Multiple Interactions and Diffractive Final States: Reconnection

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(based upon discussions with M.G.Ryskin and G.Gustafson)

Motivation

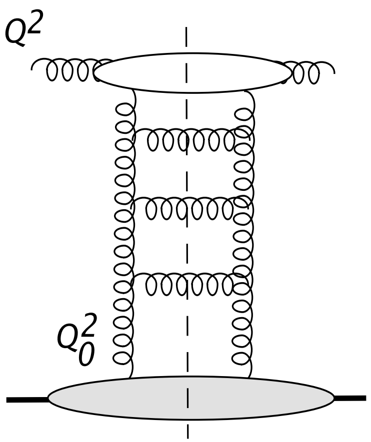
Most diffractive phenomena in pp-scattering are close to - or even dominated by - nonperturbative strong interactions:

- 'soft Pomern physics'
- exclusive states (double diffractive Higgs, jets): survival probability
- semi-inclusive (diffractive parton densities, hard color singlet exchange): survival probability

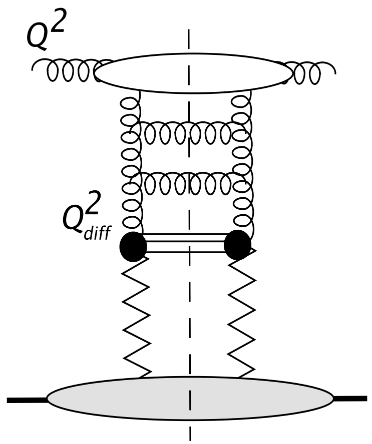
Aim of this talk: approach rapidity gap physics on the partonic level:
structure of events.

Basic idea: one needs two gluon exchange in color singlet state $\longrightarrow$ multiple interactions.

The HERA situation:



sigma_tot
DGLAP/BFKL evolution (Monte Carlo)



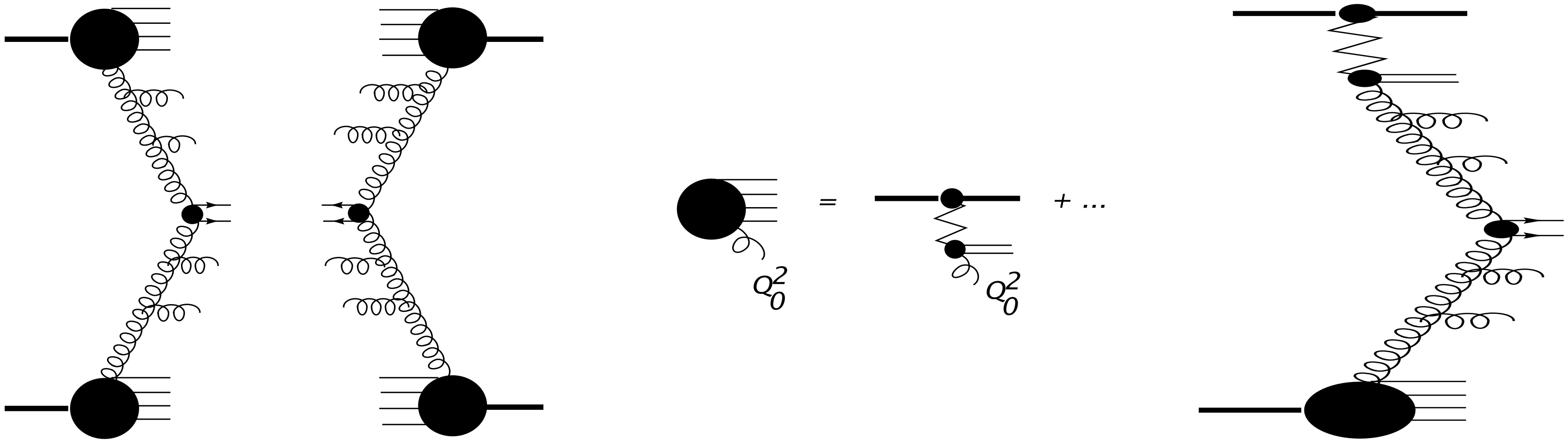
sigma_diff
diffractive parton densitites (RapGap)

(notation: gluon ladder = DGLAP/evolution; rung denotes splitting function).

Two (almost) separate desriptions. Immediate questions:
1) Counting: how much diffraction is contained in the low-Q^2 part of DGLAP?
2) is it possible to find a unified description which contains both:
non-diffractive and diffractive (=rapidity gap) final states?

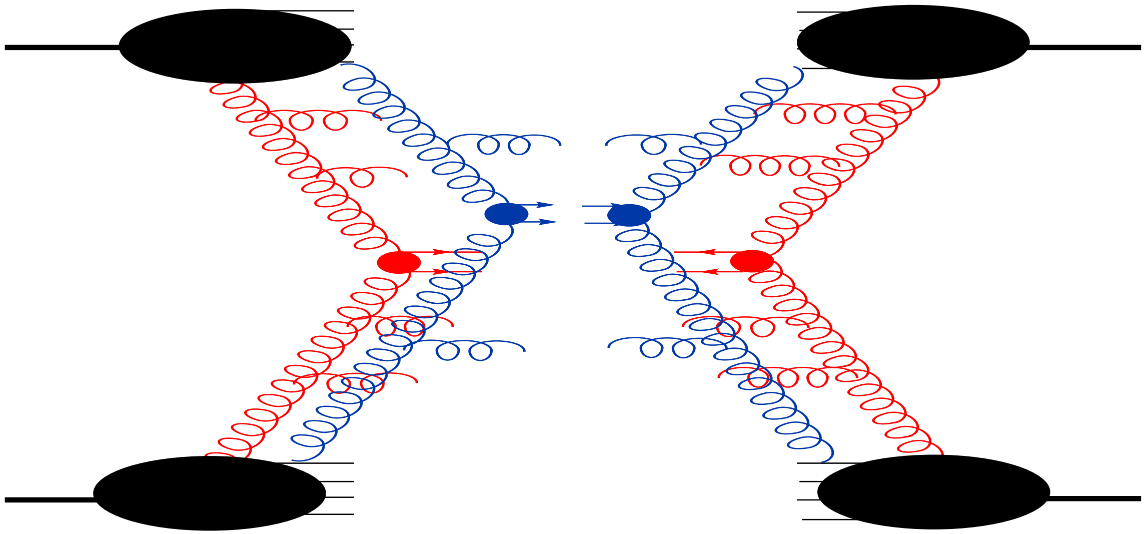
Reconnection

Single chain in pp: rapidity gaps (diffractive final states) are contained only in the initial conditions to DGLAP evolution:



No large rapidity gap between successive emissions:
$\longrightarrow$ included are diffractive final states only up to scale Q_0^2,
but not as a visible part of the final state.

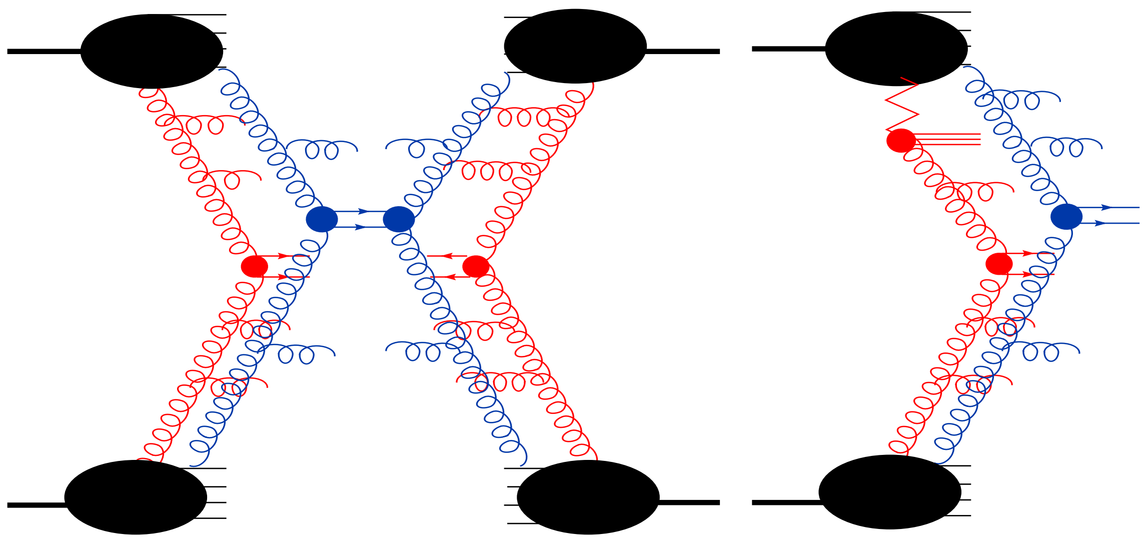
The same in two-chain events:



By construction: each chain is 'normal chain'

- no large rapidity gap between successive emissions
- rapidity gaps only in initial conditions, below scale Q_0^2.
- zero momentum transfer
- color singlet

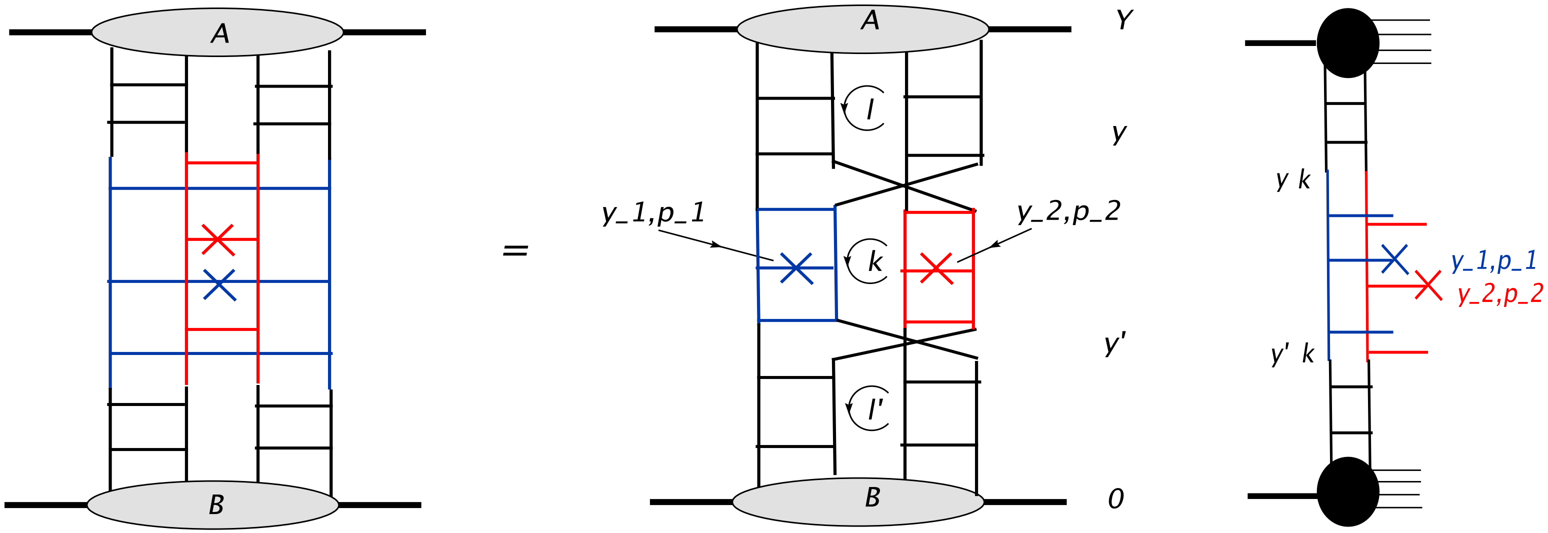
This includes:



Second chain could fill the rapidity gap:
but need to include rapidity gap in the first chain!

In the follwoing:
a first step towards including rapidity gaps on the partonic level 'reconnection'.

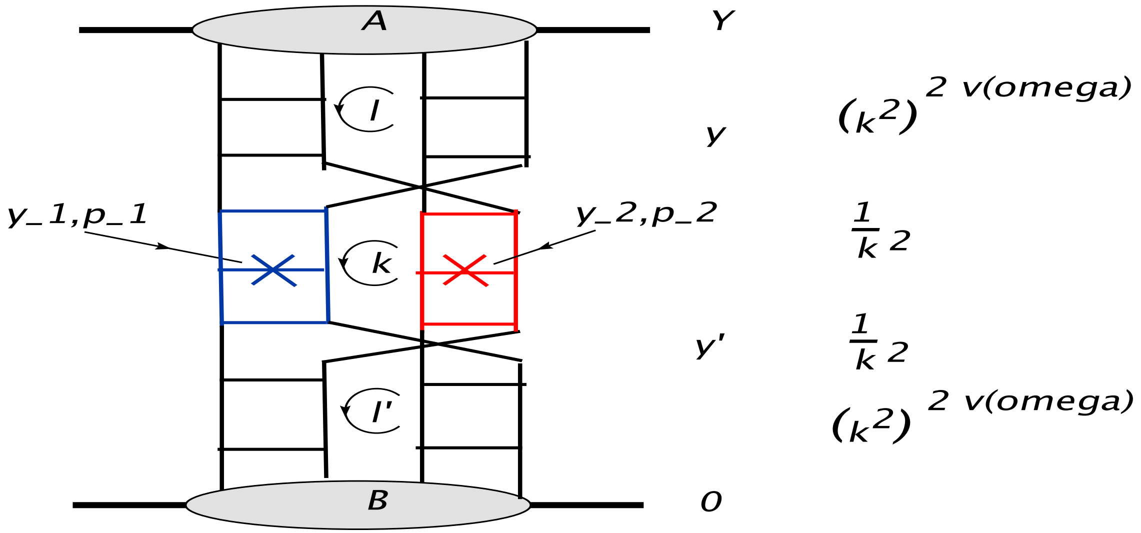
Rapidity gaps on the partonic level need two gluon state in color singlet.
Minimal mechanism: 'reconnection',



Characteristic features:

- three additional loop momenta
- evolution paths

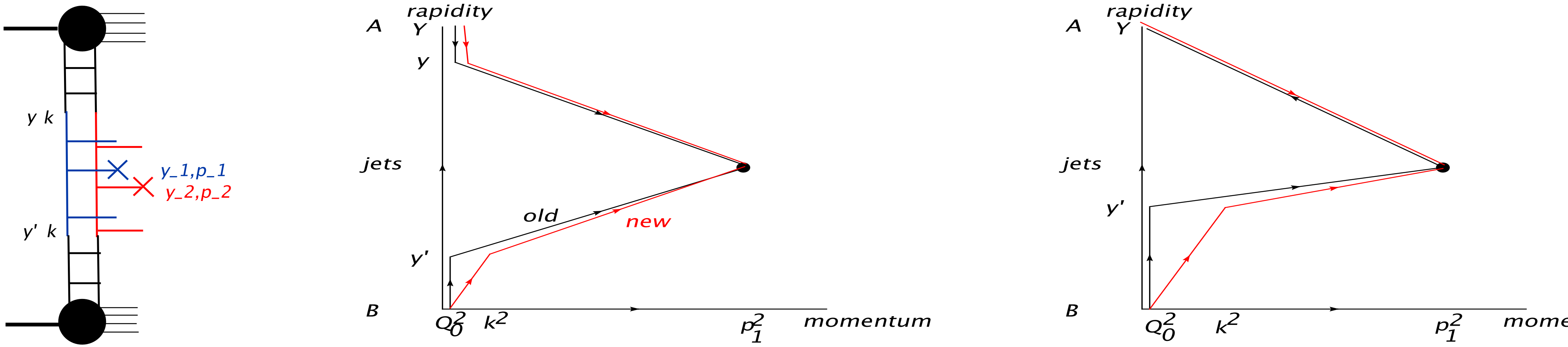
On the role of the k-integral:



Under normal conditions:
small k^2 dominates $\longrightarrow$ diffraction inside the proton (inside initial conditions)

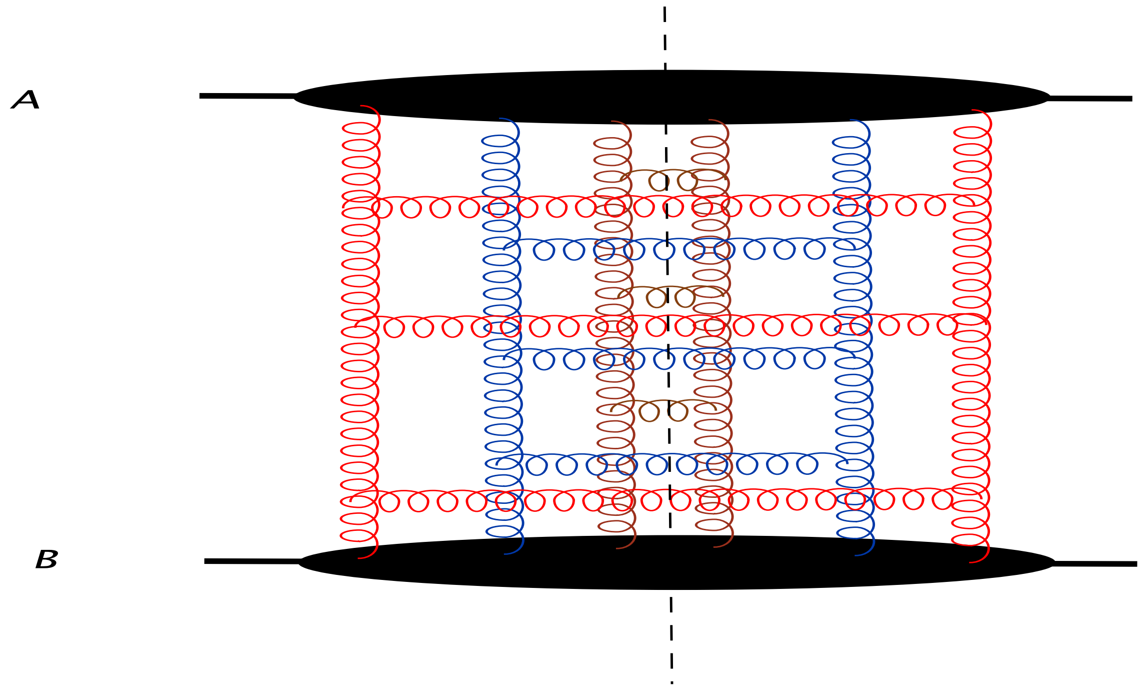
for large $Y - y$, y':
larger values k^2 become important (semihard diffraction).

Paths of evolution in rapidity and momentum scale:



For intermediate y, y: momentum scale k small, back to soft diffraction.
For y close to y_1, y_2: scale k^2 moves up, allows for harder diffraction.

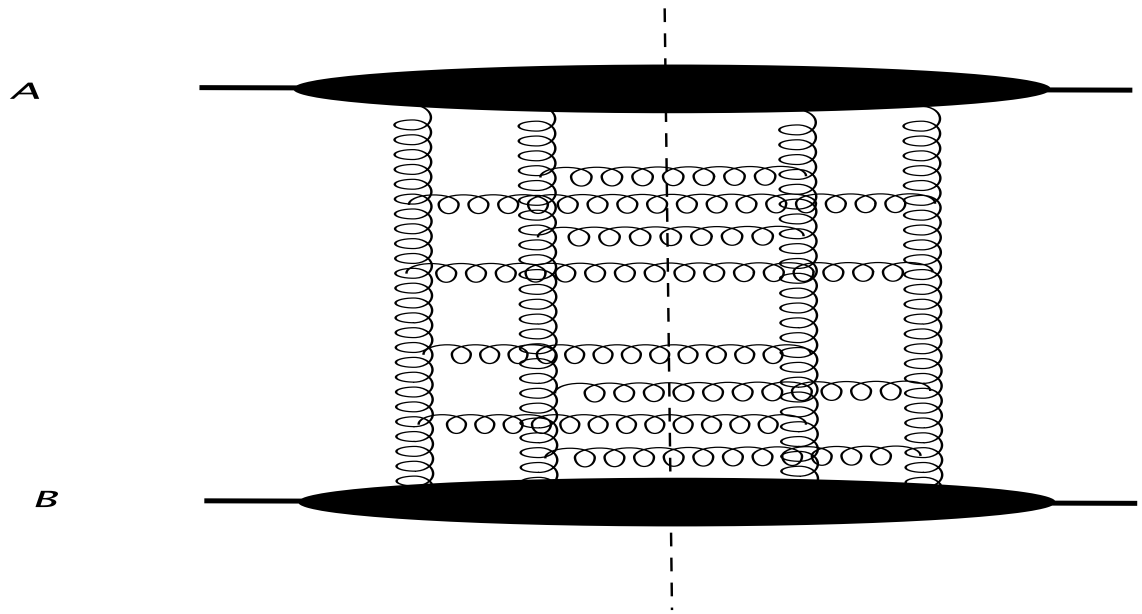
More chains:



Combinatorics: number of possibilities of reconnections $= \frac{3\times 2}{2} = 3$,
competes with colour suppression: $1/(N_c^2 - 1)$ per switch.

Order of magnitude estimate: factor $\frac{1}{8}$, $\frac{3}{8}$, $\frac{3}{4}$, $\frac{5}{4}$ for $n = 2, 3, 4, 5$.

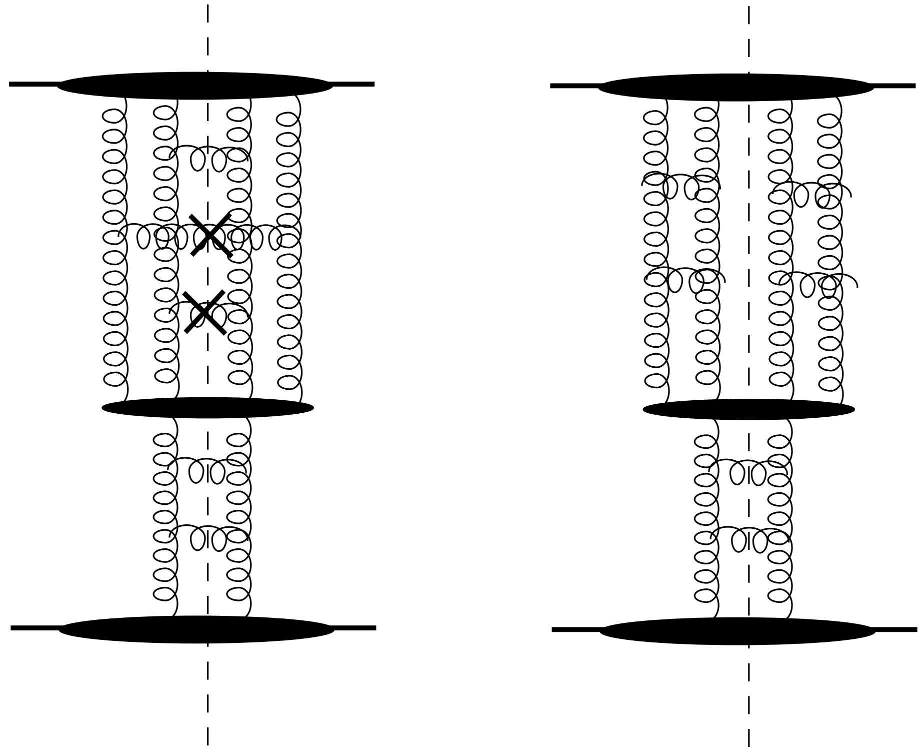
Other reconnections:



Reconnection without rapidity gaps: double density $\longrightarrow$ double density.
Characteristic counting of ratio: diffractive:nondiffractive (modified AGK: JB, Ryskin).

t-channel iterations of reconnections.
Reconnection changes final state hadronization (multiplicities vs E_T).

More radical: Triple pomeron vertex



Combines diffractive and nondiffractive events: AGK counting

Conclusions

'Reconnection' could be a first step towards including rapidity gaps on the partonic level.
Correct description of data might require more sophisticated structure.

It is consistent with existing models of multiple interactions (which have rapidity gaps only inside the low-momentum part of the evolution), but it enlarges the possibilities (allows for semihard diffraction).
Evolution kernels are known in NLO.
Reconnection cannot be neglected multichain configurations.

To be done:

- numerical estimate
- Final states: color reconnection
- multiple reconnections
- consistency with initial and final state interactions: AGK rules.