F_L in DIPSY

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Work done with Gösta Gustafson and Leif Lönnblad.

Content

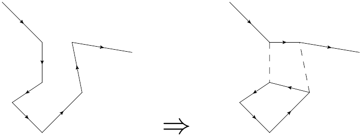
- Saturation in DIPSY
  - Swing
  - Multiple interactions
- Saturation in F_2 and F_L
  - x dependence.
  - Q^2 dependence.

Saturation

- Breaks the growth of the cross section to protect unitarity.
- Important in dense states.
- Nonlinear effect.
- Acts in evolution and in interaction.

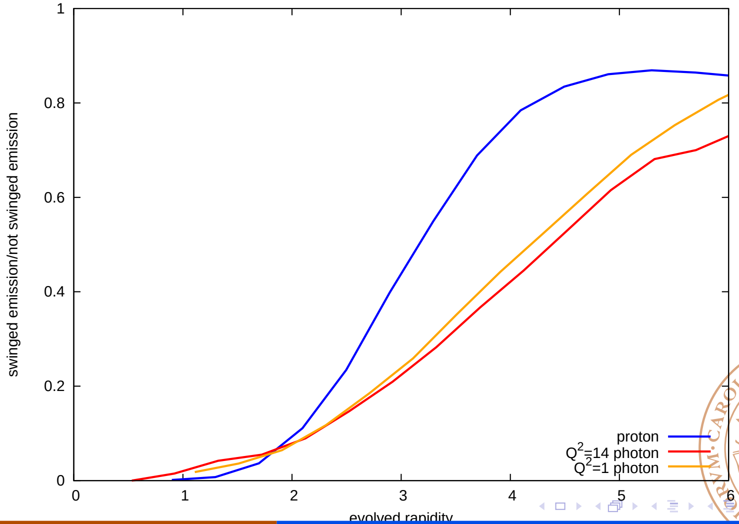
The Swing

- Recombines 2 dipoles



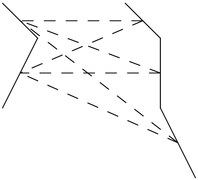
- Tends to swing large dipoles into small dipoles.
- Can be interpreted as quadrupole or gluon exchange.

Saturation energy

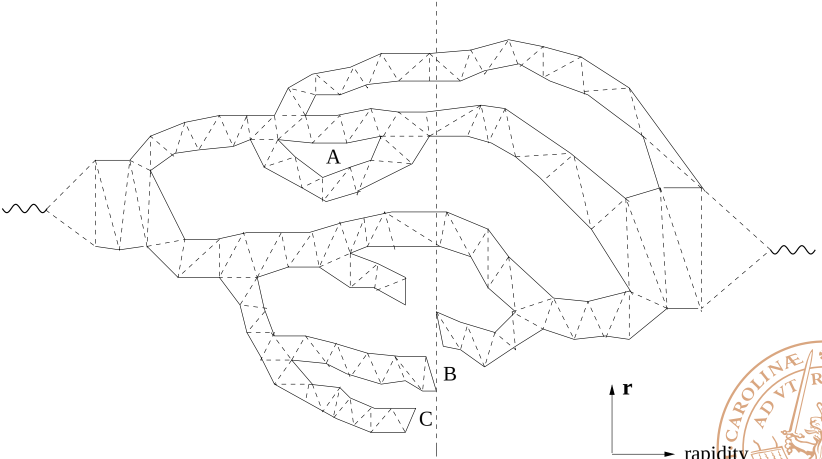


Unitarisation

- Accounts for multiple interactions: total interaction probability is not the sum of the dipole interaction probabilities.
- Instead use non-interaction probability $1 - e^{\sum f_{ij}}$.



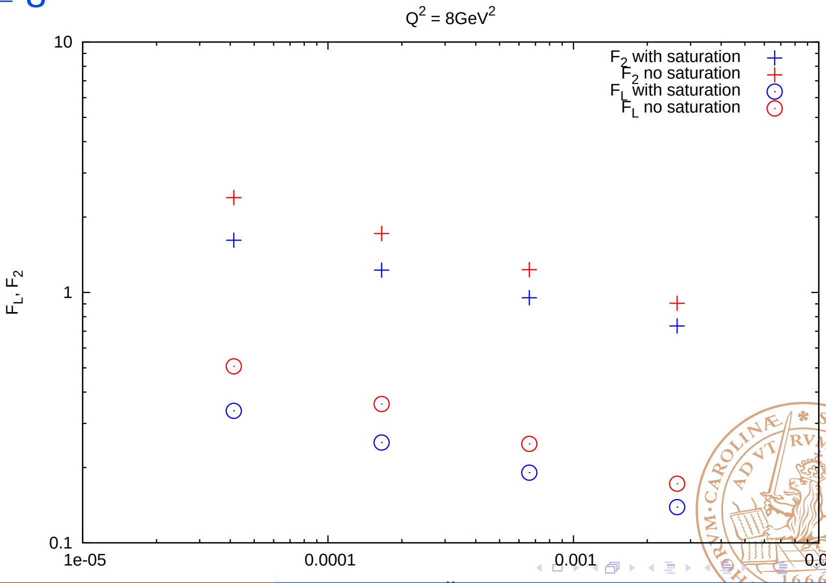
These two cooperate to provide same saturation no matter which frame we collide in.



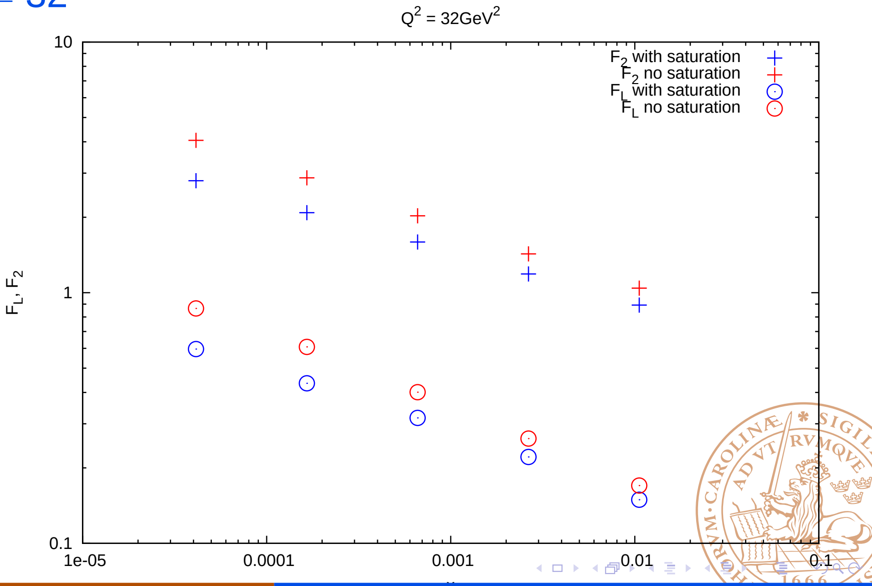
F_2 and F_L saturated?

- Depends mainly on the evolved rapidity, that is x.
  - Proton can evolve around 3 units before saturating.
  - $Q^2 = 14 GeV^2$ photon can evolve around 4.
  - total around 7 units, ie $x = 0.00091$.
- Higher $Q^2 \quad \Rightarrow \quad$ quicker saturation.
- Very gradual transition.

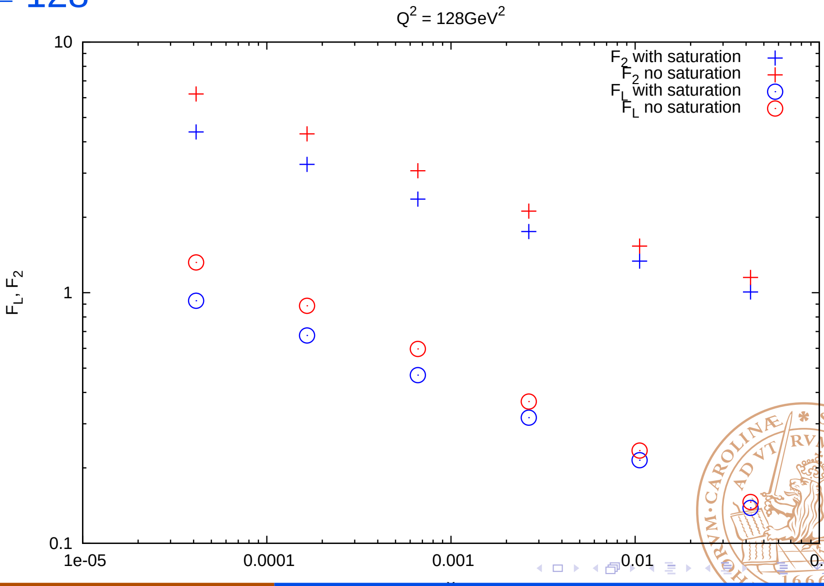
$Q^2 = 8$


Q² = 8GeV²
F₂ with saturation
F₂ no saturation
F_L with saturation
F_L no saturation
F_L, F_2
10
1
0.1
1e-05
0.0001
0.001
0.01

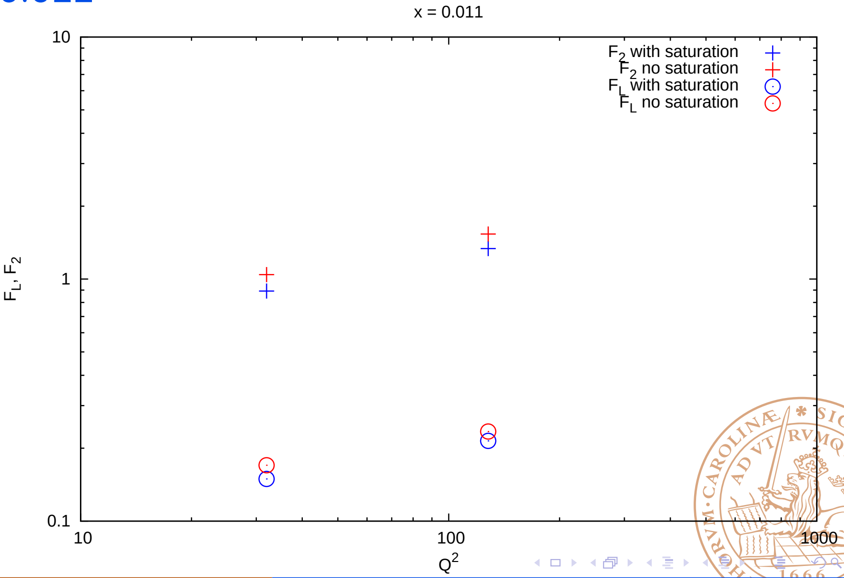
$Q^2 = 32$


Q2 = 32GeV2
10
1
0.1
1e-05
0.0001
0.001
0.01
0.1
x
FL, F2
F2 with saturation
F2 no saturation
FL with saturation
FL no saturation

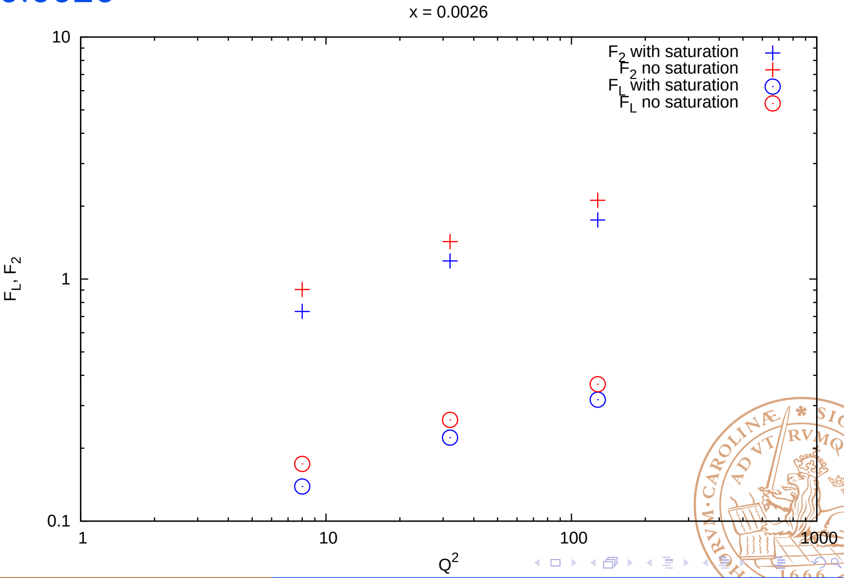
$Q^2 = 128$


Q2 = 128GeV2
F2 with saturation
F2 no saturation
FL with saturation
FL no saturation
FL, F2
10
1
0.1
1e-05
0.0001
0.001
0.01
0.1
x

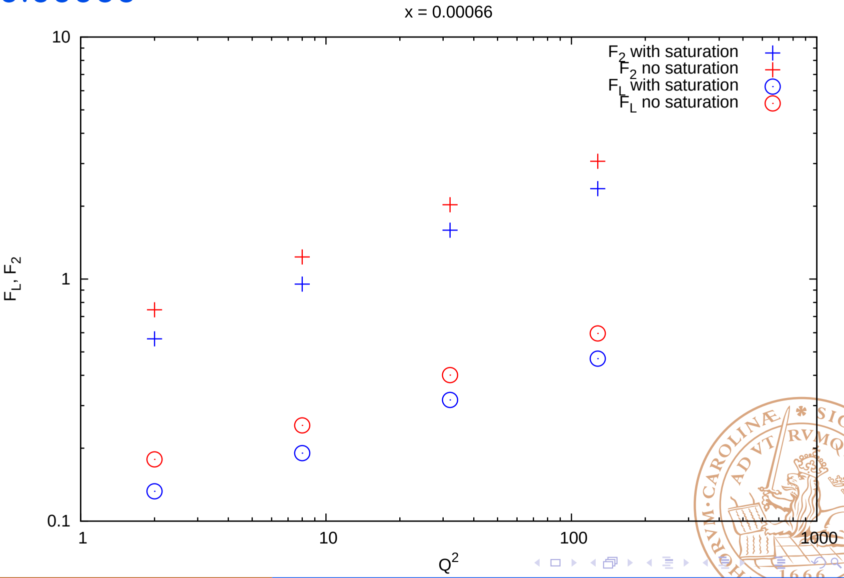
$x = 0.011$


x = 0.011
10
1
0.1
10
100
1000
Q^2
F_L, F_2
F_2 with saturation
F_2 no saturation
F_L with saturation
F_L no saturation

$x = 0.0026$


x = 0.0026
10
1
0.1
1
10
100
1000
Q^2
F_L, F_2
F_2 with saturation
F_2 no saturation
F_L with saturation
F_L no saturation

$x = 0.00066$


x = 0.00066
10
1
0.1
1
10
100
1000
F_L, F_2
Q^2
F_2 with saturation
F_2 no saturation
F_L with saturation
F_L no saturation

Conclusions

- Saturation effects are present also at high Q^2!
- Each incoming particle contribute with a number of saturation free units of rapidity.
- Very gradual transition.
- Differences in saturation energy for F_L and F_T at high Q^2?