Introduction WG4

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MPI and low x and diffraction (theory talks)

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MPI & low x — why care?

- multi-parton interactions become usually important in the intermediate and low x region (phase space)

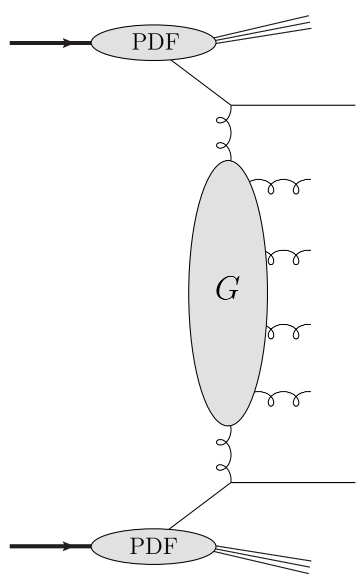
- in this region: standard fixed order DGLAP description (may) lose its validity.

  Reason: $\alpha_S \ln(1/x) \sim 1$ → need to be resumed to all orders

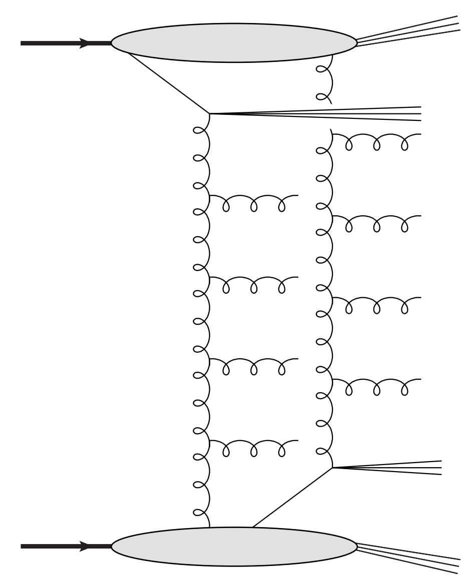
- within QCD perturbation theory, this is achieved by the BFKL equation

- can affect the MPI analysis

example: forward-backward diets (Mueller-Navelet jets)



vs.



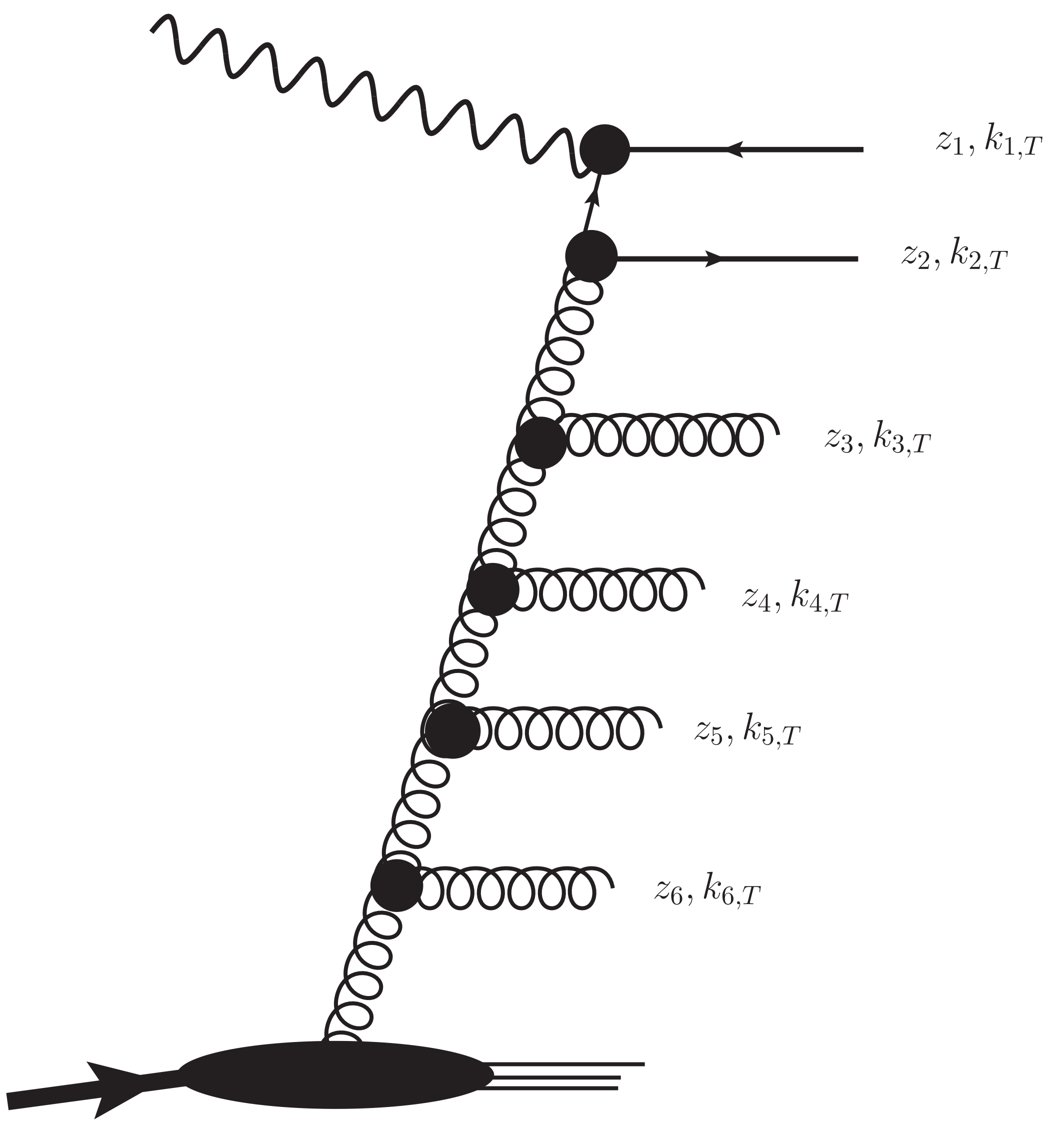
picture taken from 1602.01882

- for long time one of the standard processes to search for BFKL effects at the LHC → signal: decorrelation in azimuthal angle with increasing rapidity
  [Duclou, Szymanowski, Wallon; 1309.3229], [Celiberto, Ivanov, Murdaca, Papa; 1504.08233], …

- MPIs can/could give such a decorrelation!

- recent BFKL studies: extend this to 3 and 4 jets
  [Caporale, Chachamis, Murdaca, Sabio Vera; 1508.07711], [Caporale, Chachamis, Gordo Gomez, Murdaca, Sabio Vera; 1606.00574]

low x → high energy factorisation → k_T factorization



- high energy factorisation & BFKL evolution provide cross-section in the low x region as convolution of
  a) kT (TMD) dependent coefficients
  b) kT (TMD) dependent parton distribution functions

- main advantage: treat kinematics with higher accuracy ("approximate NLO"),

- can/could affect size MPI contributions

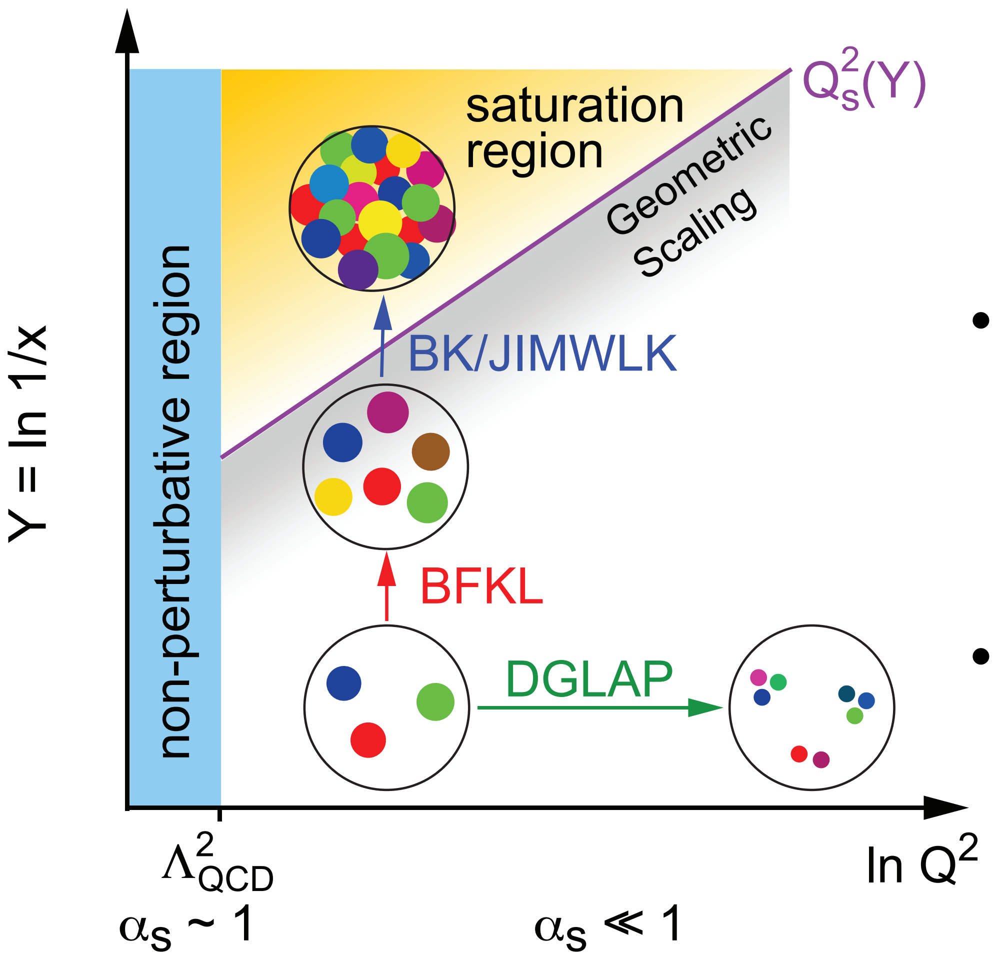
Double parton scattering in 4-jet production
(Mirko Serino, Cracow)

- 4 jet production within high energy factorisation (=off-shell initial partons)
- study combination of single and double parton contributions
- Question: how to maximize the double-parton scattering (DPS) contribution in four-jet production by selecting kinematical cuts?

Automated calculations for MPI
(Andreas van Hameren, Cracow)

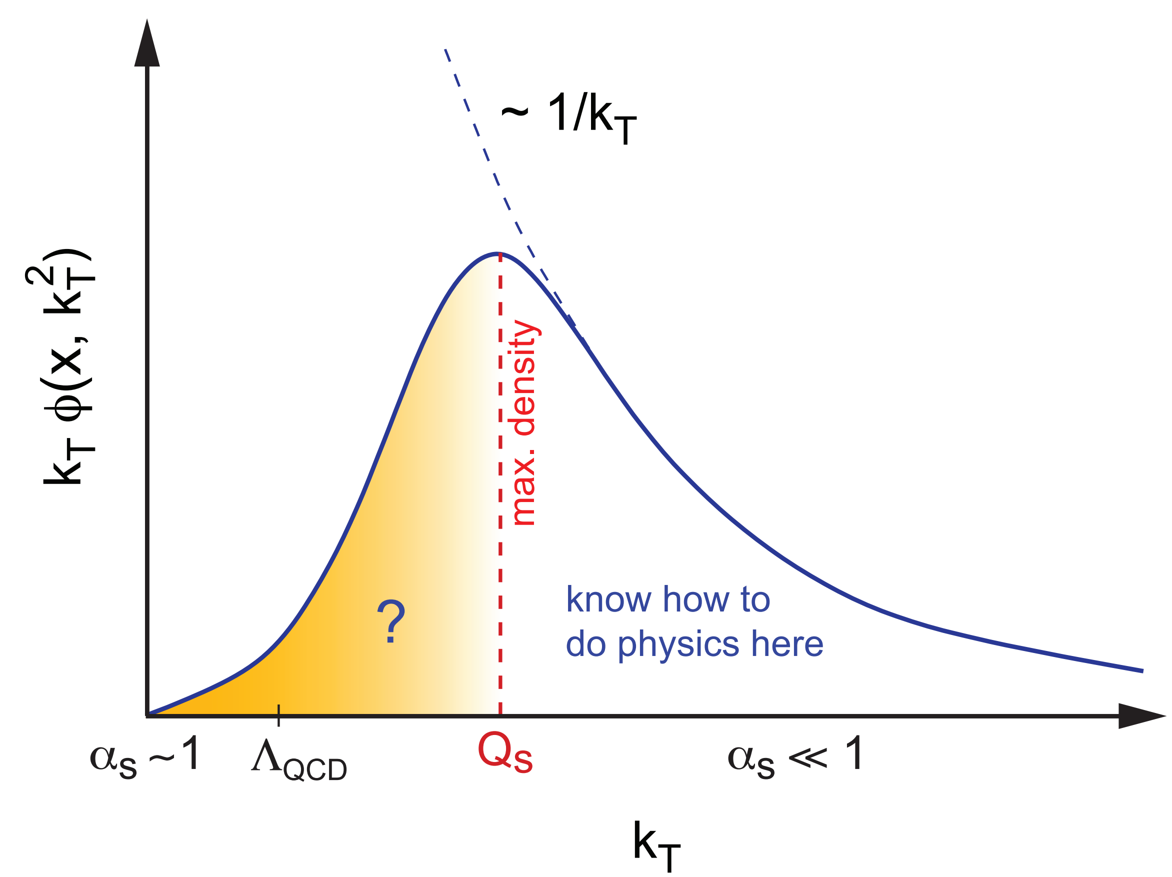
- Monte-Carlo code for automatic calculations of hard single- and multi parton scattering processes
- both kT factorisation and collinear factorisation, all tree-level matrix elements for SM processes

At some (very small) x: saturation effects



- HERA data, BFKL: power like rise of the gluon distribution $\sim x^{-\lambda}$,
  unitarity: most slow down & stop at some value of x

- mechanism: high density effects; system characterised by correlation length/saturation scale



- saturation scale acts as an effective cut-off of k_T-dependence at small k_T

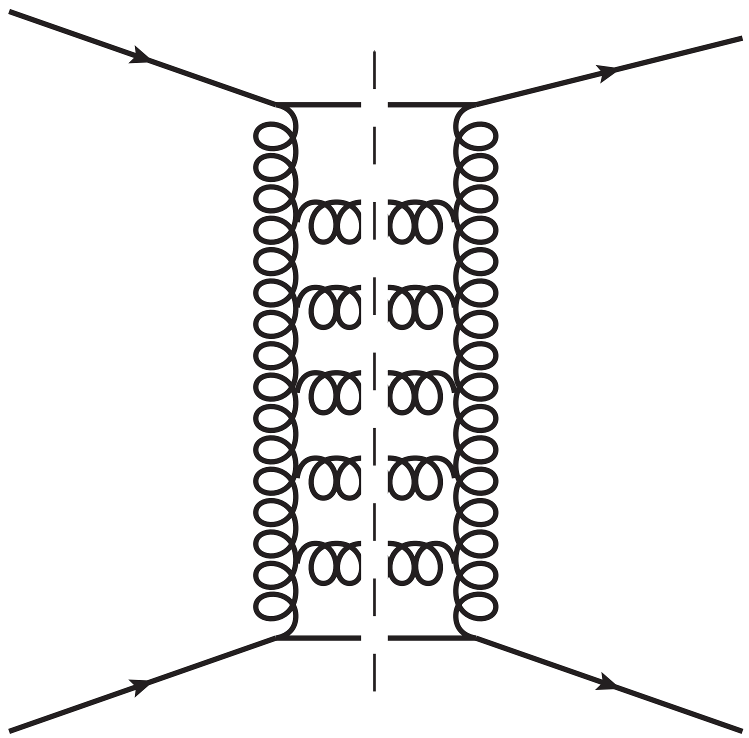
Exploring minijets beyond leading power
(Piotr Kotko, Penn State)

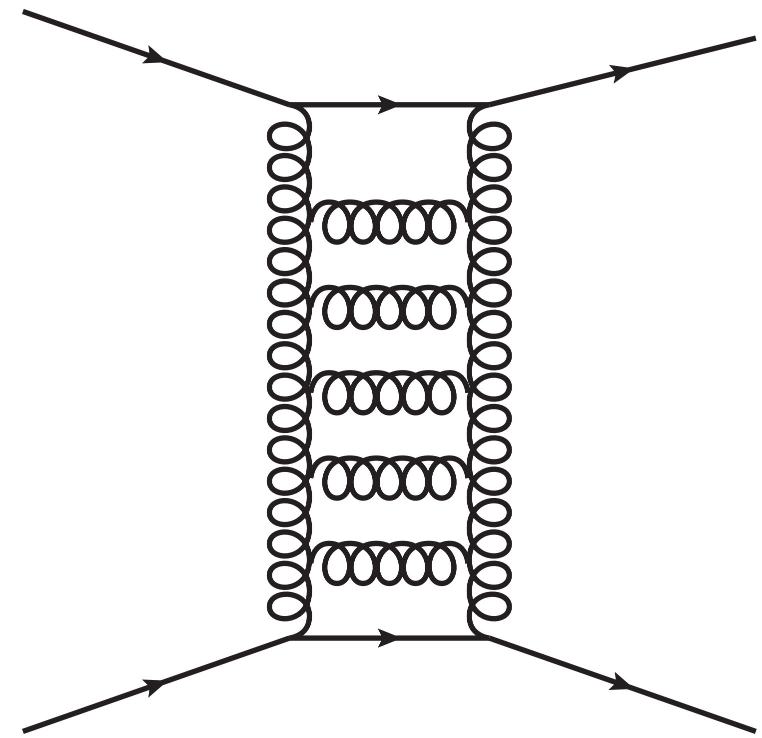
- MPI models in Monte-Carlos rely on mini-jet Xsec, derived from collinear factorization

$$\frac{d\sigma_{2\mathrm{jet}}}{dp_T^2} \sim \frac{\alpha_s^2\left(p_T^2\right)}{p_T^4} .$$

- differential Xsec. divergent for small p_T
- introduce energy dependent cut-off $p_T > p_{T,min}(s)$
- Two questions investigated within high energy factorisation →off-shell initial patrons!
  i) cut-off provided by initial off-shell gluons?
  ii) minijet suppression away from the small p_T region?

MPI & low x diffraction





'cut' Pomeron: high multiplicity events (total Xsec.)

$$\sigma_{\text{tot}} = \frac{1}{s}\Im\text{m}\mathcal{A}(s, t=0)$$

'uncut' Pomeron: elastic/diffractive scattering (amplitude level)

$$\mathcal{A}(s,t)$$

at cross-section level: multi-parton scattering (if resolved)

Hard diffractive processes in the kT- factorisation approach (Marta Luszczak, Rzeszow)

- diffractive production of open charm, bottom mesons and diets at the LHC
- Pomeron: Ingelmass-Schlein model + absorptive corrections
- parton distributions: kT-factorization (from collinear pdfs using KMR description)