High Precision Parton Distribution Functions

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- Theoretical Activities & Development of Tools
- Collaboration between Theory & Experiment
- Schools / Workshops
- Funding Requests

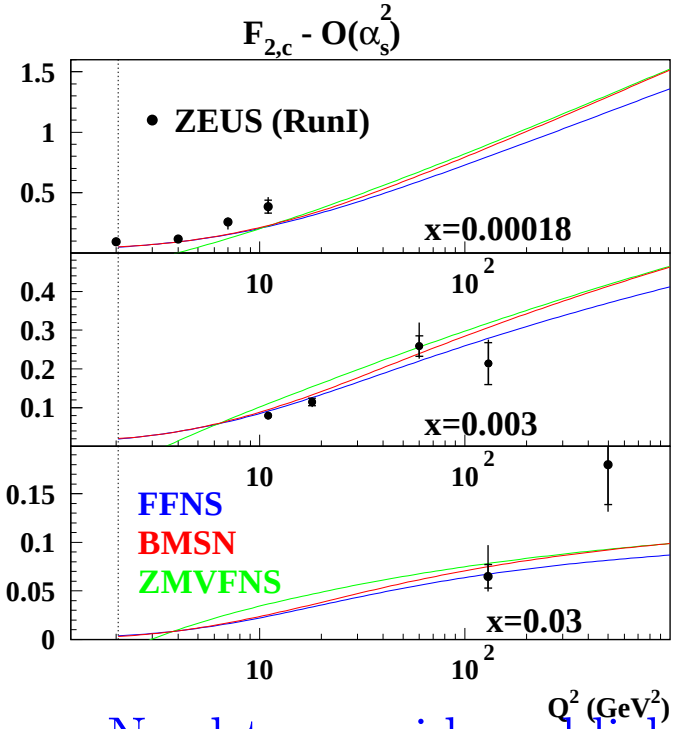
Meeting: Analysis Center Groups, Management Board, DESY Directorate, May 4th 2009

Theoretical Activities & Development of Tools

Main Objectives :

- Precise description of the light and heavy quark contributions to the deep-inelastic structure functions: $\Longrightarrow$ 3-loop order
- Massless $O(a_s^3)$ corrections known, Moch, Vermaseren, Vogt 2004/05.
- $O(a_s^3)$ corrections heavy quark contributions : (widely) solved recently I. Bierenbaum, J.B., S. Klein, [arXiv:0904.3563]
- Fast Evolution Codes needed, allowing for analytic error propagation.
- Modern math. methods $\Longrightarrow$ compact and fast implementations of evolution kernels: e.g. J.B. arXiv:0901.0837,0901.3106; S. Alekhin, J.B. Phys. Lett. B594 (2004) 299
- Still more theoretical calculations needed !

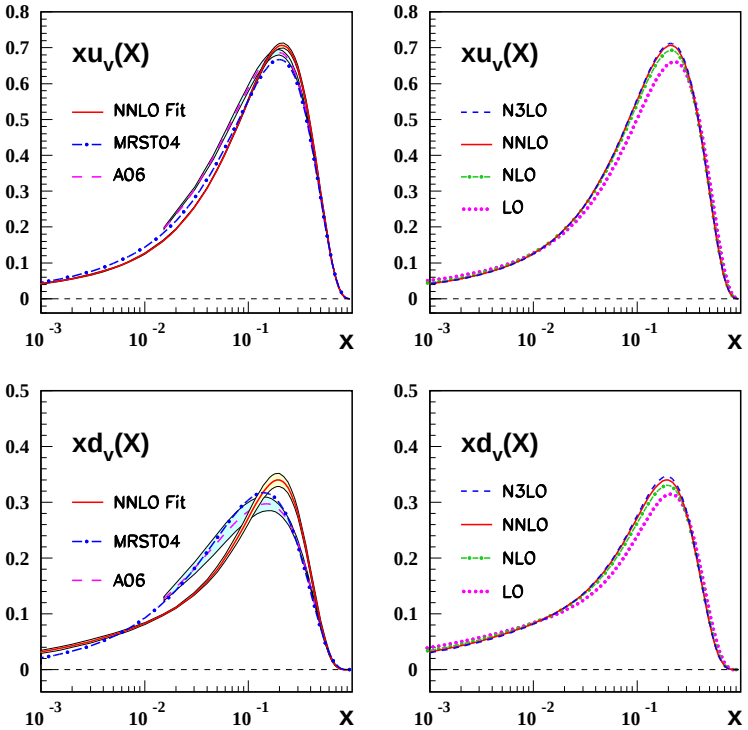
Theoretical Activities & Development of Tools

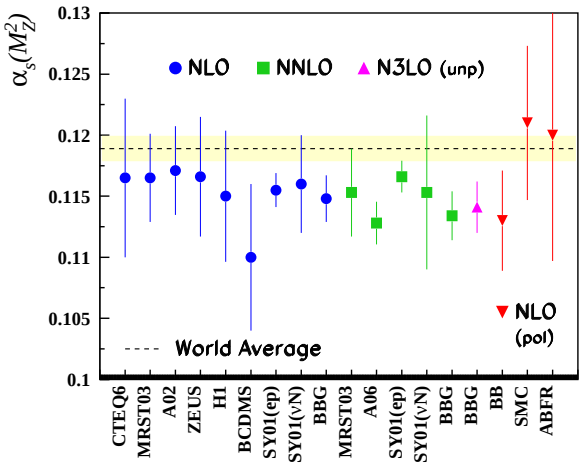


Correct implementation of heavy flavor corrections needed $\Longrightarrow$ precision analyses.
(A. Alekhin, J.B., S. Klein)

- Need to provide publicly accessible codes in N-space and x-space.
- $\Longrightarrow$ Controlled codes with a clear description of the theory background [not yet standard everywhere].
- Fast and precise codes are instrumental to perform sophisticated systematics studies. $\Longrightarrow$ H1 & ZEUS

Collaboration between Theory & Experiment





- Performed the only N^{3}LO SF-analysis to measure $\alpha_s(M_Z^2)$ with correlated errors
  J.B., H. Böttcher, A. Guffanti, Nucl. Phys. B774 (2007) 182.
- World data Higher Twist extraction (N^{3}LO),
  J.B., H. Böttcher Phys. Lett. B662 (2008) 336.
- Singlet analysis in preparation. J.B., H. Böttcher (DESY, $\Longrightarrow$ retired)

Collaboration between Theory & Experiment

- $\Longrightarrow$ Theory tools need to be quickly transferred to experiment
- $\Longrightarrow$ Close contacts and collaboration T+E on analysis issues required
- $\Longrightarrow$ Incorporate newly calculated 3-loop heavy flavor corrections into data analysis of $F_2(x, Q^2)$
- $\Longrightarrow$ Apply newly calculated 3-loop heavy flavor corrections in ongoing data analyses of $F_2^{c\bar{c}}(x, Q^2)$ and $F_2^{b\bar{b}}(x, Q^2)$ at H1 and ZEUS
- $\Longrightarrow$ With the advent of LHC data : systematic study of light candle processes as Drell-Yan, W/Z-production ... to unravel the different sea quark distributions.
- $\Longrightarrow$ Include also groups outside Hamburg and Zeuthen/ Berlin; one candidate : U. Dortmund; Everybody is very welcome!
- Final Goal : High precision pdfs and value of $\alpha_s(M_Z^2)$ for LHC.

Schools / Workshops

- PDF-school, Nov. 2008 J.B., A. Glazov, S.O. Moch
- In preparation : PDF-school, Oct. 2009 J.B., A. Glazov, S.O. Moch
- Bi–annually since 1992 :

Loops and Legs in Quantum Field Theory;

next workshop: April 2010, J.B., S.O. Moch, T. Riemann

- a central meeting to discuss all new theoretical activities in Terascale-physics

Funding Requests

- Support for Helmholtz-Alliance schools & short term visitors collaborating
- Funding for one experienced post-doc/guest scientist position for at least one year to collaborate on code development and transfer of theory tools into experimental analysis