

RESUMMATION AND PDFS: SHOULD WE WORRY?

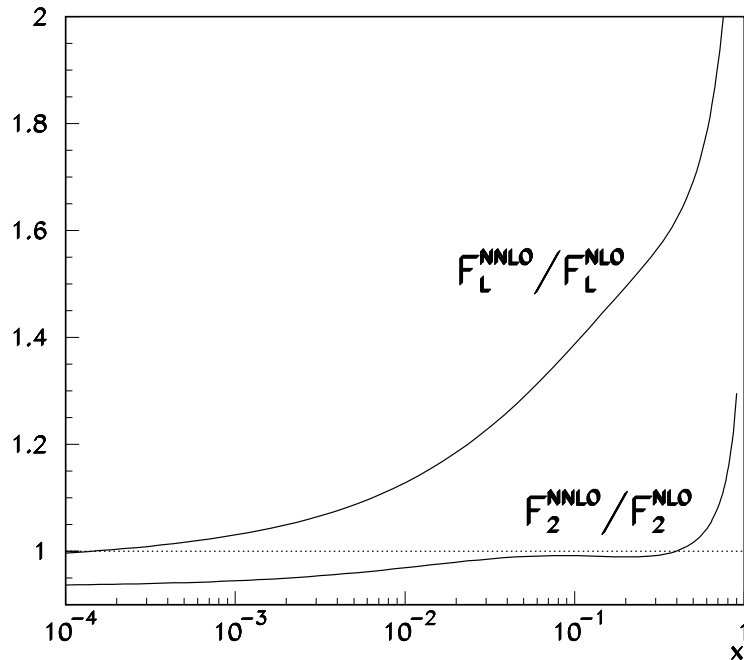
STEFANO FORTE
UNIVERSITÀ DI MILANO

PDF4LHC, CERN, FEBRUARY 23, 2008

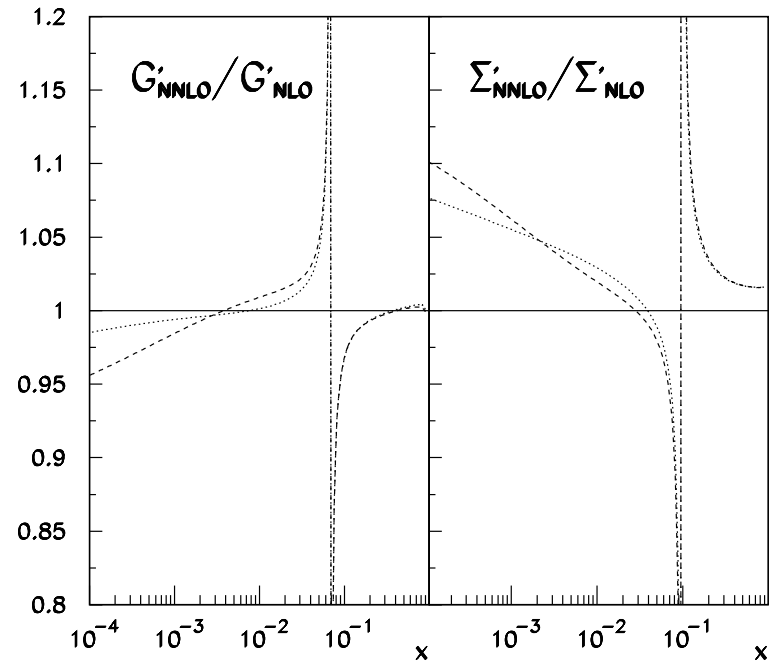
NNLO INSTABILITIES

- PERTURBATION THEORY **UNSTABLE**:
 - LARGE $x \rightarrow$ COEFFICIENT FUNCTIONS (ONLY, IN $\overline{\text{MS}}$)
 - SMALL $x \rightarrow$ ANOMALOUS DIMENSIONS (MOSTLY)
- INSTABILITY APPARENT AT NNLO

PERTURBATIVE COEFFICIENTS



EVOLUTION



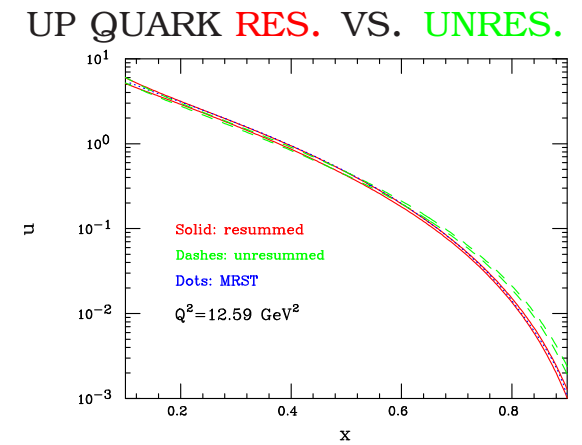
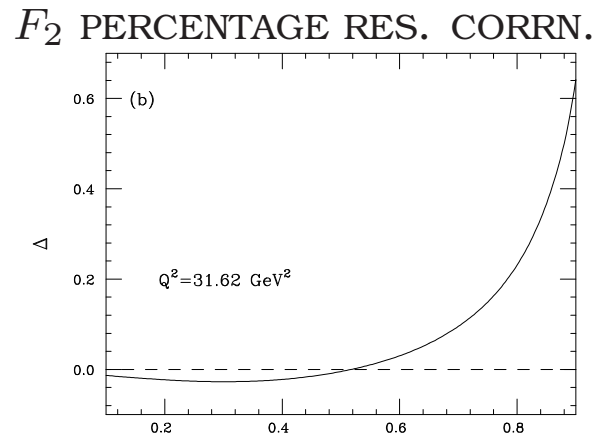
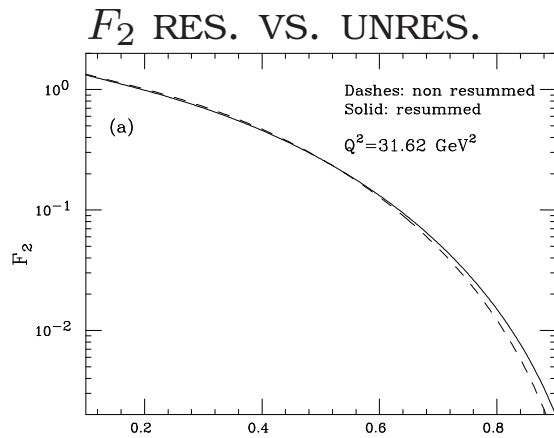
Alekhin

- EFFECT OF NNLO CORRECTIONS AROUND 5-10 %
- MUCH LARGER IN SPECIFIC KIN. REGIONS (SMALL x , LARGE x)

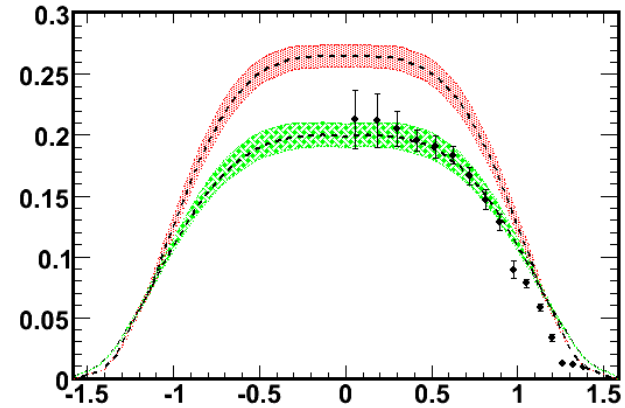
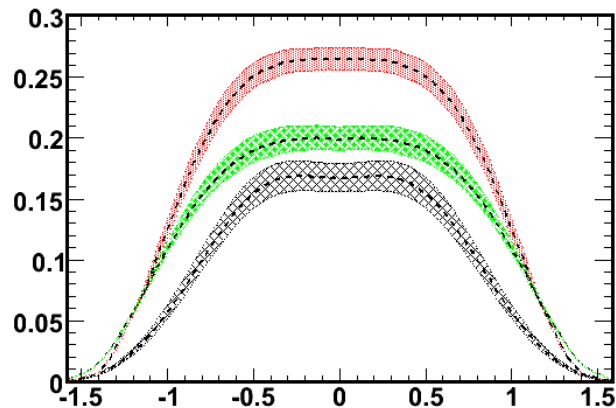
THRESHOLD (LARGE x) RESUMMATION

PERT. TH. UNSTABLE AT LARGE x : (C.M. ENERGY \sim FINAL STATE MASS)
 AT $O(\alpha_s^n)$, $O[\ln^{2m}(1-x)]$ CONTRIBUTIONS

- **DIS:** SIZABLE ONLY @ VERY LARGE x , WHERE XSECT & PDF TINY (Corcella, Magnea 2005)
- **DY:** CAN HAVE SIZABLE EFFECTS, ESPECIALLY ON RAP. DISTN. (CMNT, 1994; Bolzoni 2006)



DY $d\sigma/dQ^2 dy$ vs. y LO NLO RES. $Q^2 = 64 \text{ GEV}^2$; $\tau = 0.04$; E866 DATA



HIGH ENERGY (SMALL x) RESUMMATION

AT $O(\alpha_s^n)$, $O[\ln(\frac{1}{x})^n]$ CONTRIBUTIONS:

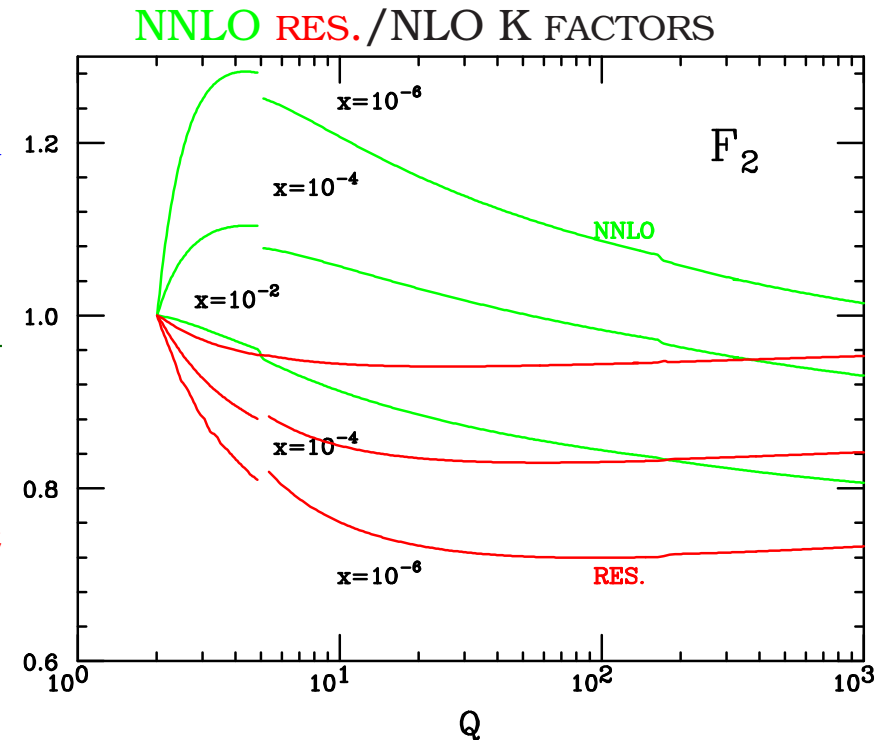
\Rightarrow PERT. TH. UNSTABLE AT SMALL x (C.M. ENERGY \gg FINAL STATE MASS)

x_{cut} :	0	0.0002	0.001	0.0025	0.005	0.01
# DATA POINTS	2097	2050	1961	1898	1826	1762
$\chi^2(x > 0)$	2267					
$\chi^2(x > 0.0002)$	2212	2203				
$\chi^2(x > 0.001)$	2134	2128	2119			
$\chi^2(x > 0.0025)$	2069	2064	2055	2040		
$\chi^2(x > 0.005)$	2024	2019	2012	1993	1973	
$\chi^2(x > 0.01)$	1965	1961	1953	1934	1917	1916
Δ_i^{i+1}		0.19	0.10	0.24	0.28	0.02

DATA-THEORY AGREEMENT
FOR EVOLUTION OF F_2
IMPROVES IF SMALL x DATA
REMOVED (MRST 2003)

χ^2 improves
with fixed # of pts
(same row)

- CONSIDERABLE PROGRESS IN FULL RESUMMATION OF SMALL x SPLITTING FUNCTIONS IN GLUON SECTOR
(Ciafaloni, Colferai, Salam, Stašto;
Altarelli, Ball, S.F.; Thorne, White)
- FULLY RESUMMED RESULTS AVAILABLE IN $\overline{\text{MS}}$ FOR DIS (ABF 2008)
- RESUMMED PERTURBATIVE EXPANSION STABLE
- RESUMMATION AS LARGE AS NNLO, OPPOSITE SIGN AT $x \sim 10^{-4}$
- NOT YET INCLUDED IN PARTON FITS



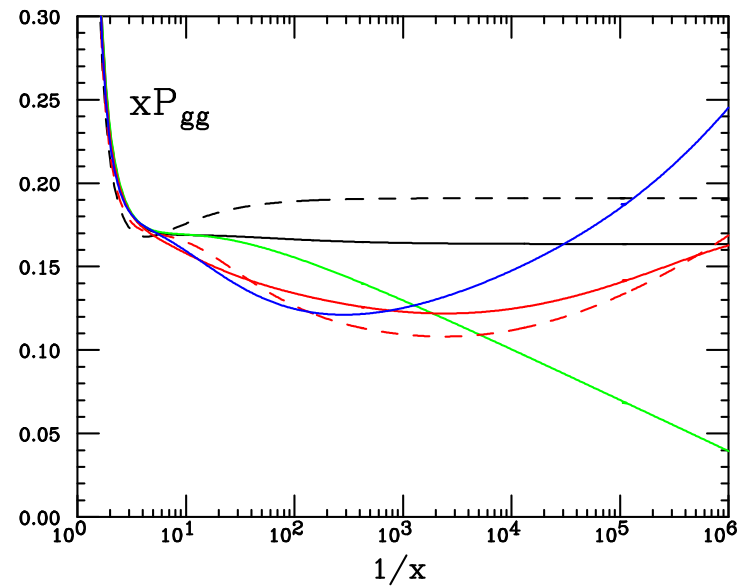
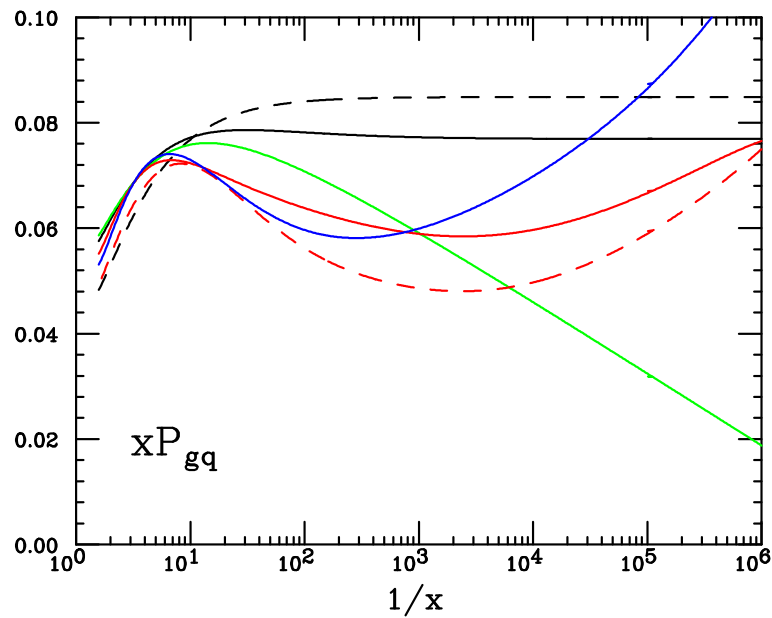
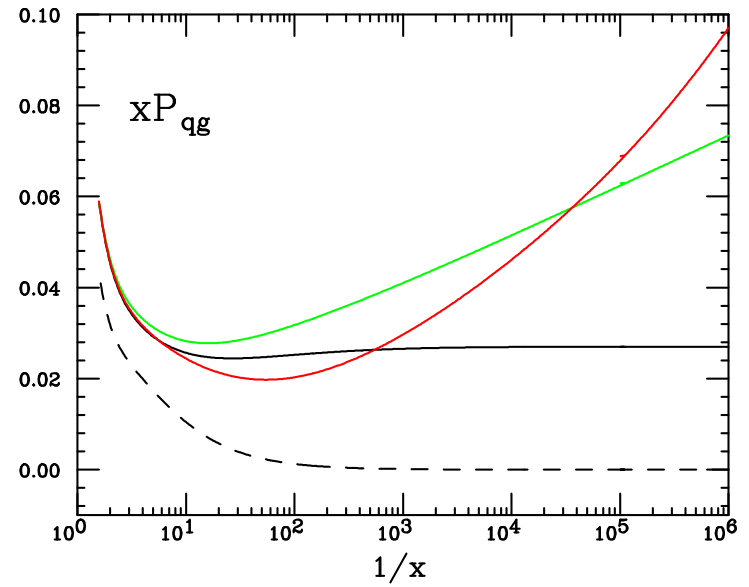
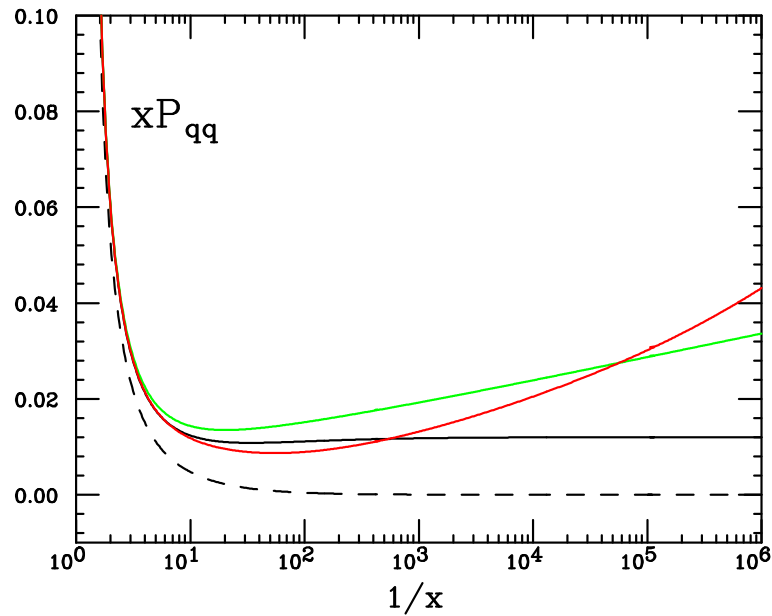
CONCLUSIONS

- PERTURBATIVE RESULTS UNSTABLE AT NNLO
- IN DY RAPIDITY DISTRIBUTIONS (FERMILAB KINEMATICS), EFFECT OF RESUMMATION AS LARGE AS NLO
- IN DIS, EFFECT OF SMALL x RESUMMATION AS LARGE AS NNLO, BUT WITH OPPOSITE SIGN FOR $x \lesssim 10^{-2}$

EXTRAS

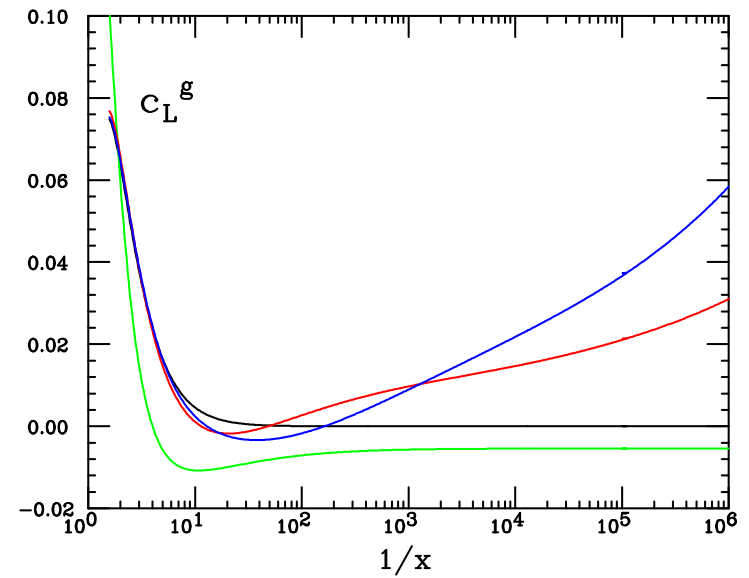
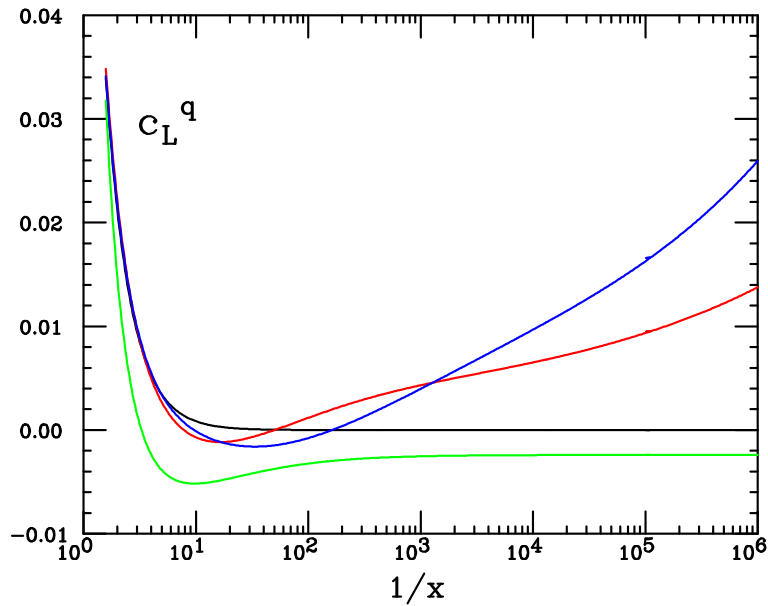
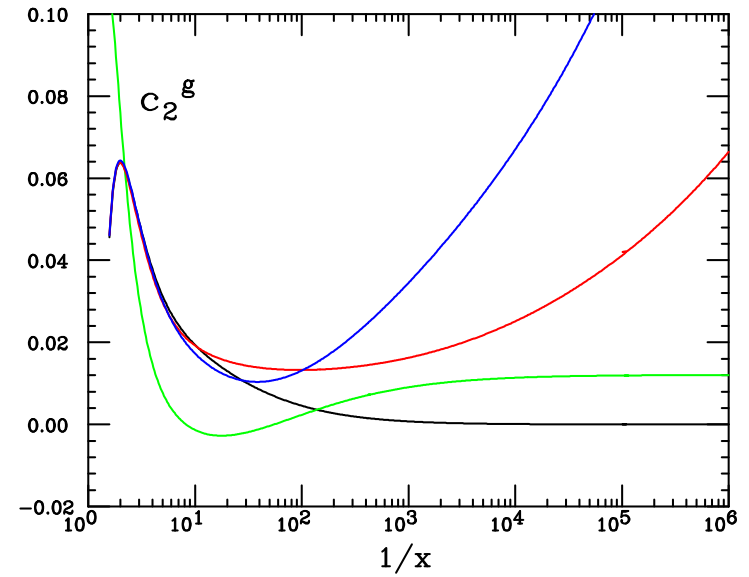
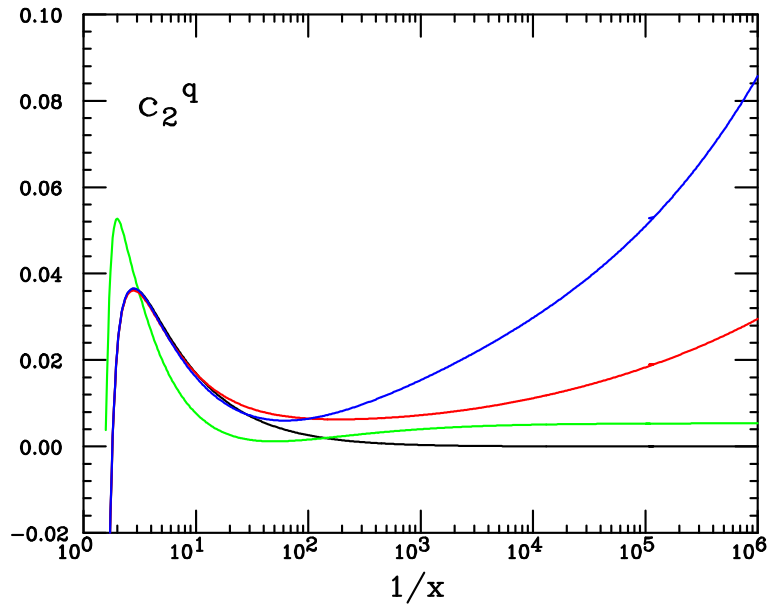
THE SPLITTING FUNCTION MATRIX

NLO, NNLO, RESUMMED Q_0 , RESUMMED $\overline{\text{MS}}$



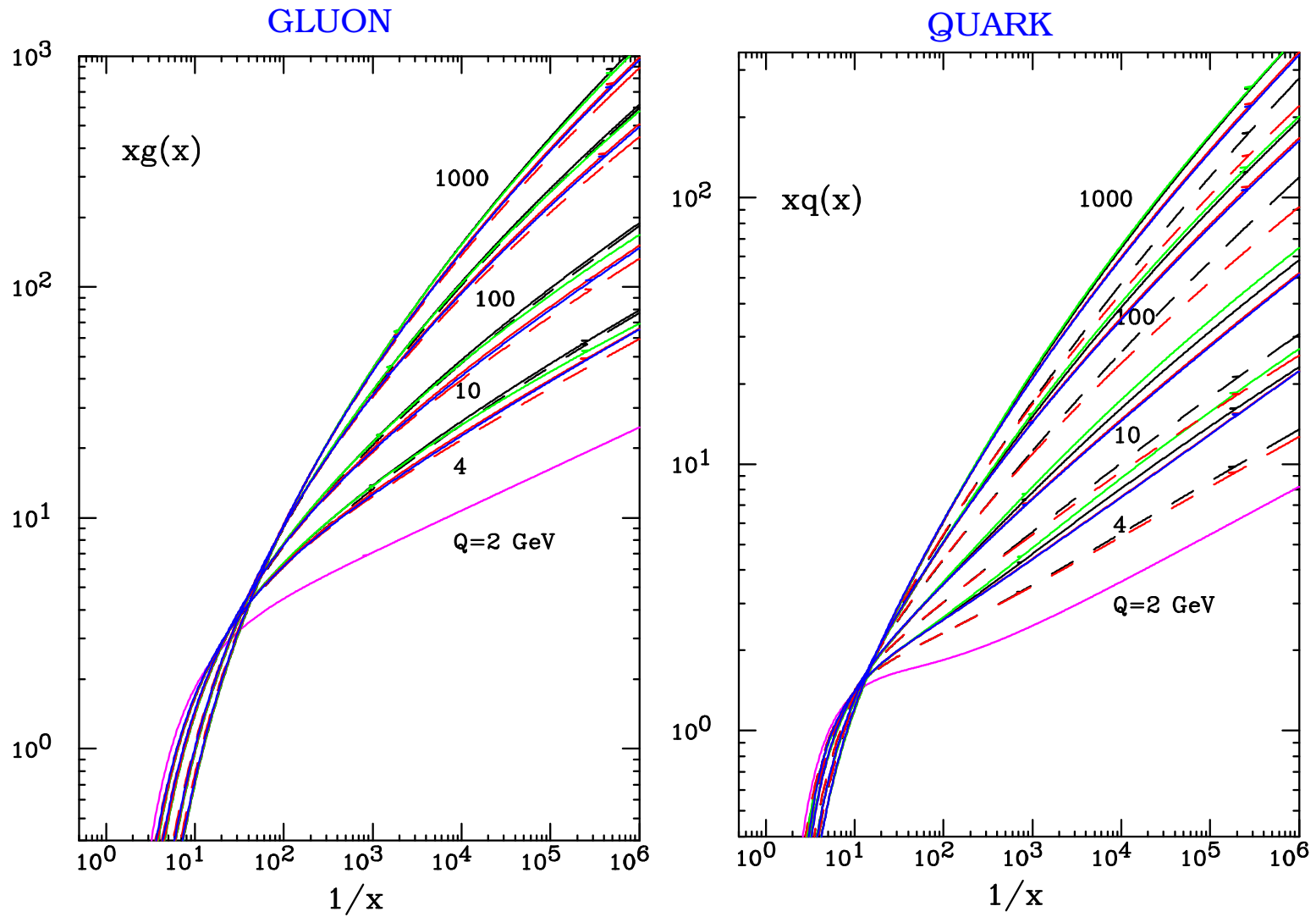
THE COEFFICIENT FUNCTIONS

NLO, NNLO, RESUMMED Q_0 , RESUMMED $\overline{\text{MS}}$



QUARK AND GLUON EVOLUTION

NLO, NNLO, RESUMMED Q_0 , RESUMMED \overline{MS}



QUARK AND GLUON K-FACTORS

