

Parton shower to calculate TMDs: PS2TMD

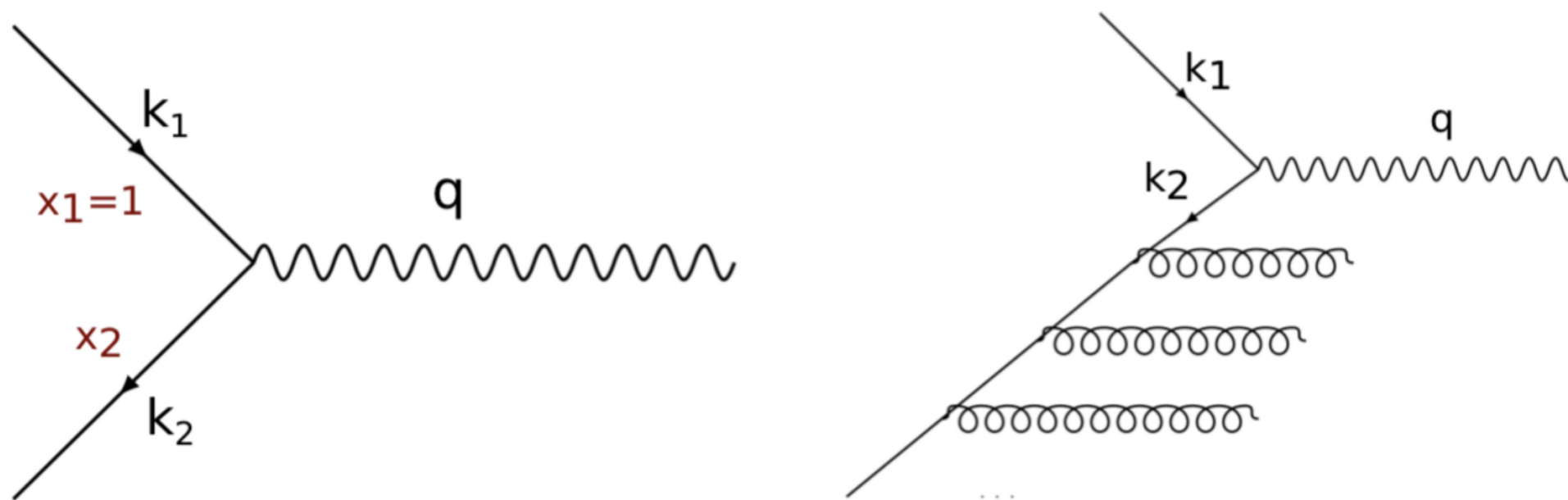
- Goal
 - easy comparison of results from parton shower MC generators with calculations from resummation
 - define transverse momentum dependent (TMD) parton density $\mathcal{A}(x, k_t, \mu)$

- originally proposed at [REF2015](#) at DESY
- based on master-thesis: Melanie Schmitz (2019) + talk at [REF2019](#)

The PS2TMD method - Technical features

Define a **toy process that simplifies calculations** of the quantities that are needed for the TMD parton densities.

- k_1 has fixed momentum fraction x_1 close to 1 and no transverse momentum to simplify calculations
- k_2 is subject to parton shower & x_2 is determined according to collinear parton distribution
- Transverse momentum of k_2 is investigated, $\vec{k}_{\perp 2} = \vec{q}_{\perp} - \vec{k}_{\perp 1}$ with $k_{t1} = 0$



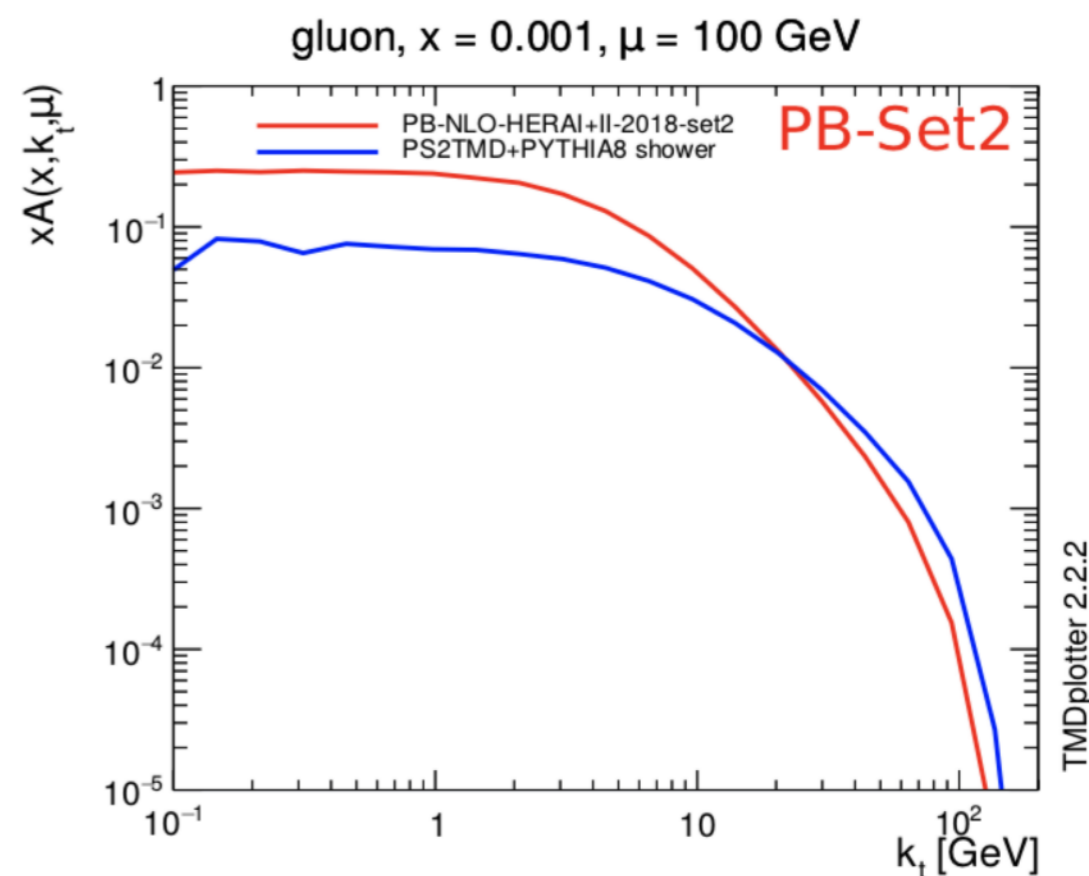
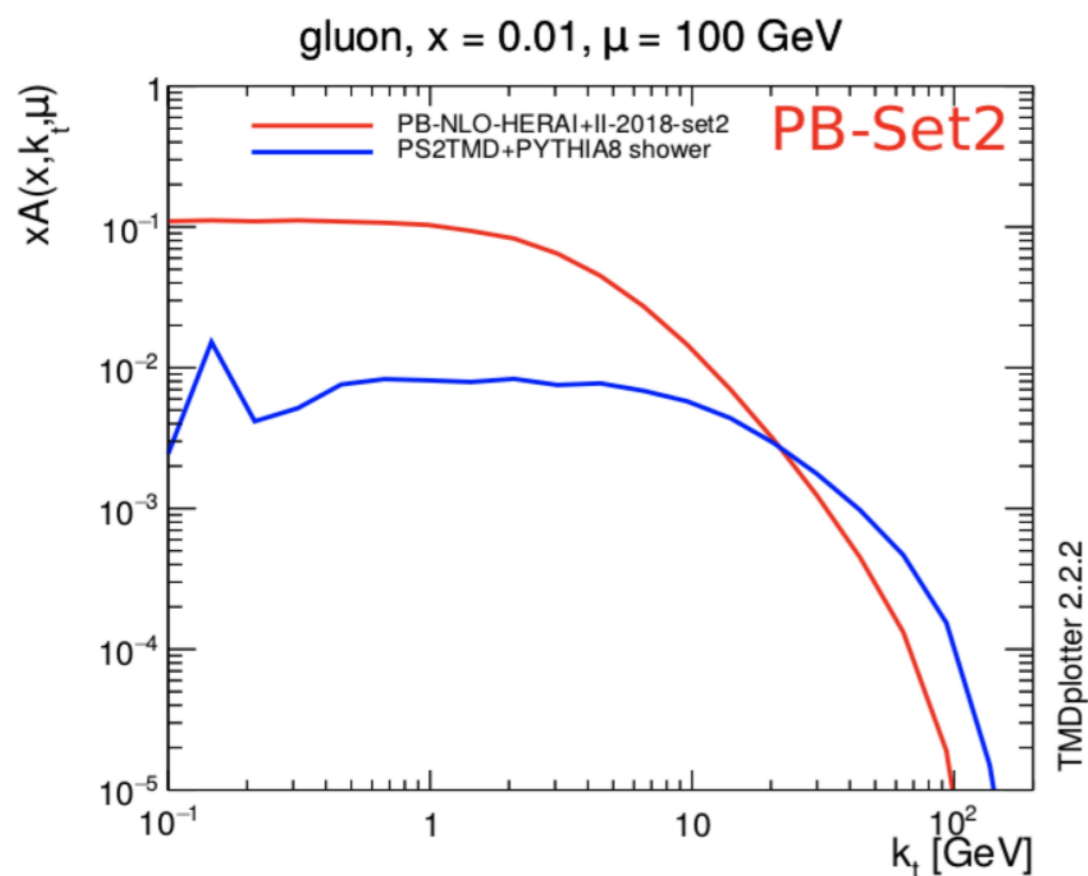
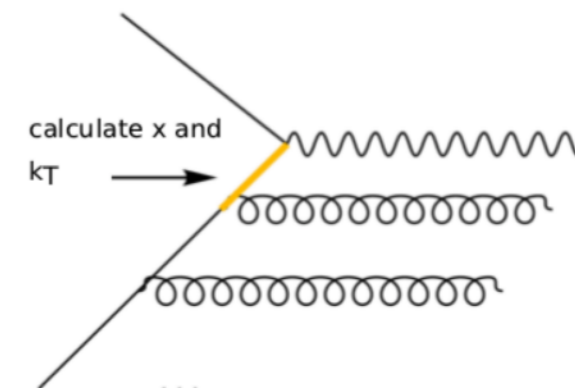
- method is applied to standard parton showers, using a PDF set that has been obtained within the parton branching method, PB-Set2

TMDs from the PYTHIA8 parton shower

Effective TMDs from PYTHIA8

PB-Set2 is used for the calculations (blue)

PB-Set2 as a collinear pdf via LHApdf for PYTHIA8



→ differences to PB-TMD observed since P8 PS uses p_T -ordering

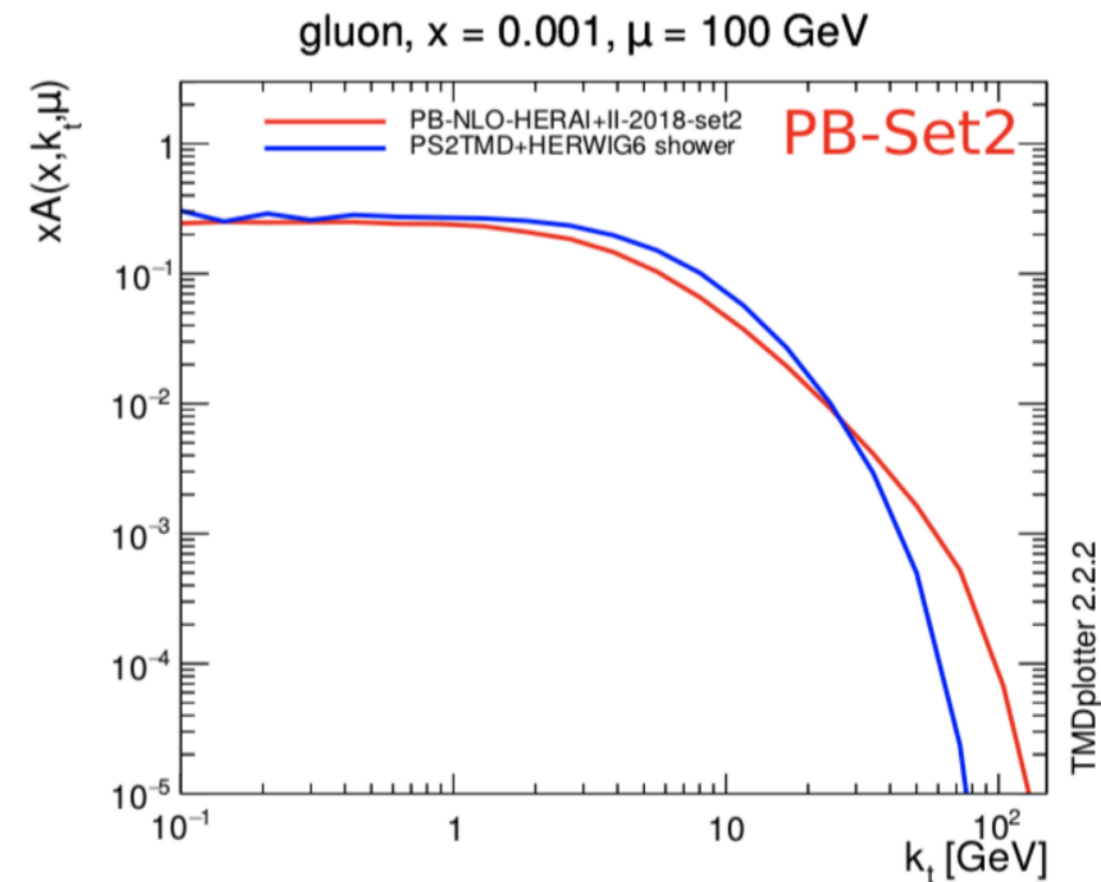
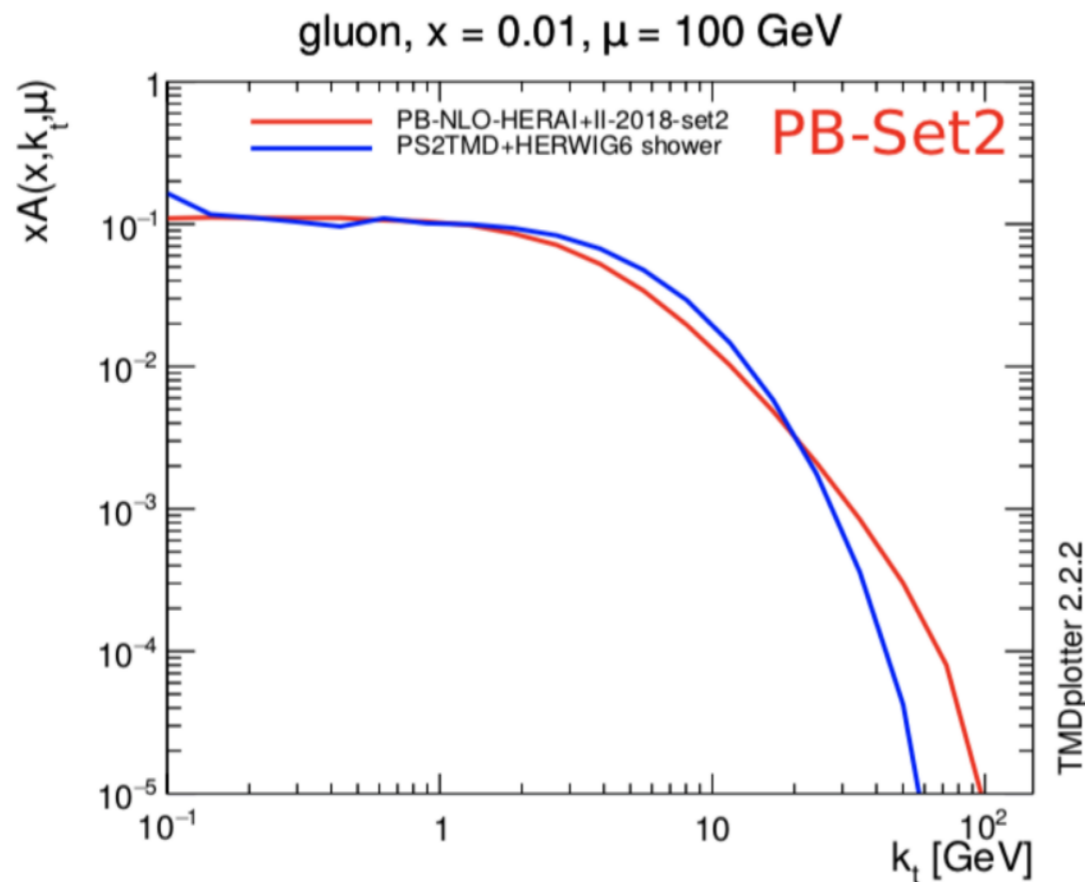
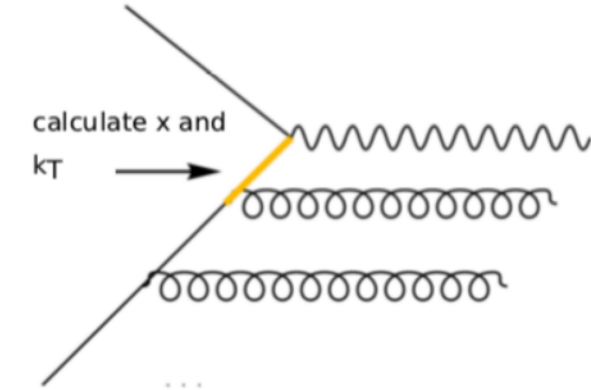
→ effective TMDs can be determined from standard parton shower

TMDs from the HERWIG6 parton shower

Effective TMDs from HERWIG6

PB-Set2 is used for the calculations (blue)

PB-Set2 as a collinear pdf via LHApdf for HERWIG6



→ distributions are **similar to PB-TMD** since both apply **angular ordering**

→ effective TMDs can be determined from **any** parton shower

PS2TMD project

- PS2TMD allows to compare predictions of the k_t of partons from PS generators
 - without going through
 - physical process
 - kinematic limitations
 - final state issues
 - allows to study in detail
 - recoil effects
 - effects on color connections
 - ordering conditions

Technicalities

- Tools:
 - TMDlib2 is ~ready to be released
 - including many new features
 - including Pavia TMDsets (a few technical issues)
 - TMDplotter using TMDlib2 is ready
 - easy to include PS2TMD
- Tools for PS2TMD on request by author:
 - LHE files
 - Rivet plugin for determination of TMDgrid
 - tool to obtain TMDlib2 compatible files