F_L and F_2 - theory model comparison with HERA data

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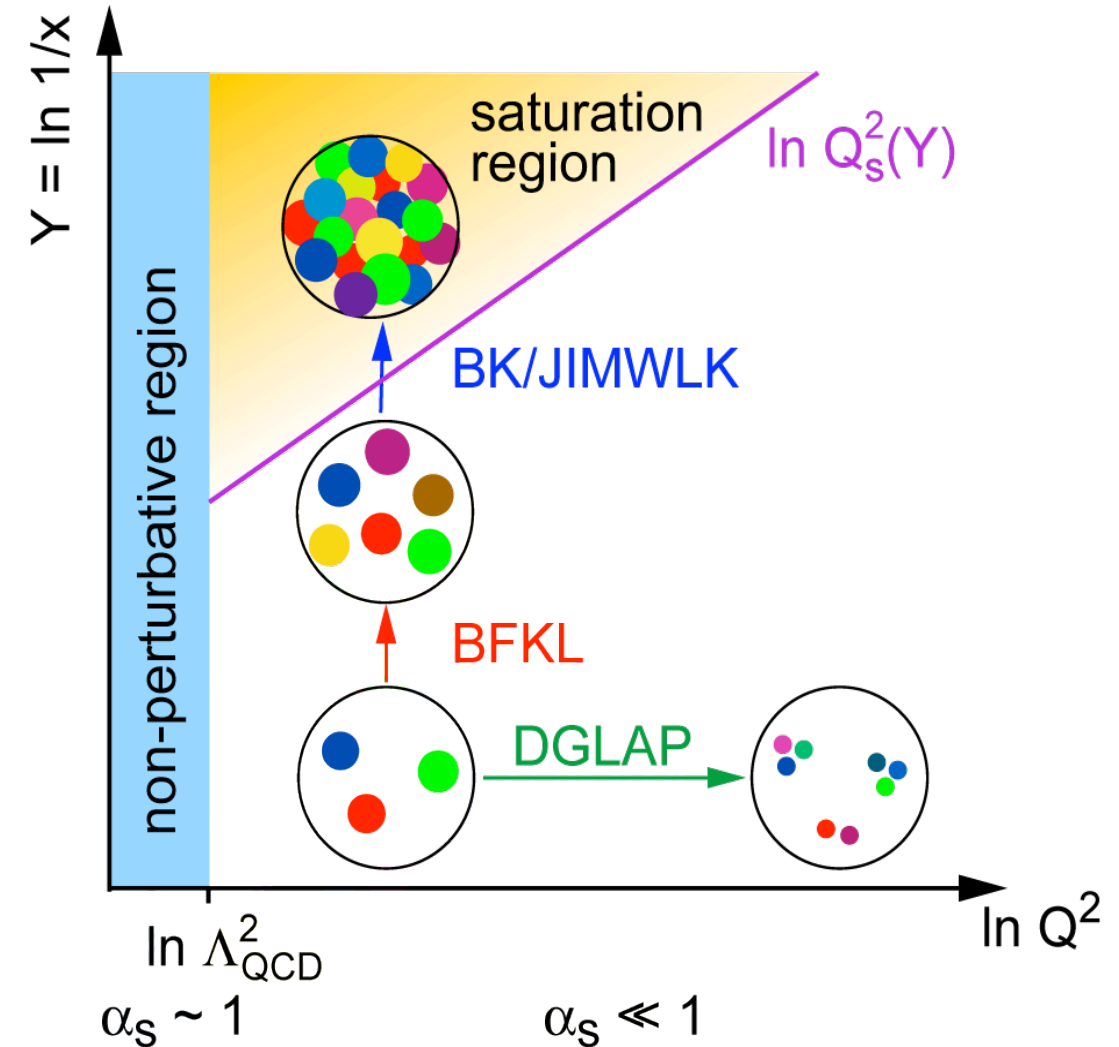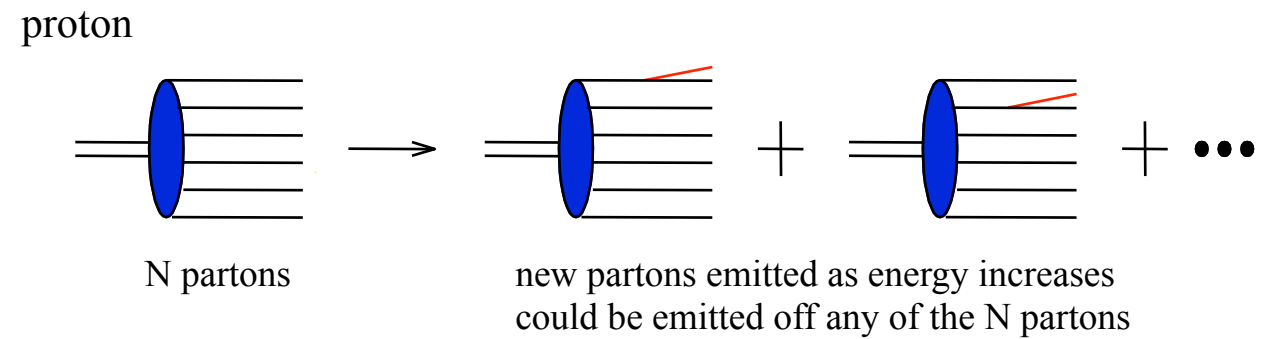
Non-linear QCD - Saturation

proton

N partons

new partons emitted as energy increases
could be emitted off any of the N partons

Non-linear QCD - Saturation

- **BFKL**: evolution in x

  ➡ linear

  ‣ explosion in colour field at low-x

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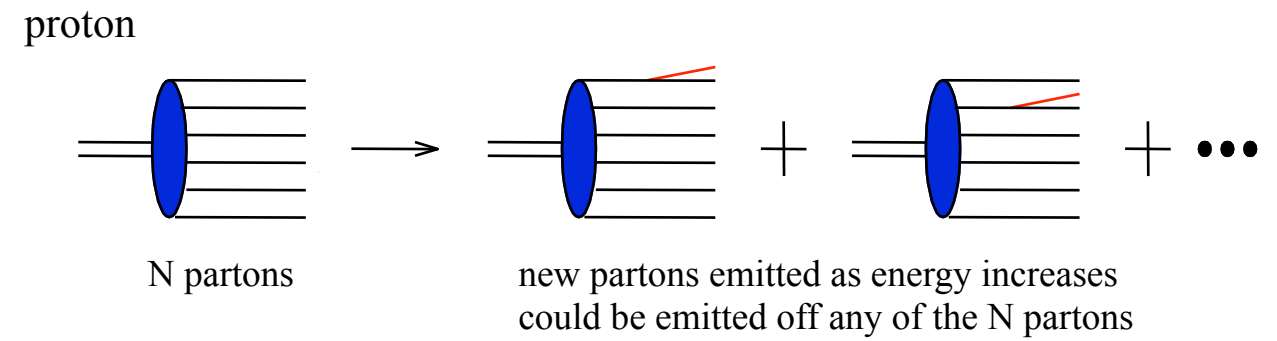
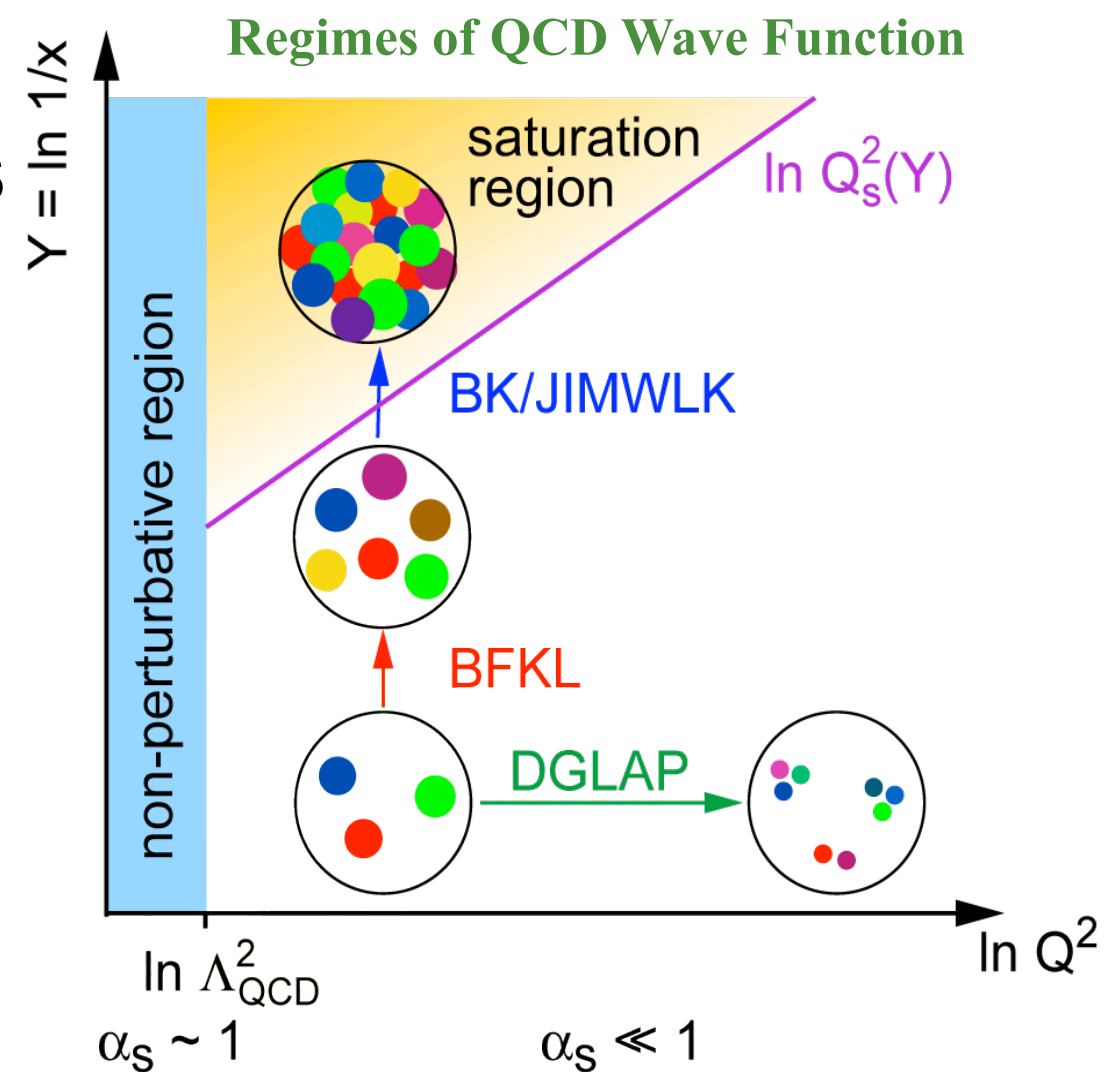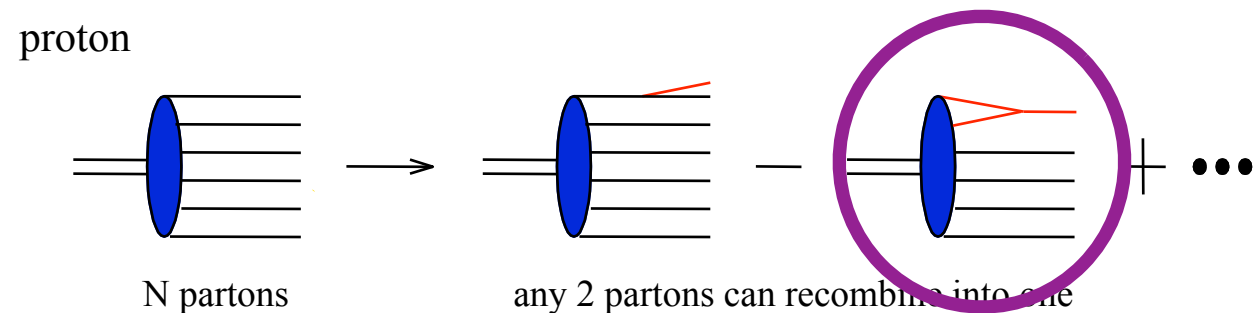# Non-linear QCD - Saturation

- **BFKL**: evolution in x

  ➡ linear

    ‣ explosion in colour field at low-x

- Non-linear **BK**/**JIMWLK** equations

  ➡ non-linearity ⇒ saturation
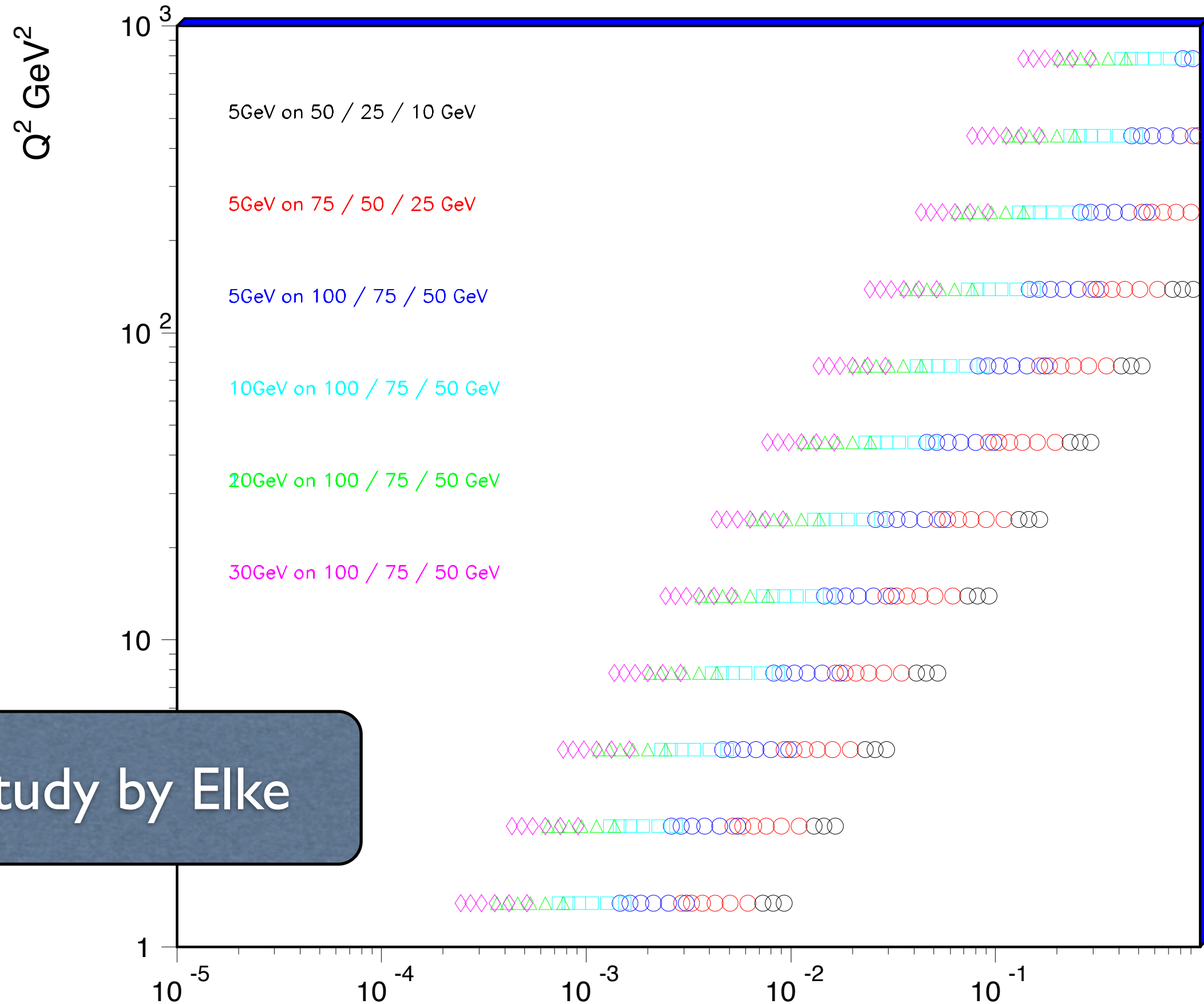
    ‣ Allows for the recombination of gluons in a dense gluonic medium
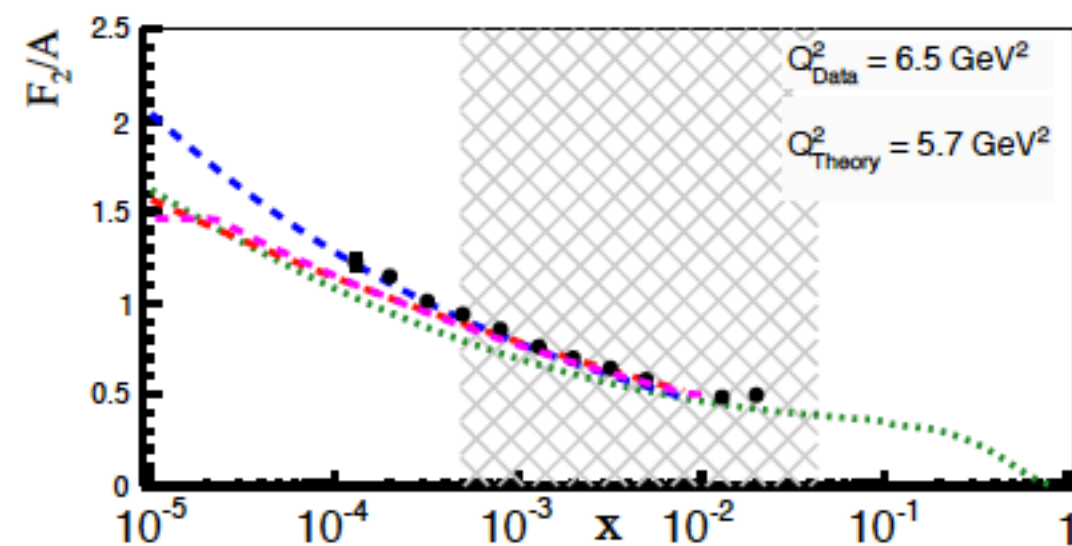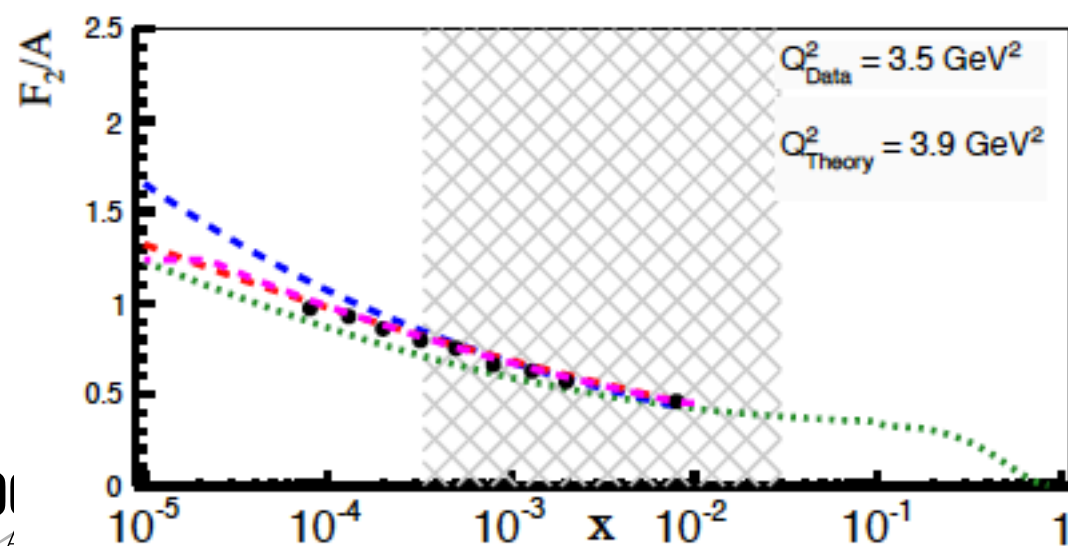
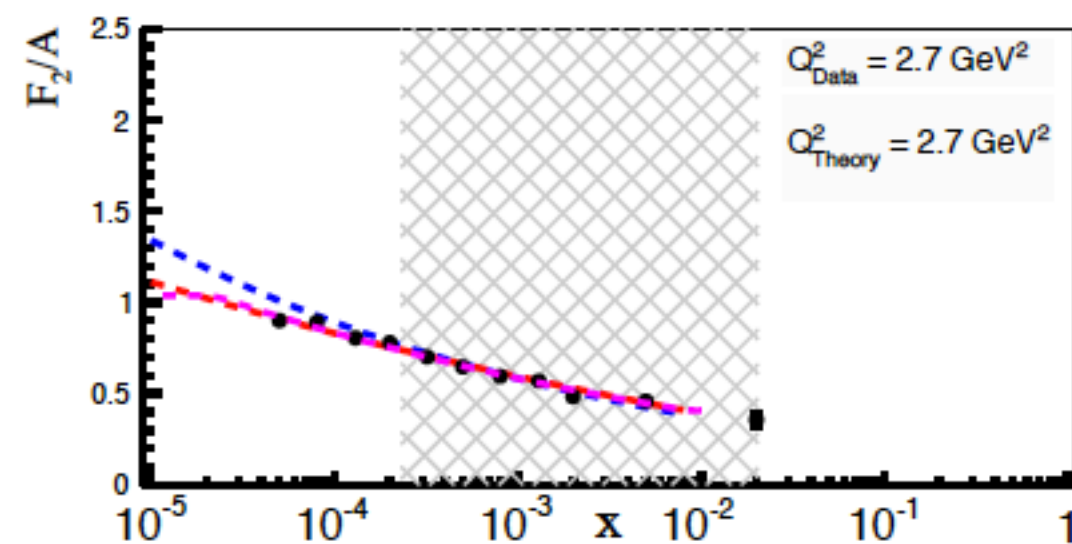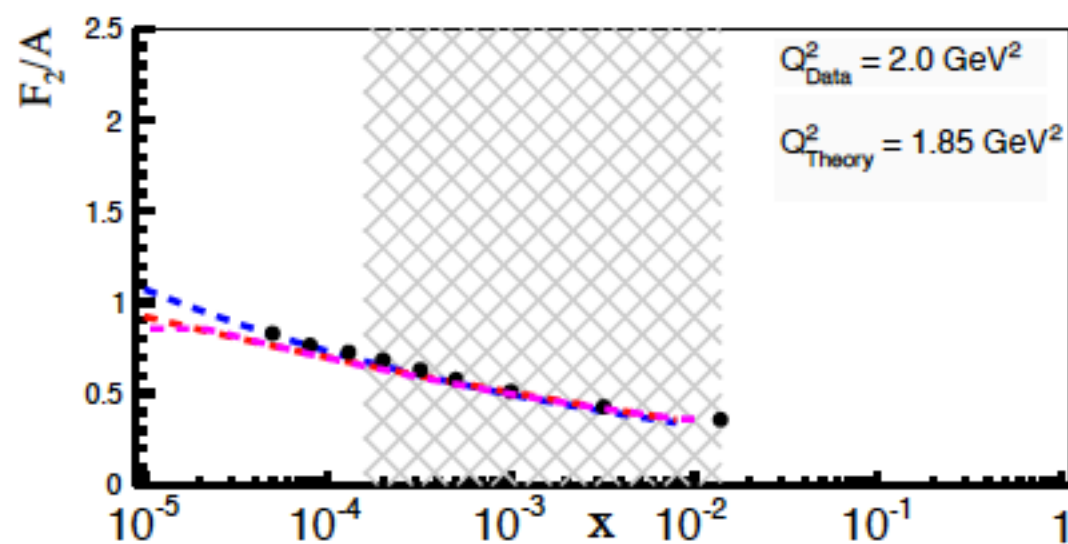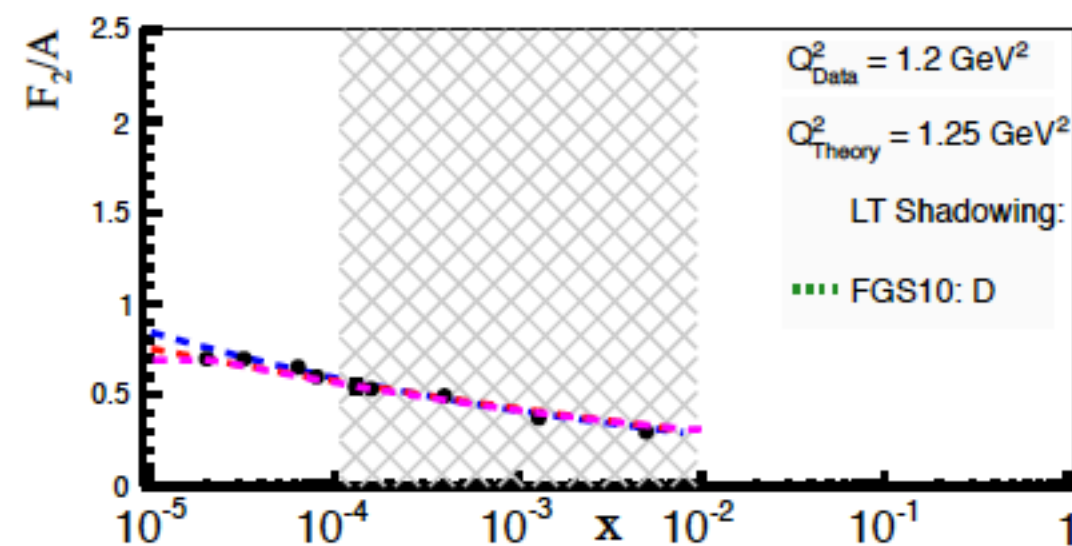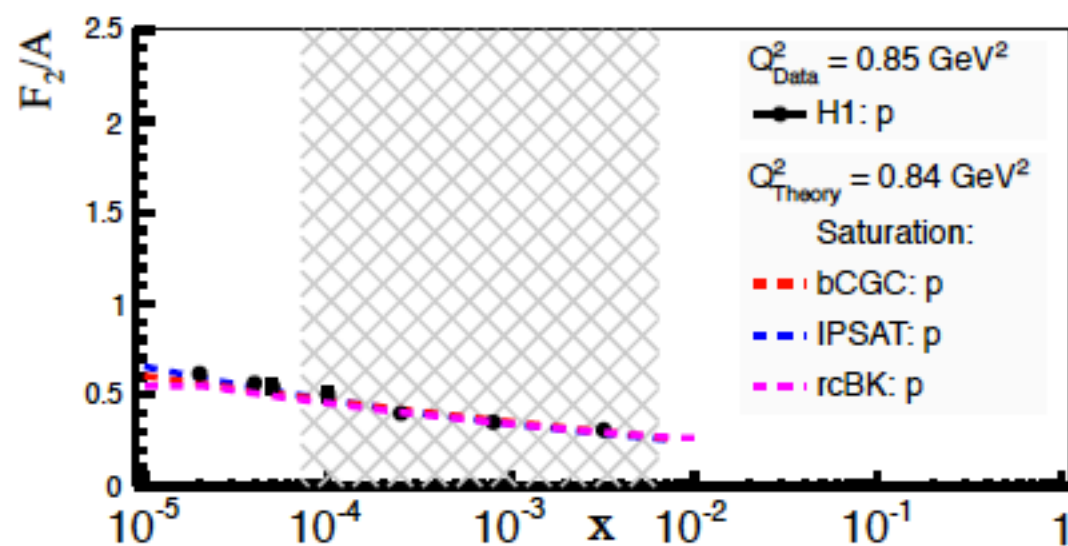 ➡ characterised by the saturation scale, $Q_S(x,A)$

Explanation of what's on the plots..

- Theory
  - ➡ Leading-Twist Shadowing
    - ‣ **FGS10** provided by Vadim Guzey
      - Evolved with a DGLAP evolution
  - ➡ Saturation, dipole models
    - ‣ **IPSat** provided by Tuomas Lappi (work by Henri Kowalski, Graeme Watt)
      - Evolved with a DGLAP evolution
      - Fit to ZEUS 96 data - χ^2/d.o.f. ~ 1.2
    - ‣ **bCGC** provided by Tuomas Lappi (work by Henri Kowalski, Graeme Watt)
      - "ad-hoc" approach to evolution but based on BK
      - Fit to ZEUS 96 data - χ^2/d.o.f = 1.62
    - ‣ **rcBK** provided by Javier Albacete (AAQMS model)
      - Evolution along x with BK equation
      - Fit to H1+ZEUS combined 2006 data
- Experimental Data
  - ➡ F_2: H1&ZEUS combined data from: http://www-h1.desy.de/psfiles/papers/desy09-158.pdf
  - ➡ F_L: H1&ZEUS combined data from: http://www-h1.desy.de/psfiles/papers/desy10-228.pdf

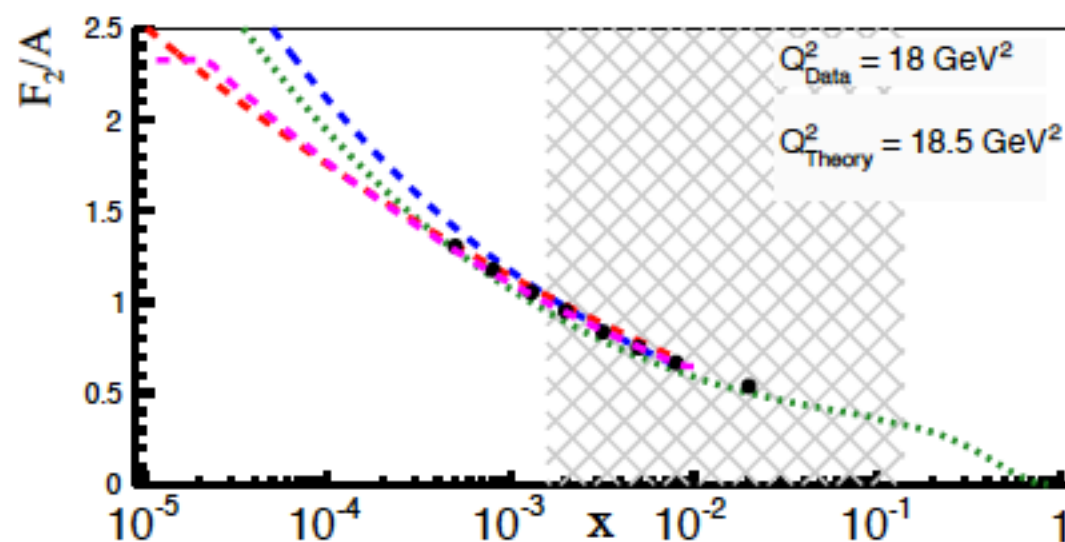# Hatched region - our x-Q^2 acceptance for F_L and F_2

Q^2 GeV^2

5GeV on 50 / 25 / 10 GeV

5GeV on 75 / 50 / 25 GeV

5GeV on 100 / 75 / 50 GeV

10GeV on 100 / 75 / 50 GeV

20GeV on 100 / 75 / 50 GeV

30GeV on 100 / 75 / 50 GeV

Study by Elke

4

$F_2(p,D) - 0.8 < Q^2 < 6$
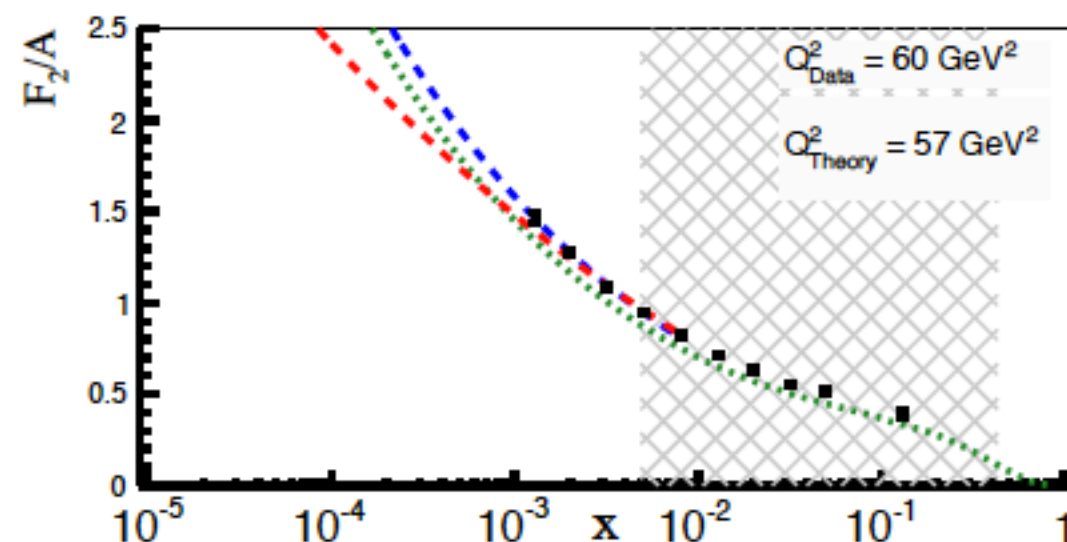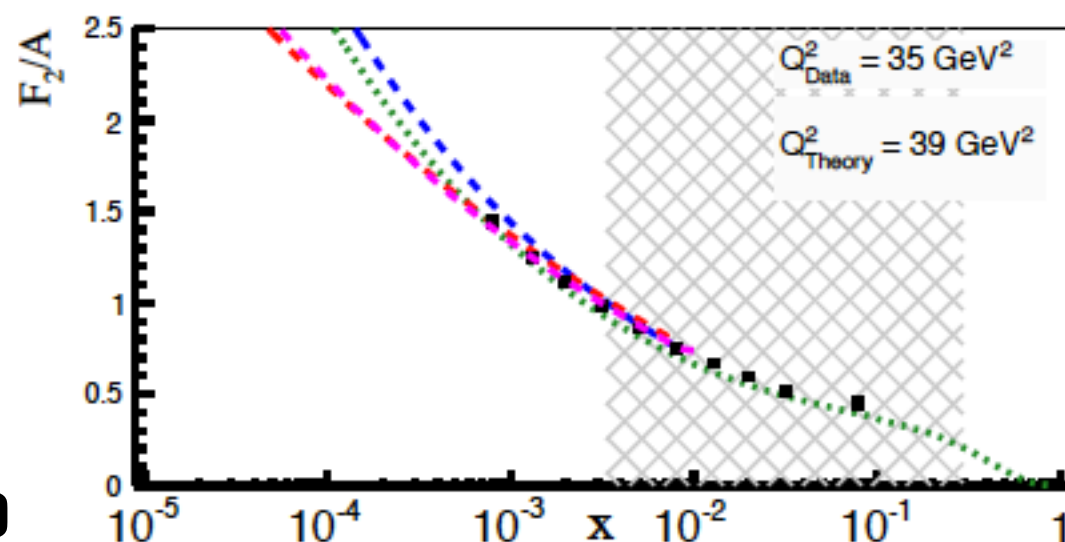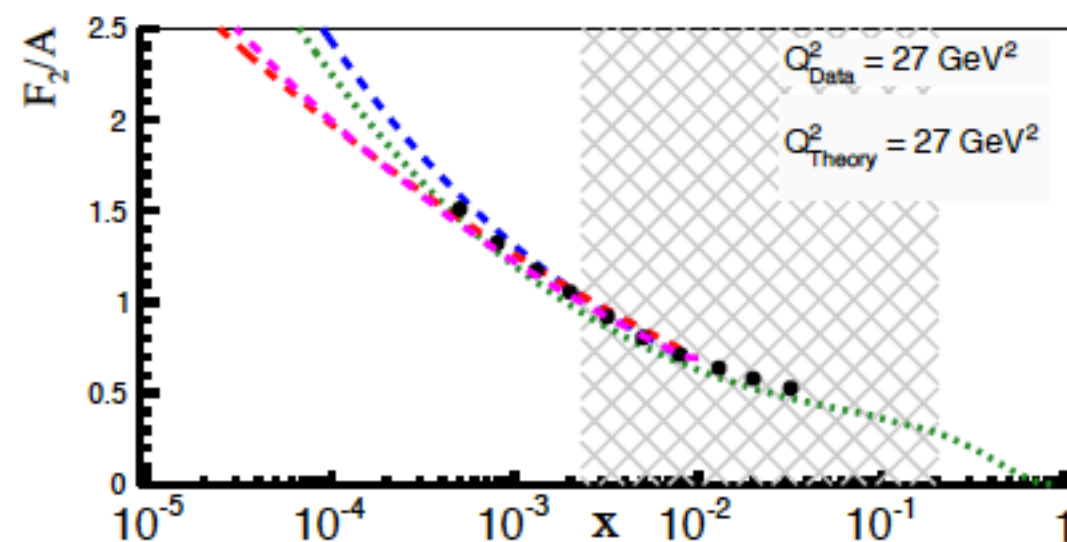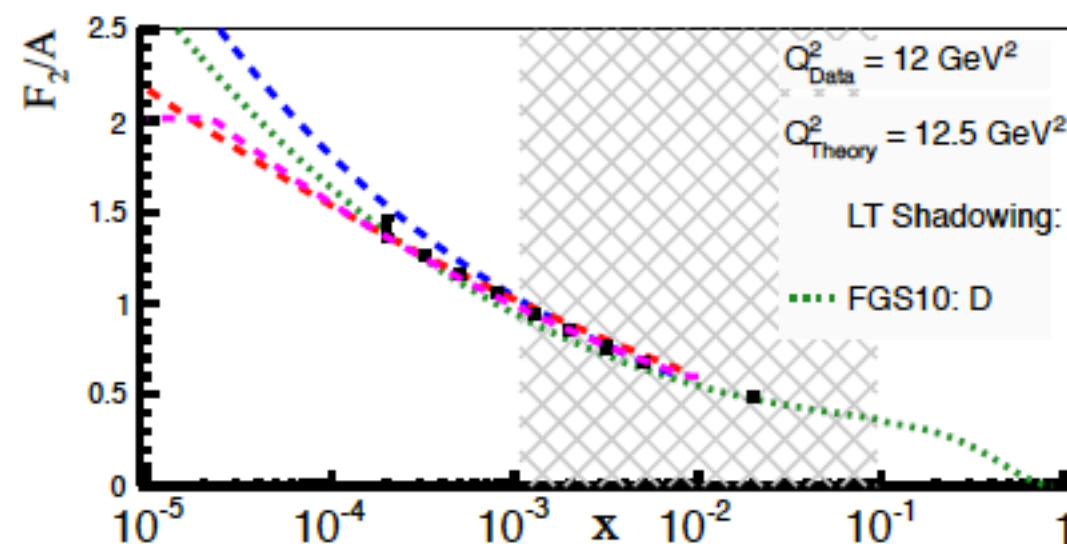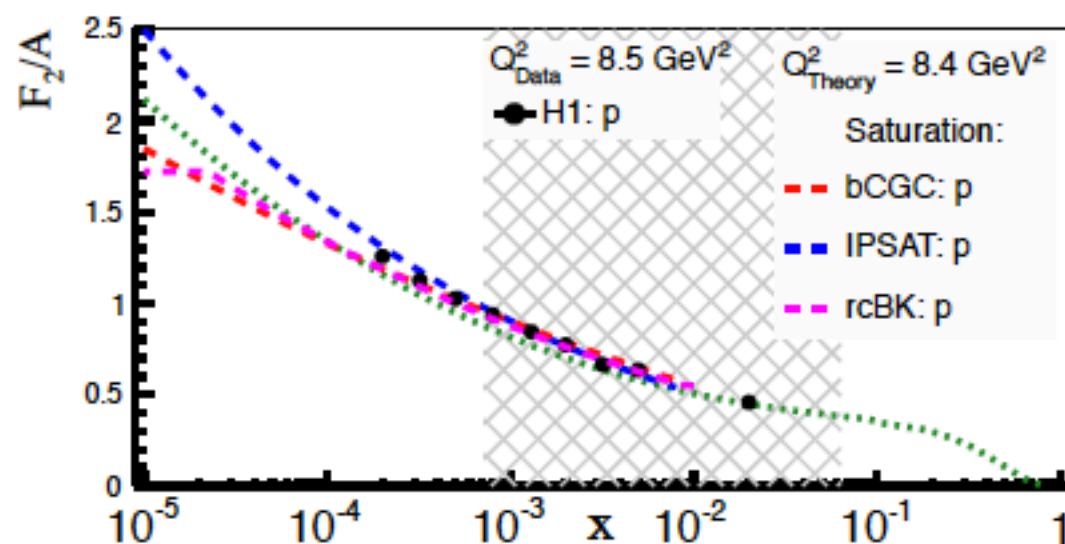
F₂(p,D) - 8 < Q² < 60

$F_L(p,D)$ - $0.8 < Q^2 < 6$
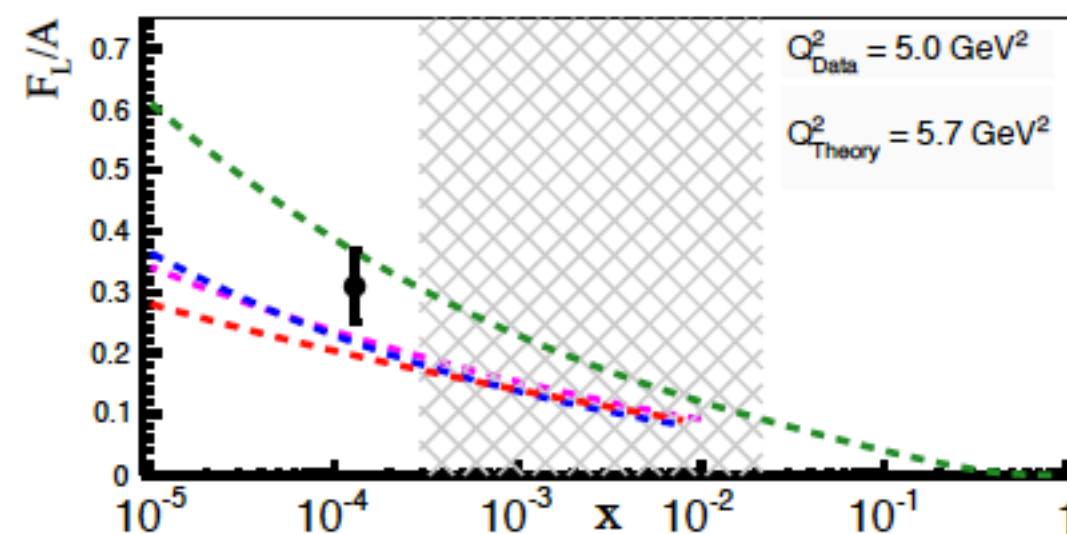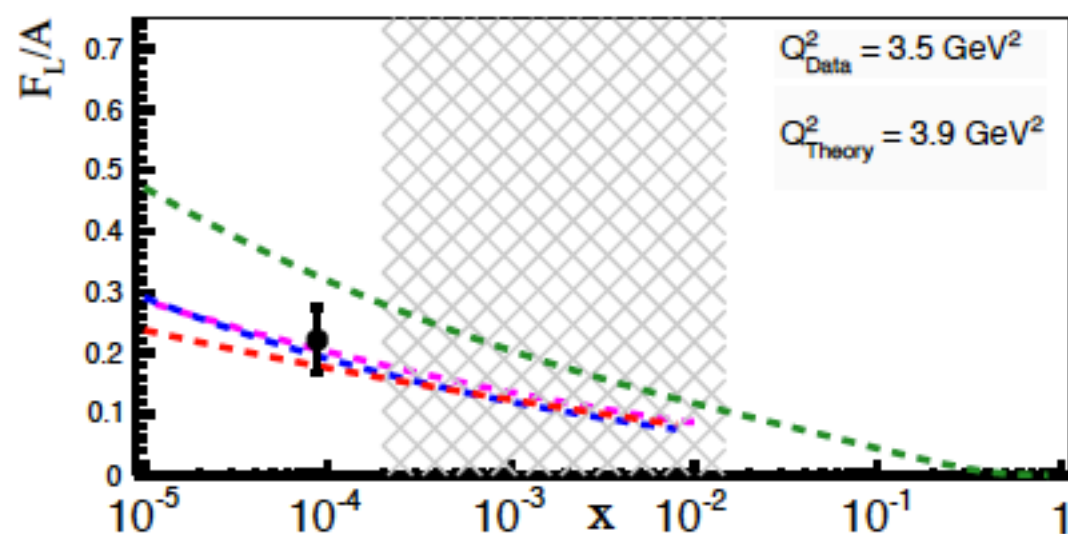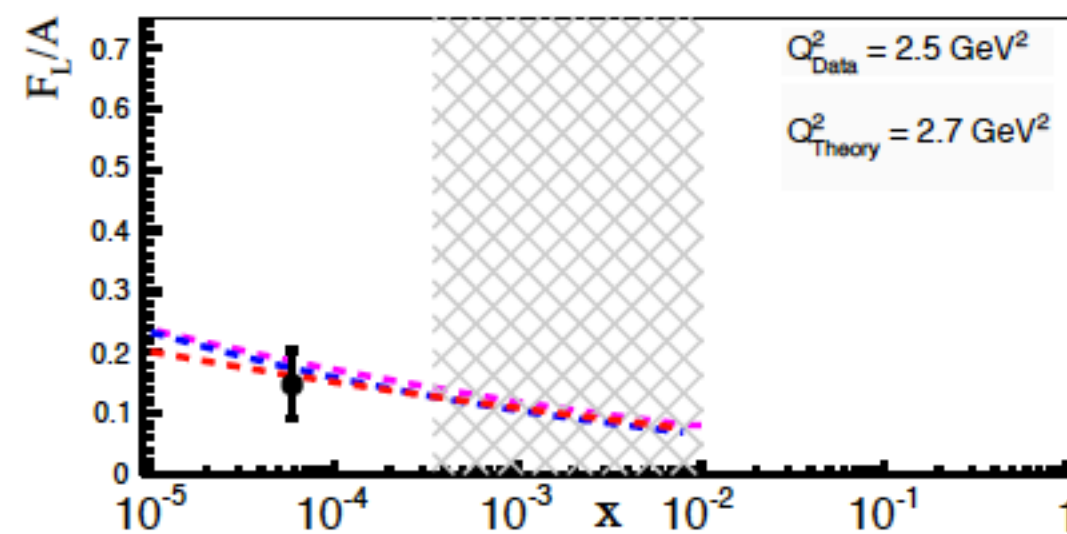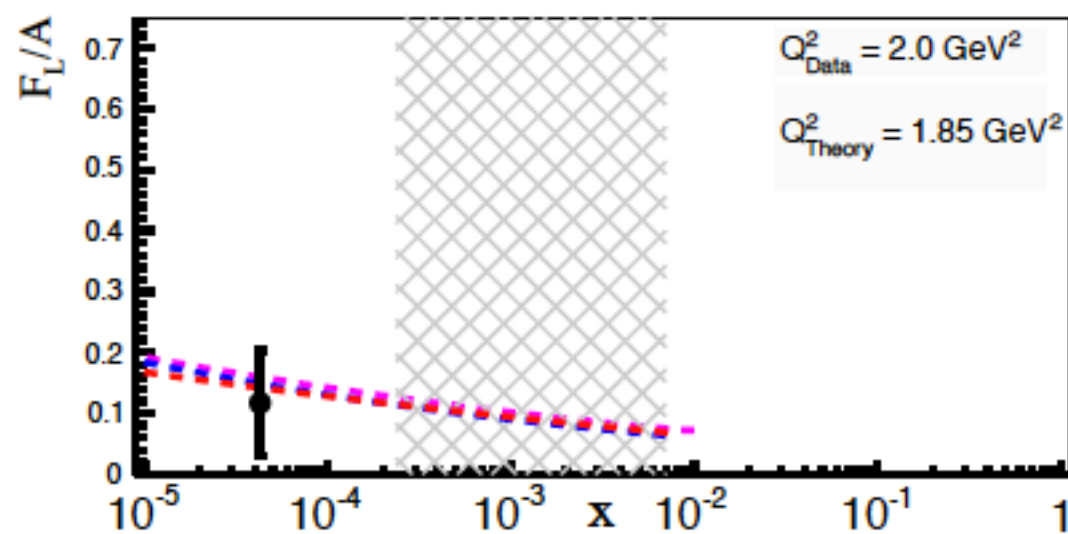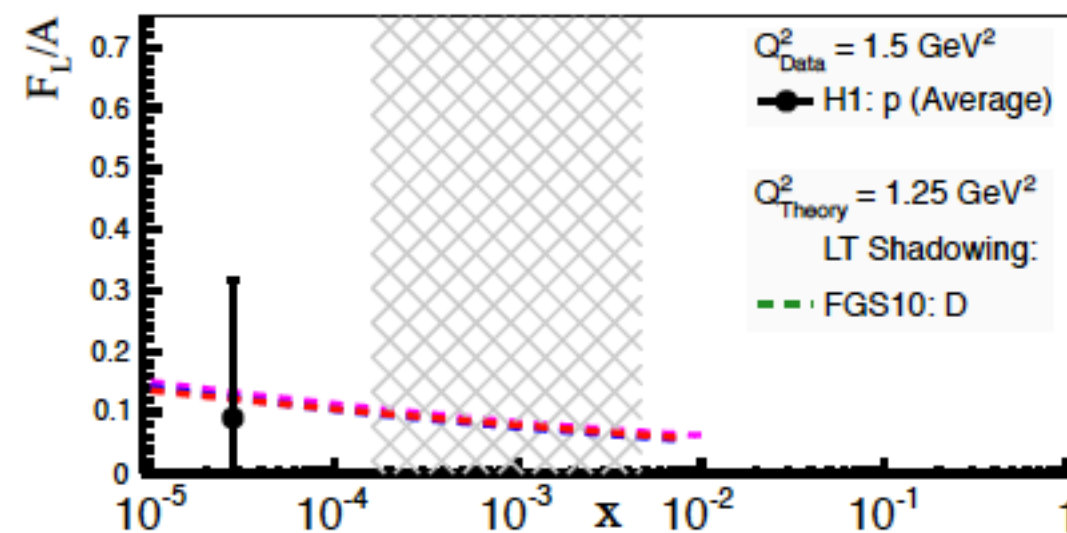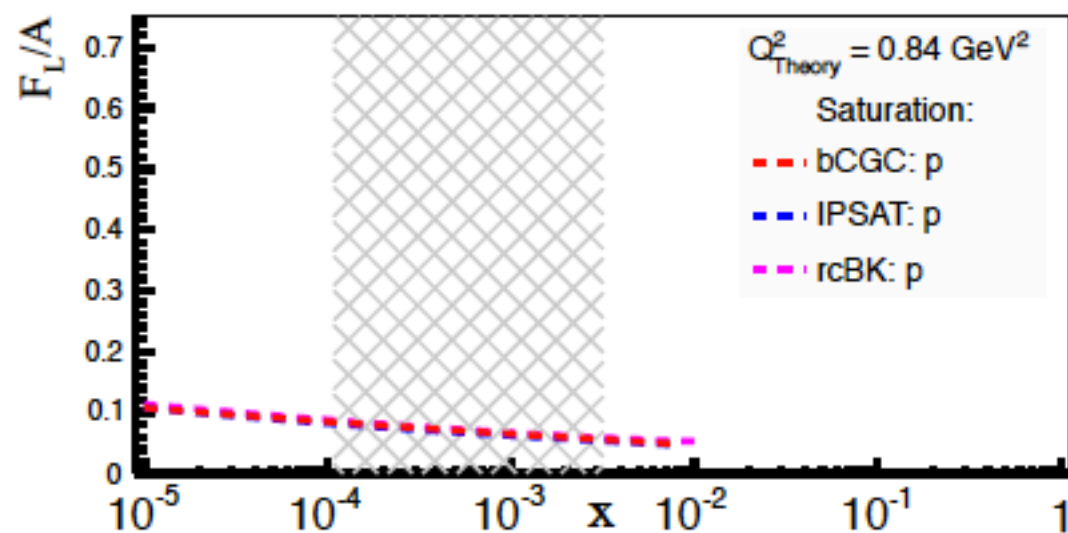
Input PDFs in FGS10 model
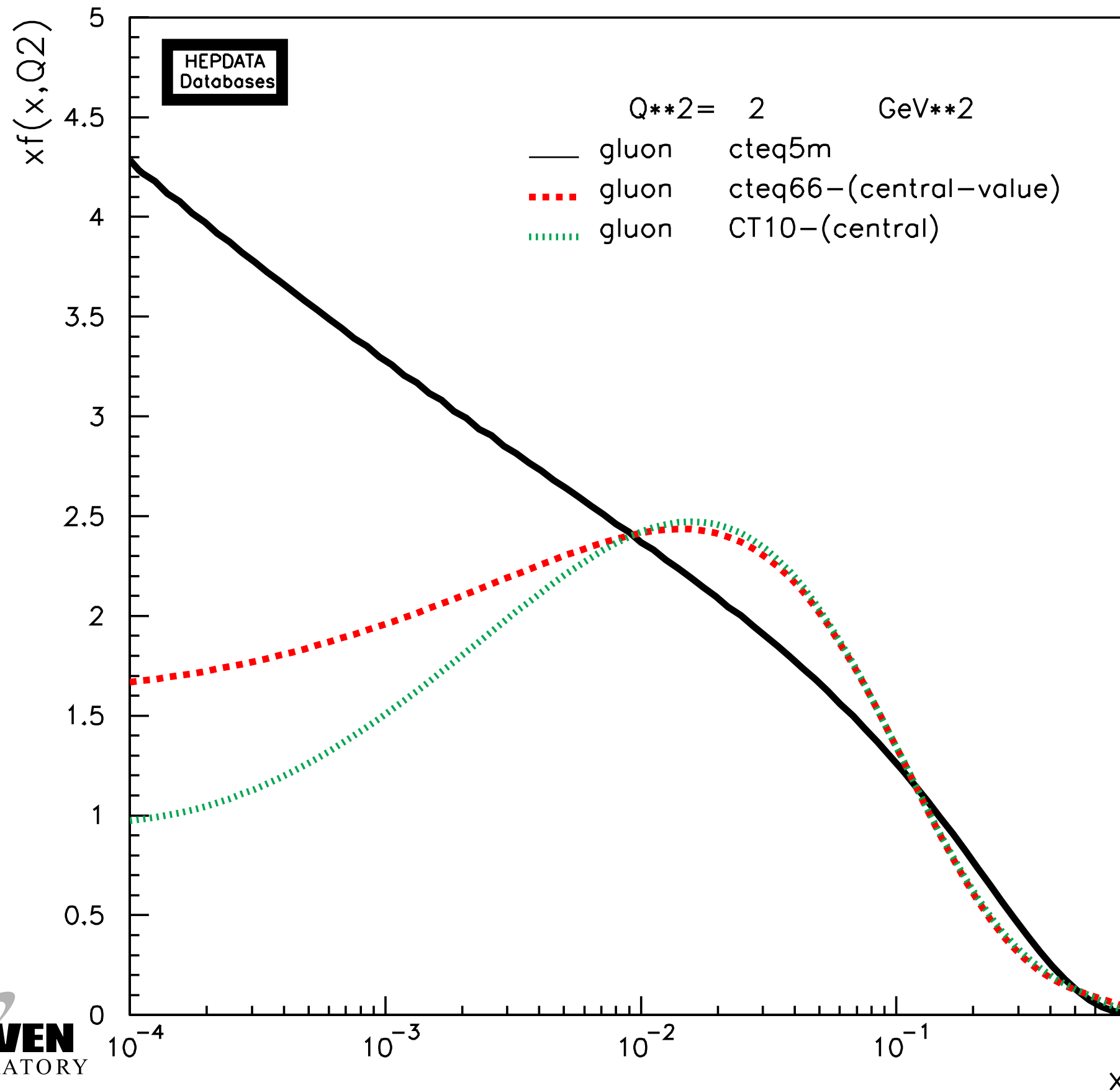
$F_L(p,D)$ - $8 < Q^2 < 60$

F$_2$(A)/A - 0.8 < Q^2 < 6

$F_2(A)/A$ - $8 < Q^2 < 60$

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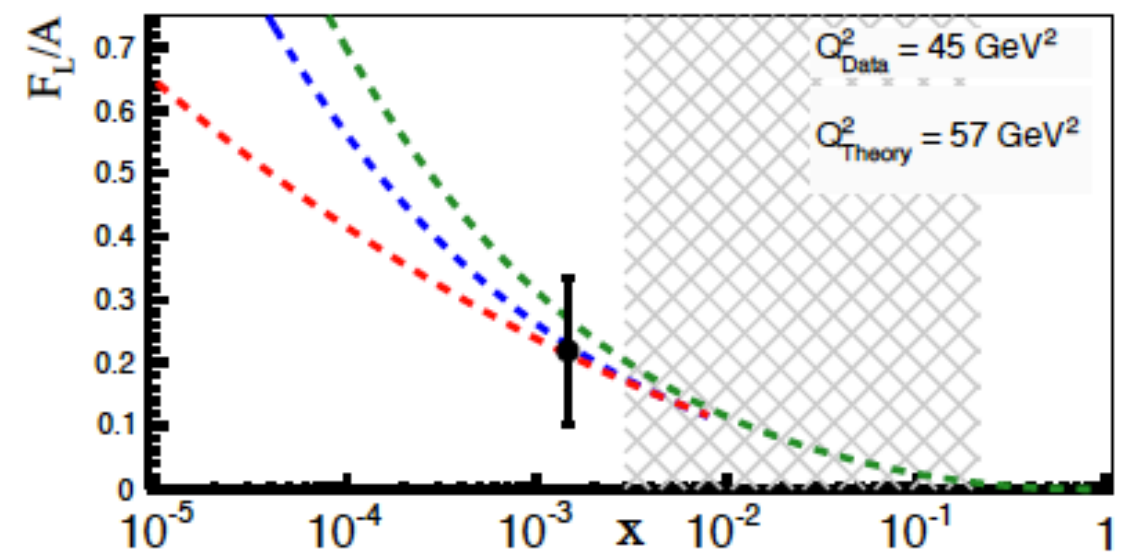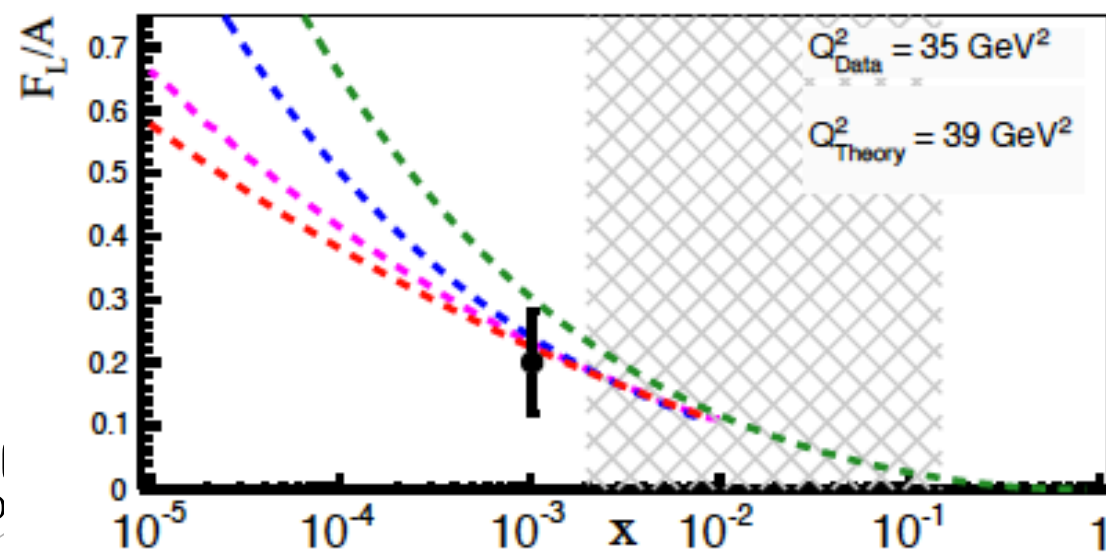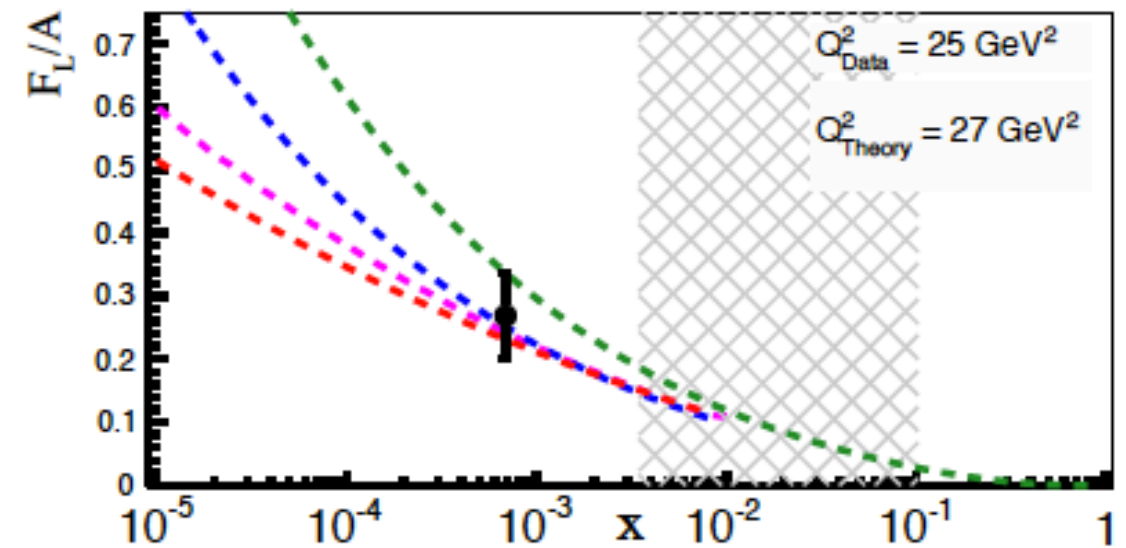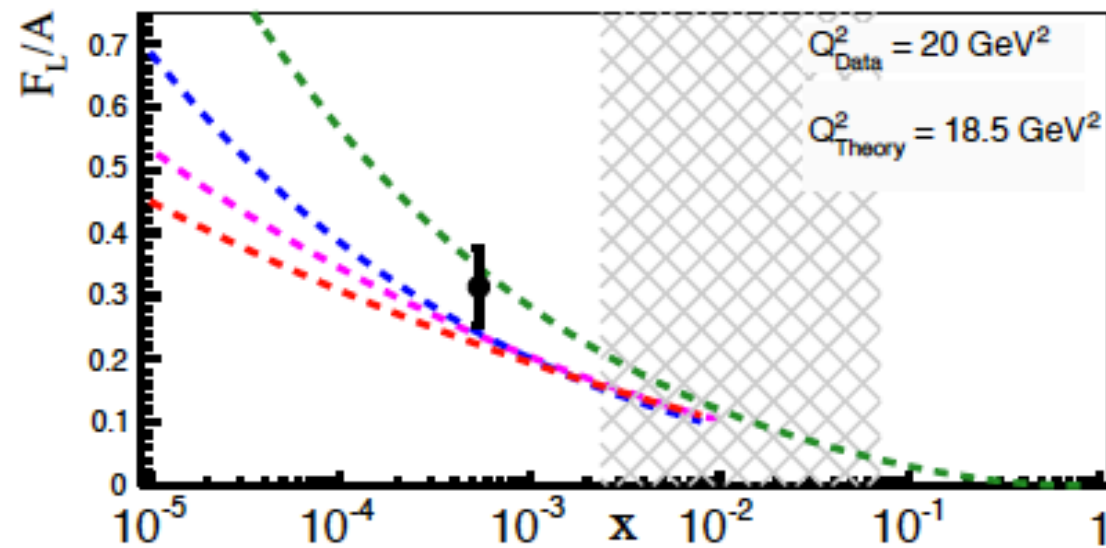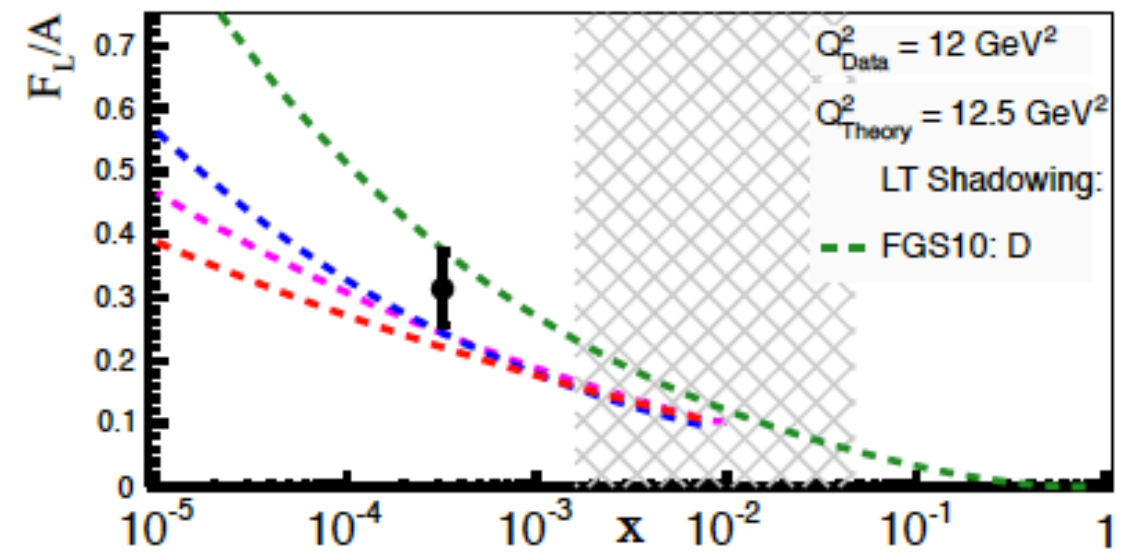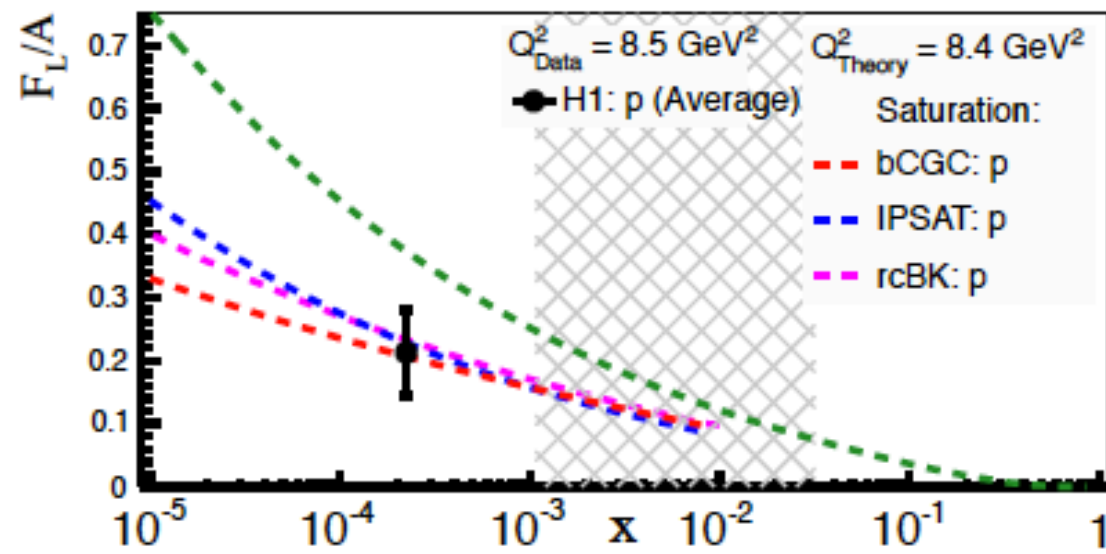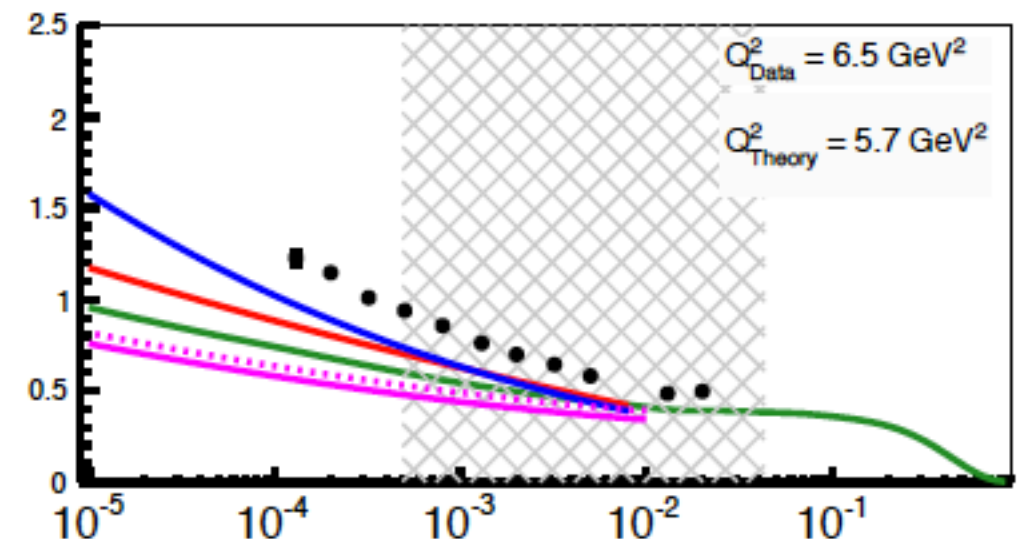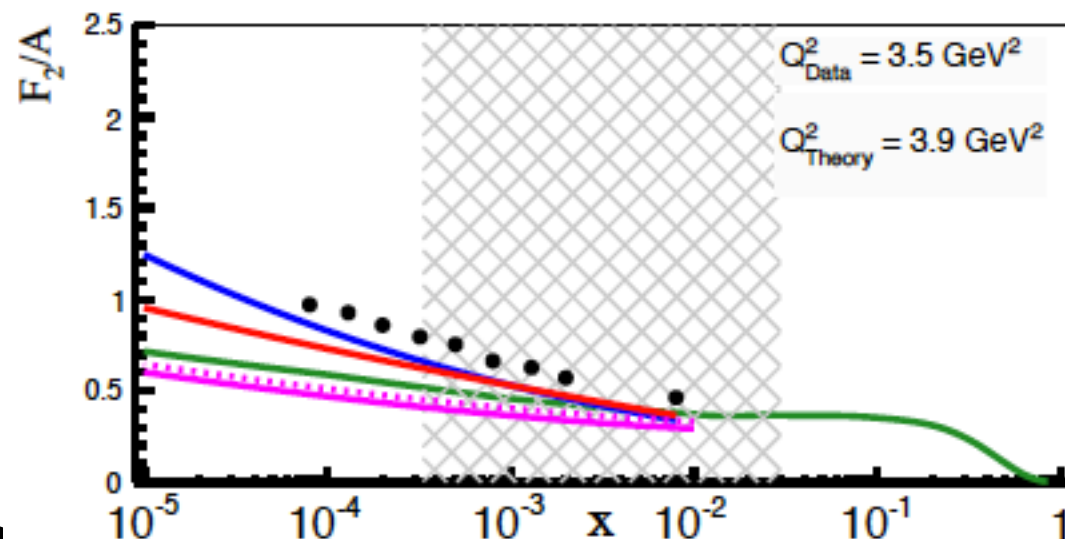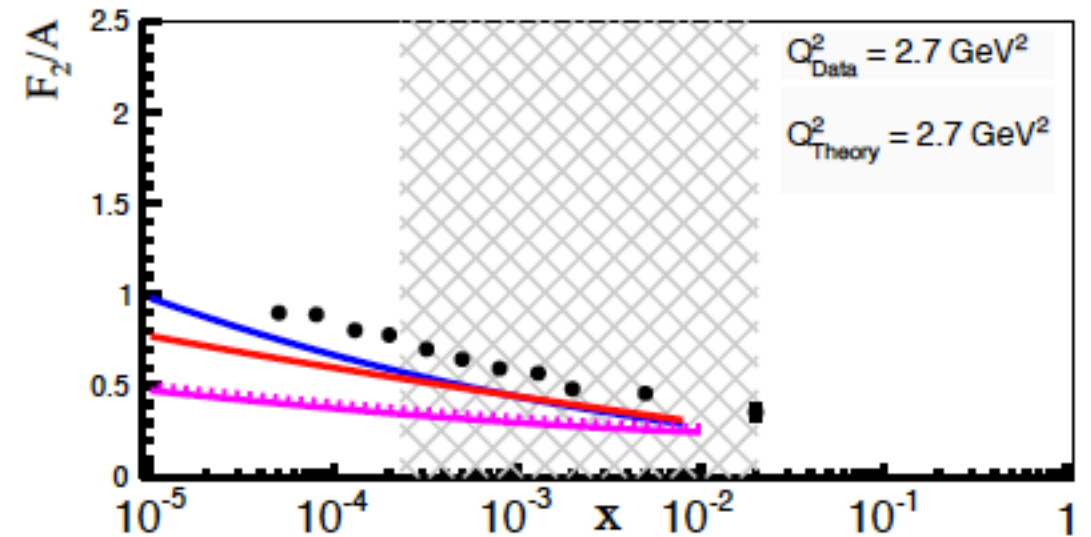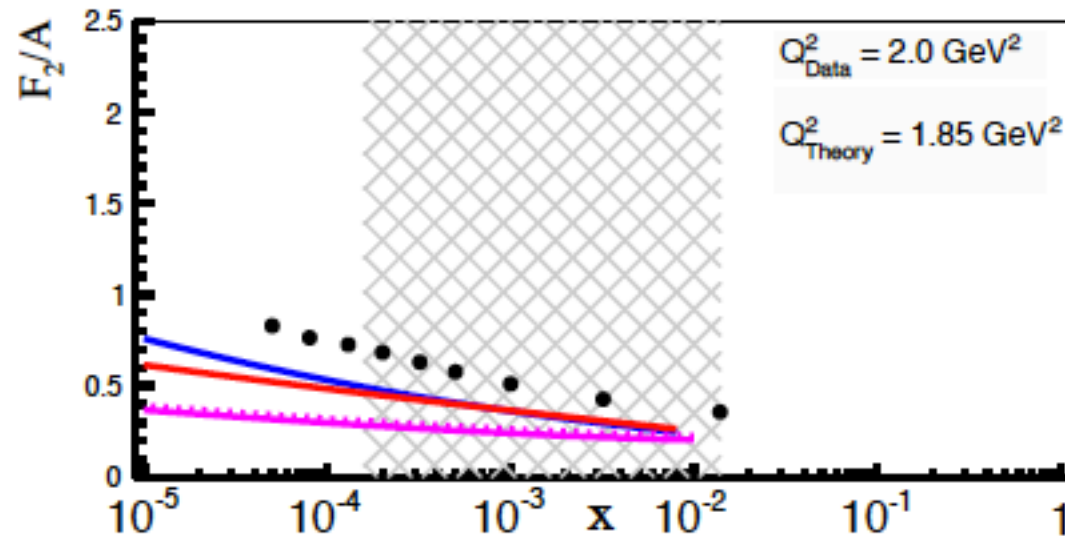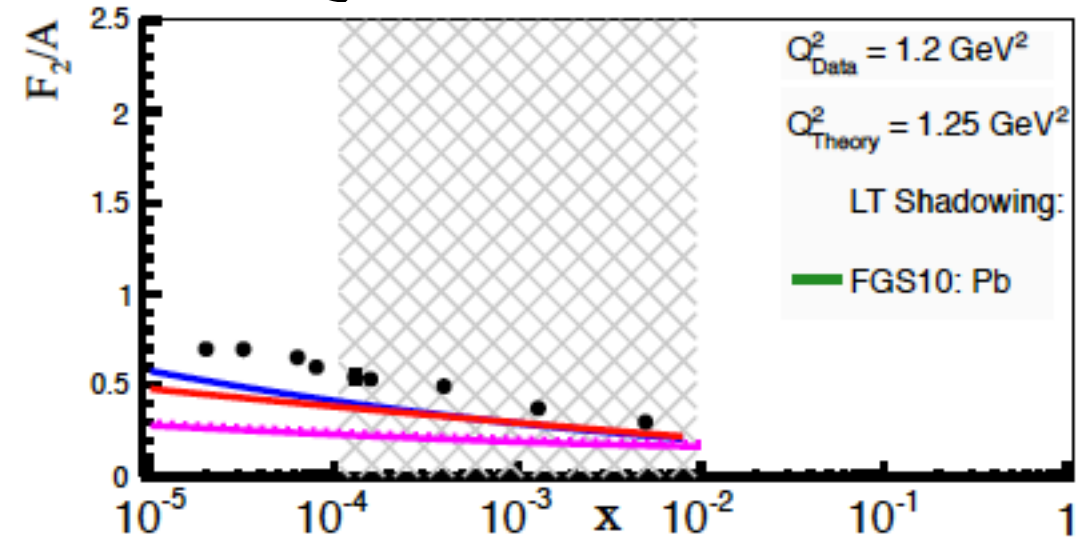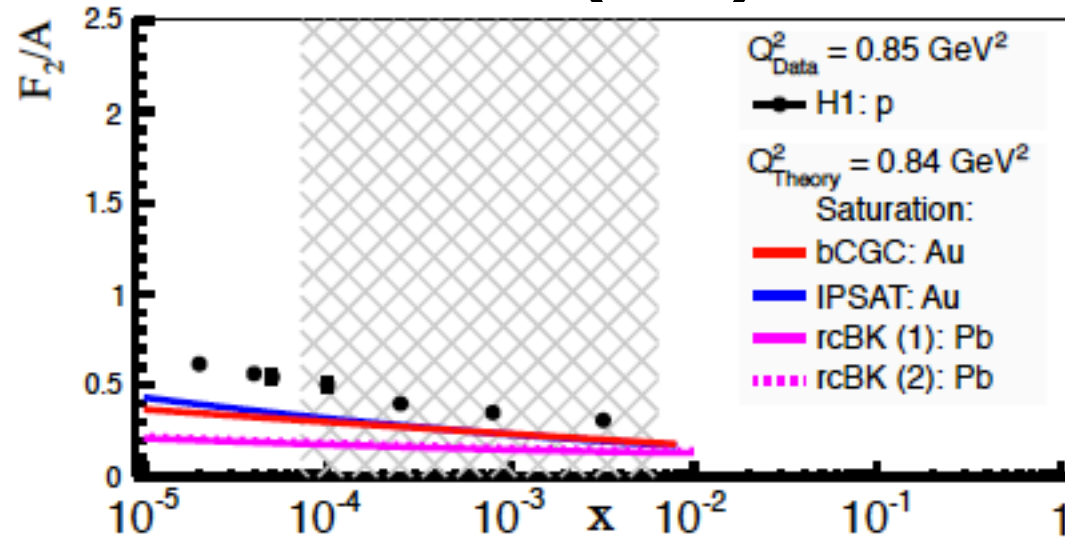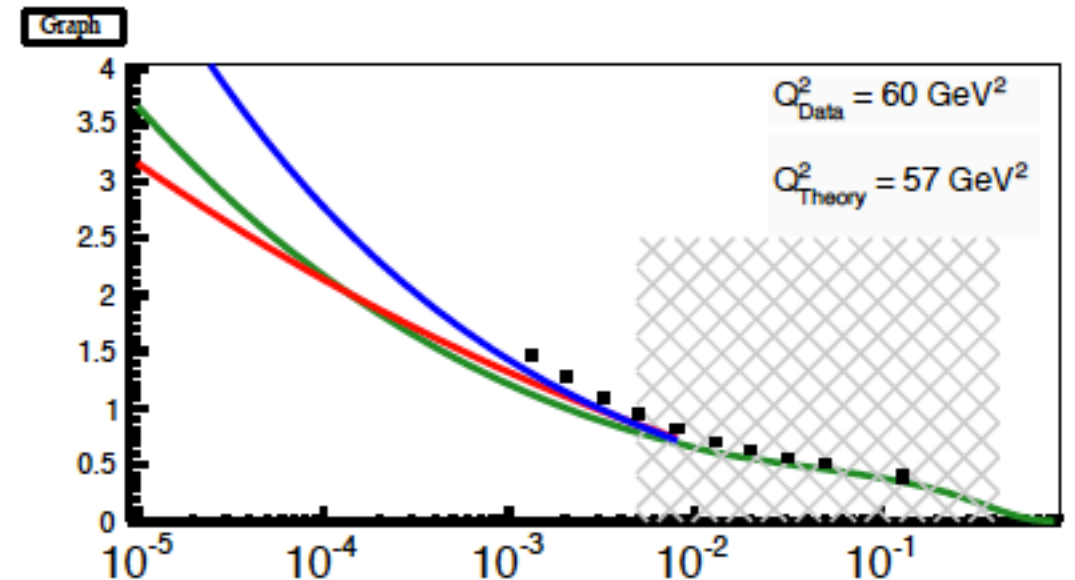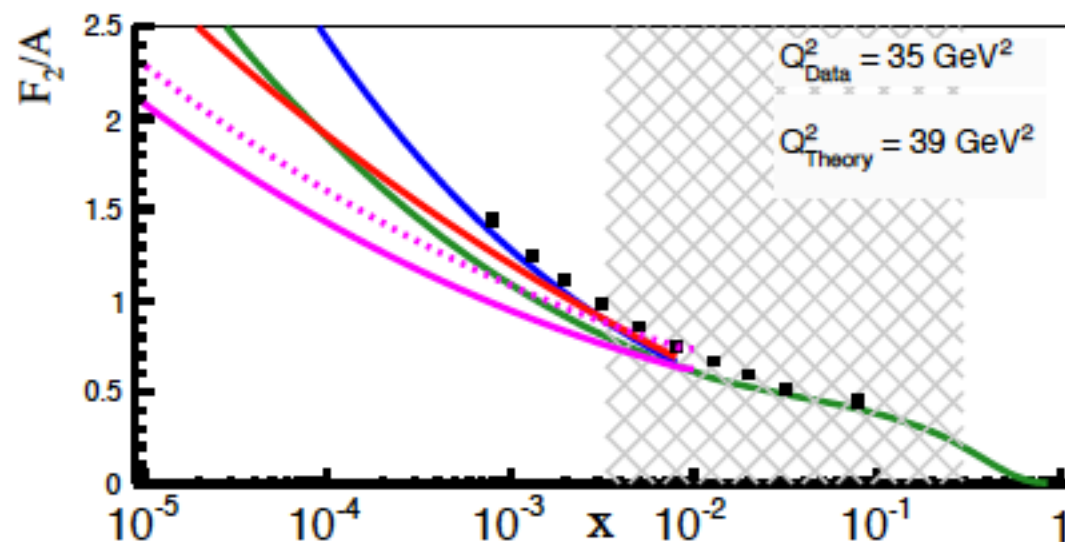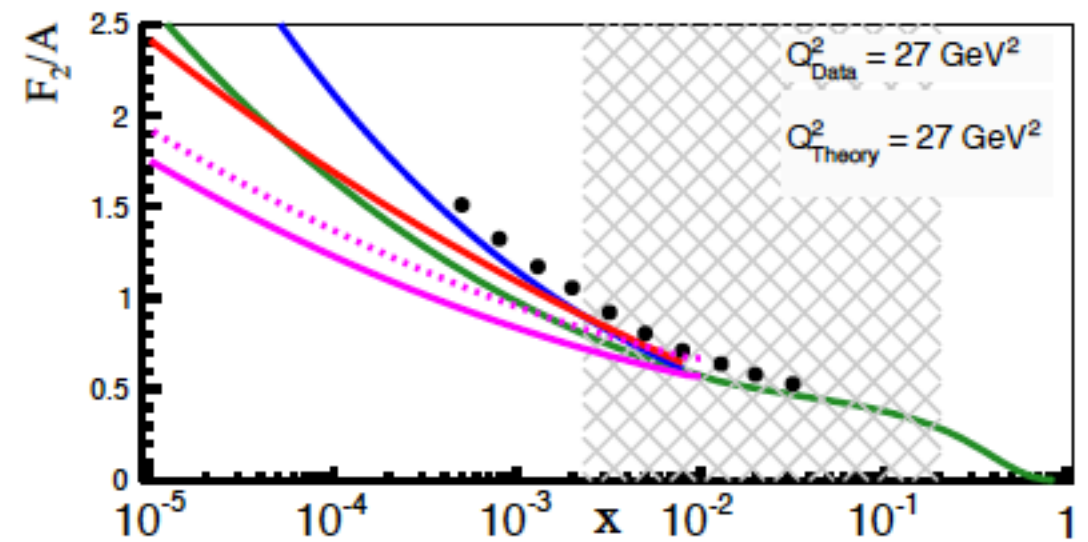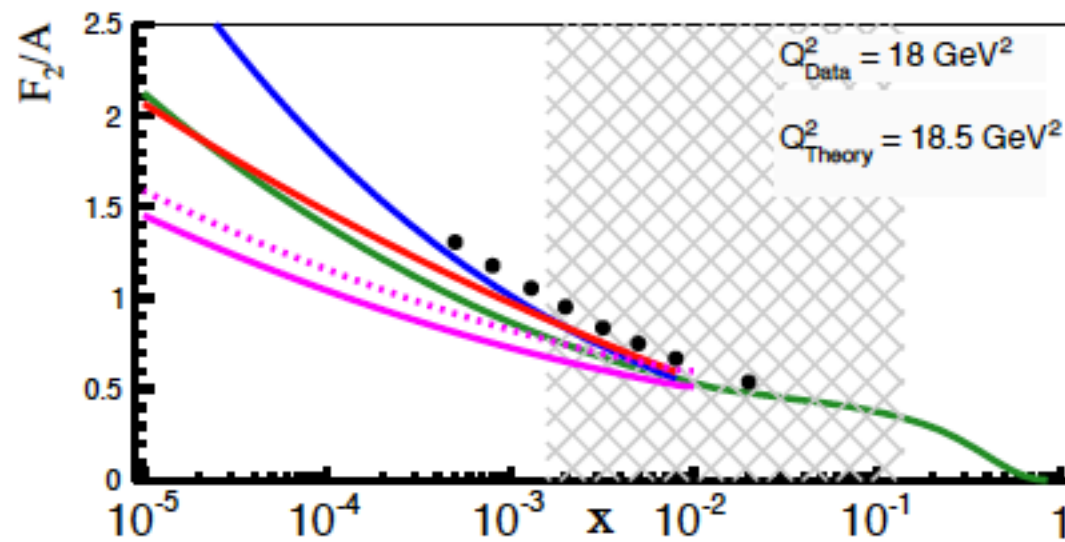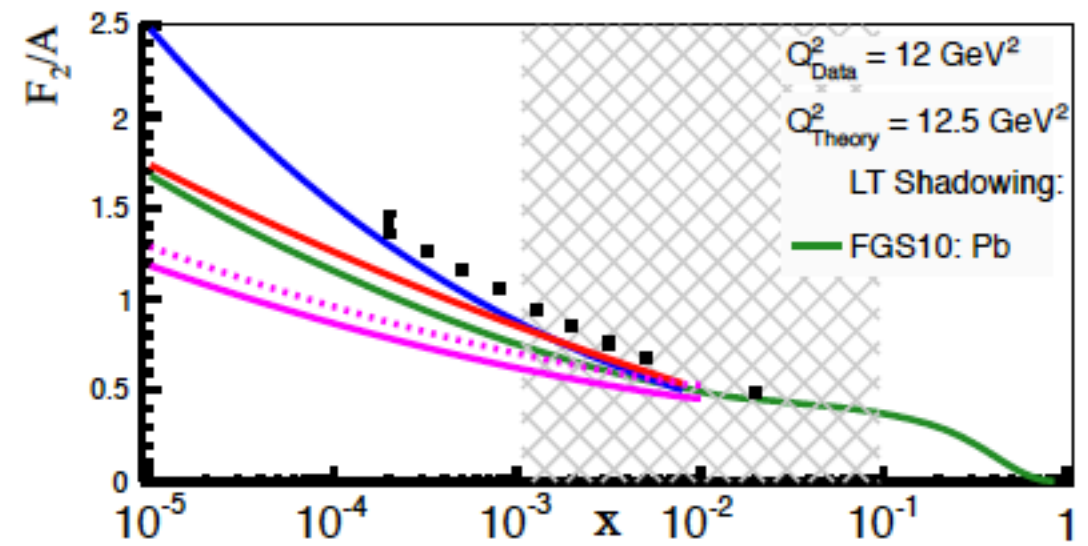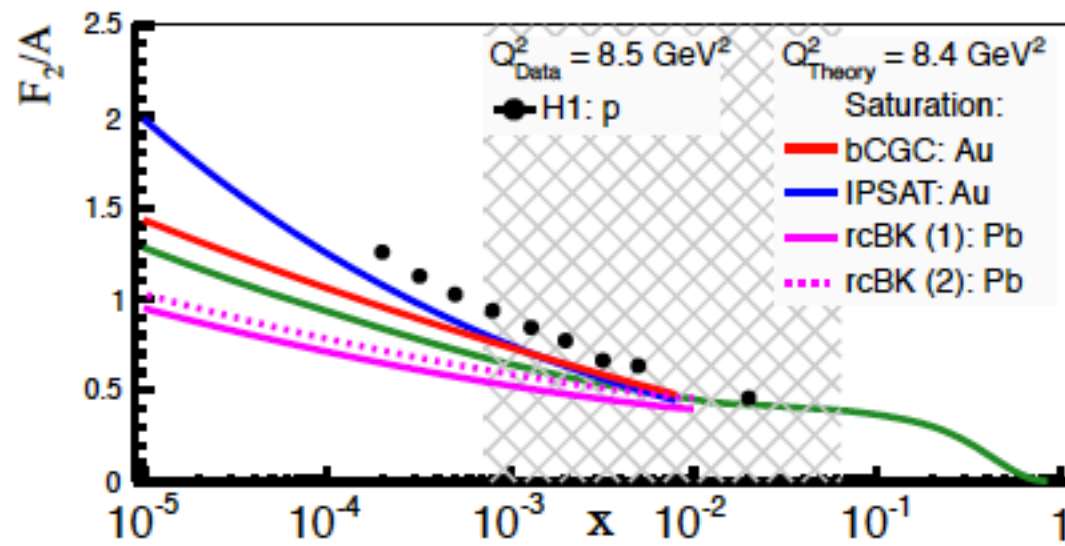
$F_L(A)/A$ - $0.8 < Q^2 < 6$
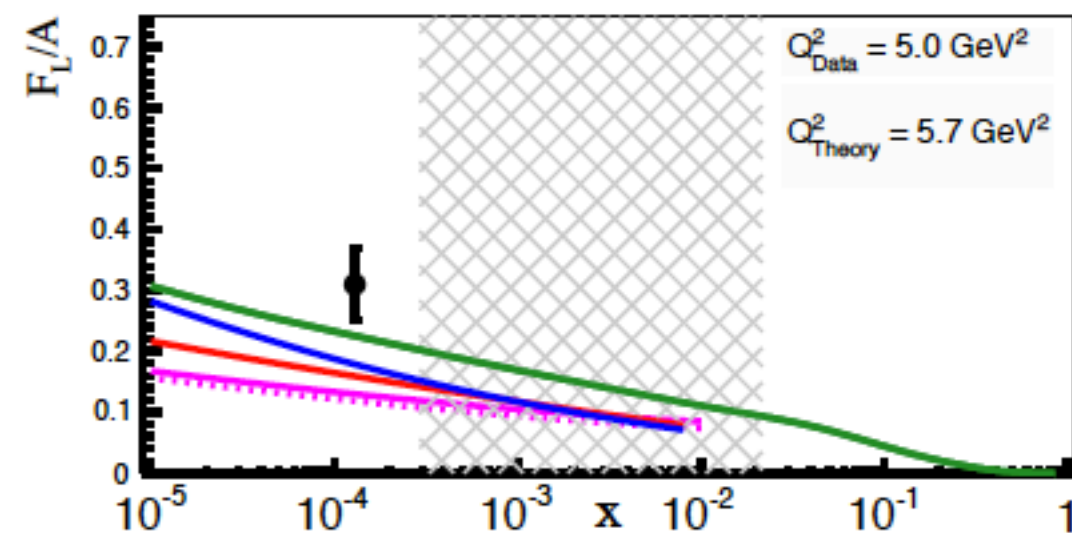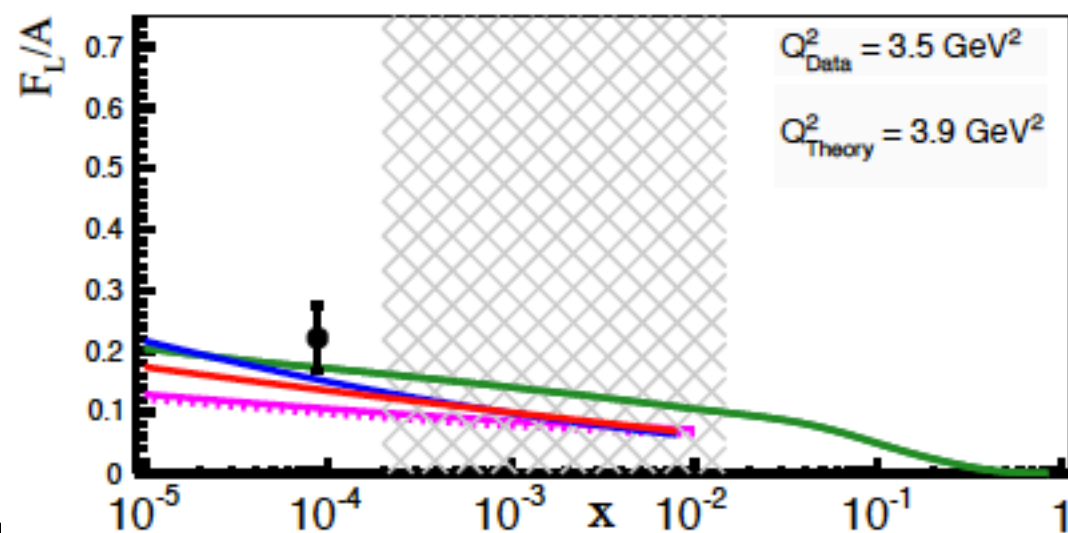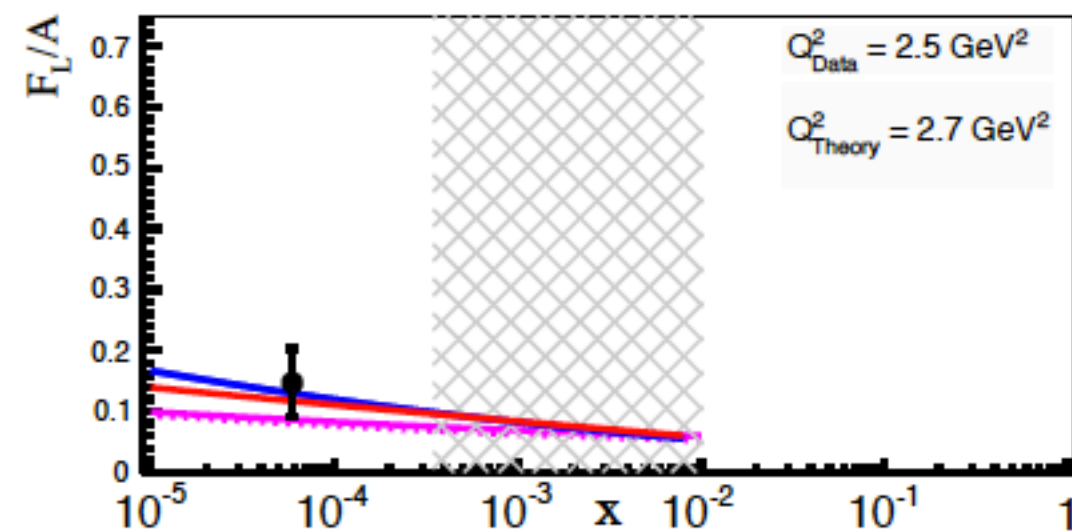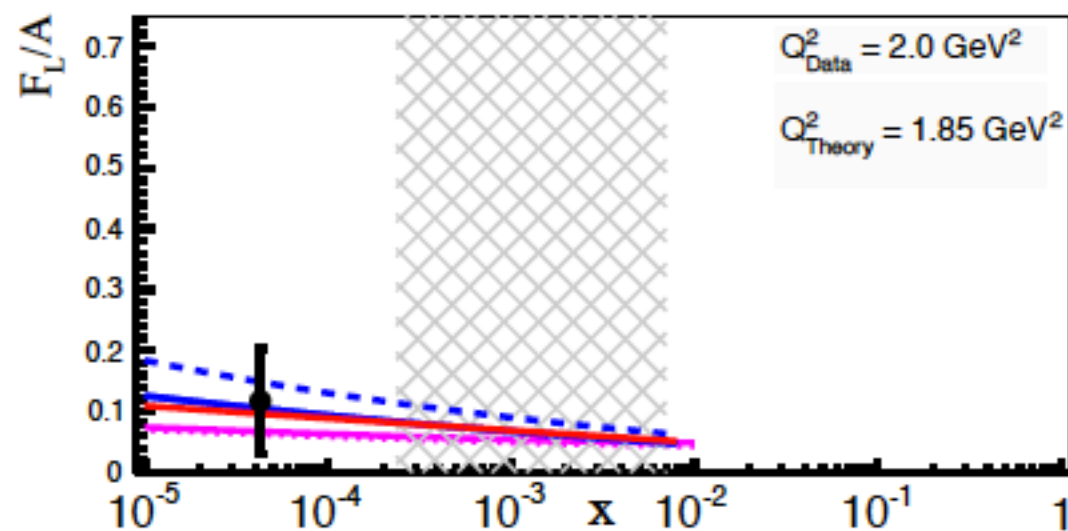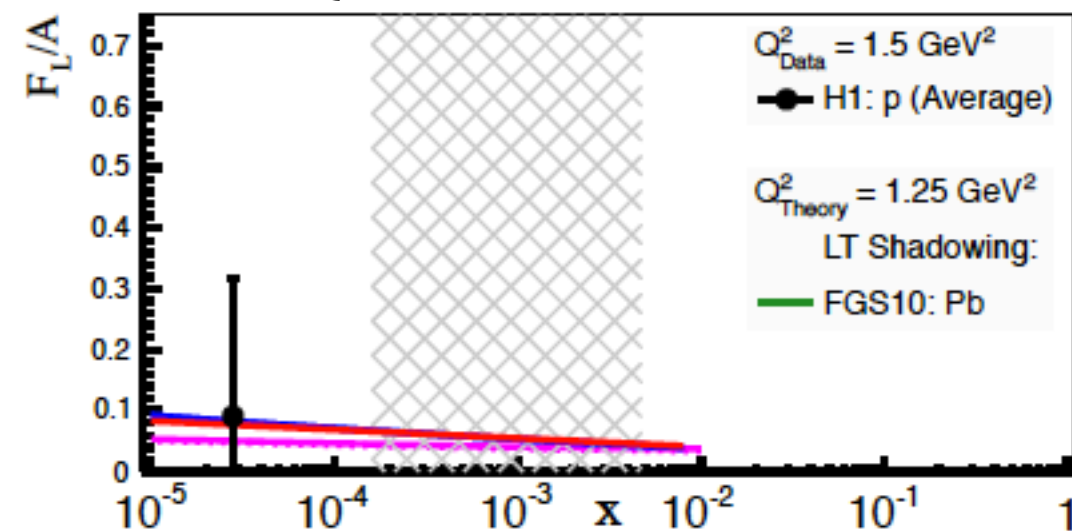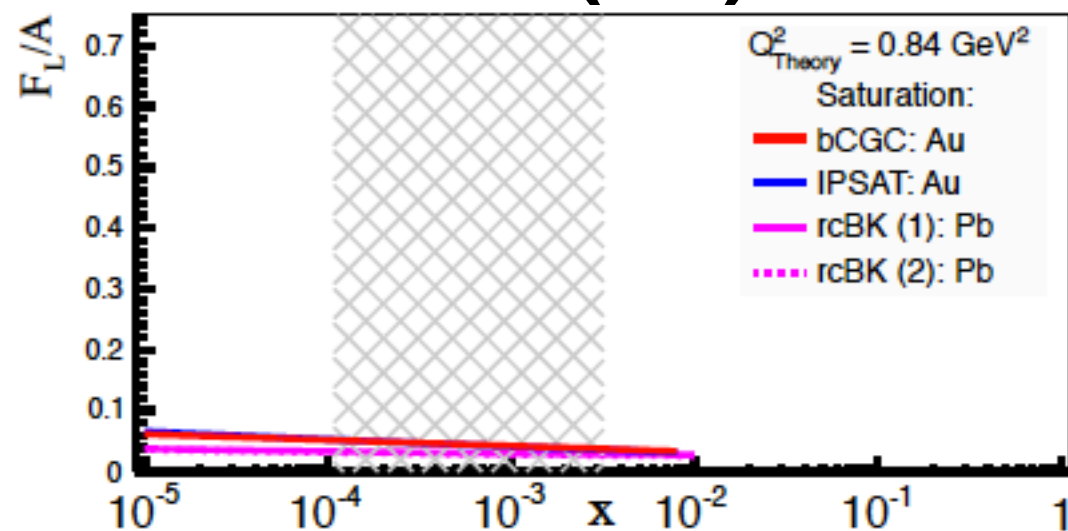
$F_L(A)/A$ - $8 < Q^2 < 60$
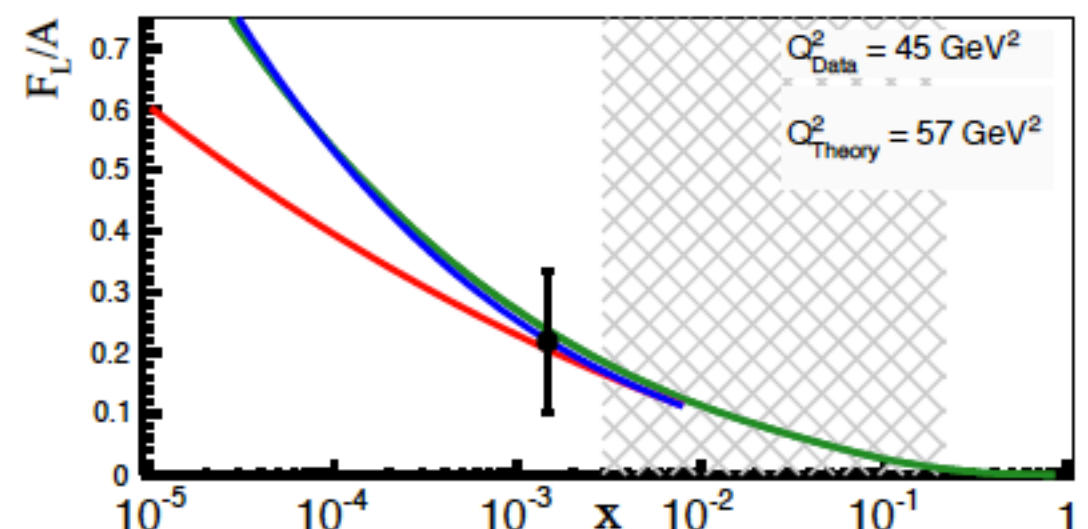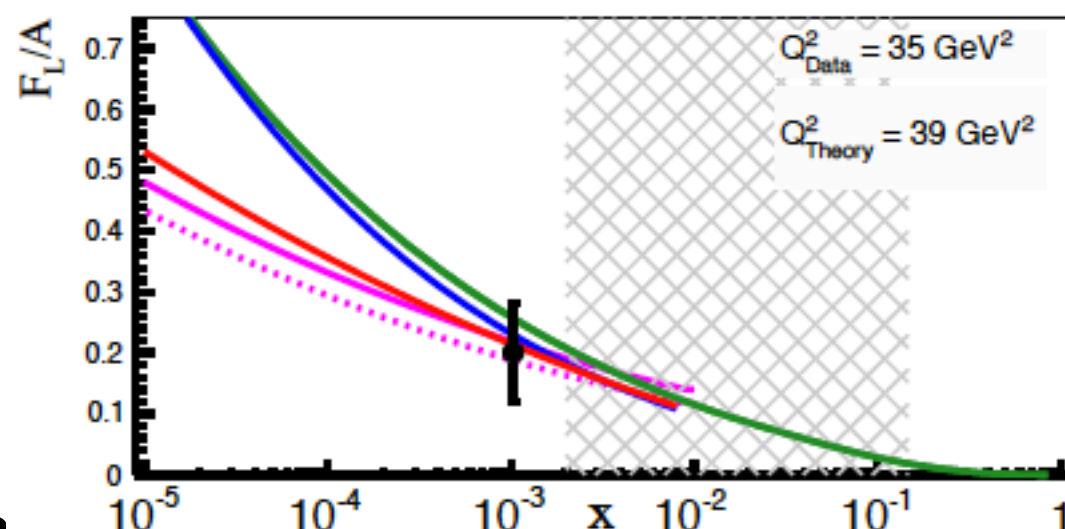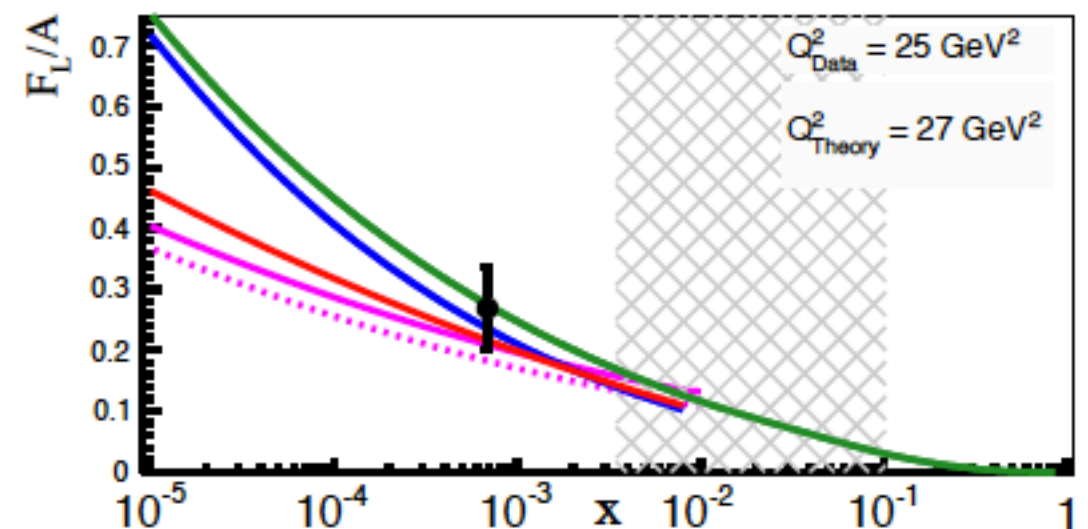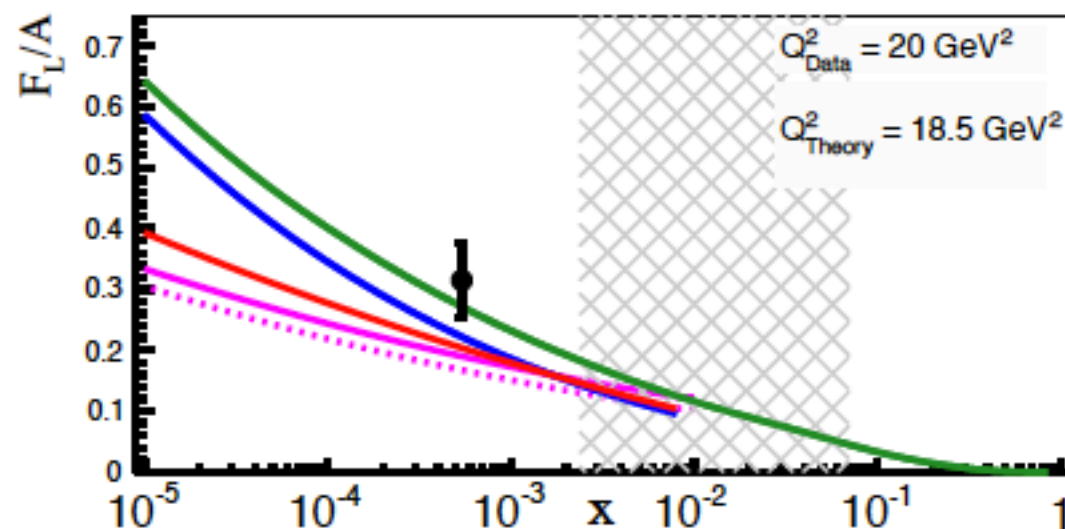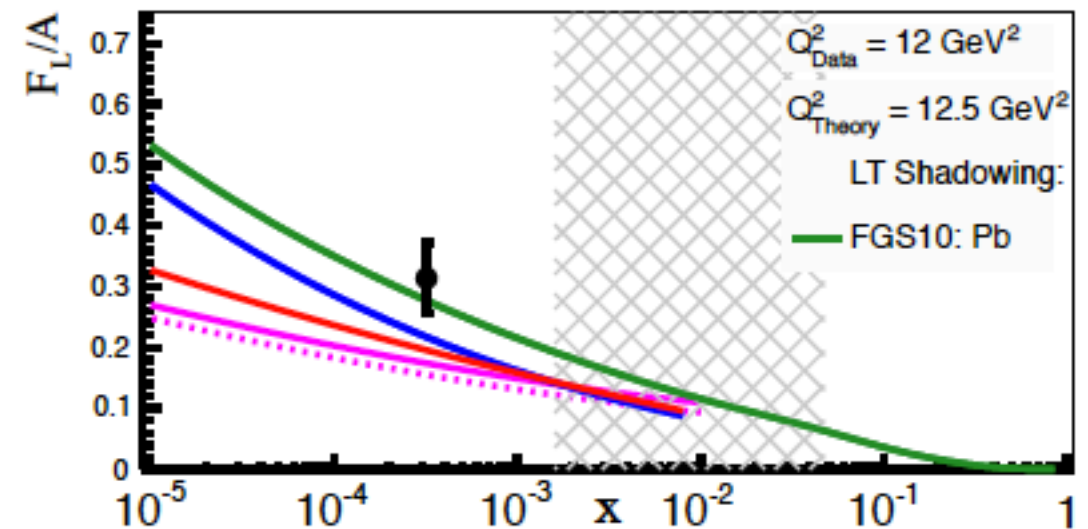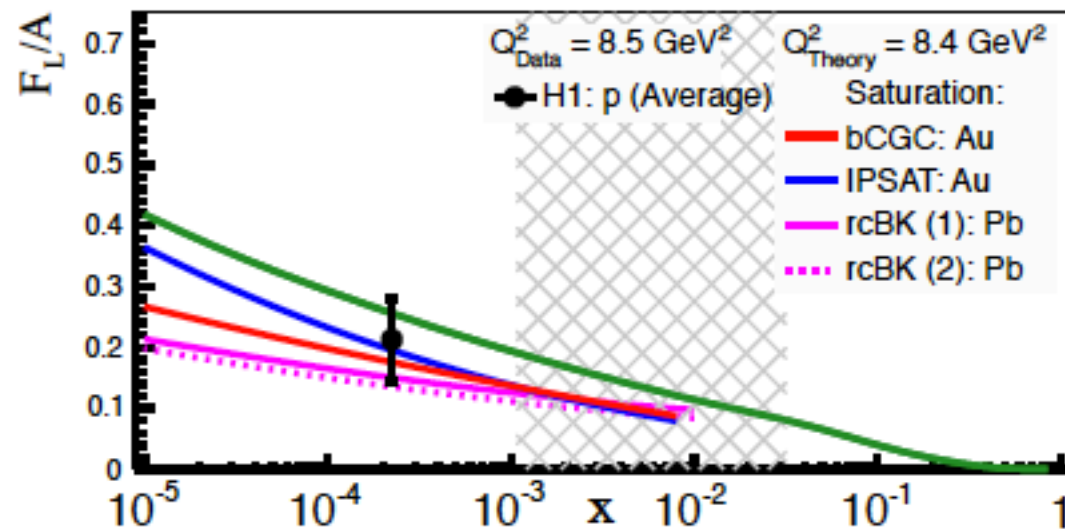
$F_2(A)/AF_2(p) - 0.8 < Q^2 < 6$

$F_2(A)/AF_2(p)$ - $8 < Q^2 < 60$

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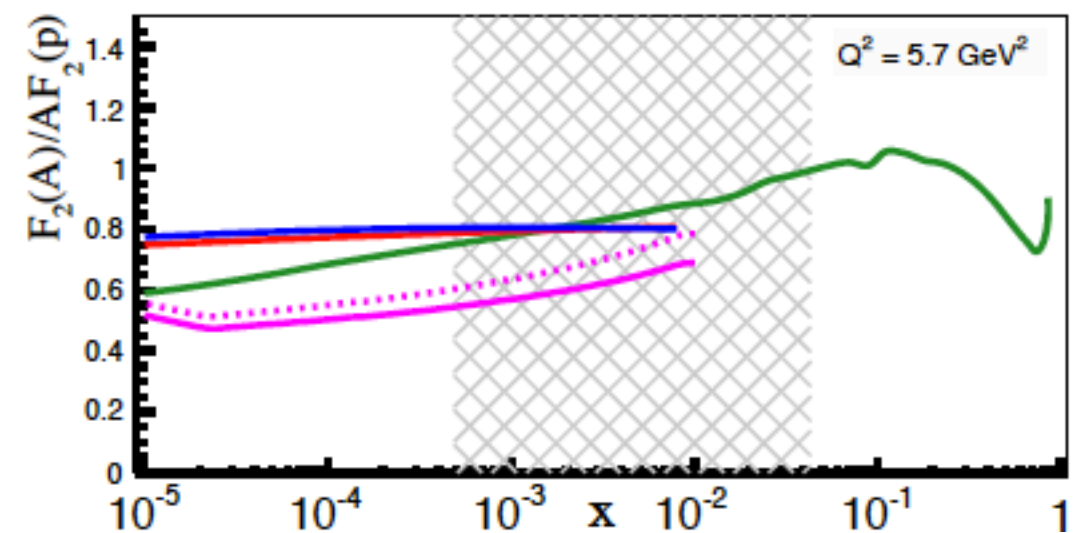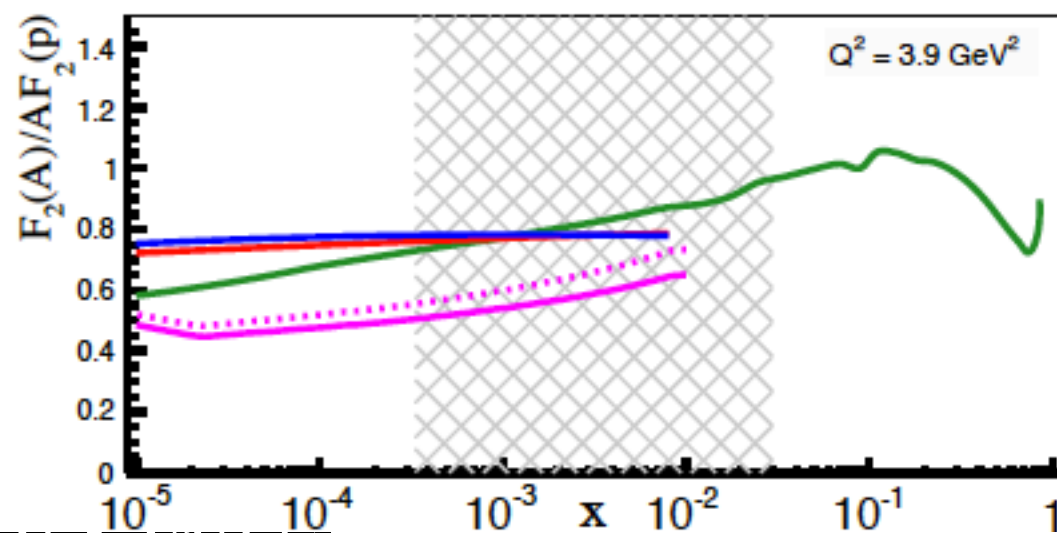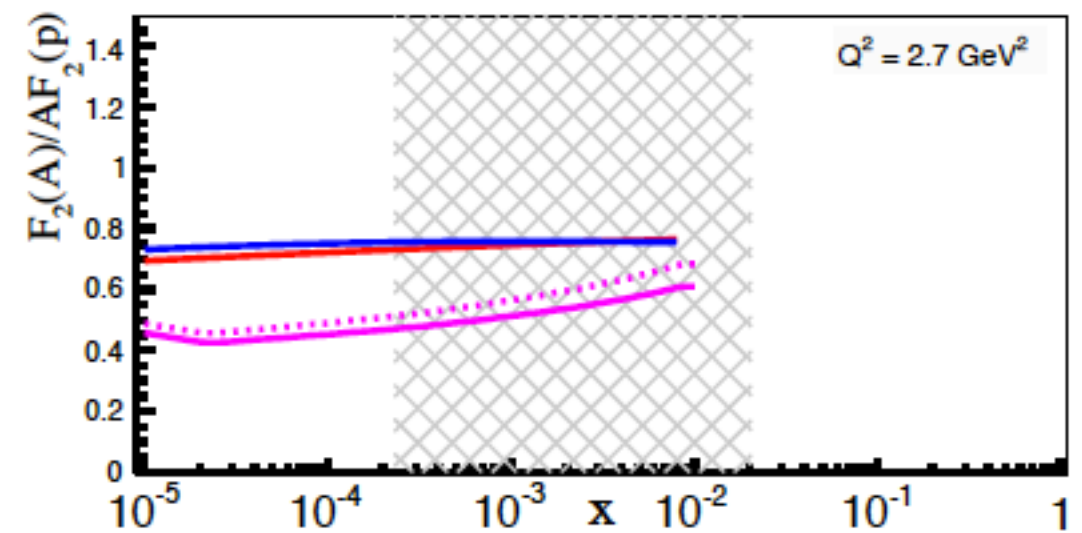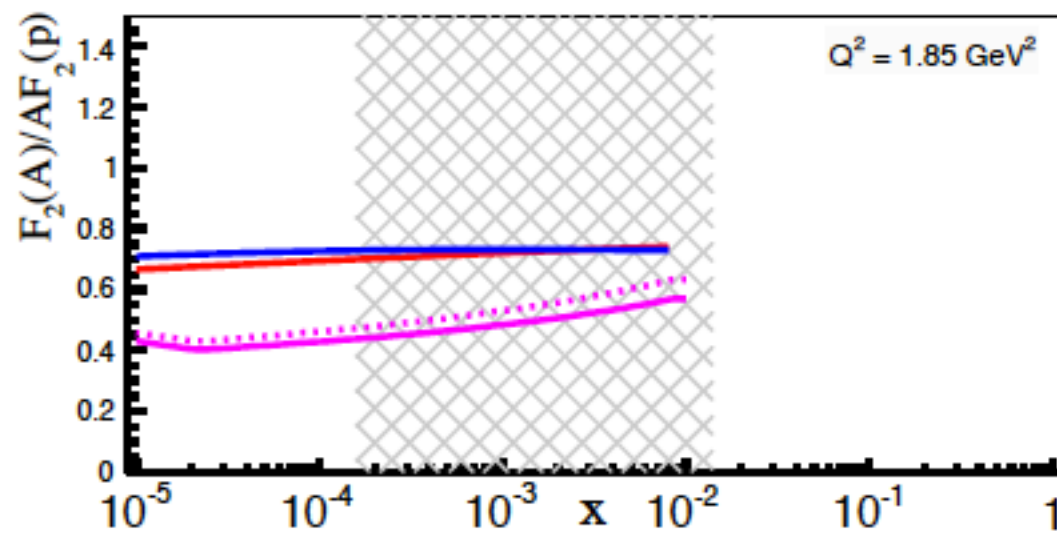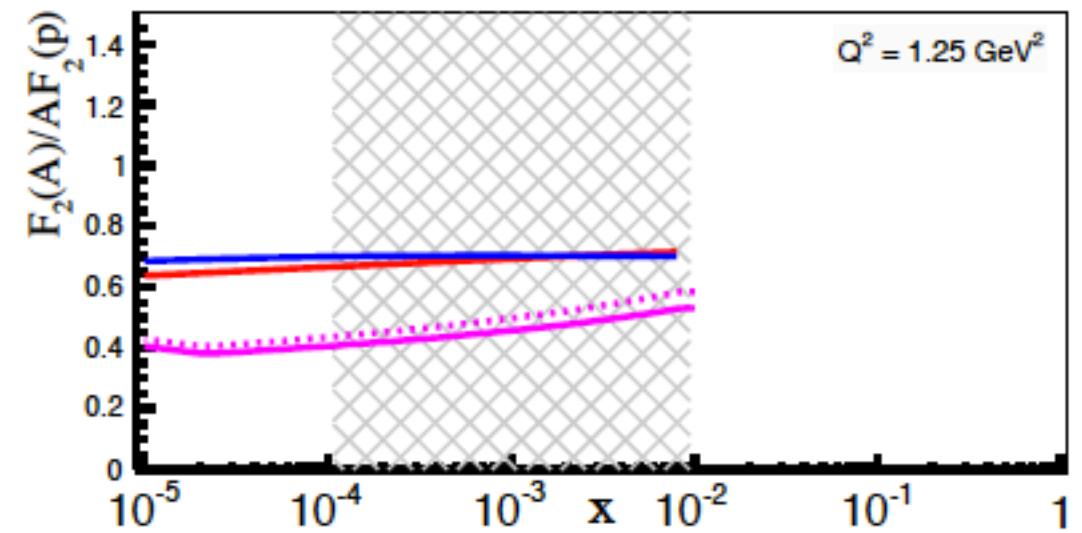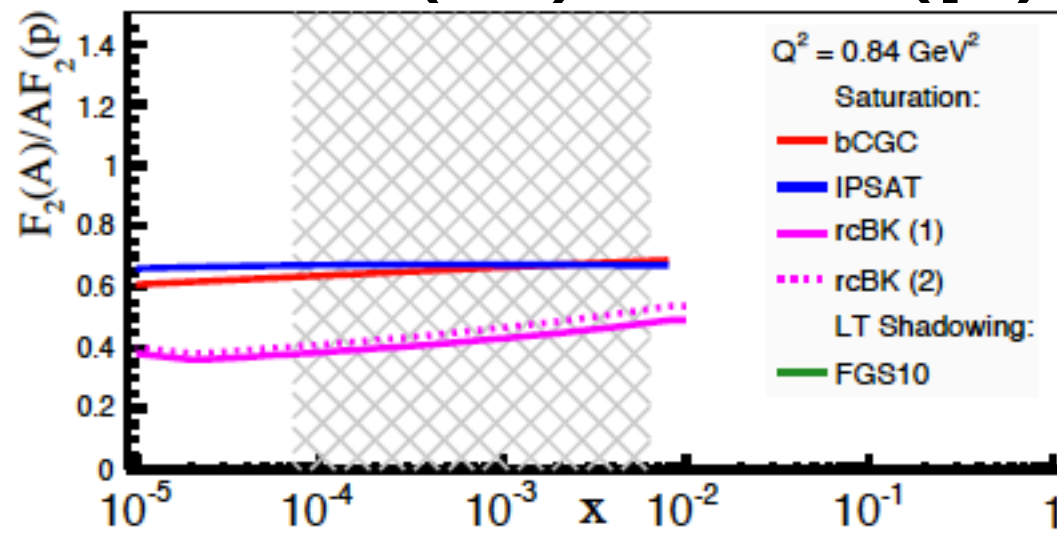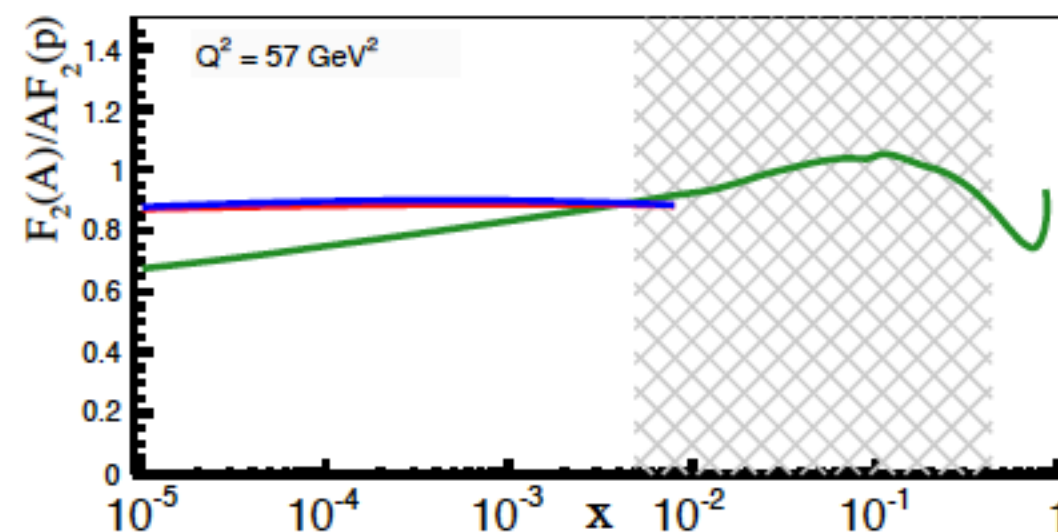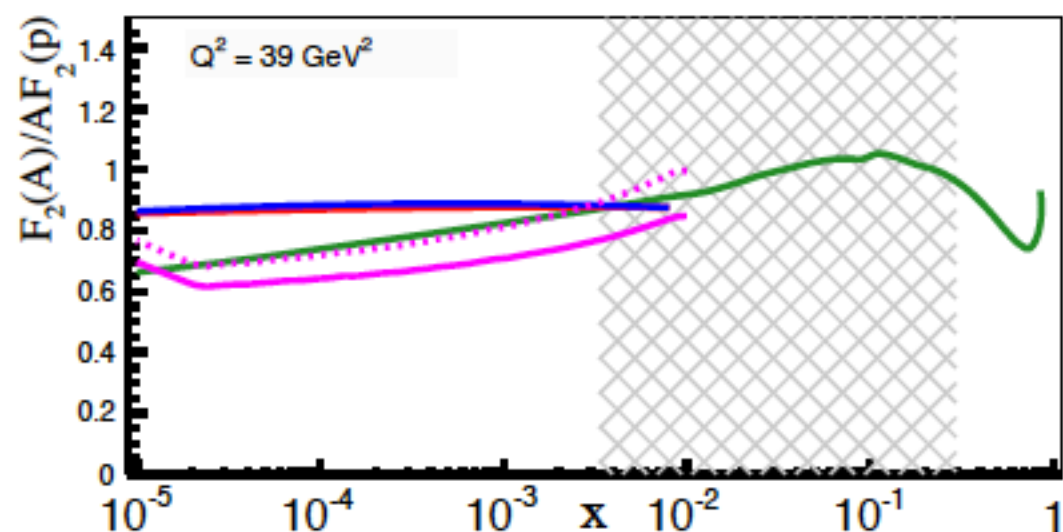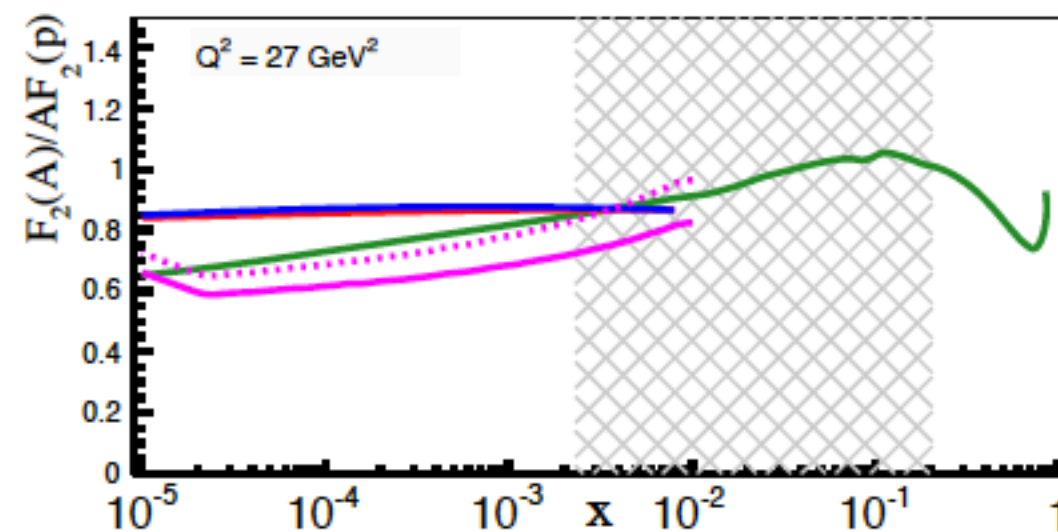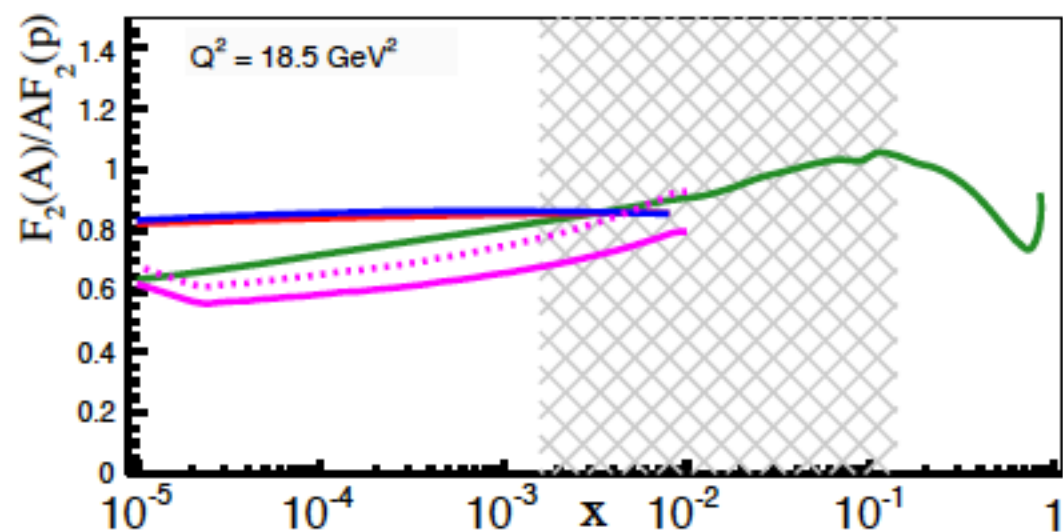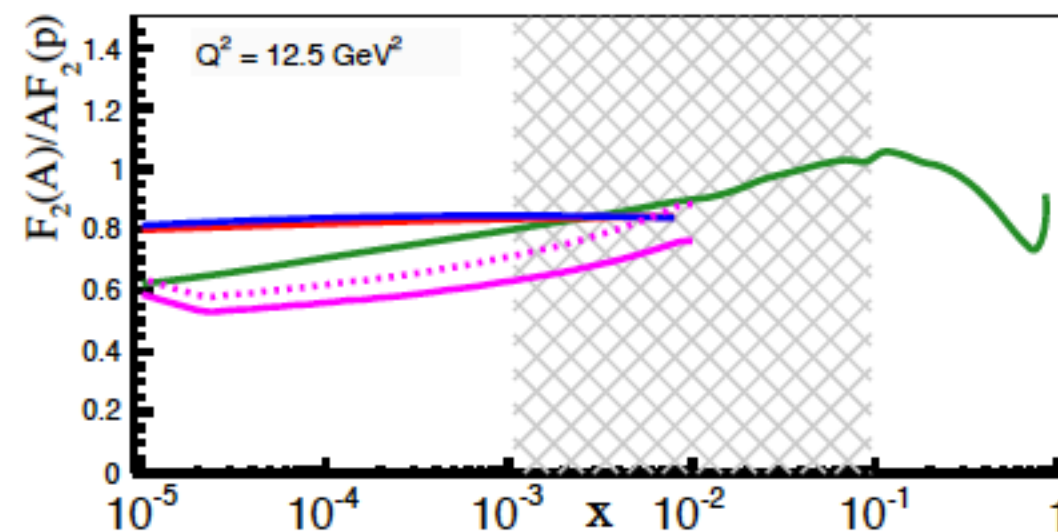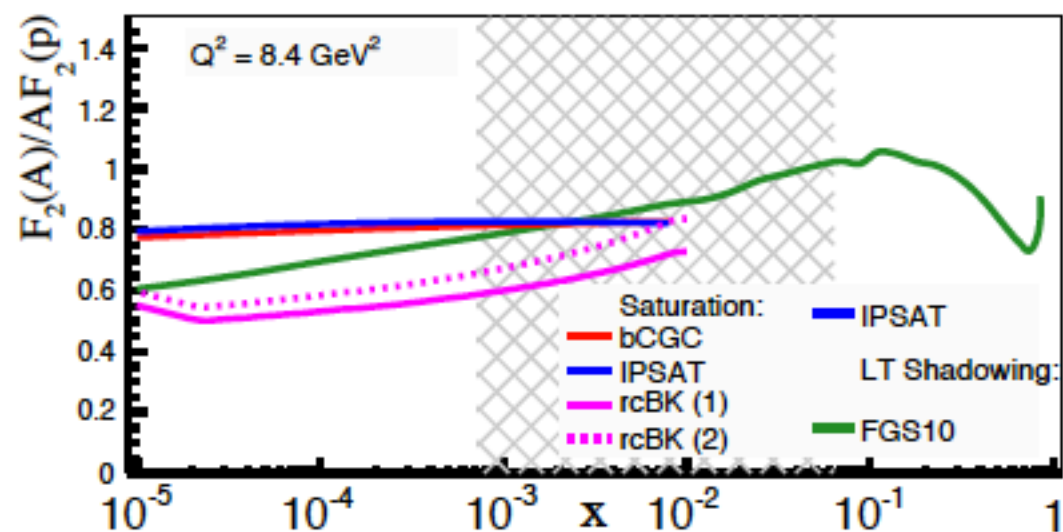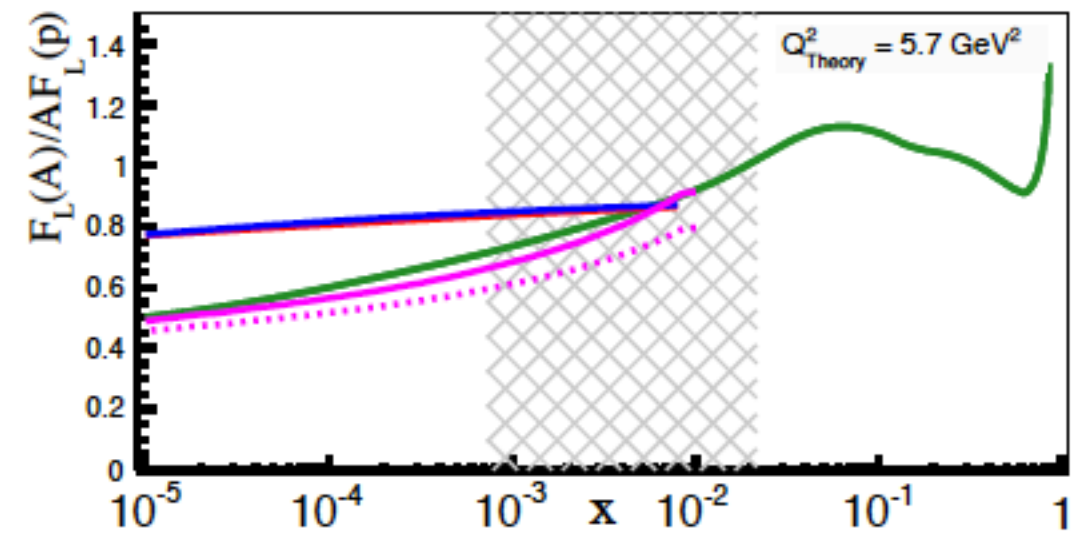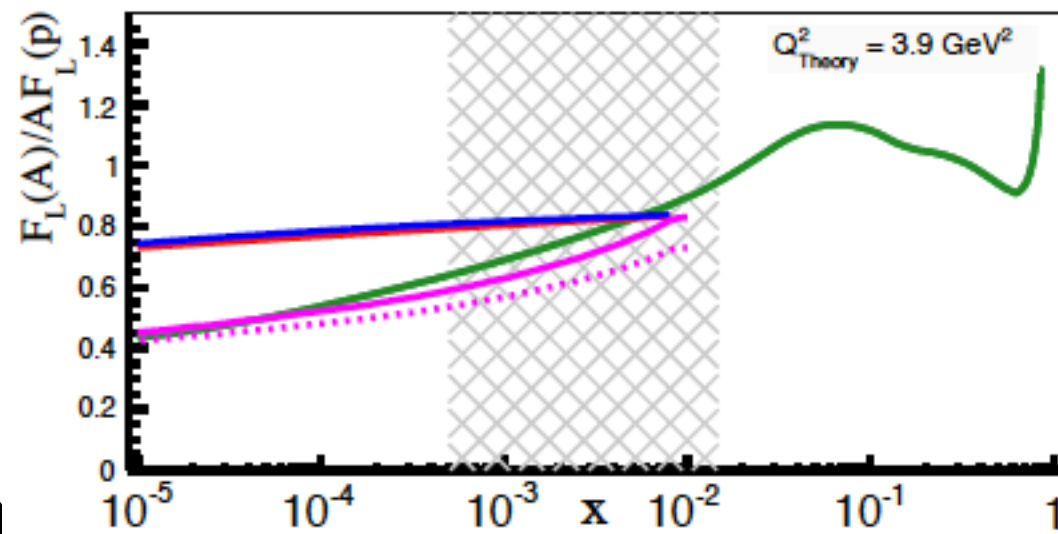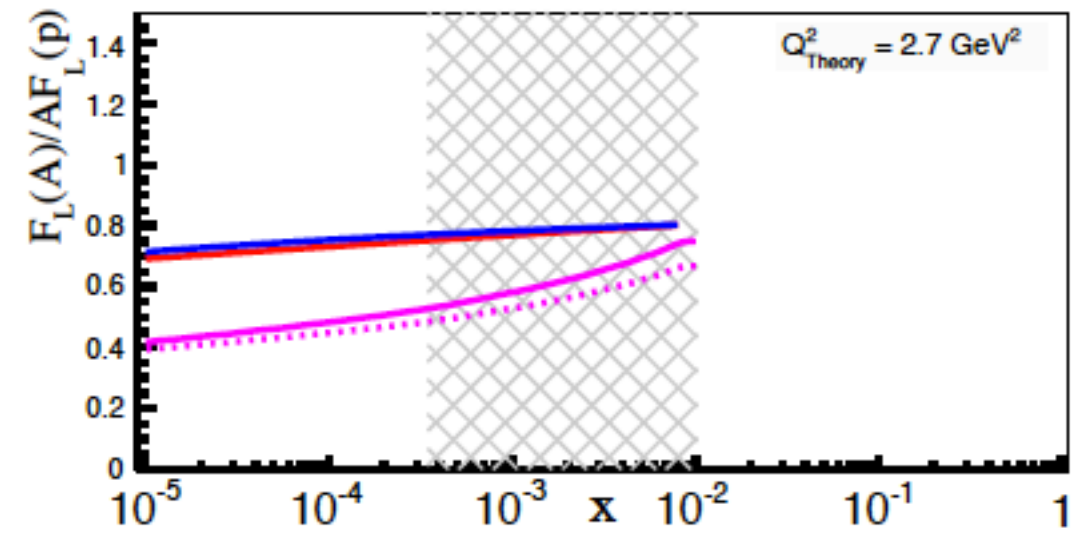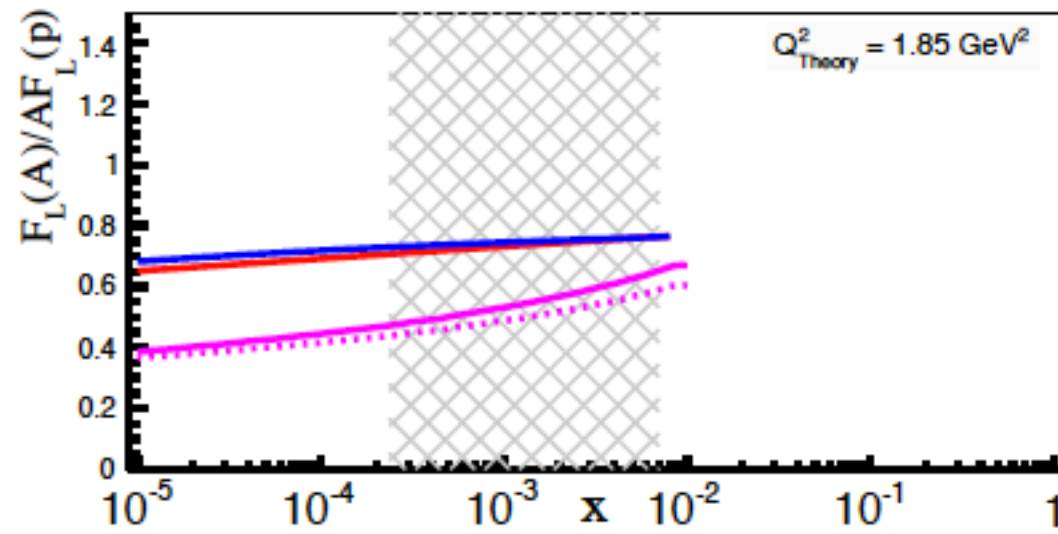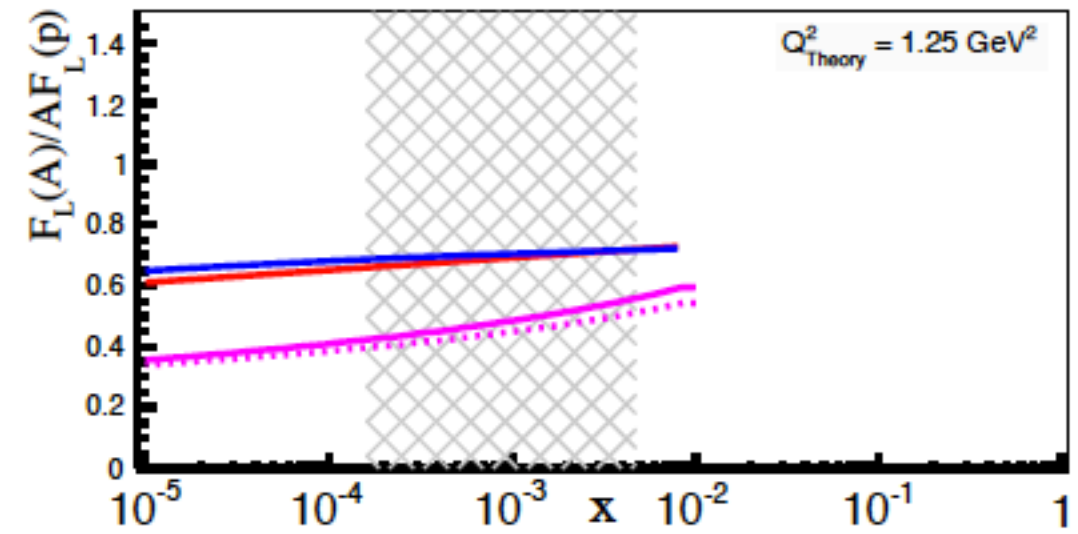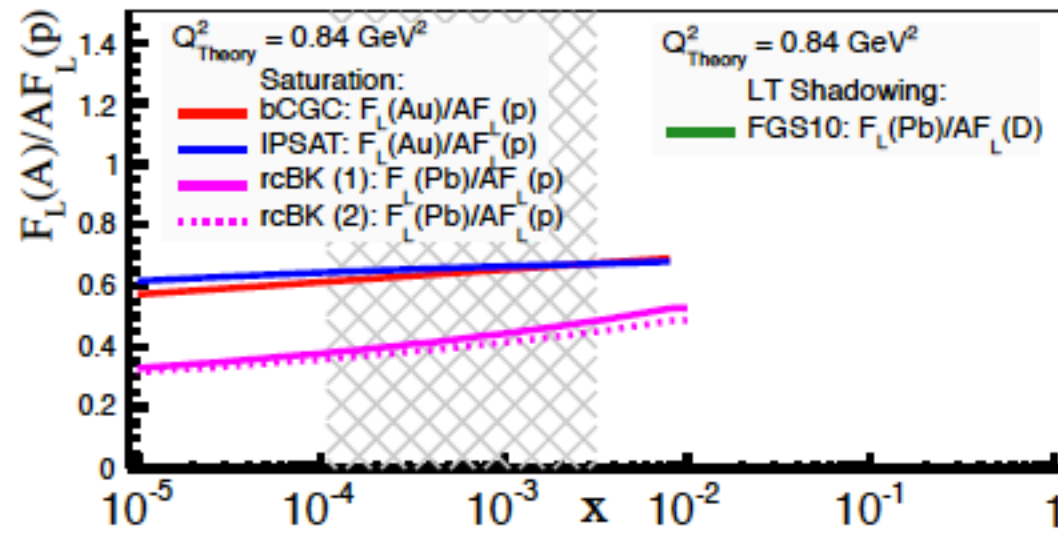
$F_L(A)/AF_L(p)$ - $0.8 < Q^2 < 6$

$F_L(A)/AF_L(p)$ - $8 < Q^2 < 60$
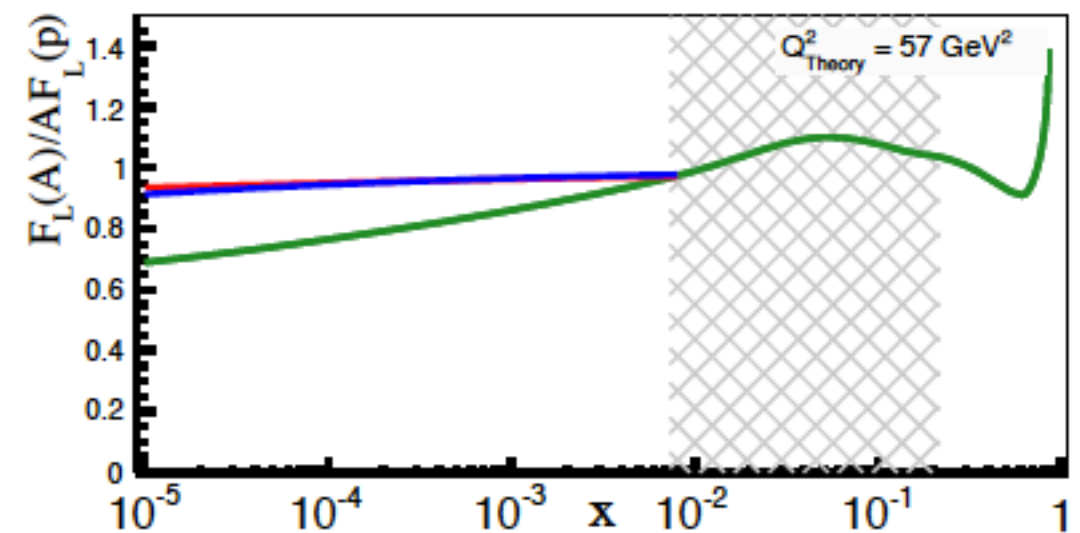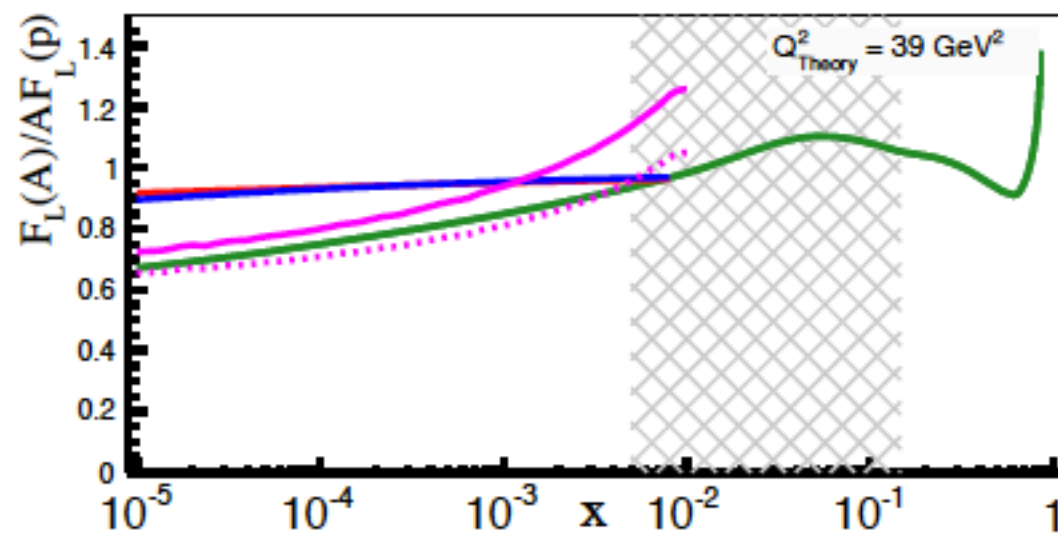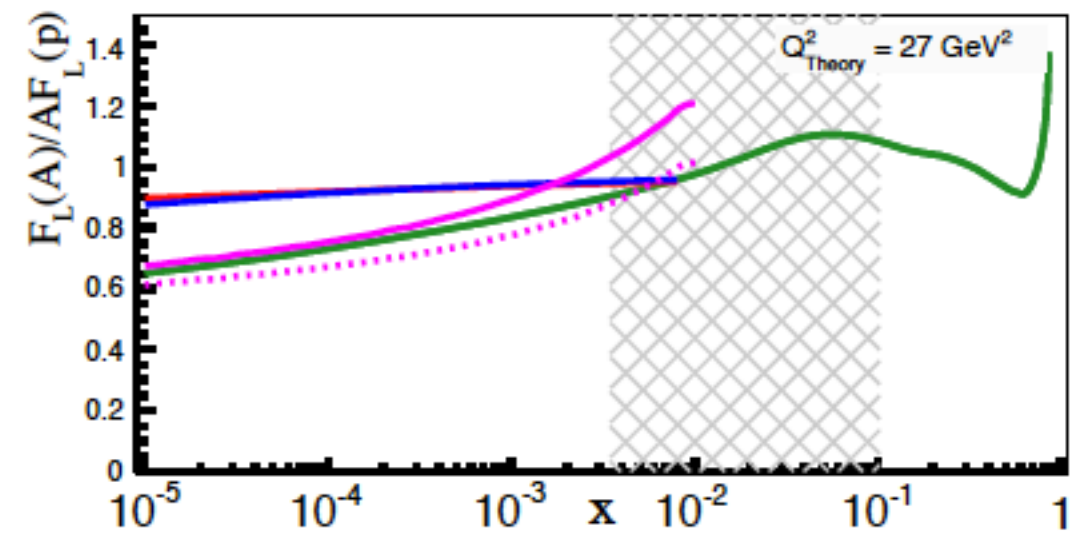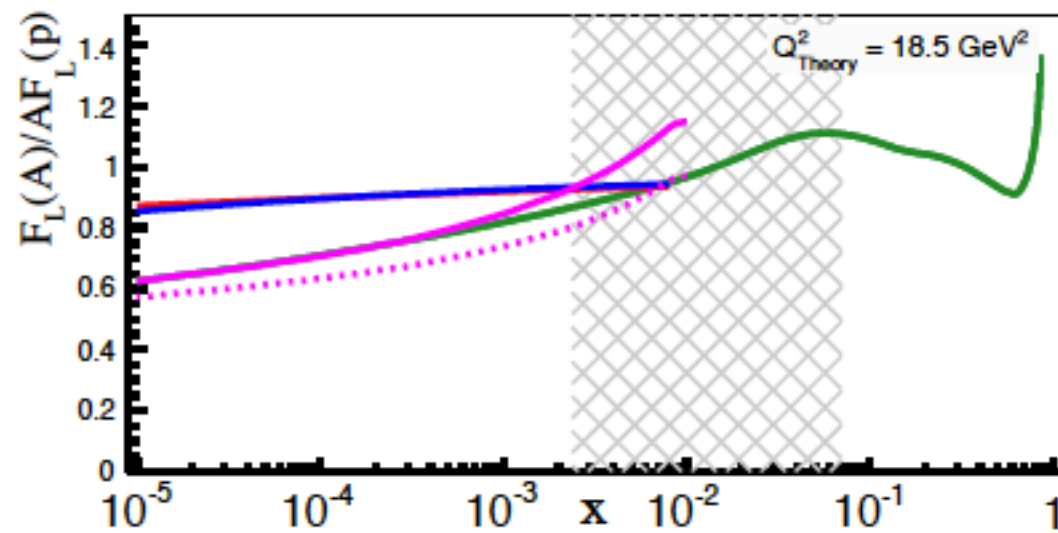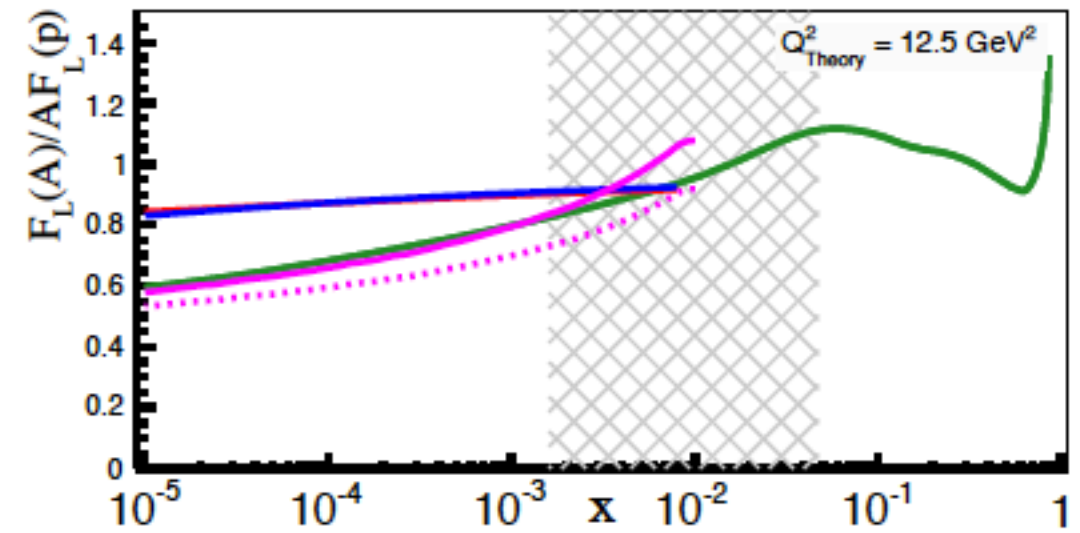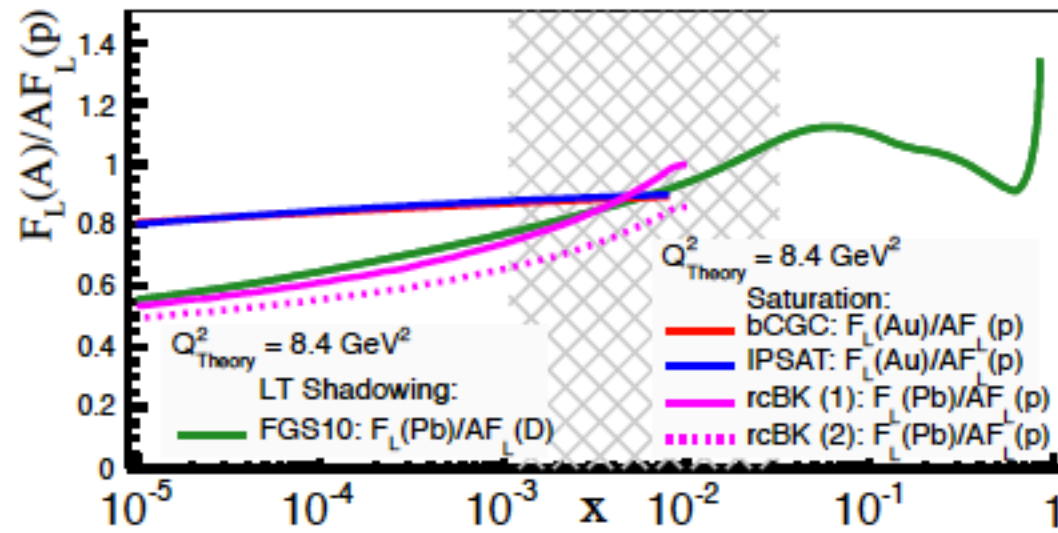
$F_L(A)/AF_L(p)$: $F_2(A)/AF_2(p)$ - $0.8 < Q^2 < 6$
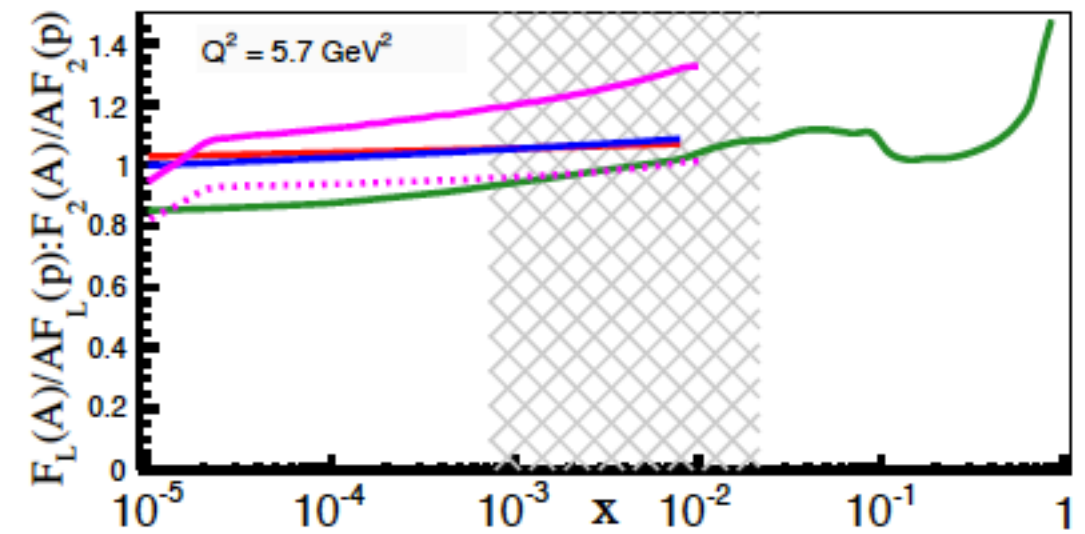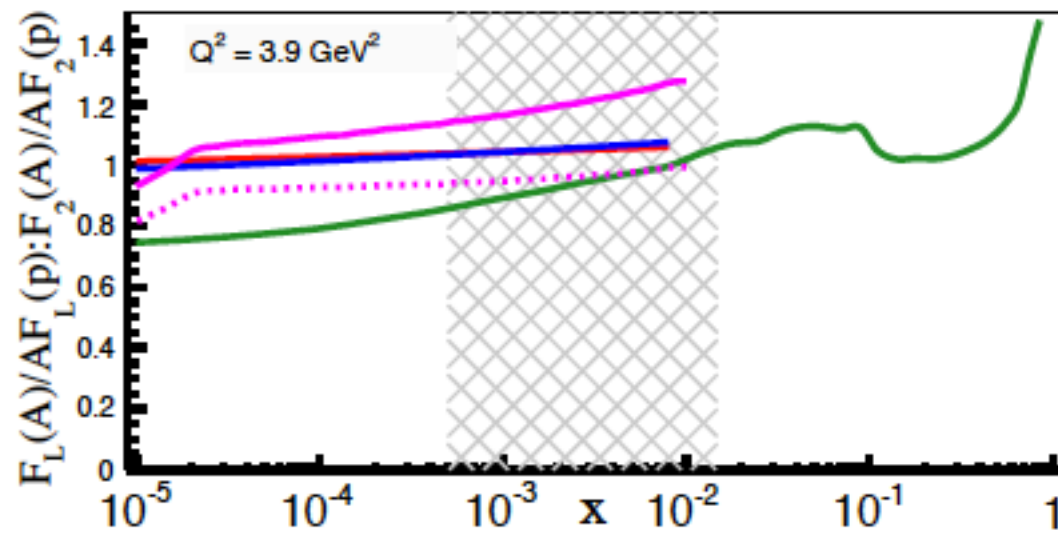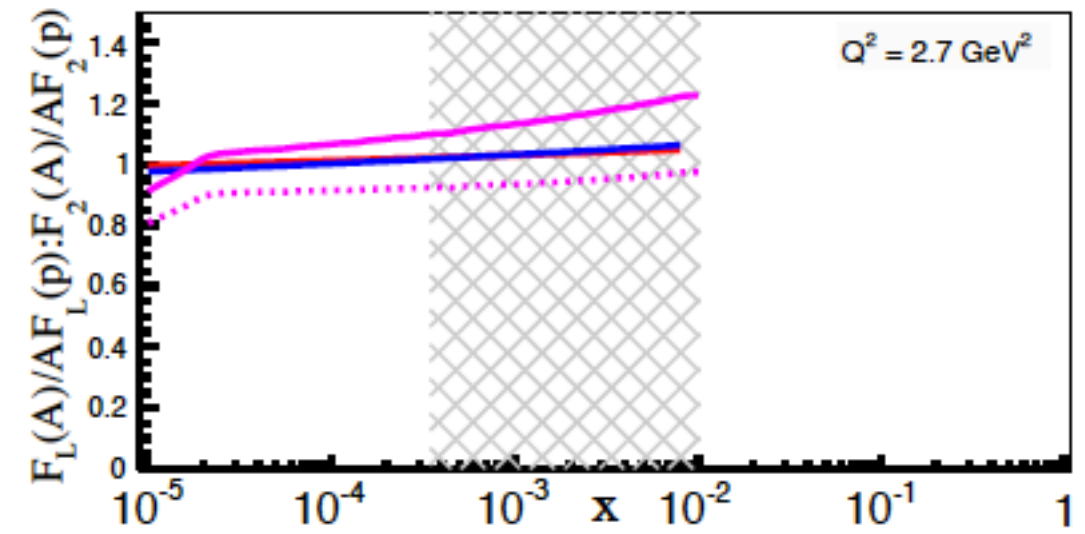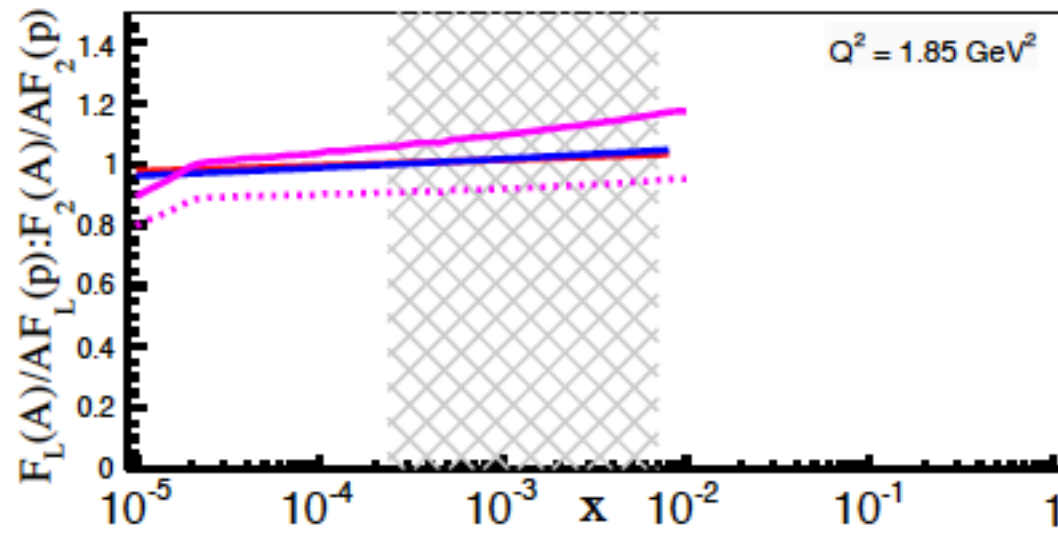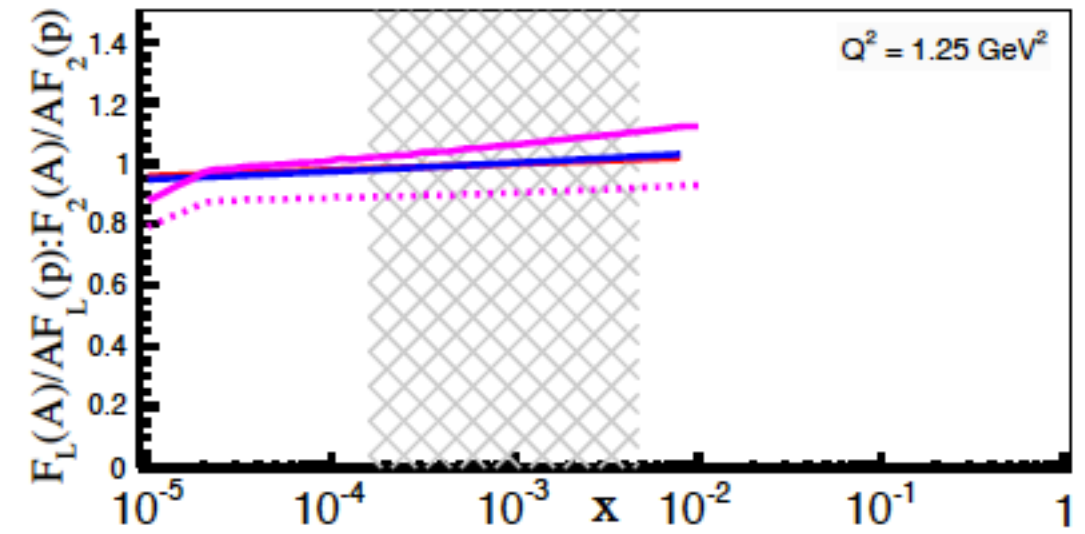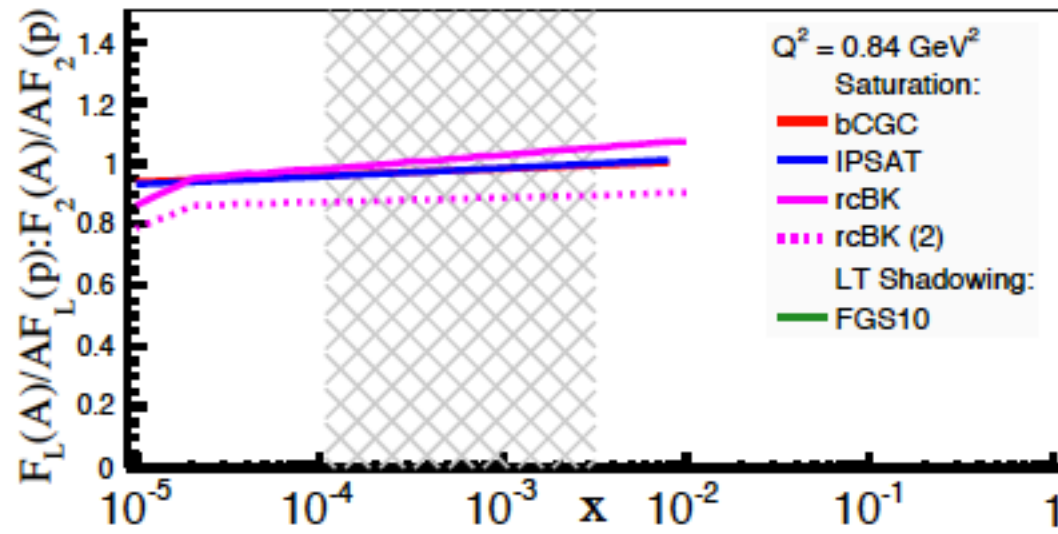
$F_L(A)/AF_L(p) : F_2(A)/AF_2(p) - 8 < Q^2 < 60$
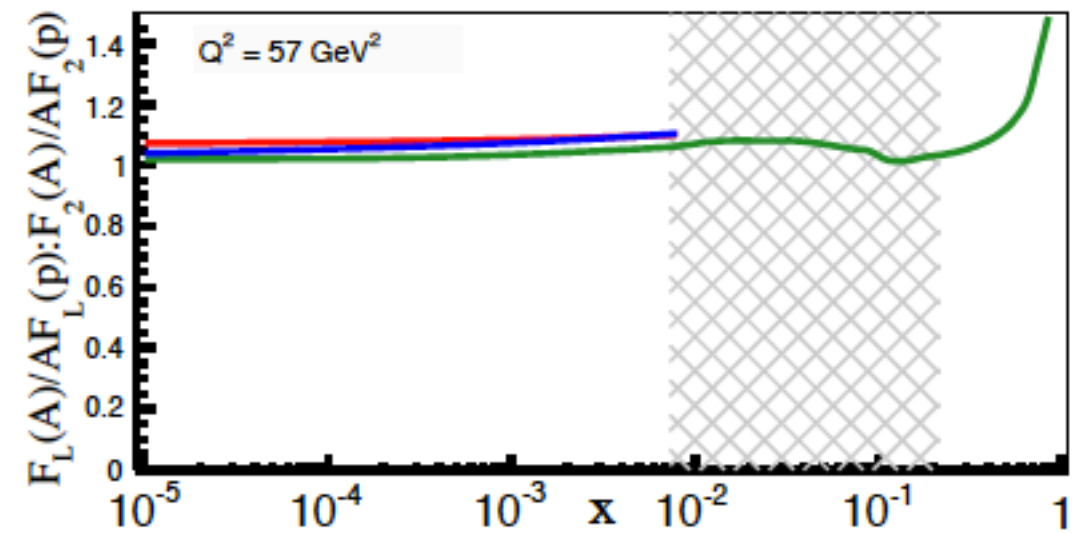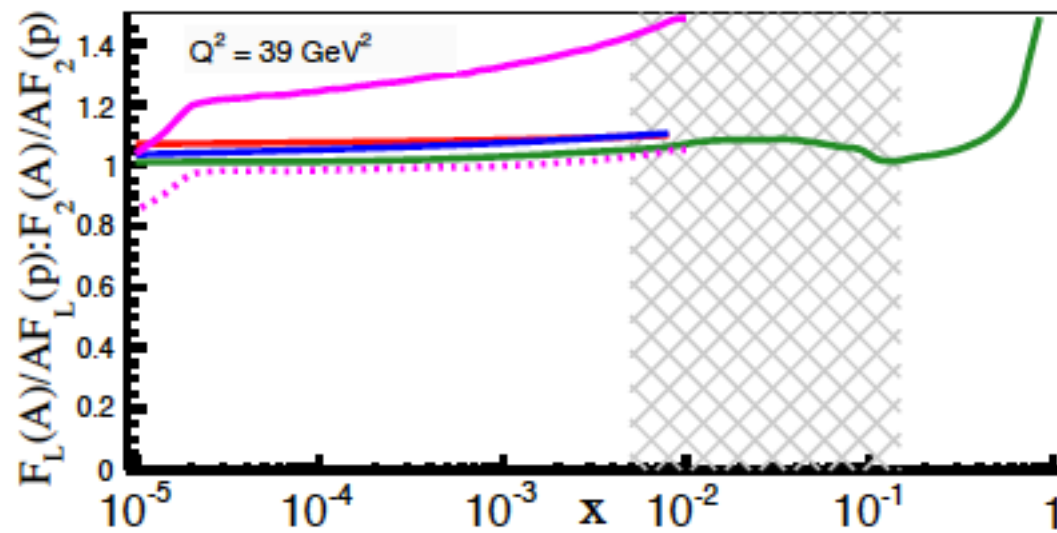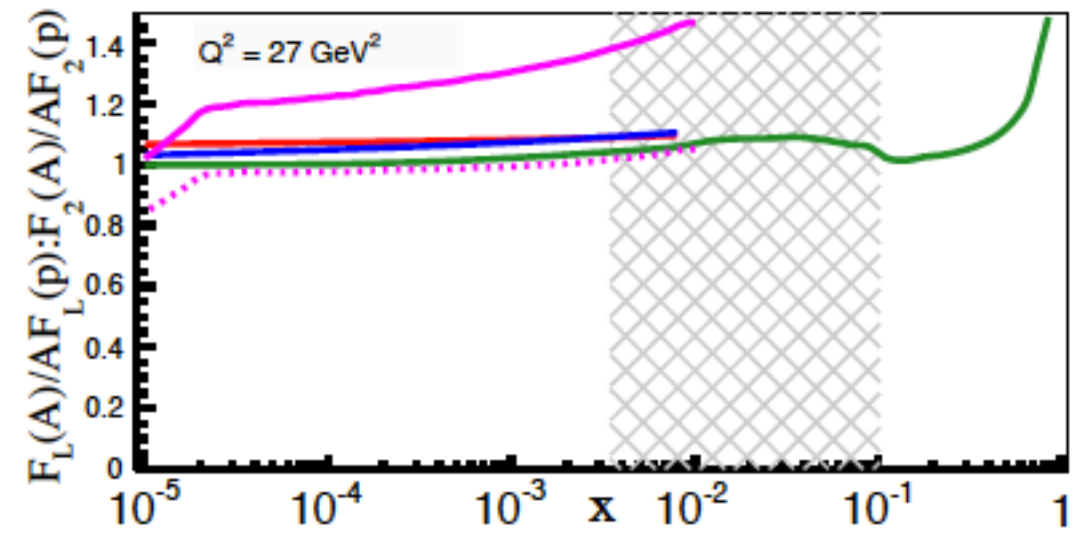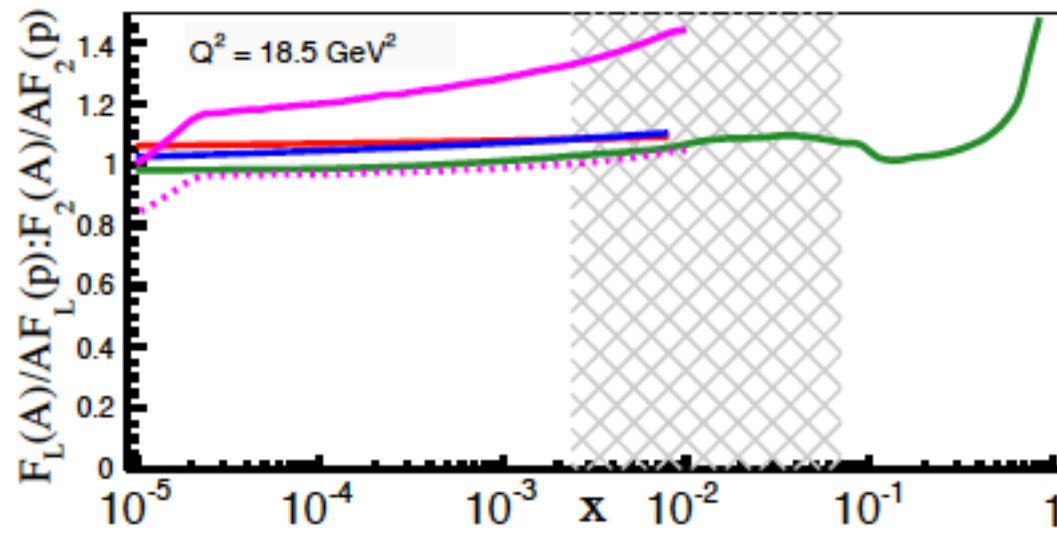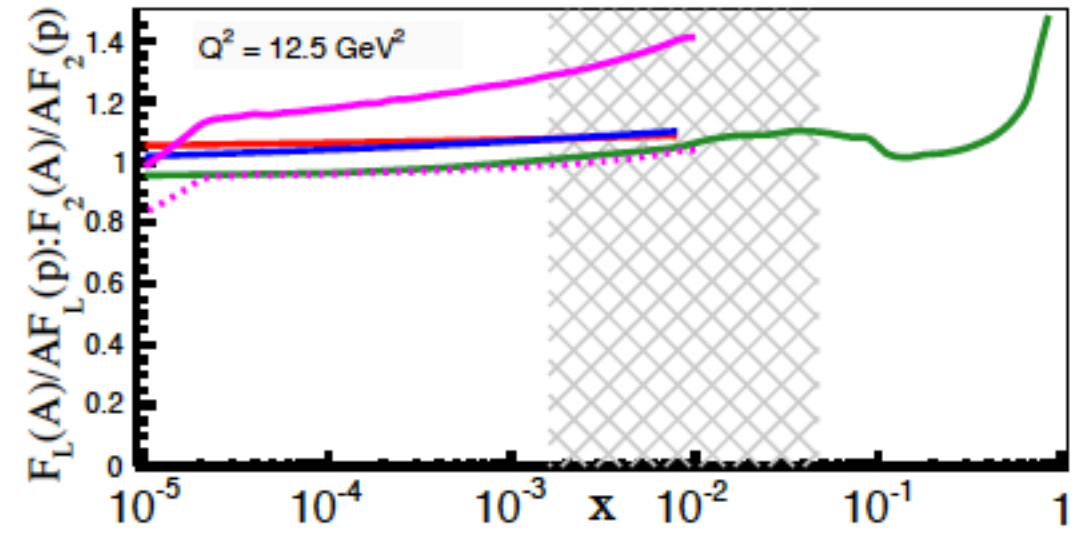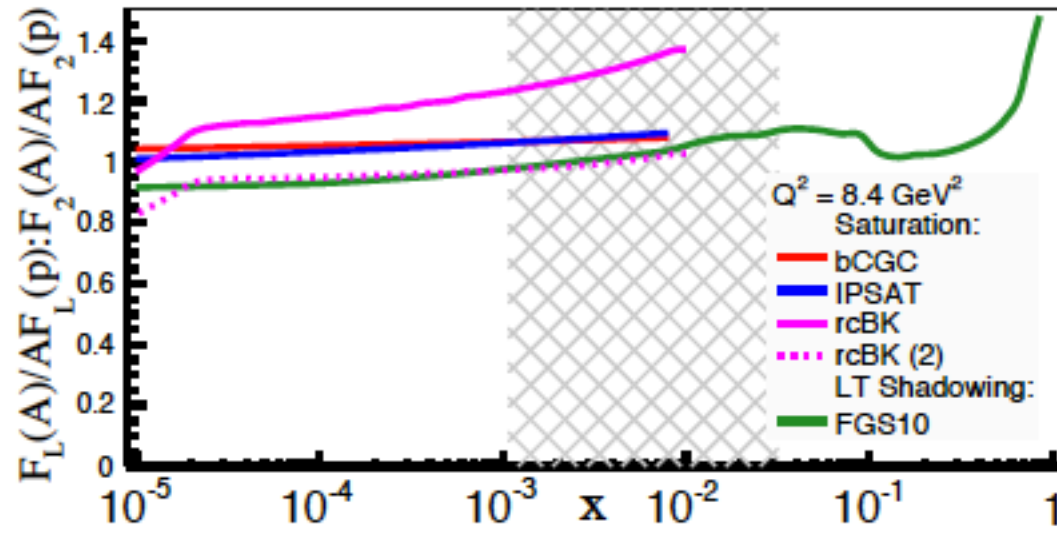
Some Questions, Points, Thoughts

- The bCGC and IPSat models are different for $F_2(p)$ and rcBK and bCGC are on top of each other

  ➡ bCGC and rcBK are based on BK - IPSat on eikonalised DGLAP…. Was the bCGC re-fit to the combined H1&ZEUS data?

- There are 10% differences between IPSat and the F2(p) HERA data

  ➡ If IPSat was re-fit (not a small effort, who would do it?), would this have any significant affect on the F_L data?

- What do we make of the difference in evolutions of $F_2(A)/AF_2(p)$ and $F_2(A)/AF2(p)$ in the saturation models?

  ➡ Must be dependent on what order the saturation is implemented in the model

- The double ratios are hard to interpret, can we use this though to constrain the normalisations in the rcBK model?

- Vadim is currently updating his code to use CTEQ6/10 instead of CTEQ5

  ➡ How will this affect the plots?

  ➡ Will the ratios be unchanged (or at least minor changes)?

- Finally, we want some clean plots for the white paper, what do we want to show?

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