

## Can $\overline{MS}$ PDF be negative?

---

Alessandro Candido

February, 2020



UNIVERSITÀ  
DEGLI STUDI  
DI MILANO



1. Parton model
2. PDF @ NLO: factorization scheme
3. An intrinsic positive scheme
4. Coefficient functions NLO behaviour
5. Is  $\overline{\text{MS}}$  negative?

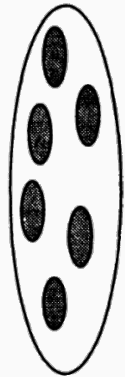
## Parton model

---

The *parton model* consist in a model of the proton structure as a bunch of free components, collectively called *partons*:

- in principle any elementary particle
- in practice mostly **quarks** and **gluons**

This assumption of course relies on the asymptotic freedom of strong interaction<sup>1</sup>.



---

<sup>1</sup>e.g. it would be completely unphysical for an atom.

Since they are free the main property of each parton is the fraction of the total momentum it carries.

The probability distribution of finding a parton  $p$  with momentum fraction  $x$  it's encoded in its *Parton Density Function*<sup>2</sup>,  $f_p(x)$ .

Plot LO PDFs

---

<sup>2</sup>In general PDFs also depend on the energy scale  $Q^2$ , but at LO they scale (see *Björken scaling*).

## PDF @ NLO: factorization scheme

---

A step further: NLO  $\rightarrow$  collinear divergences  $\rightarrow$  coefficient functions  
ambiguity (collinear subtraction)  $\rightarrow$  factorization scheme (as PDF definition)

Catani-Seymour formula for factorization @ NLo

## An intrinsic positive scheme

---



DIS scheme and similar.

Defined on physical observables.

## Coefficient functions NLO behaviour

---

We can play this game because we know in advance that the relevant structure (the one related to the collinear subtraction) is universal.

How we switch scheme and  $K$  properties

## A bunch of nontrivial positivity schemes

POS, MPOS, DPOS

Is  $\overline{MS}$  negative?

---

The easy way in *N-space* and Why we need an argument in *x-space*

Argument from MPOS  $\rightarrow$  MSbar



Thanks for your attention