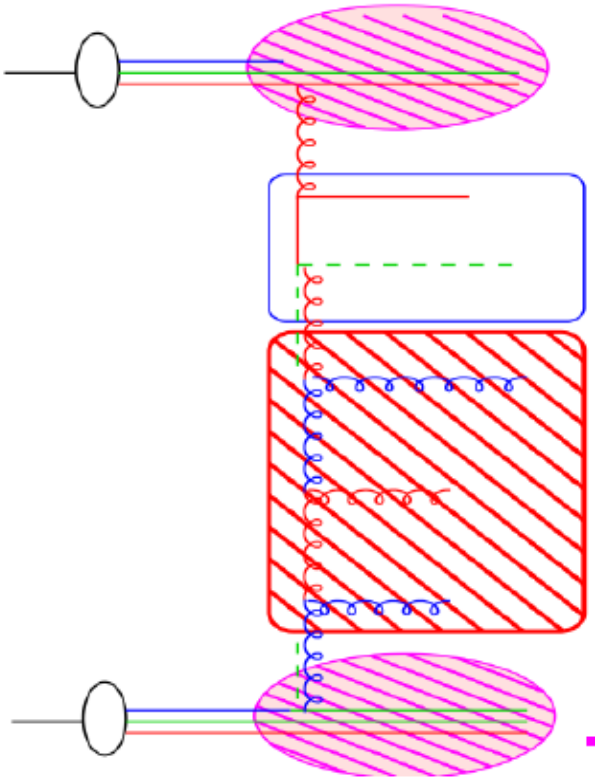
Cascade exercise

Terascale Monte Carlo School 2008
DESY-HH

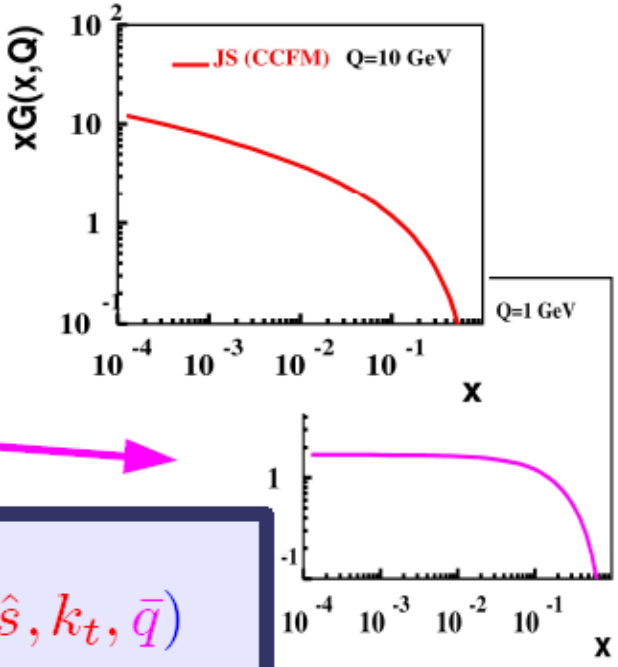
Cascade – basic idea



matrix element

evolution of parton cascade:

$$\tilde{P} = \bar{\alpha}_s \left(\frac{1}{1-z} + \frac{1}{z} + ... \right)$$



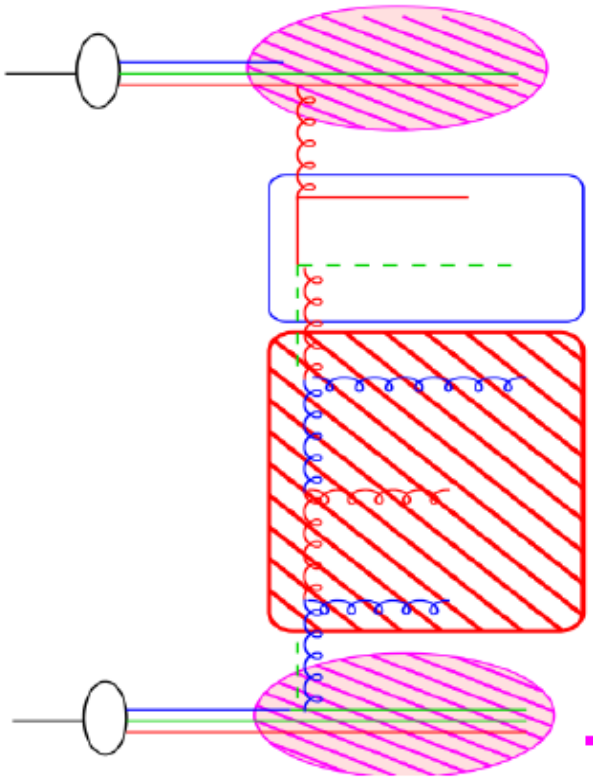
initial distribution ~ flat

$$\sigma(pp \to q\bar{q} + X) = \int \frac{dx_{g1}}{x_{g1}} \frac{dx_{g2}}{x_{g2}} \int d^2k_{t1} d^2k_{t2} \hat{\sigma}(\hat{s}, k_t, \bar{q}) \times x_{g1}\mathcal{A}(x_{g1}, k_{t1}, \bar{q}) x_{g2}\mathcal{A}(x_{g2}, k_{t2}, \bar{q})$$

$$\int d^2k_t x_g \mathcal{A}(x_g, k_t, \bar{q}) = x_g G(x_g, Q^2) \text{ if } \hat{\sigma} = \hat{\sigma}(\hat{s}, 0, \bar{q})$$

Catani Ciafaloni Fiorani Marchesini evolution

CASCADE: H.Jung and G.P.Salam, Eur.Phys.J. **C19** (2001) 351



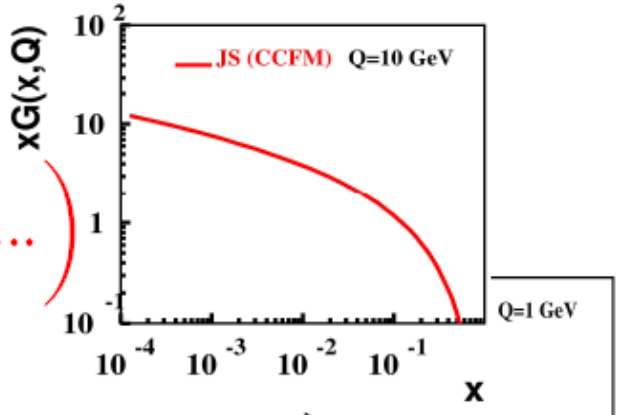
matrix element
off shell

CCFM (all loops)

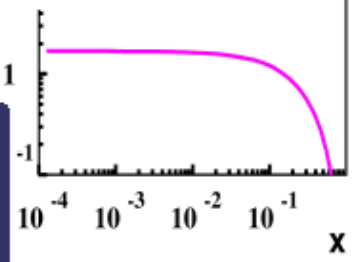
- angular ordering
- non - Sudakov Δ_{ns}

evolution of parton
cascade:

$$\tilde{P} = \bar{\alpha}_s \left(\frac{1}{1-z} + \frac{1}{z}\Delta_{ns} + ... \right)$$



initial distribution
~ flat



$$\sigma(pp \to q\bar{q} + X) = \int \frac{dx_{g1}}{x_{g1}} \frac{dx_{g2}}{x_{g2}} \int d^2k_{t1} d^2k_{t2} \hat{\sigma}(\hat{s}, k_t, \bar{q}) \times x_{g1}\mathcal{A}(x_{g1}, k_{t1}, \bar{q}) x_{g2}\mathcal{A}(x_{g2}, k_{t2}, \bar{q})$$

$$\int d^2k_t x_g \mathcal{A}(x_g, k_t, \bar{q}) \simeq x_g G(x_g, Q^2)$$

Using Cascade

- Setup Cascade and HepMC enviroment
- Edit the steering file according to our needs
- Parameter:

```
* ++++++++++++++++ Hard subprocess selection ++++++++++++++++++
*
    'IPRO'     1       0        11      ! (D=1)
*                                 !  2: J/psi g
*                                 ! 10: Light quarks
*                                 ! 11: Heavy quarks
*                                 ! 102: g g -> Higgs
*
    'IHFL'     1       0        6      ! (D=4) produced flavour for IPRO=11
*                                 ! 4: charm
*                                 ! 5: bottom
*
```

Using Cascade

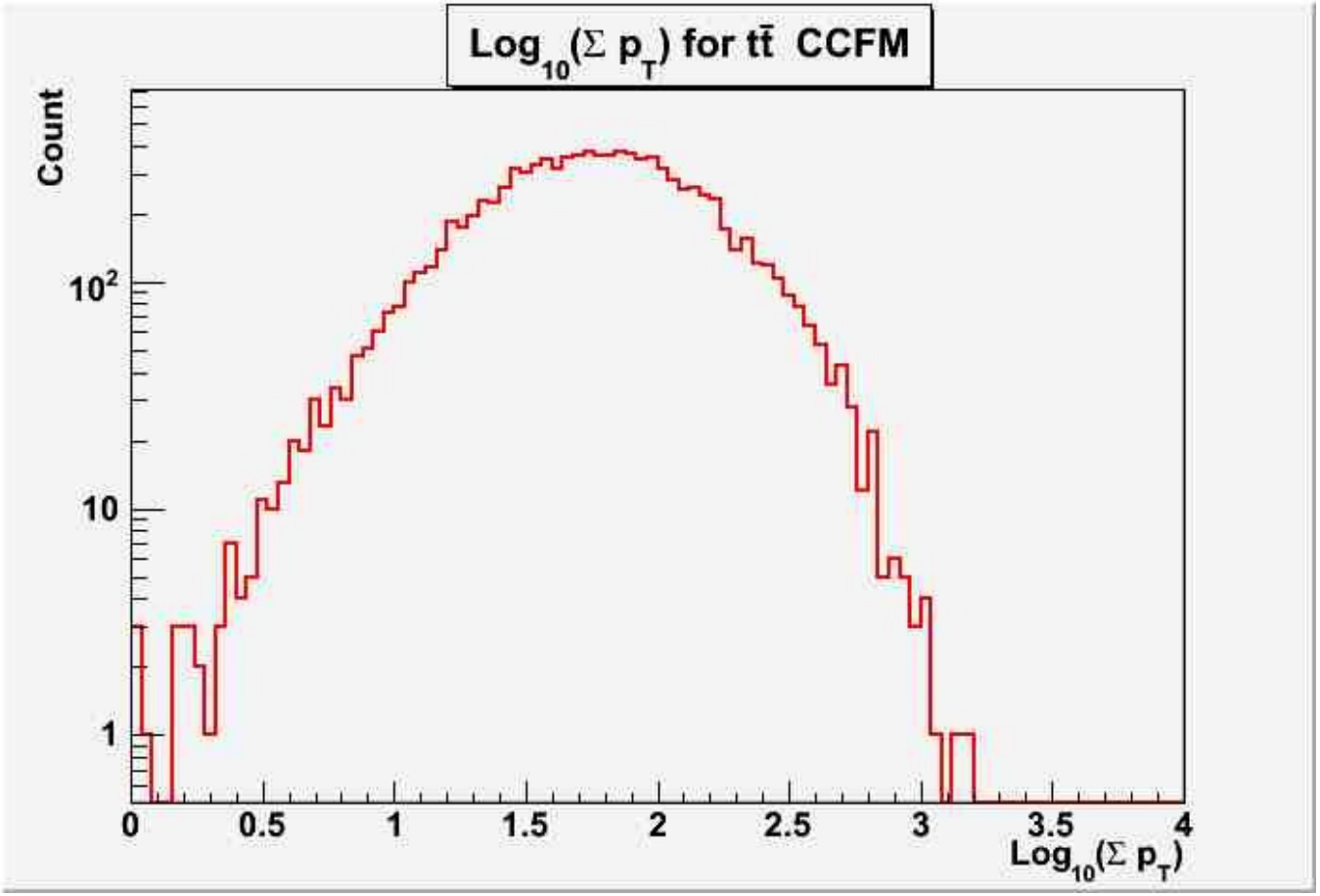
```
* ++++++++++++ Parton shower and fragmentation ++++++++++++
*
    'NFRA'     1       0       1       ! (D=1) Fragmentation on=1 off=0
*
    'IFPS'     1       0       0       ! (D=3) Parton shower
*                                      ! 0: off
*                                      ! 1: initial state PS
*                                      ! 2: final state PS
*                                      ! 3: initial and final state PS

*
    'ICCF'     1       0       1       ! (D=1) Evolution equation
*                                      ! 1: CCFM
*                                      ! 0: DGLAP
*
```

- Run Cascade and analyze HepMC output

Exercise 1

Exercise 1: Produce ttbar-events with Cascade in CCFM mode and Plot the p_T-Distribution for the ttbar system!



Exercise 2

Exercise 1: Compare with ttbar-events in produced in DGLAP mode!