

Monte Carlo evolution of the parton distributions in QCD

The case of LL

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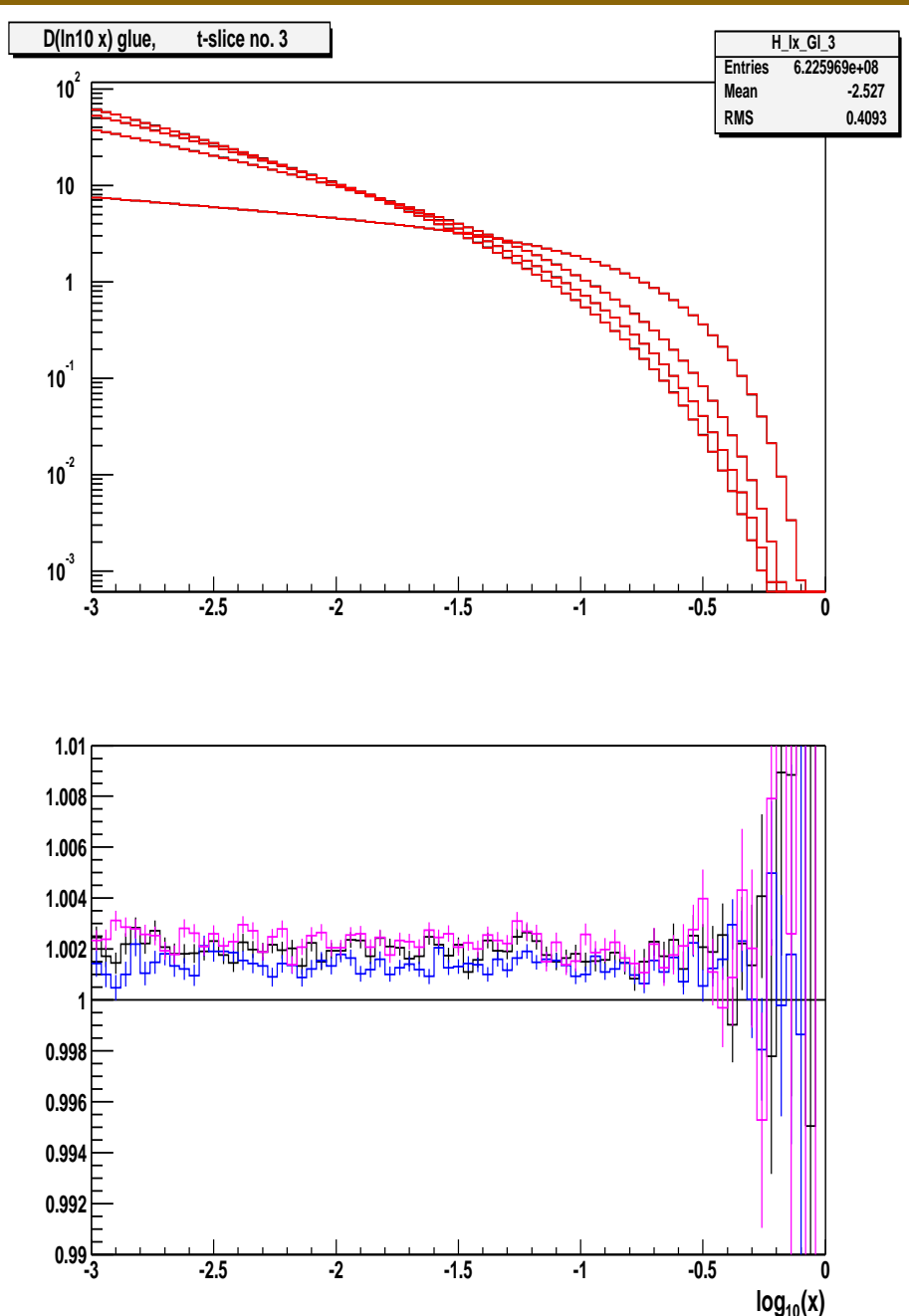
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Introduction/Motivation

- PDFs are evolved in Q^2 using non-MC type standalone tools like QCDnum (time sequencing, Laguerre polyn. etc.)
- PDFs are used in the fixed order MC integrators and parton-shower MC event generators as an input (Sjostrand backward shower)
- QUESTION: Can one integrate the QCD evolution of the PDFs into a MC event generator more tightly? (ISR of course)
- We present a warm-up exercise in which we solve *exactly* the QCD evolution equation with the precision **0.01%**, from $Q=1\text{GeV}$ up to 1TeV using pure MC method.
- Next step will be efficient tagging of x and flavor of parton entering hard process. (For QCD ISR MC not knowing PDFs apriori).
- **Said to be impossible!** However, it now looks feasible with the present computing methods and resources.

Proton \rightarrow gluon; 1GeV \rightarrow 1TeV

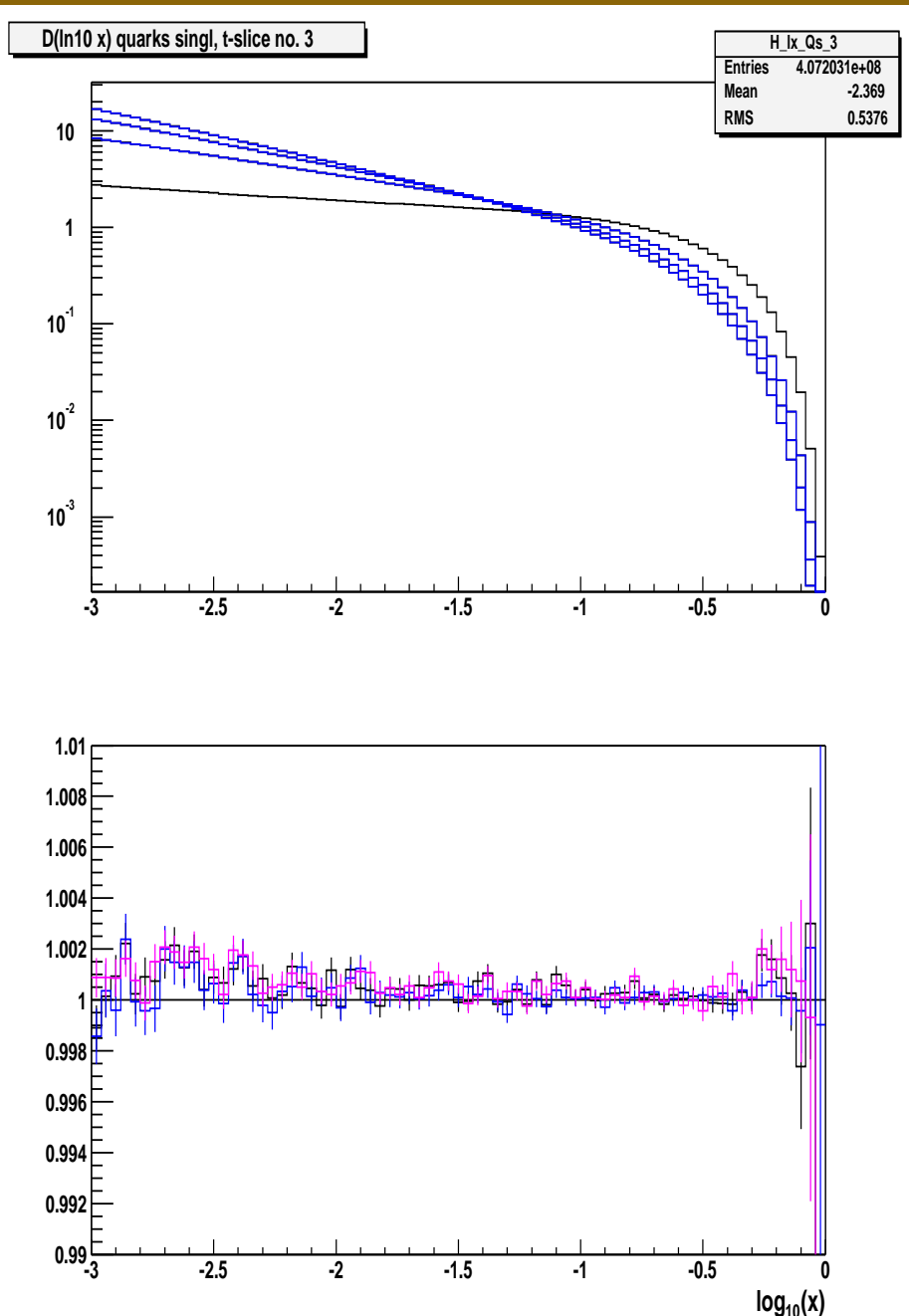


MC provides rather easily 3-digit precise PDFs!

Upper plot shows gluon distribution $x D_G(x, Q_i)$ evolved from $Q_0 = 1$ GeV to $Q_i = 10, 100, 1000$ GeV obtained from QCDnum16 and Evo1MC1, while lower plot shows their ratio.

The horizontal axis is $\log_{10}(x)$. Starting distribution is complete proton at $Q = 1$ GeV.

Proton \rightarrow quarks; 1GeV \rightarrow 1TeV



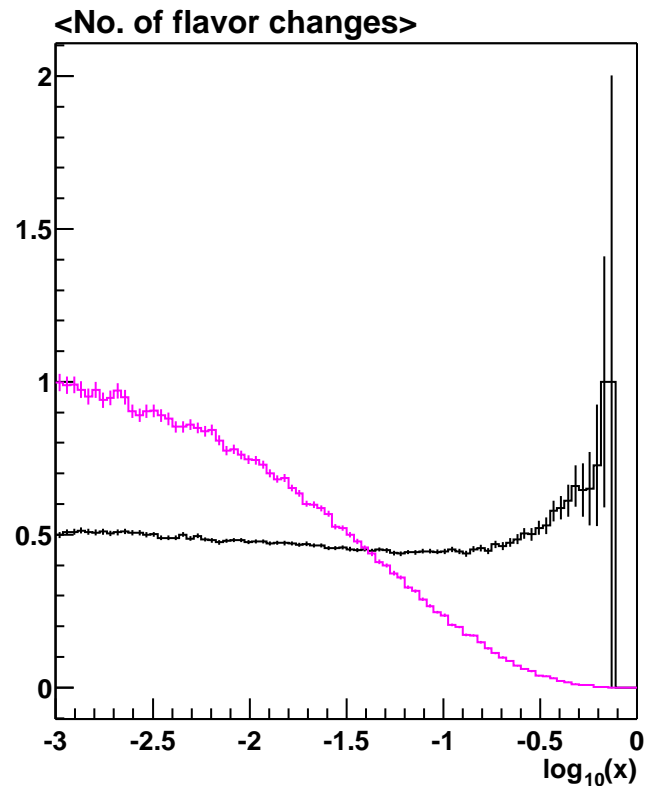
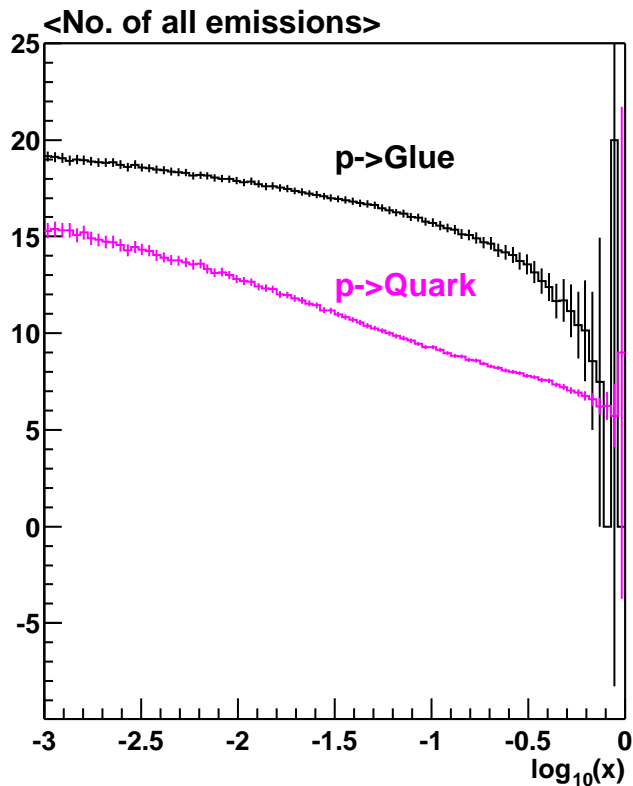
MC provides rather easily 3-digit precise PDFs!

Upper plot shows quark singlet distribution $x D_G(x, Q_i)$ evolved from $Q_0 = 1\text{GeV}$ to $Q_i = 10, 100, 1000\text{GeV}$ obtained from QCDnum16 and EvolMC1, while lower plot shows their ratio.

The horizontal axis is $\log_{10}(x)$. Starting distribution is complete proton at $Q = 1\text{GeV}$.

MC can provide 4-digit precision in PDFs evolution.

Prospects of x and flavor tagging



Next step will be efficient tagging of x and flavour of parton entering hard process. (QCD ISR MC not knowing PDFs a priori). The above plot suggests that it is feasible.