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# Transverse Momentum Dependent Parton Distribution Function (TMD PDF) with self-similarity and Proton Structure Function $F_2(x, Q^2)$ at Large and Small $x$ .

## Content :

Transverse Momentum Dependent Parton Distribution Function (TMD PDF) is an important component of Quantum Chromodynamics (QCD) along with Parton Distribution Functions (PDFs) and more recent Generalised Parton Distribution Functions (GPDs). New experimental data from the LHC have led to increased awareness of their importance in understanding hadron physics. While TMDs are generally used to study details of hadronic final states in high energy lepton-hadron and hadron-hadron collisions, PDFs are used for conventional deep inelastic inclusive processes.

In this work, we outline the construction of TMD PDFs with one and two hard scales imposing self-similarity at small  $x$  as suggested by Lastovicka (2002). We then study large  $x$  limit of the model and modify the defining TMDs to make them compatible with theoretical expectations in such limit. We reanalyze the PDFs in this approach using its conventional relation with TMDs. Possibility of saturation of Froissart-Martin bound  $F_2(x, Q^2) \sim \ln^2(1/x)$  at ultra small  $x$  is also highlighted.

Keywords: Transverse Momentum Dependent Parton Distribution Function, Parton Distribution Function, Self-similarity, Small  $x$ , Froissart-Martin bound.

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