TMDlib – TMDplotter project

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- Why TMDlib
  - different TMDs
- Some technicalities
- beta-release

Why TMDlib: differentTMDs ?

- take derivative of integrated PDF:

$$f(x,k_\perp^2) = \frac{dg(x,k_\perp^2)}{dk_\perp^2} = \left[\frac{\alpha_s}{2\pi}\int_x^{1-\delta} P(z) g\left(\frac{x}{z},k_\perp^2\right) dz\right]$$

- KMR approach:

$$f(x,k_\perp^2,\mu^2) = \frac{dg(x,\mu^2)}{d\mu^2}\exp\left(-\int_{k_\perp^2}^{\mu^2}\frac{\alpha_s}{2\pi} d\log k_\perp^2 \sum_i \int_0^1 P(z')dz'\right)$$

  - generated from integrated PDF, only last emission generates transverse momentum via sudakov form factor.

- TMD with evolution in hard scale in CSS formalism (http://tmd.hepforge.org/)

TMD Project

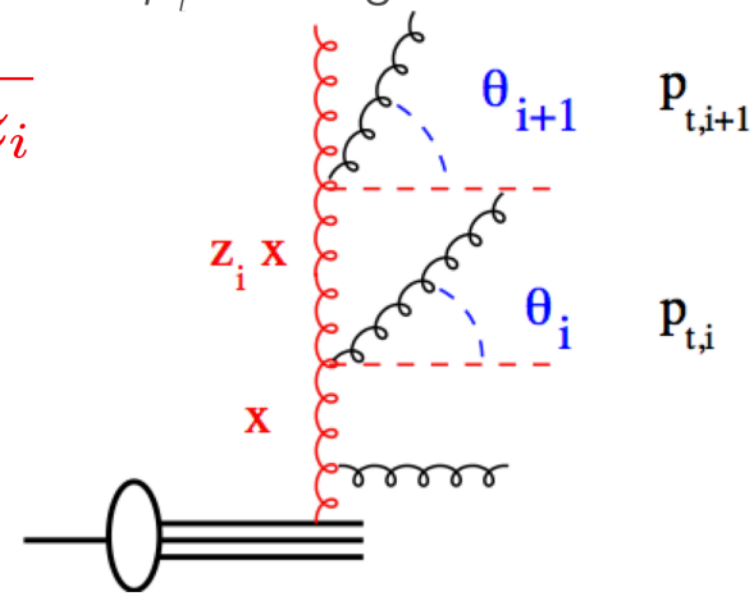
Webpage maintained by: Ted Rogers, Andrea Signori

This is the development page for the TMD project. The purpose of this project is to organize a repository for theoretical and phenomenological studies of transverse-momentum-dependent parton distribution functions (TMD PDFs) and fragmentation functions (TMD FFs). We provde access to parametrizations and fits of TMDs, with and without taking into account the perturbative QCD evolution.

Why TMDlib? CCFM approach

- Color coherence requires angular ordering instead of p_t ordering …

$$q_i > z_{i-1} q_{i-1} \qquad \text{with} \qquad q_i = \frac{p_{ti}}{1 - z_i}$$



➔ recover DGLAP with q ordering at medium and large x

➔ at small x, no restriction on q

p_{ti} can perform a random walk

➔ splitting fct:

$$\tilde{P}_g(z, q, k_t) = \bar{\alpha}_s \left[\frac{1}{1-z} - 1 + \frac{z(1-z)}{2} + \left(\frac{1}{z} - 1 + \frac{z(1-z)}{2} \right) \Delta_{ns}) \right]$$

$$\log \Delta_{ns} = -\bar{\alpha}_s \int_0^1 \frac{dz'}{z'} \int \frac{dq^2}{q^2} \Theta(k_t - q) \Theta(q - z' p_t)$$

➔ Catani Ciafaloni Fiorani Marchesini evolution forms a bridge between DGLAP and BFKL evolution

Why TMDlib ?

- Collect in a unique and easy accessible way all different available TMDs
  - small x TMDs
  - large x TMDs
  - polarized TMDs
  - and ?
- provide information on different TMD evolution and parameters used
  - α_s , Λ_{QCD} , nr of flavors
  - starting scale for evolution
  - evolution frame
  - sets for uncertainty calculation or different replicas
  - and ?

TMDlib and TMDplotter

- combine and collect different ansaetze and approaches:
  http://tmd.hepforge.org/ and
  http://tmdplotter.desy.de

- TMDlib: a library of parametrization of different TMDs and uPDFs (similar to LHApdf)
  - started by F. Hautmann, H. Jung, P. Mulders, A. Signori, T. Rogers

- first release within next weeks

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TMDlib and TMDplotter:
library and plotting tools for
Transverse Momentum Dependent parton distributions
Version 0.1.02

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Abstract

Transverse-momentum-dependent distributions (TMDs) play a crucial role in high-energy physics from the theoretical and phenomenological point of view. The library of transverse-momentum-dependent parton distribution functions (TMD PDFs) and fragmentation functions (TMD FFs) TMDlib is descibed together with the online plotting tool TMDplotter.

A detailed program description is given, with emphasis on parameters the user wants to change.

Some technicalities

- easily callable from C++ or Fortran

```
TMDinit(name)
TMDpdf(x,xbar,kt,mu, uval, dval, sea, charm, bottom, gluon);
```

  - $\alpha_s(\mu)$

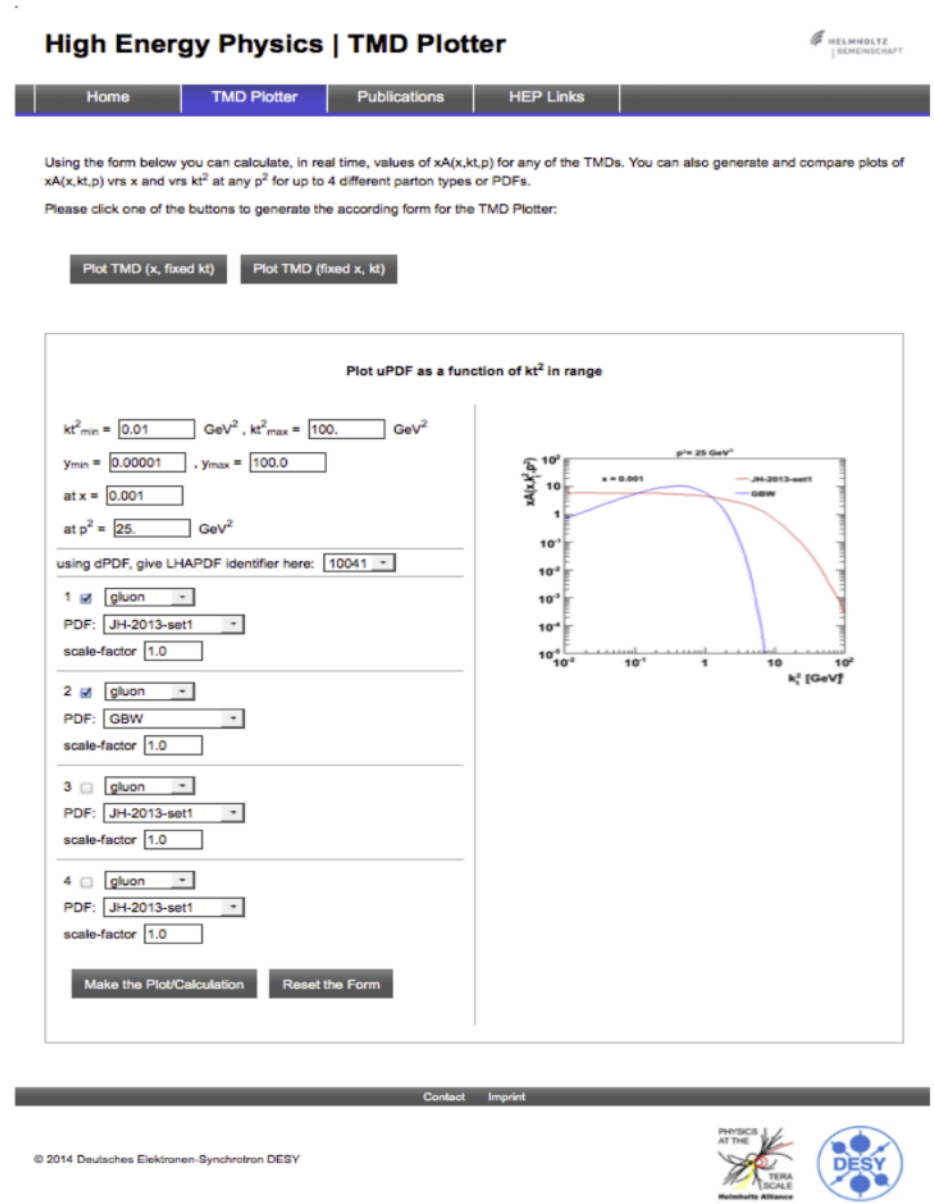
```
TMDalphas(mu)
```

  - utilities

```
TMDgetLam4
TMDgetNf
TMDgetOrderAlphaS
TMDgetOrderPDF
TMDgetXmin
TMDgetXmax
TMDgetQ2max
TMDnumberPDF
```

TMDlib and TMDplotter

- combine and collect different ansaetze and approaches
- ➔ from http://tmd.hepforge.org/ and http://tmdplotter.desy.de
- ➔ TMDlib: a library of parametrization of different TMDs and uPDFs (similar to LHApdf)
  - started by F. Hautmann, H. Jung, P. Mulders, A. Signori, T. Rogers
- ➔ platform for online plotting of TMDs using TMDlib
- ➔ http://tmdplotter.desy.de



Summary

- TMDplotter is available form http://tmdplotter.desy.de
  - please test it and give feedback
- TMDlib (beta release is ready, including a few TMDs)
  - please test it and give feedback

- TMDlib relies on feedback from users
  - please use it and cite it

- TMDlib needs support from TMD developers:
  - provide code to be included in TMDlib

Backup Slides