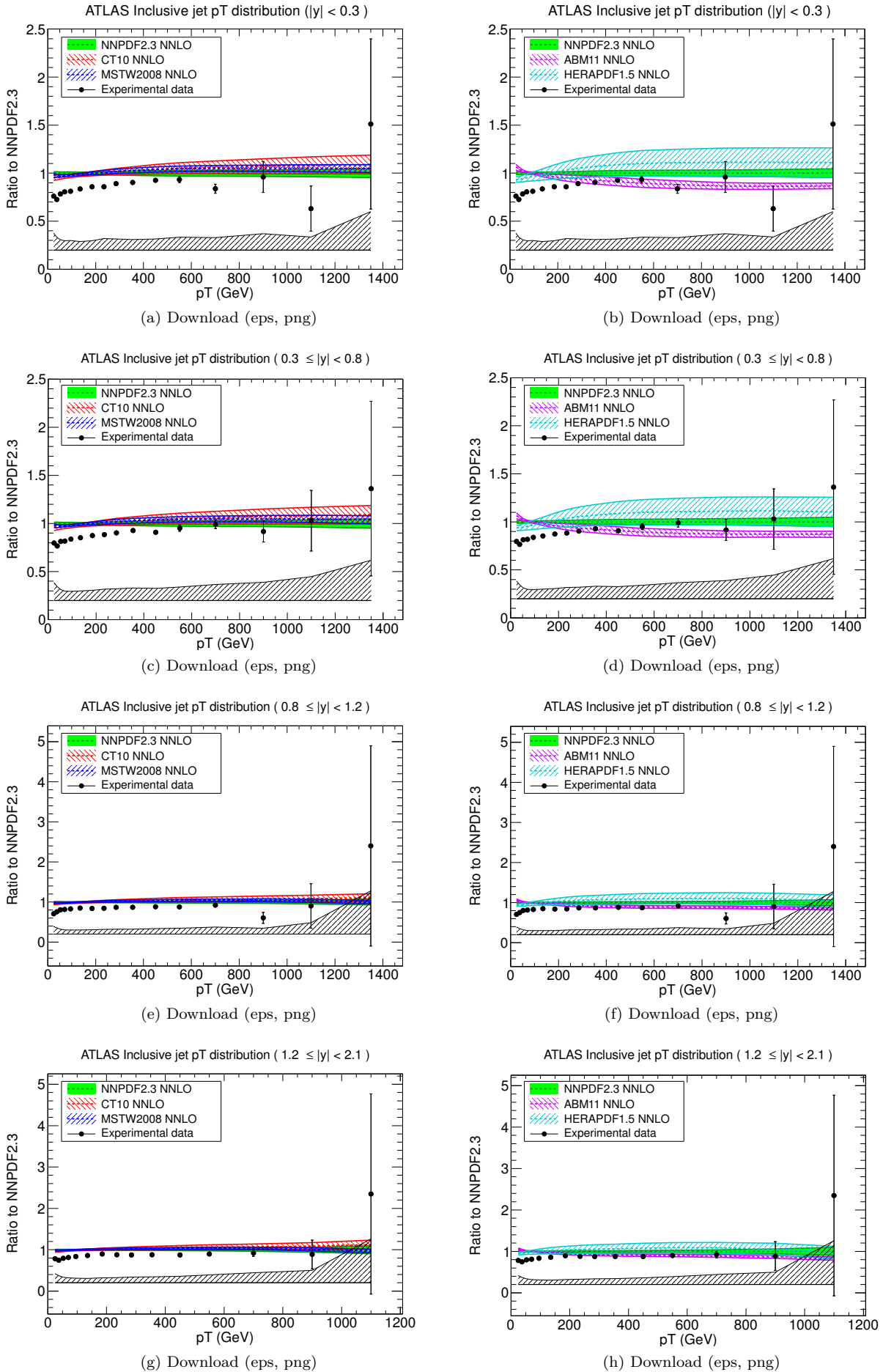


Figure 83
90

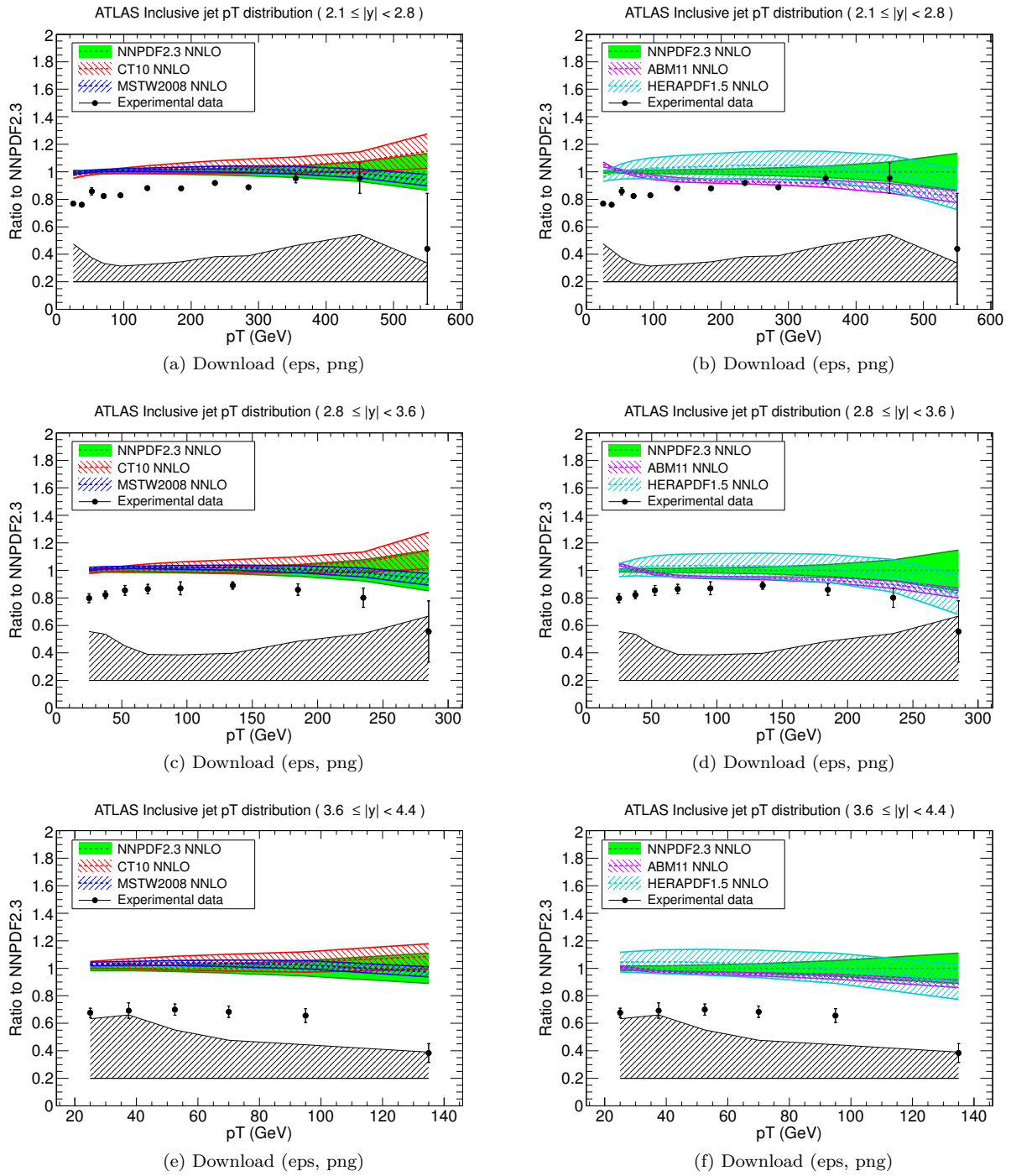


Figure 84

5.1.2 ATLAS and CMS gauge boson production data with predictions

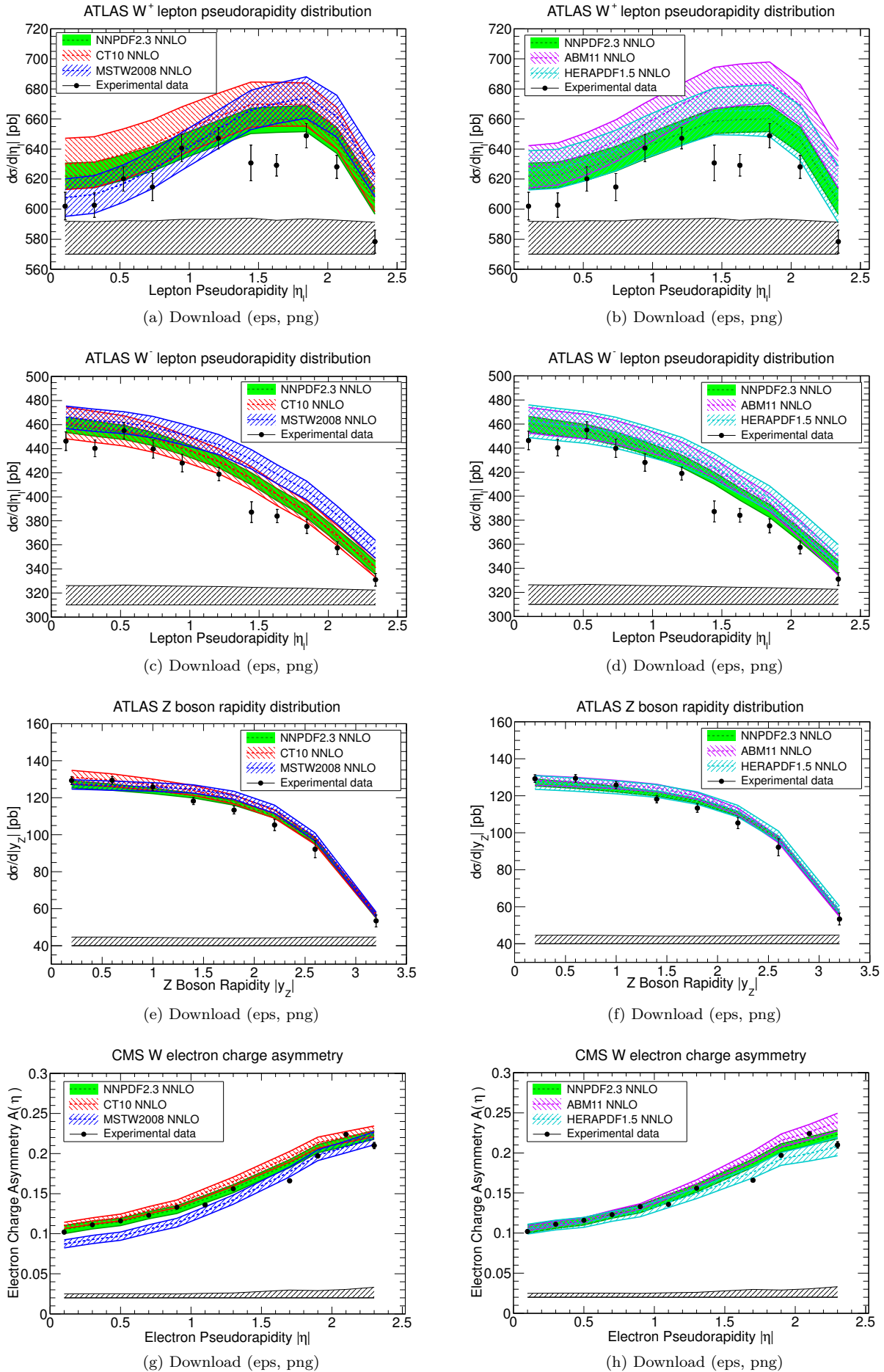


Figure 85

5.1.3 LHCb electroweak gauge boson production data with predictions

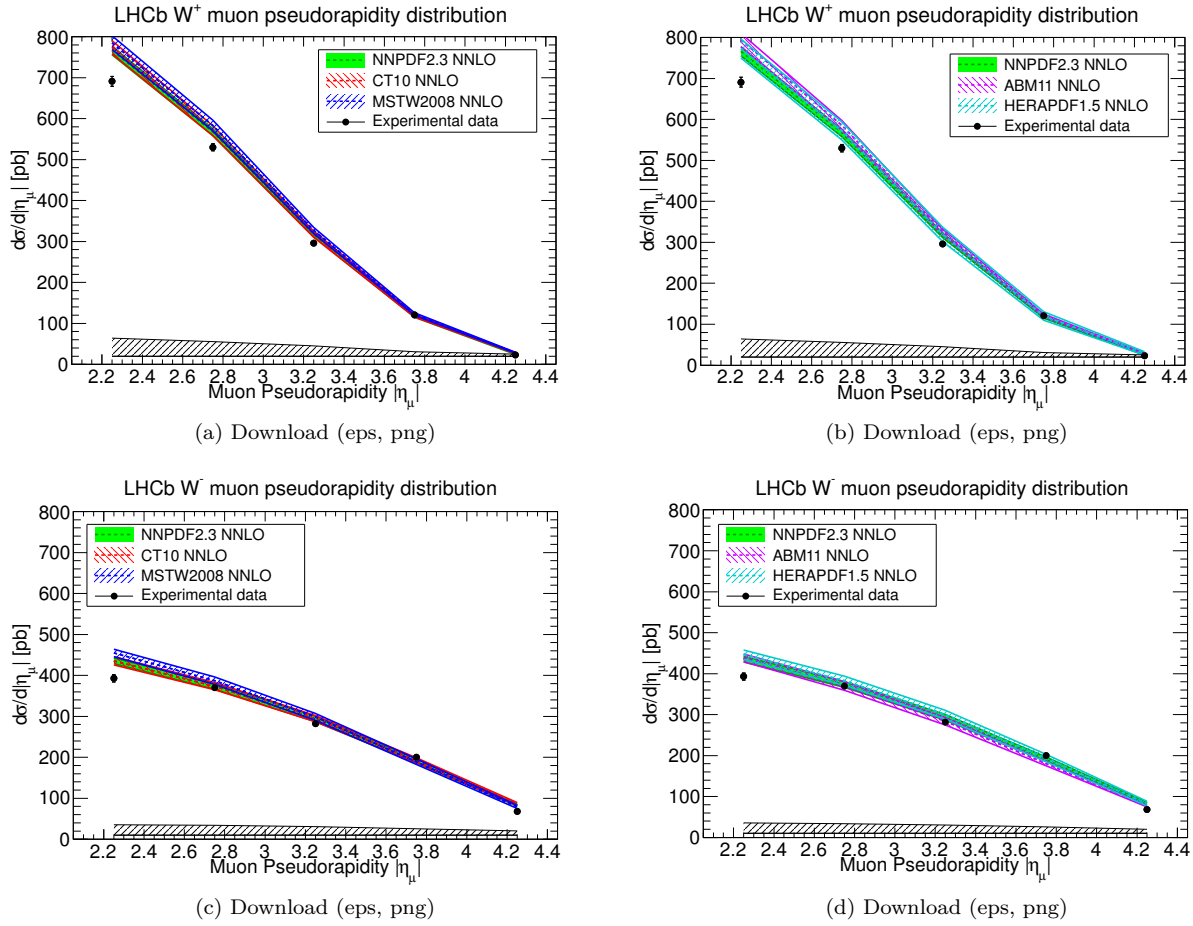


Figure 86

5.2 Predictions at $\alpha_s = 0.118$

5.2.1 ATLAS inclusive jet data with predictions

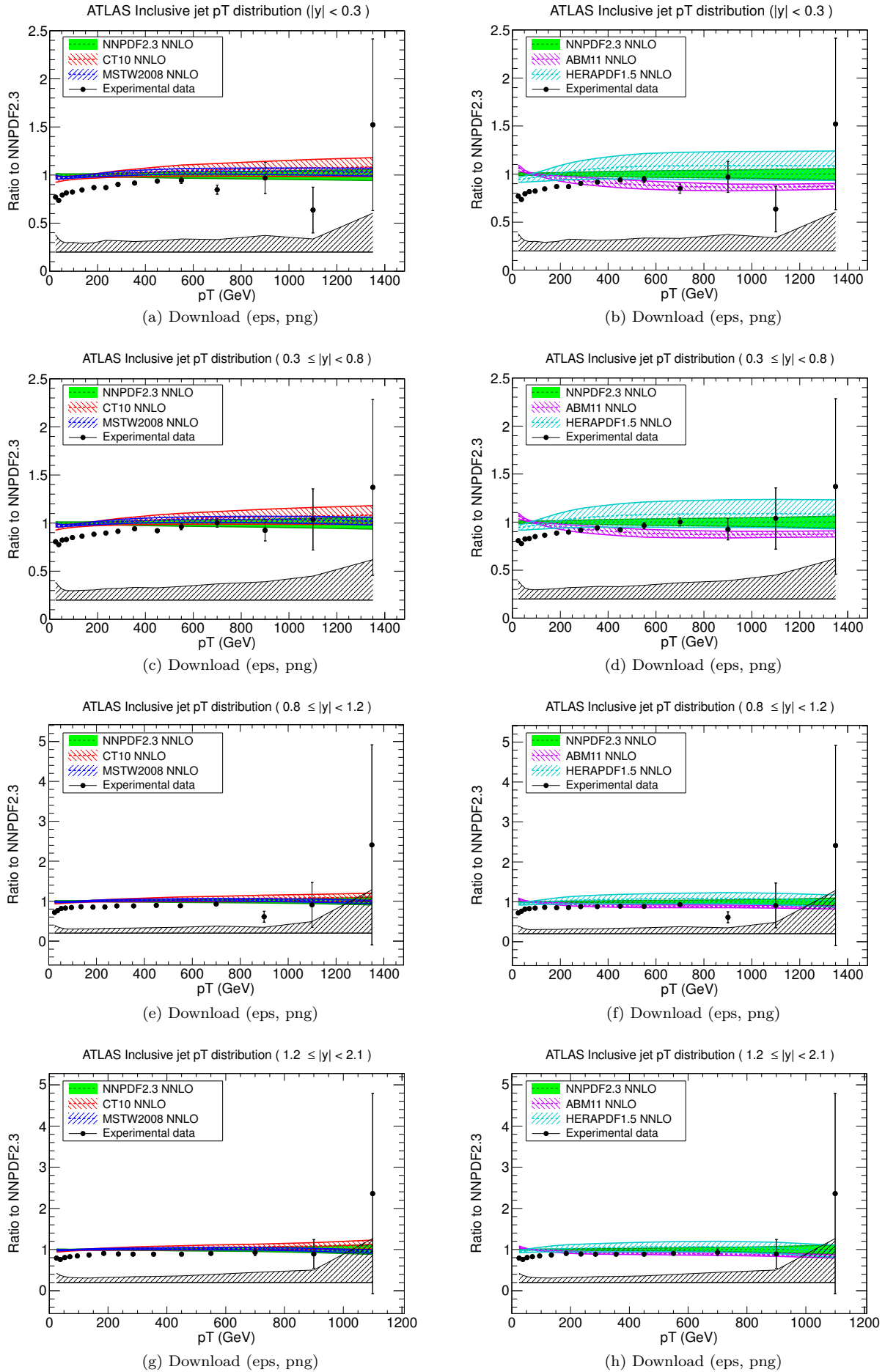


Figure 87

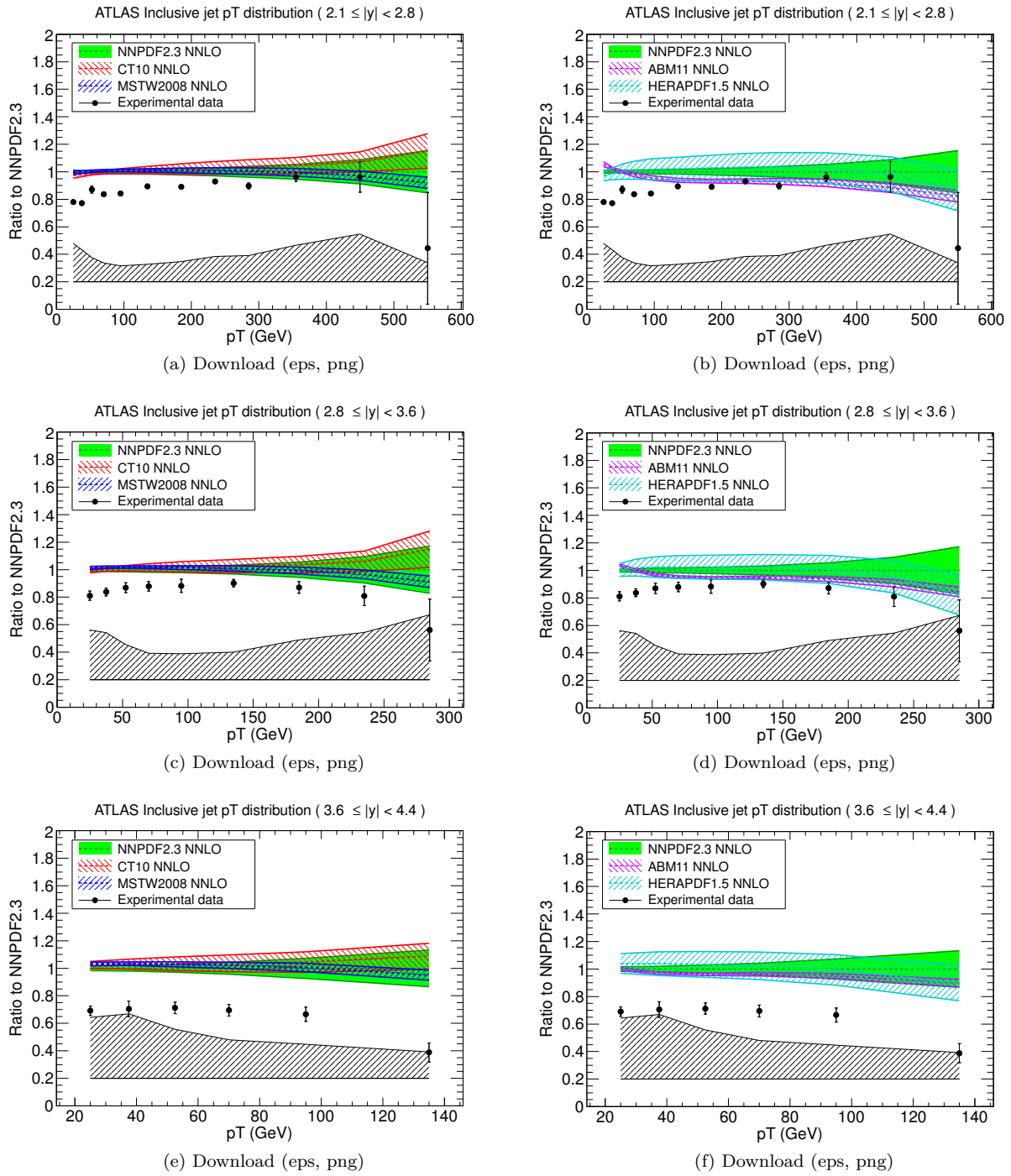


Figure 88

5.2.2 ATLAS and CMS gauge boson production data with predictions

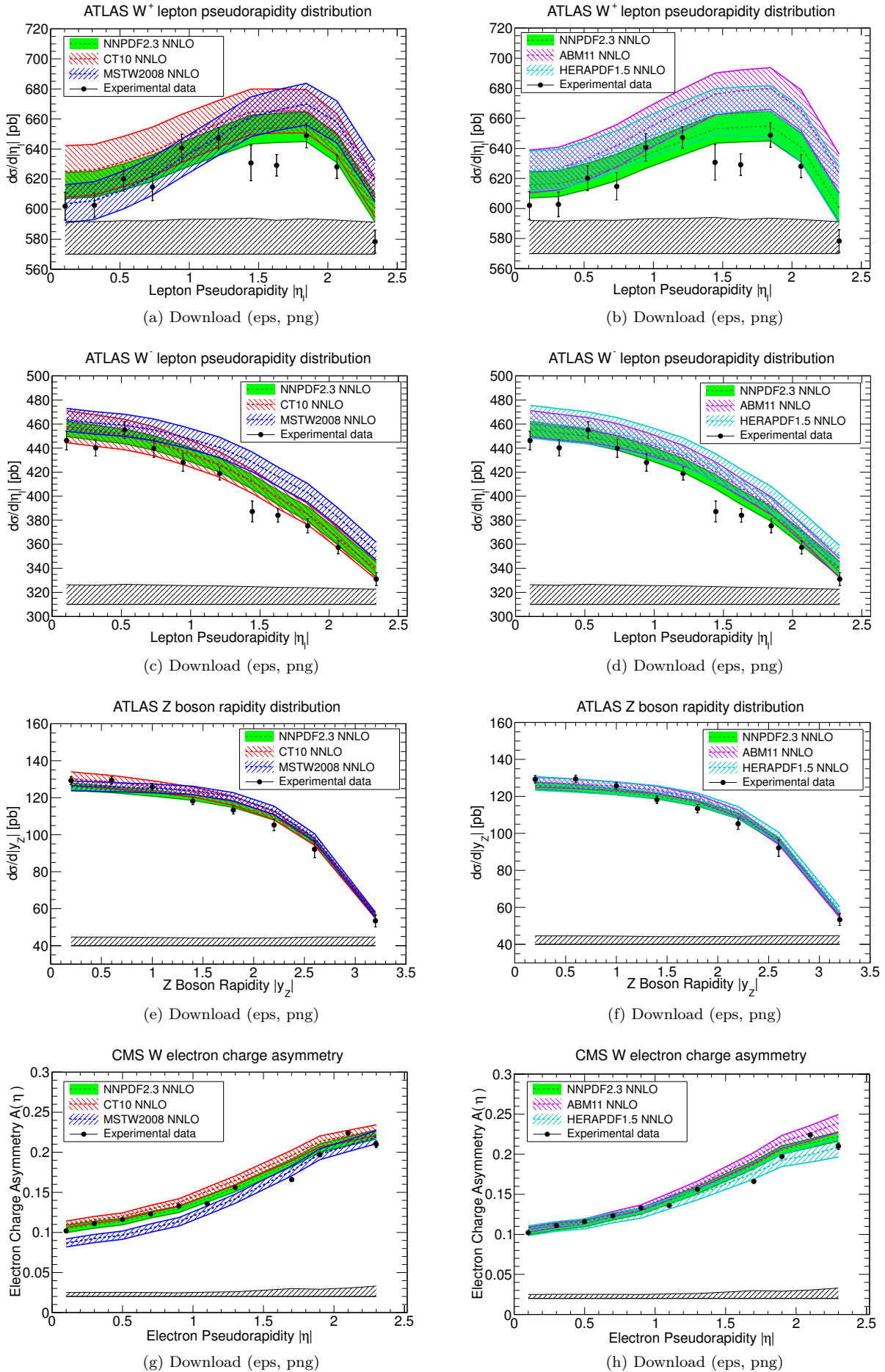


Figure 89

5.2.3 LHCb electroweak gauge boson production data with predictions

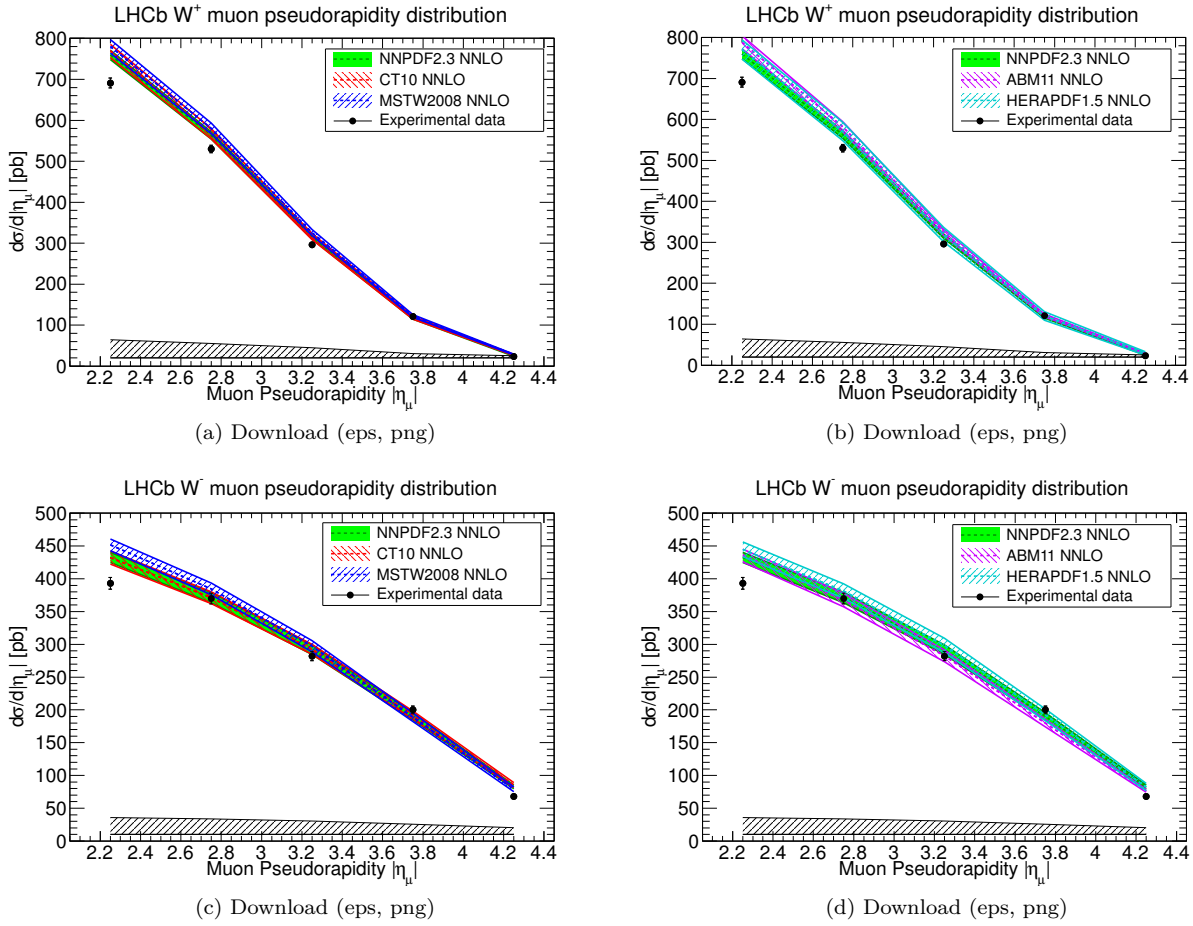


Figure 90

5.3 Predictions at $\alpha_s = 0.117$

5.3.1 ATLAS inclusive jet data with predictions

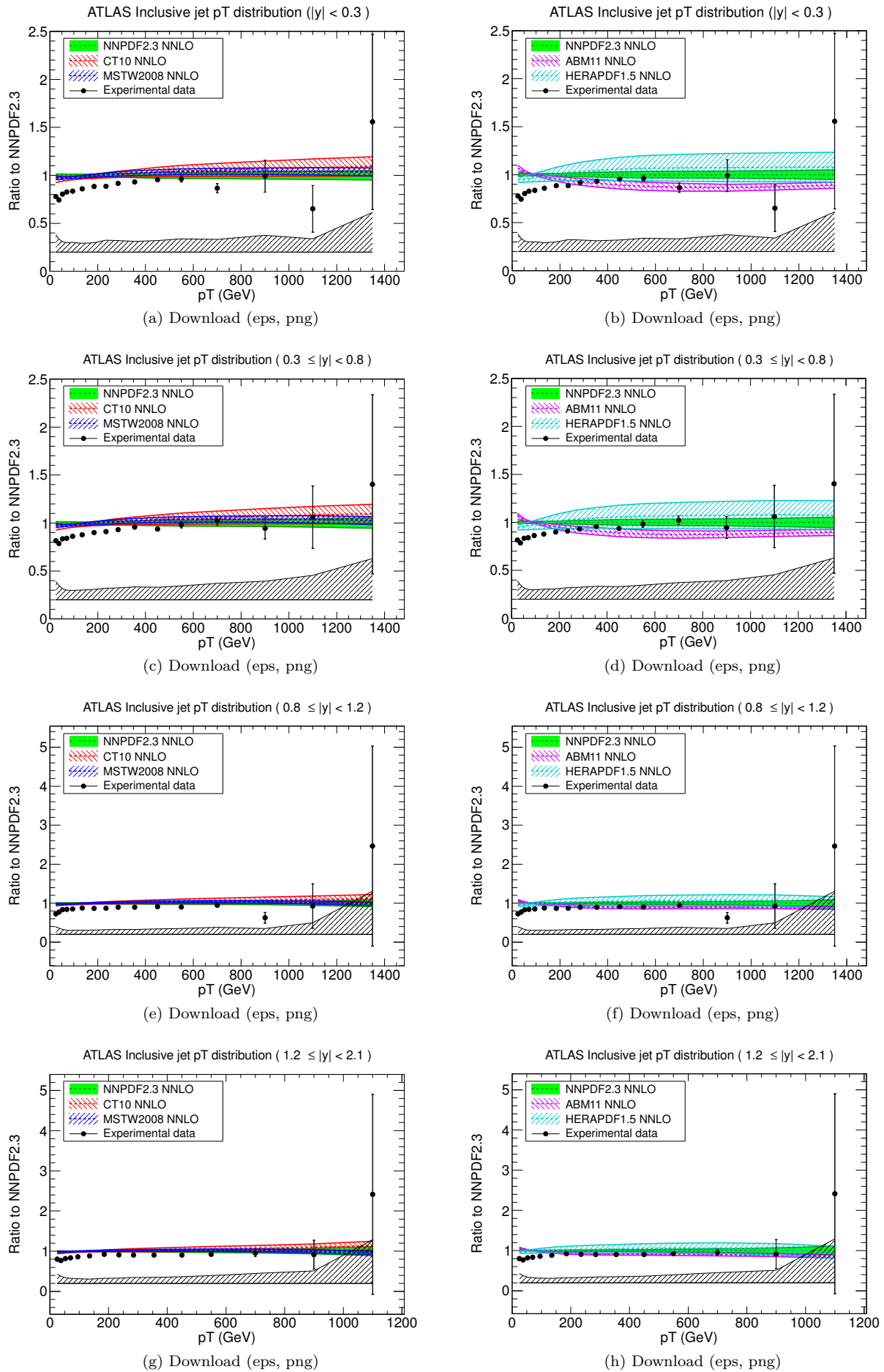


Figure 91

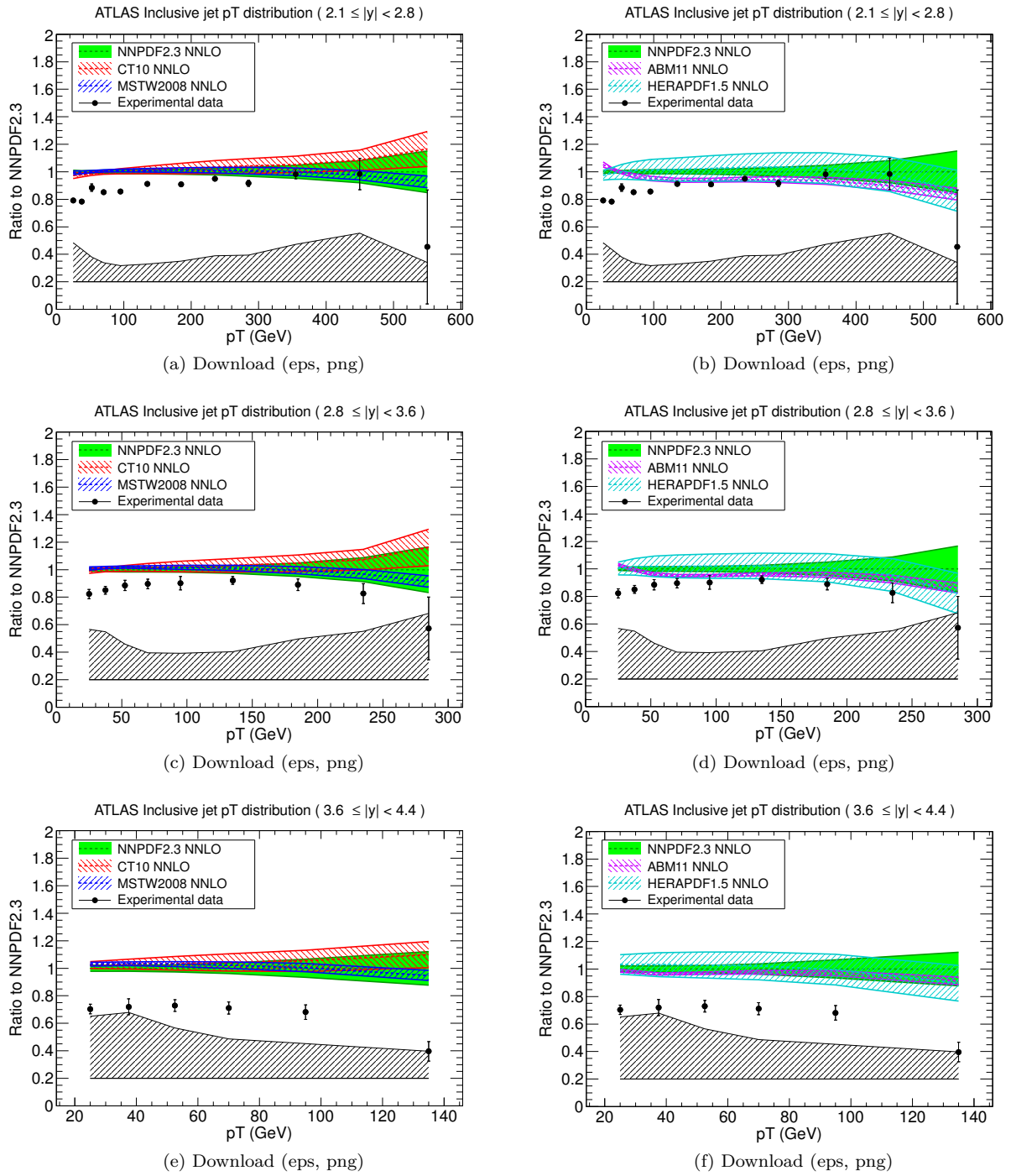


Figure 92

5.3.2 ATLAS and CMS gauge boson production data with predictions

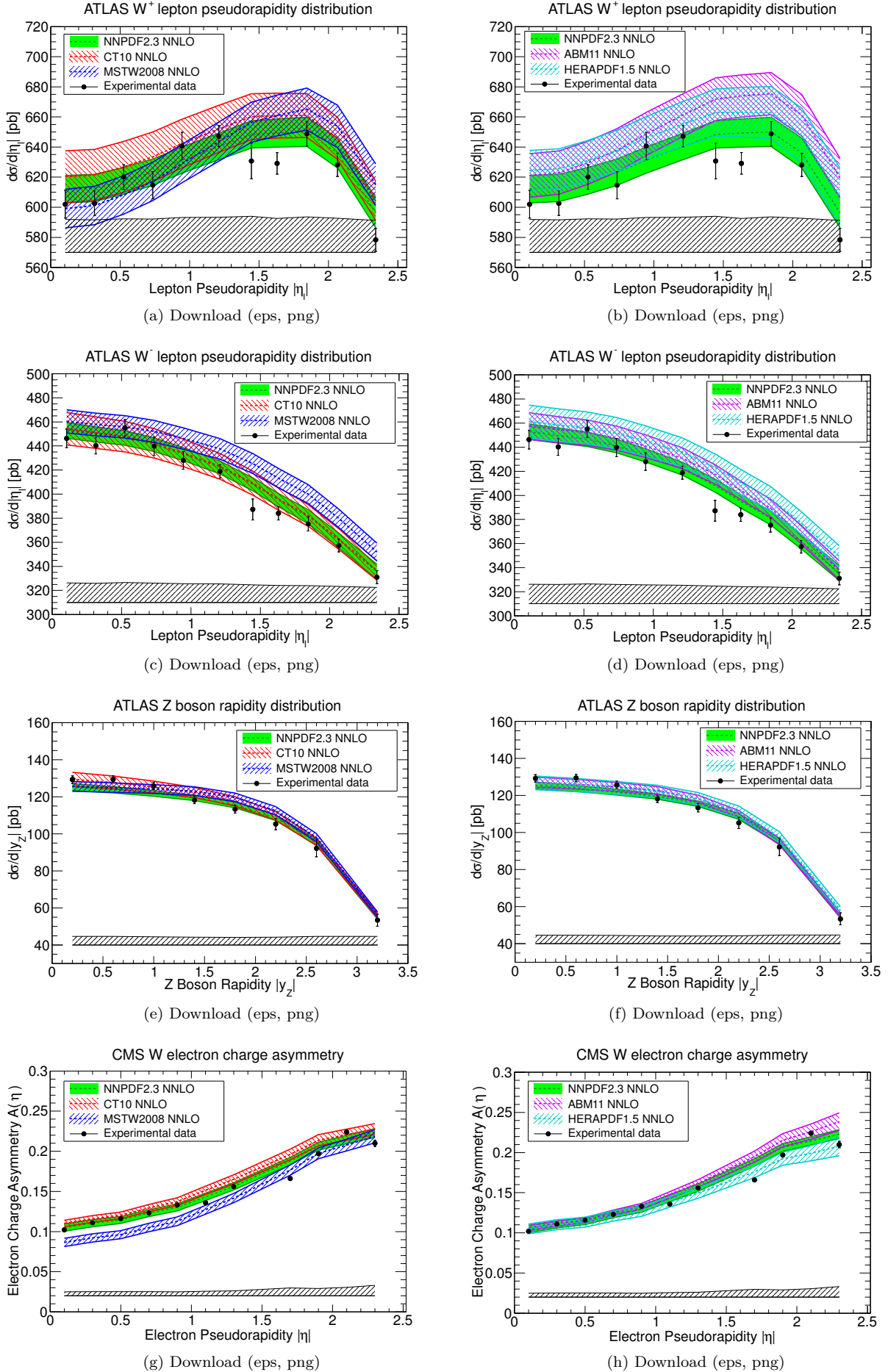


Figure 93

5.3.3 LHCb electroweak gauge boson production data with predictions

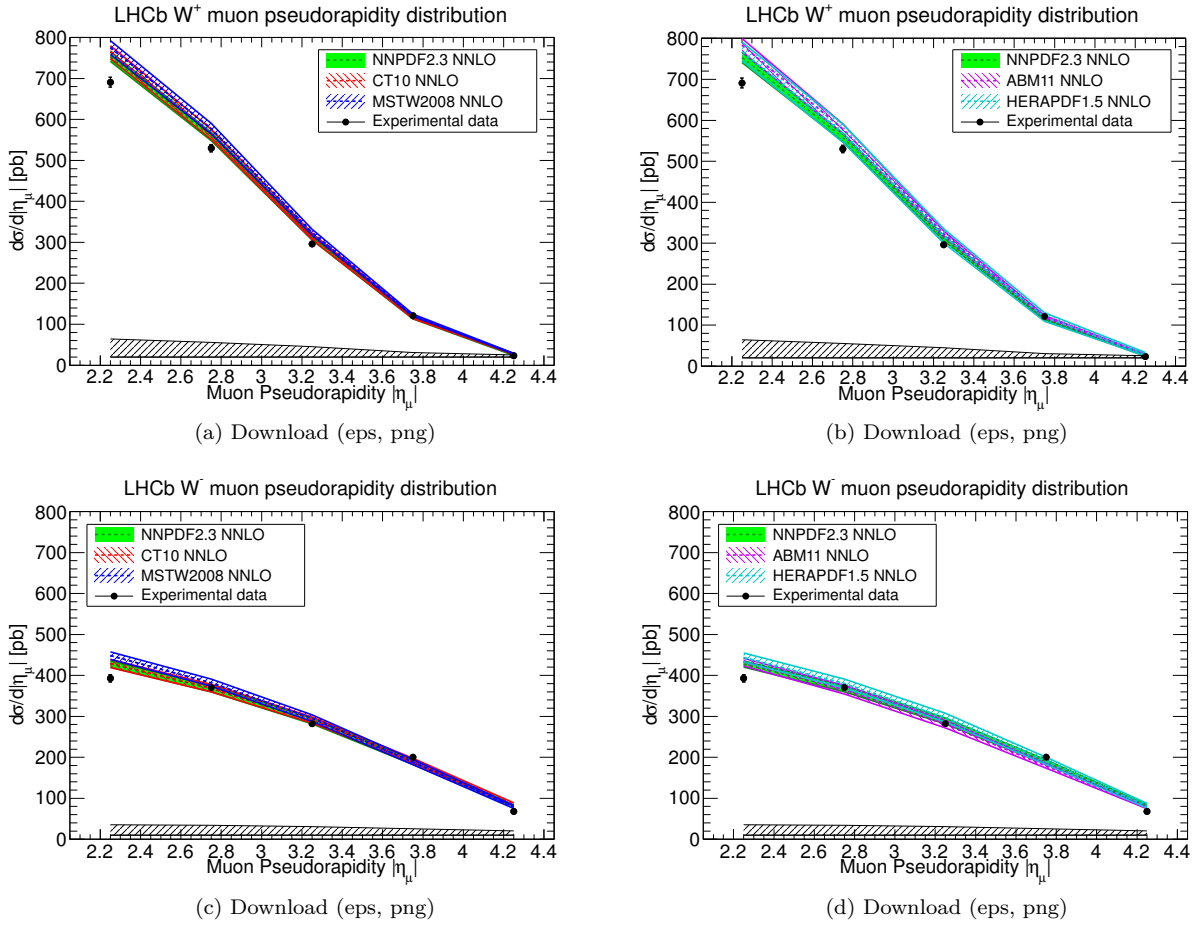


Figure 94

6 Phenomenology

6.1 Higgs

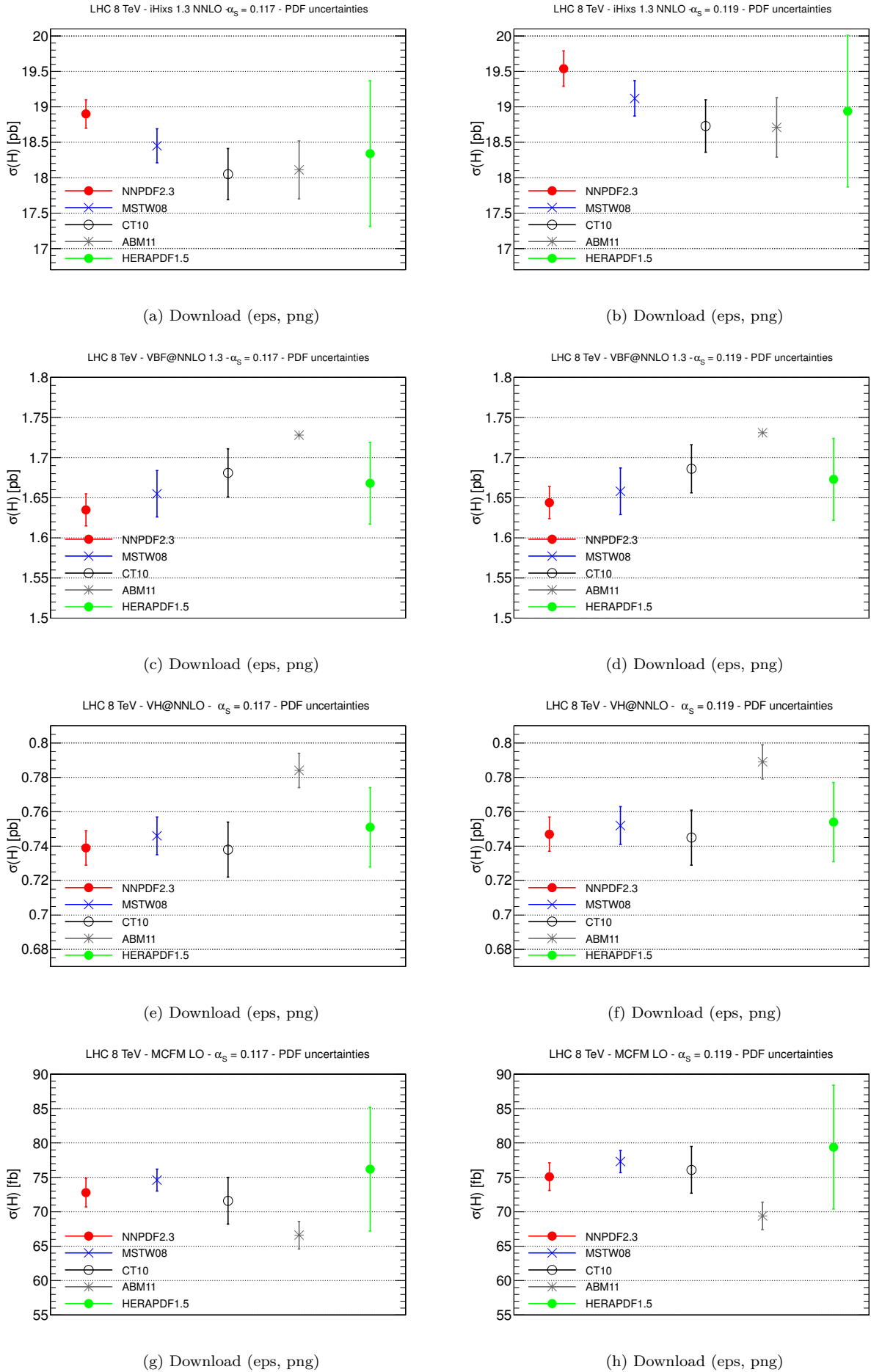
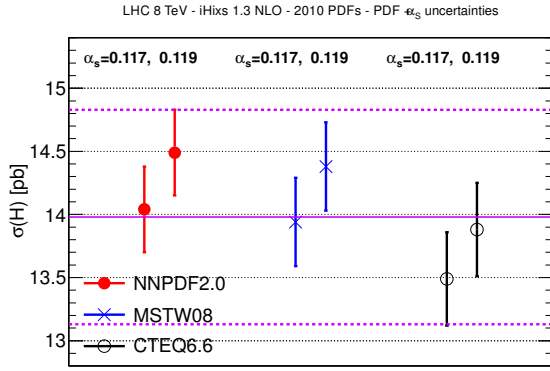
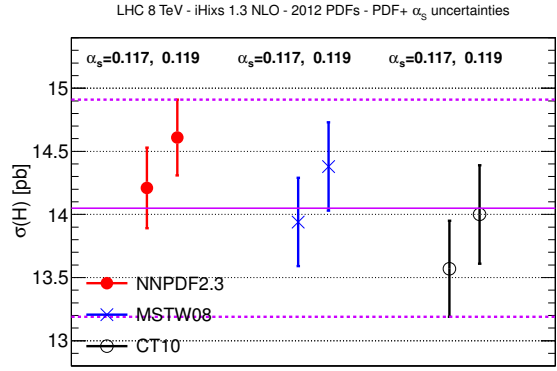


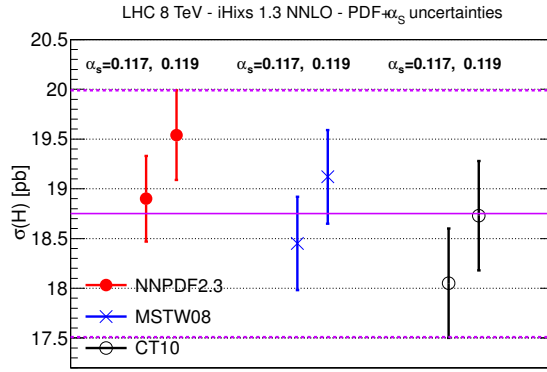
Figure 95



(a) Download (eps, png)



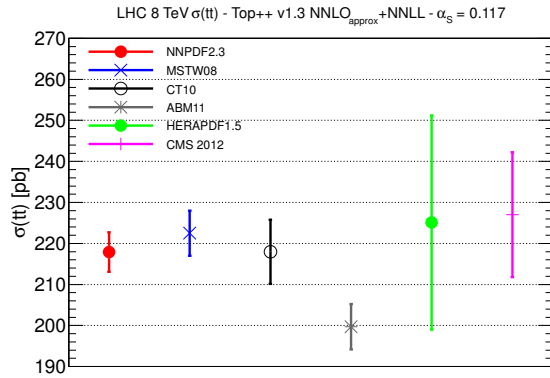
(b) Download (eps, png)



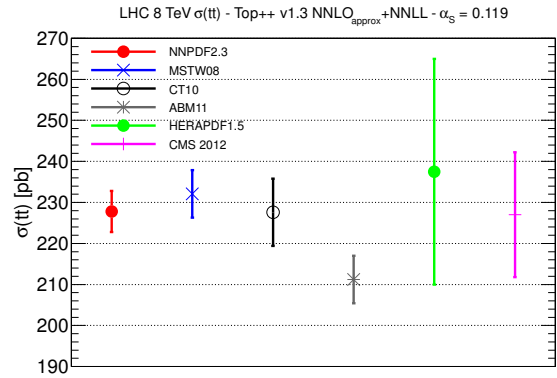
(c) Download (eps, png)

Figure 96

6.2 Top



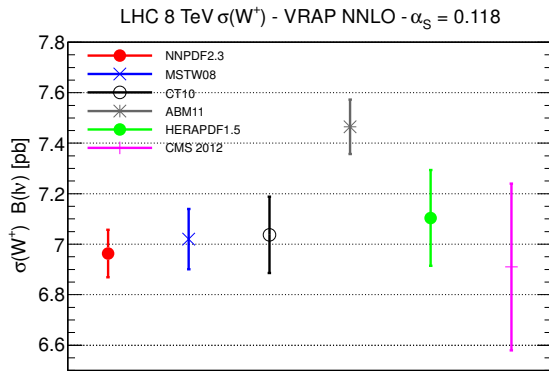
(a) Download (eps, png)



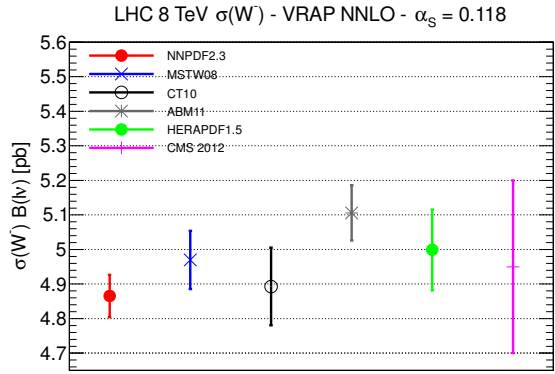
(b) Download (eps, png)

Figure 97

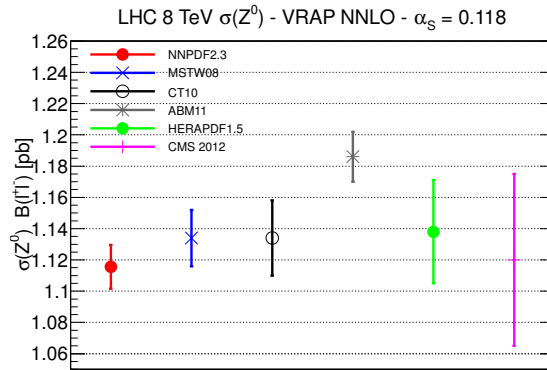
6.3 W, Z bosons



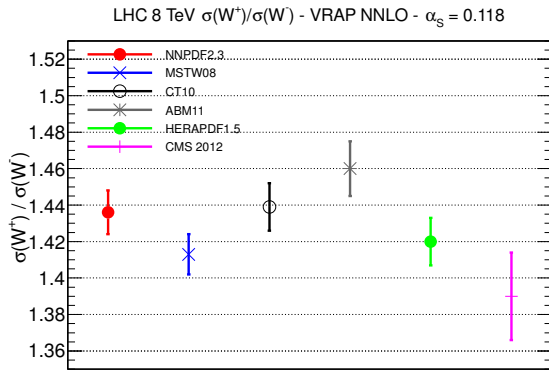
(a) Download (eps, png)



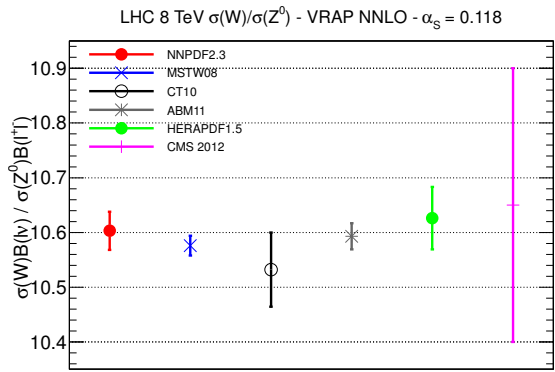
(b) Download (eps, png)



(c) Download (eps, png)

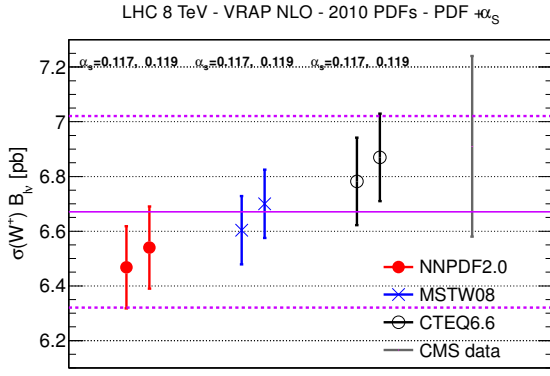


(d) Download (eps, png)

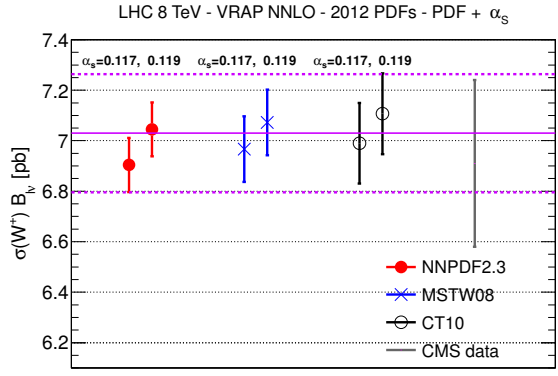


(e) Download (eps, png)

Figure 98



(a) Download (eps, png)

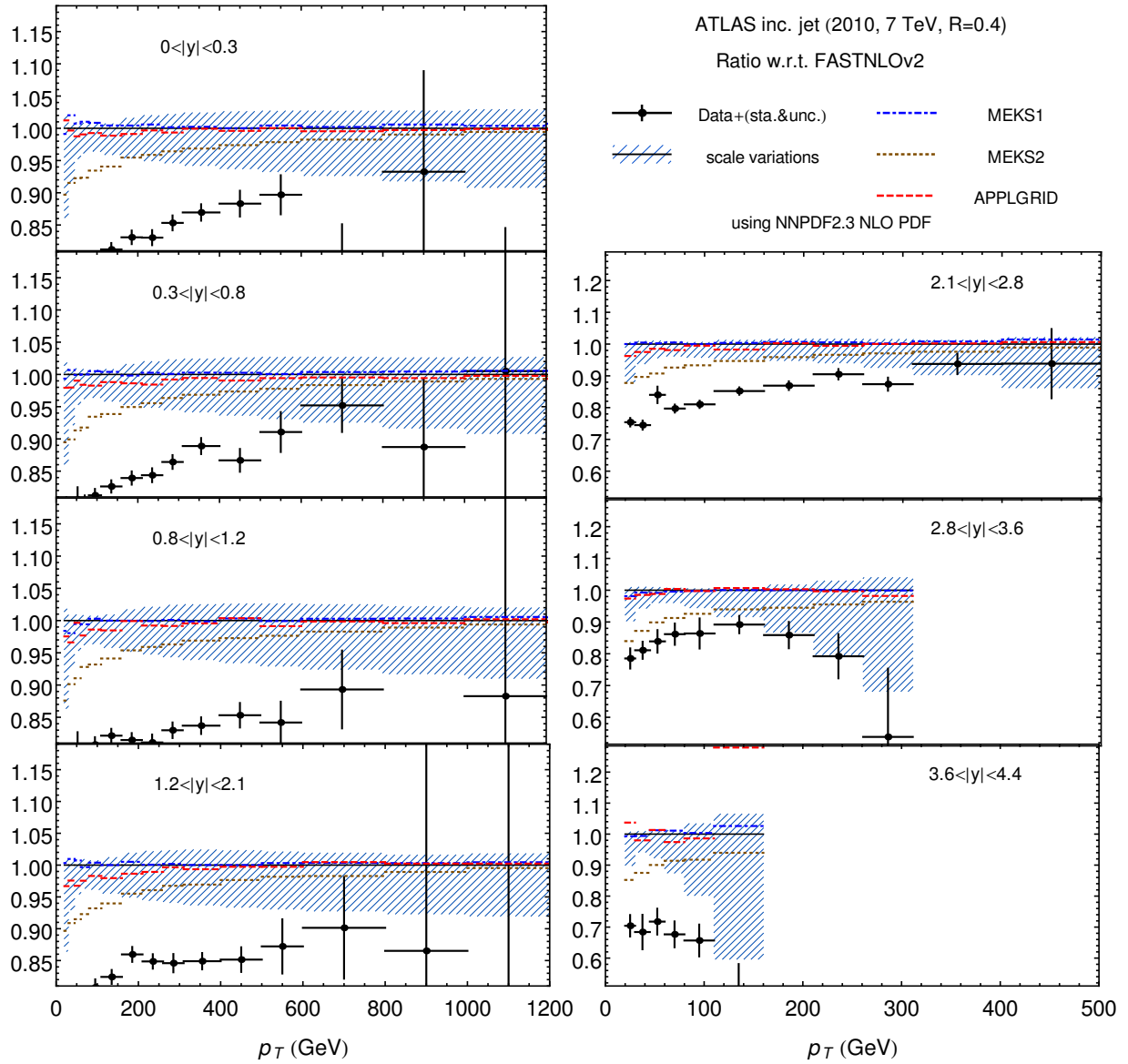


(b) Download (eps, png)

Figure 99

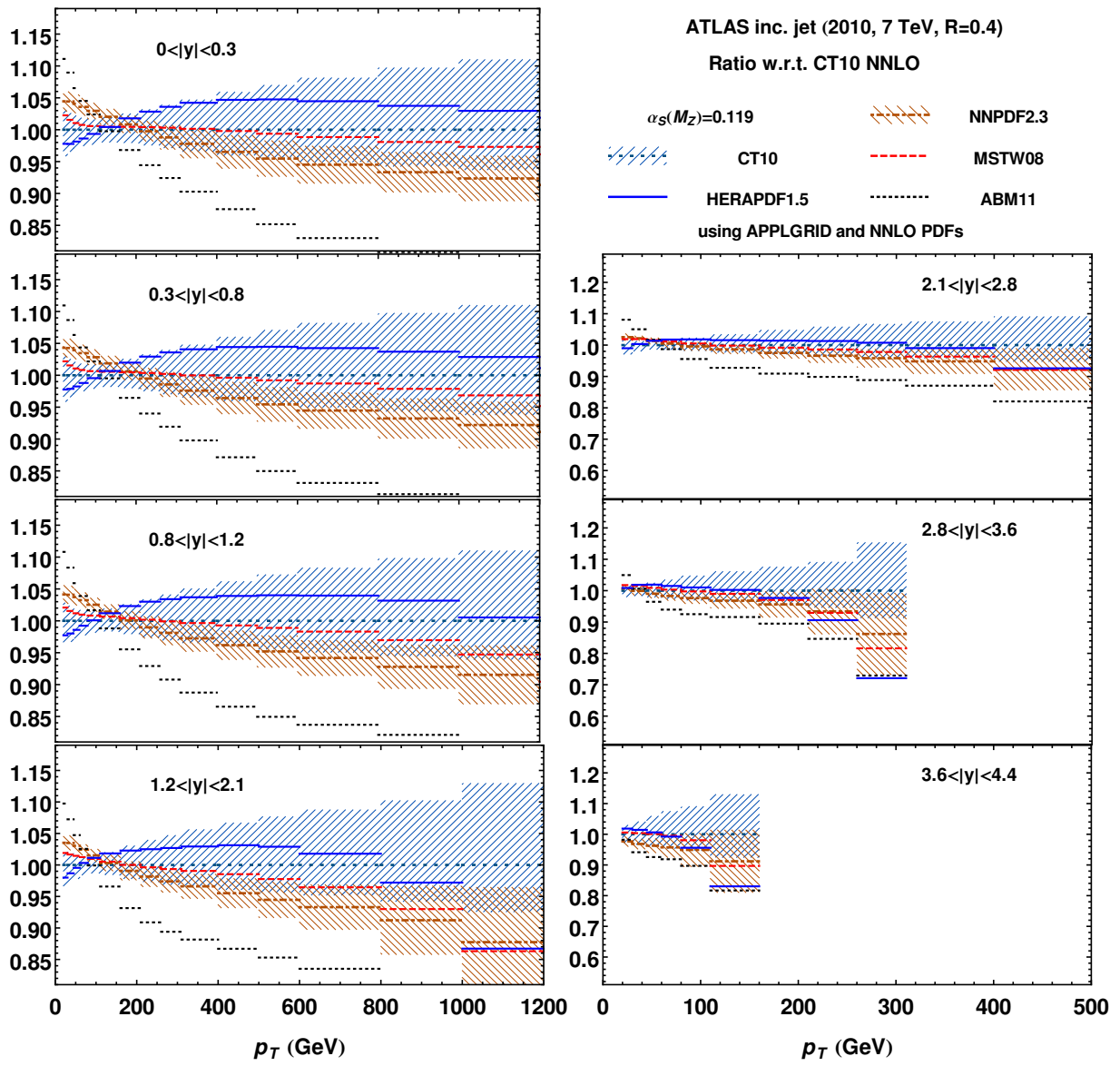
7 ATLAS inclusive jet production at NLO

7.1 Comparison of NLO theoretical predictions



(a) Download (eps, png)

Figure 100



(a) Download (eps, png)

Figure 101

7.2 Distribution of residuals and best-fit nuisance parameters

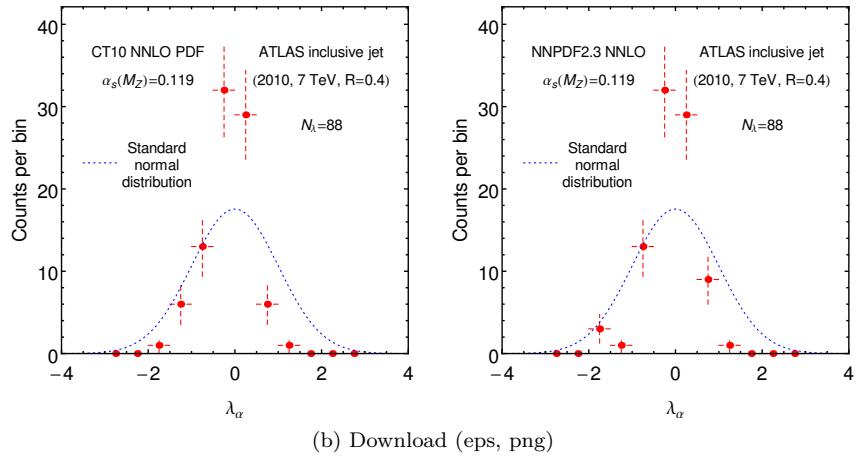
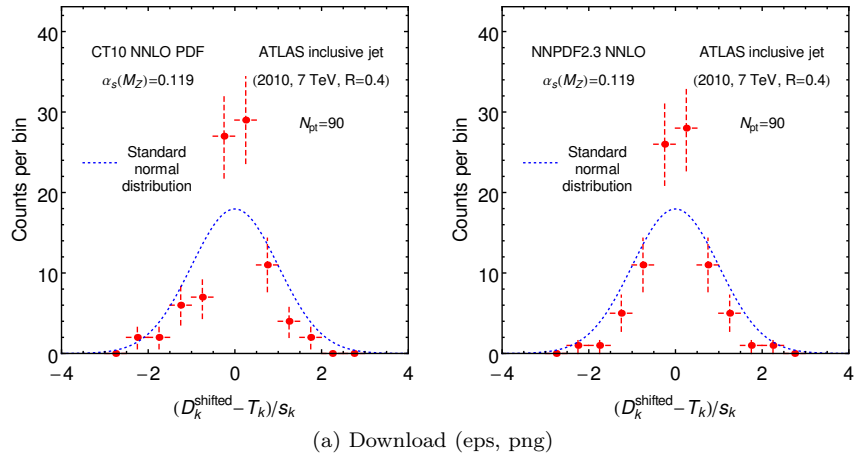


Figure 102