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Deeply Inelastic Multiple Scattering

- Introduction
- A first look at DIMS
- Future Plans

München
2002.12.19
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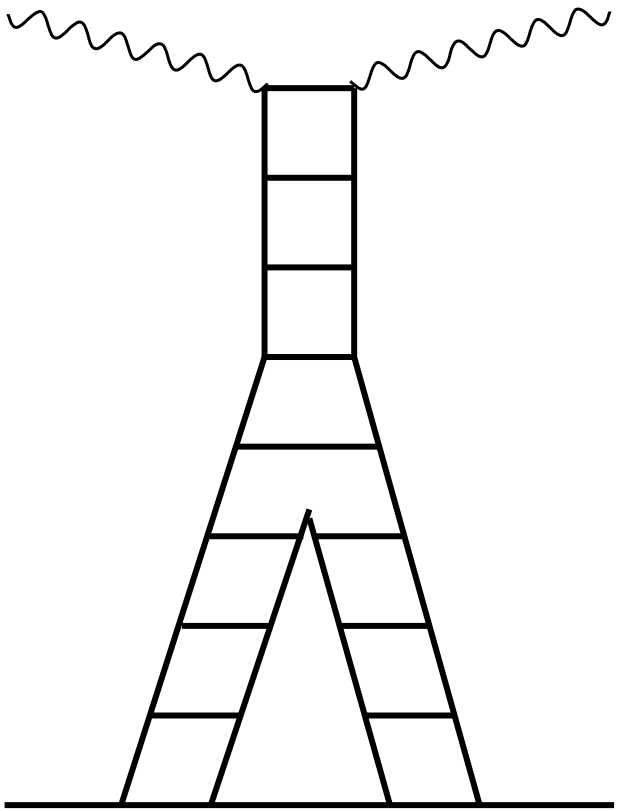
THE Diagram



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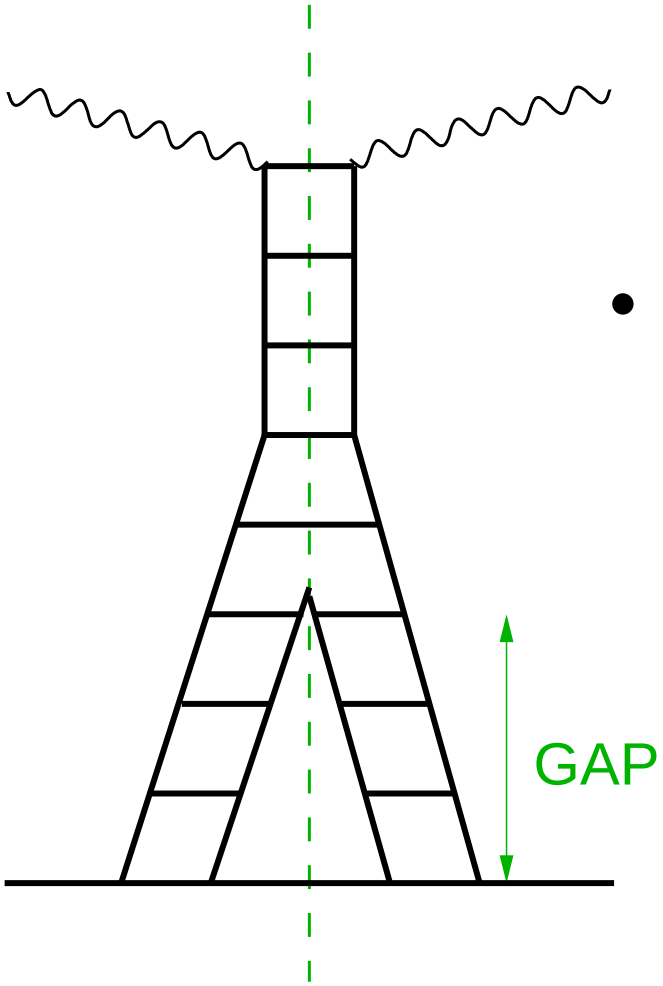
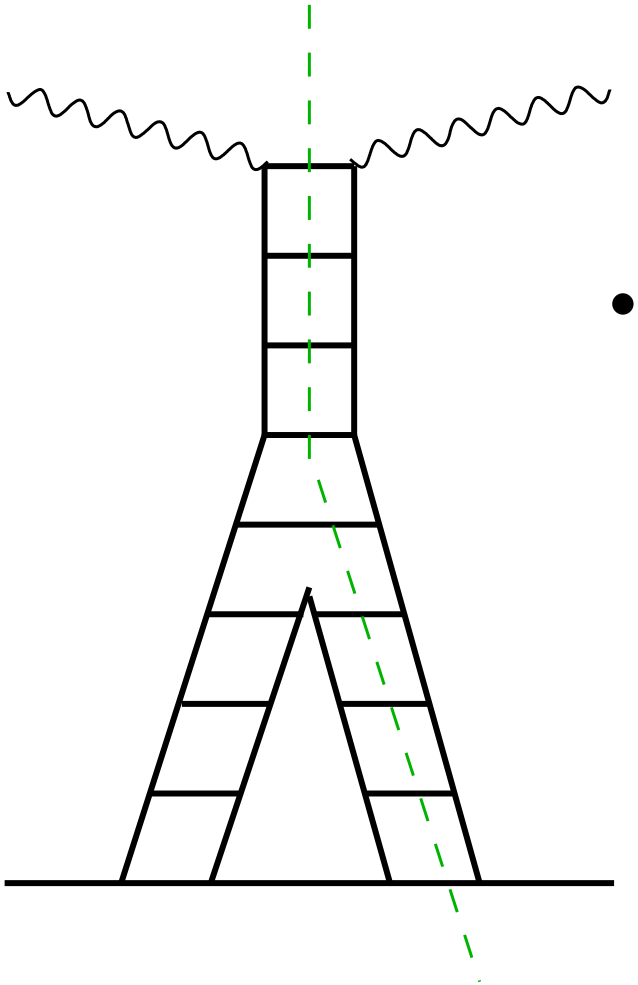


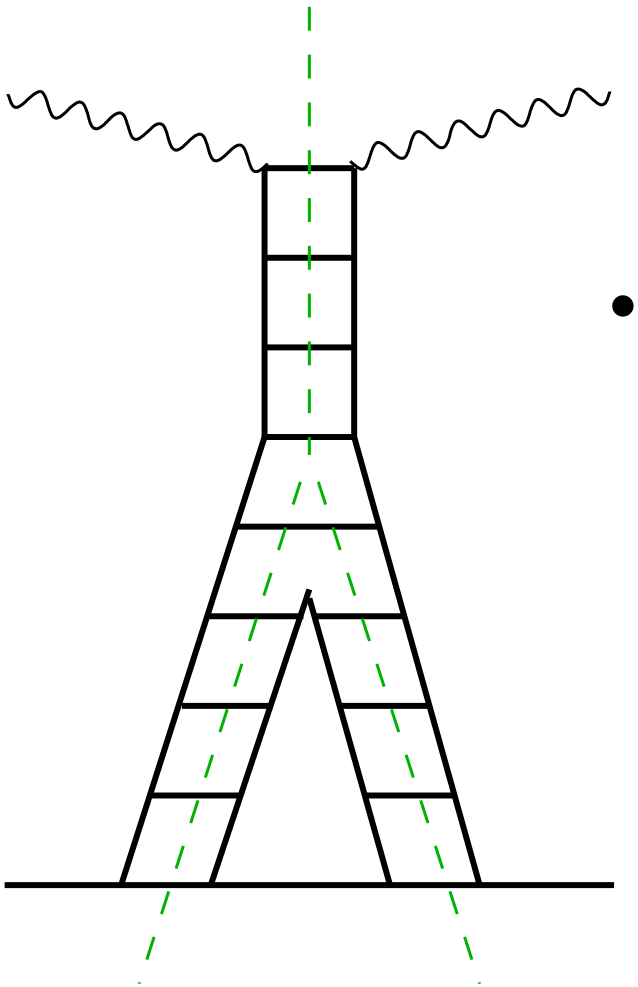
- Gives rapidity gaps

THE Diagram



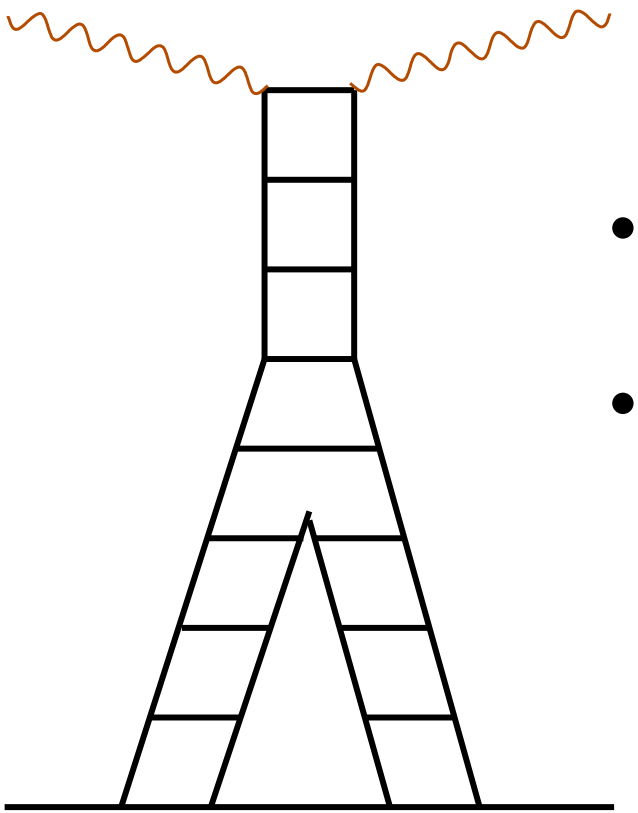
- Gives rapidity gaps & saturation

THE Diagram



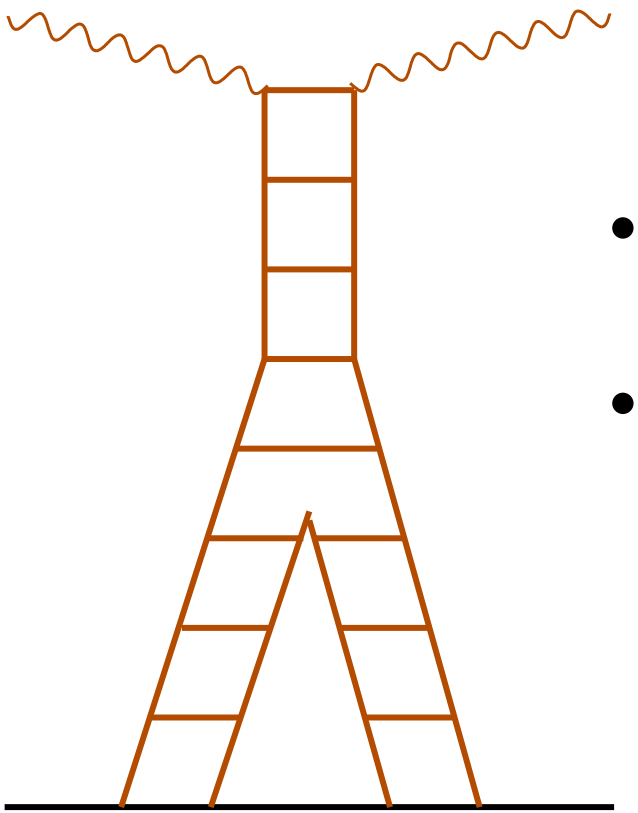
- Gives rapidity gaps & saturation
  & multiple interactions

THE Diagram



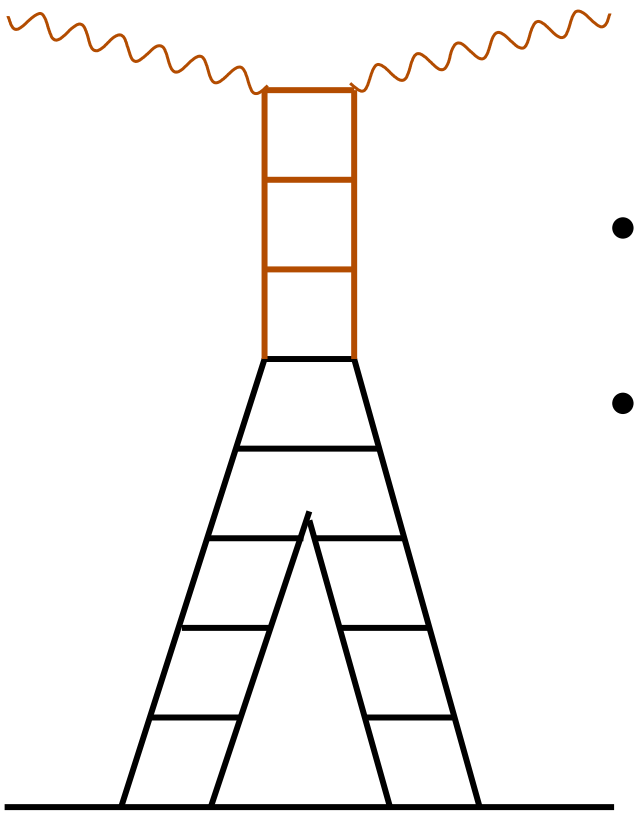
- Gives rapidity gaps & saturation
  & multiple interactions
- Is it soft?

THE Diagram



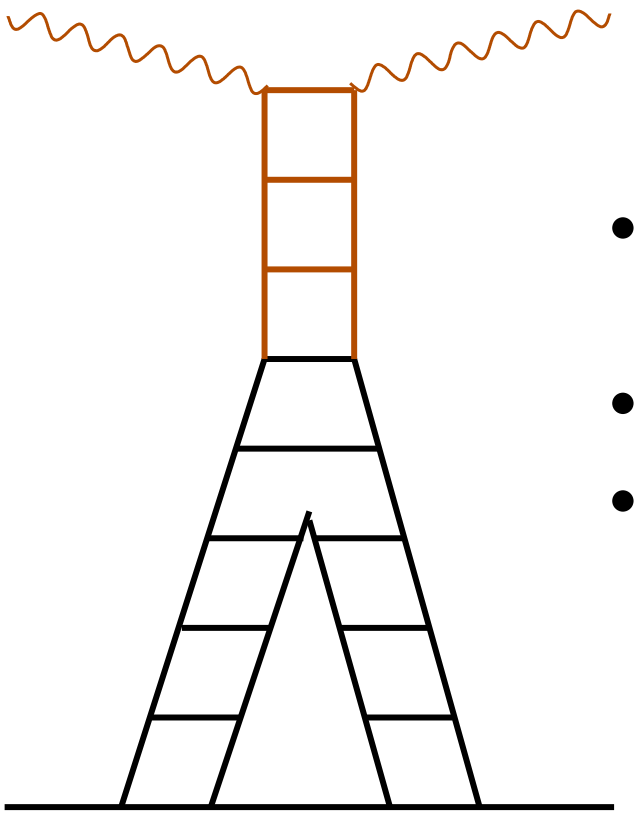
- Gives rapidity gaps & saturation
  & multiple interactions
- Is it soft? Hard?

THE Diagram

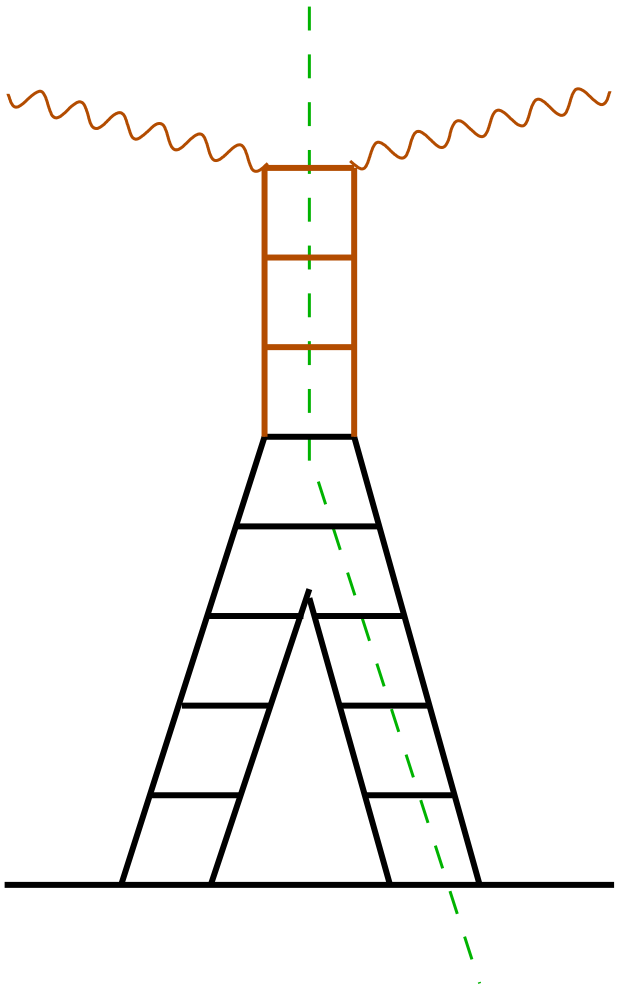


- Gives rapidity gaps & saturation
  & multiple interactions
- Is it soft? Hard? Or Both

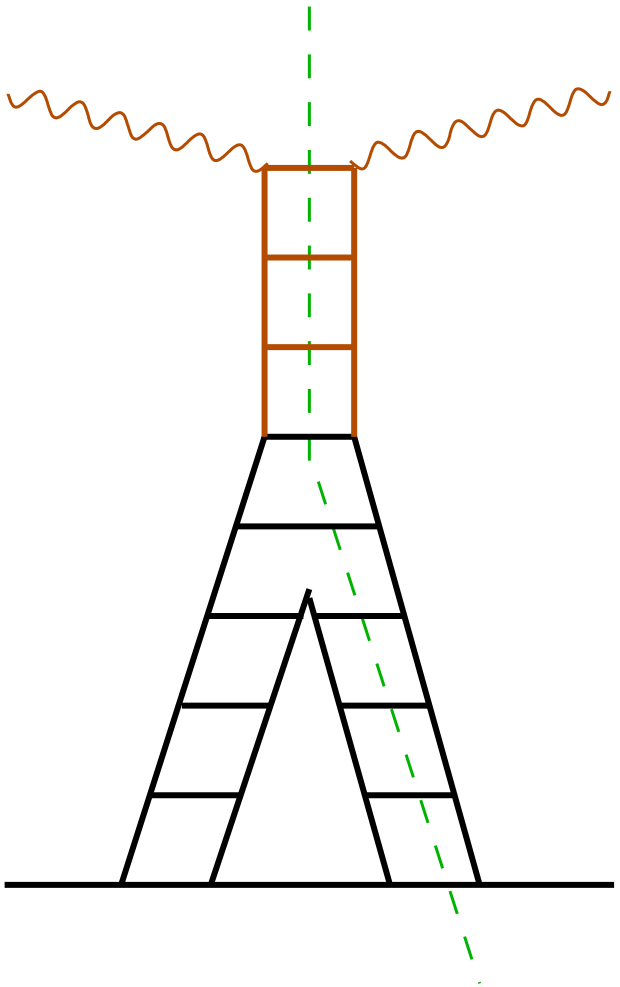
THE Diagram



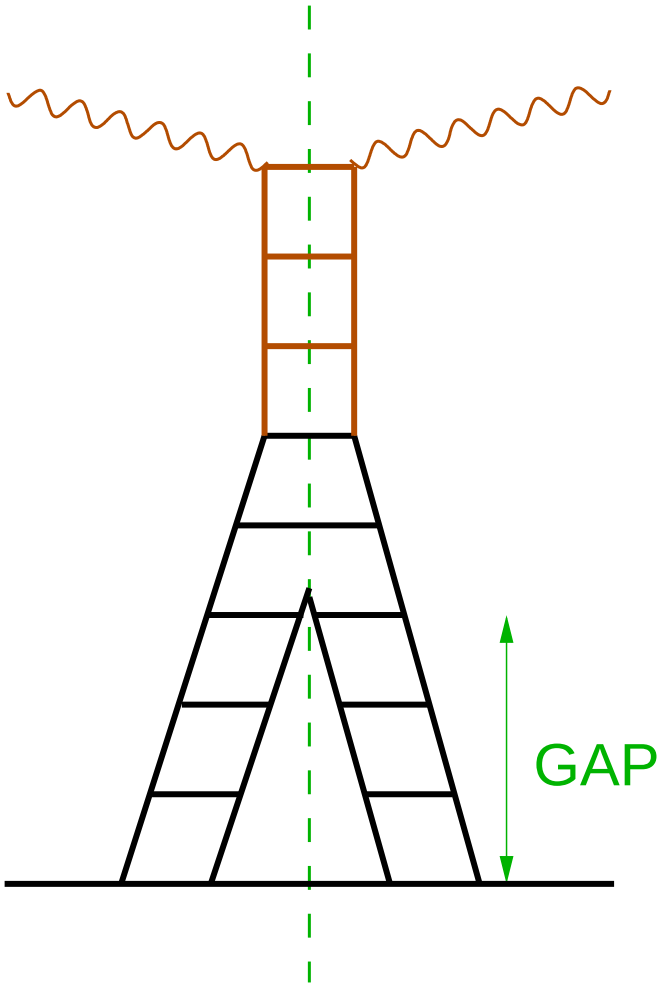
- Gives rapidity gaps[1] & saturation[-4] & multiple interactions[2]
- Is it soft? Hard? Or Both
- AGK cutting rules: 10% diffraction means ≈20% multiple interactions.



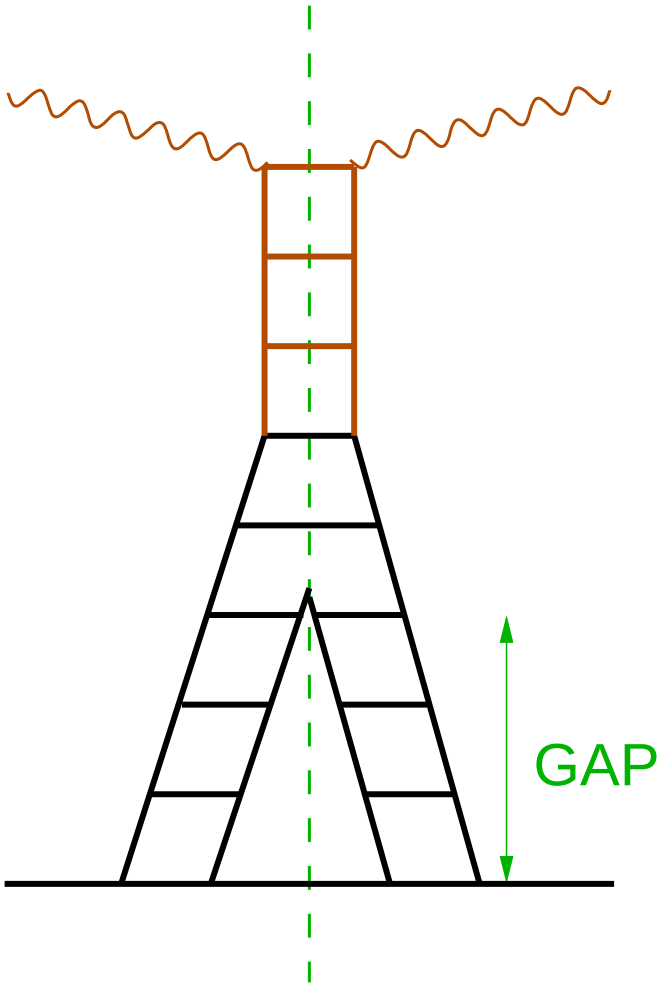
We can study saturation effects. But how do we know we have perturbative saturation. Even if the photon is virtual, the recombination may be soft.



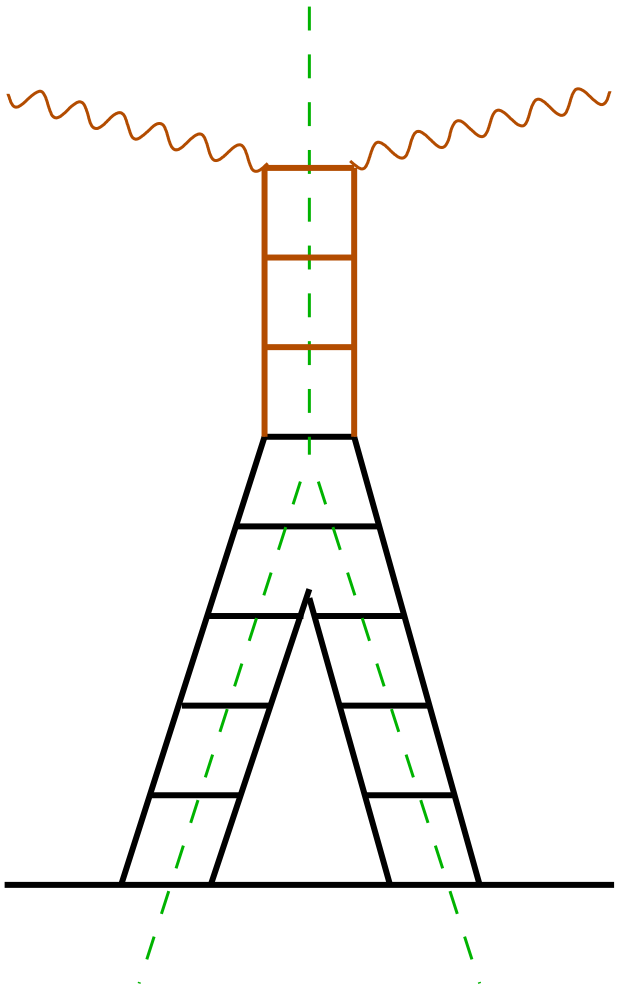
We can study saturation effects. But how do we know we have perturbative saturation. Even if the photon is virtual, the recombination may be soft. Looking for a possible decrease in inclusive cross sections is difficult, mainly due to the unknown non-perturbative input parton densities.



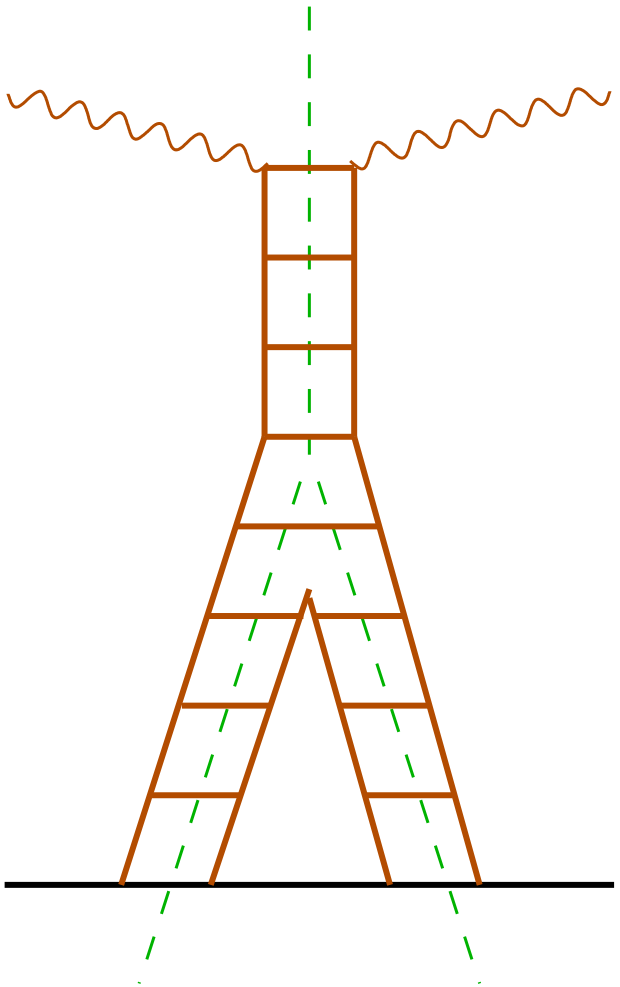
We can study rapidity gaps. But how do we know we study the exchanged pomeron? Even if the photon is virtual, the pomeron may be soft.



We can study rapidity gaps. But how do we know we study the exchanged pomeron? Even if the photon is virtual, the pomeron may be soft.
We can look at the t-dependence. We can study the pomeron remnant



By studying multiple scattering final states we can get a proper handle on how the recombination actually works.



By studying multiple scattering final states we can get a proper handle on how the recombination actually works. We can require a forward jet and look at the jet-pedestal beneath it. This way we make sure that the non-linear effects can, in principle, be calculated in perturbation theory.

Unfortunately, we do not have a reliable model to describe multiple scattering final states.

But we have models.

The PYTHIA multiple interactions model works fairly well for hadronic collisions and for photoproduction. And it can be used for γ^*p.

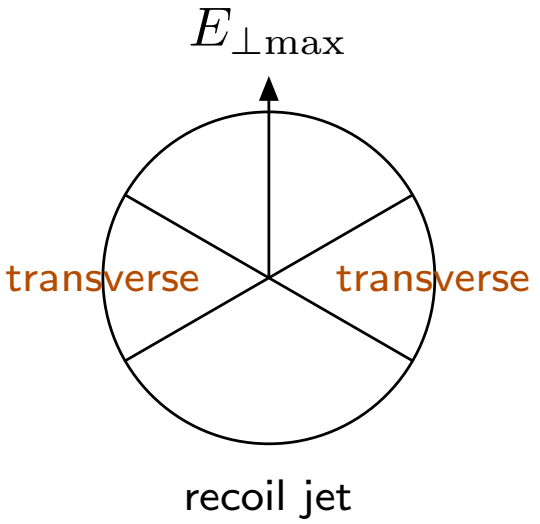
A first look at DIMS

We use PYTHIA in DIS. Not because we think it will describe things in detail, but because it may tell us what kinds of effects to look for.

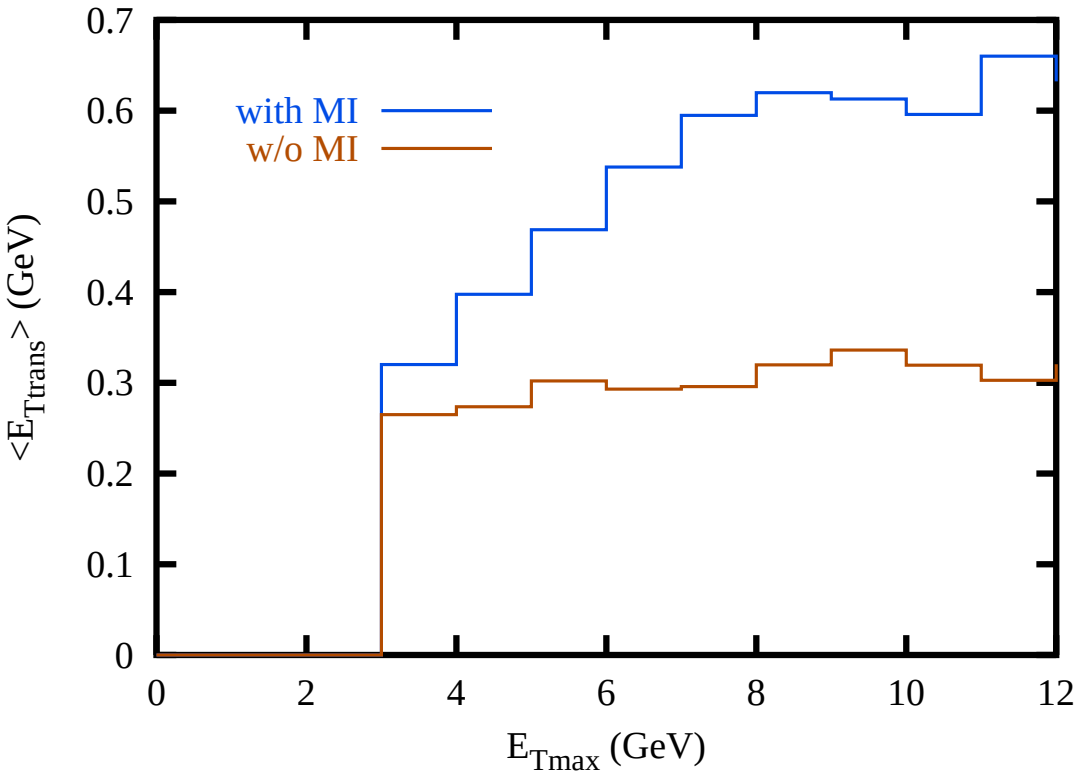
Let PYTHIA generate γ^*p events with $Q^2 = 5$ GeV^2 and $x = 10^{-4}$. Use direct and resolved. F_2 gives the total cross section and we can use it to eikonalize the partonic cross section.

Require a forward jet ($0 < \eta < 2$ in the γ^*p cms).

Look at $E_\perp$ flow in the same rapidity interval, but transverse to the jet. (On the side with the least activity)



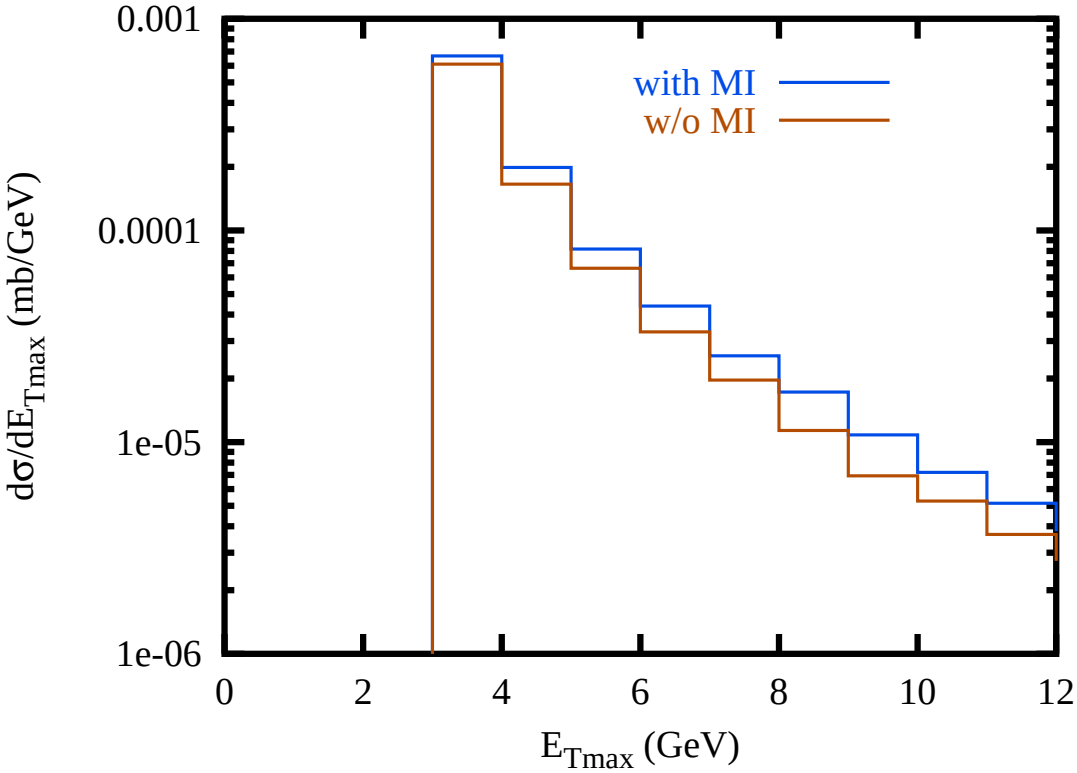
Average $E_\perp$ as a function of $E_{\perp\mathrm{jet}}$.



Typical (potentially large) jet-pedestal effect.

≈ 50 % of the events have an additional scattering.

This may affect the forward jet rates:

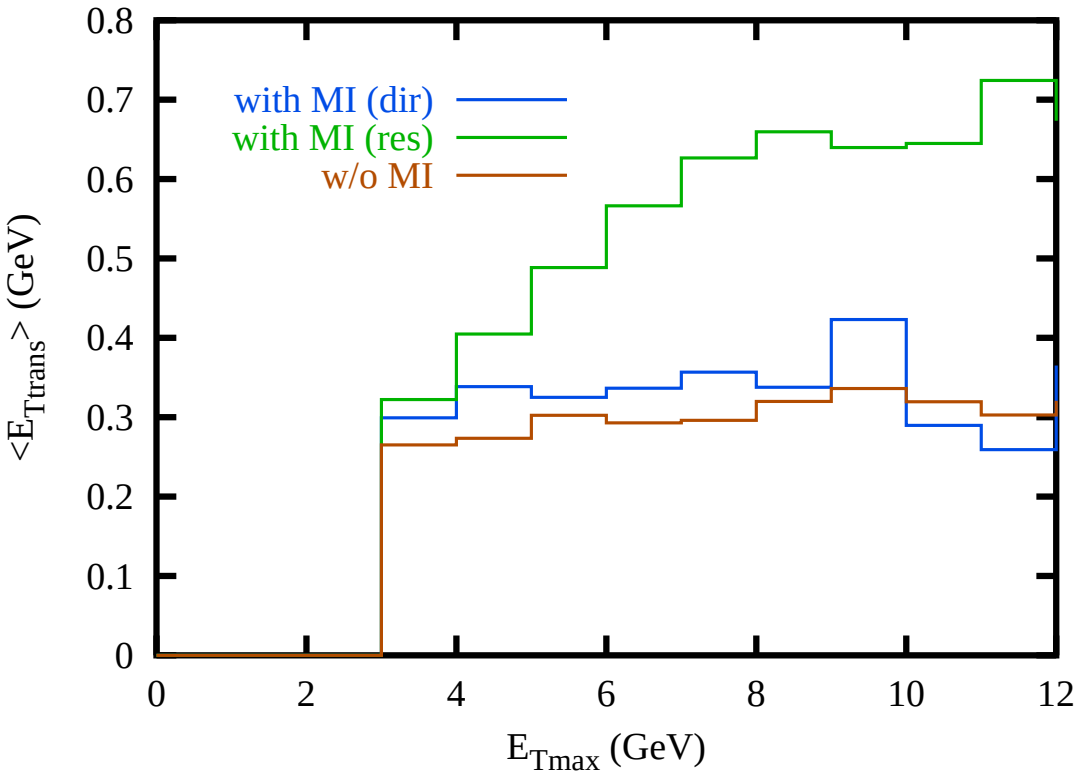


The measurements may need a correction from the *underlying event*.

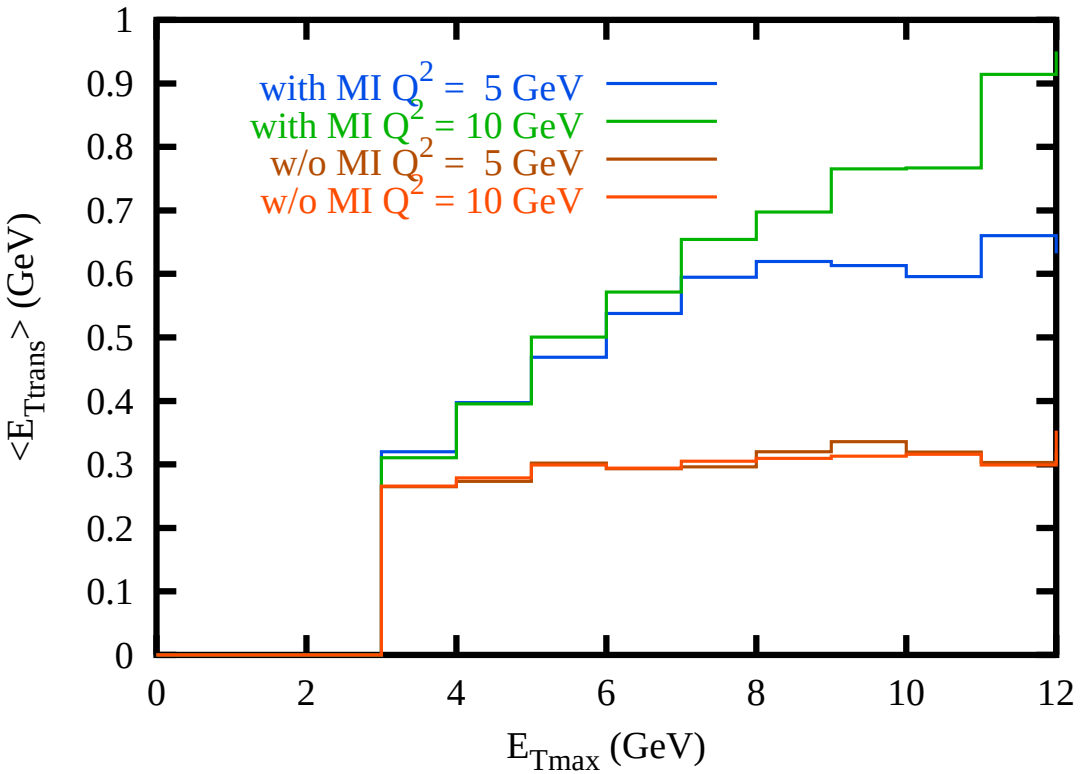
(Up to 30% correction, due to the steeply falling $E_\perp$spectrum.)

Sensitive to the jet algorithm you use.

We can switch on and off multiple scatterings
by separating direct from resolved with an x_γ cut:



Will multiple scatterings go away if we increase Q^2?



Future Plans

- Investigate further possible observable for DIMS:
- Q^2 and W^2 dependence.
- $E_{\perp \mathrm{jet}}$, η_{jet} dependence.
- η dependence.