

Team Germany:

DESY, Zeuthen; HU Berlin; U. Hamburg;
KIT Karlsruhe; MPI München; BU Wuppertal

LHCPHENOnet, Mid-term Evaluation

September 2012



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Team

- U. Hamburg [S. Moch](#)
- DESY Zeuthen [J. Blümlein](#)
- HU Berlin [P. Uwer](#)
- MPI München [G. Heinrich](#)
- KIT Karlsruhe [M. Steinhauser](#), [L. Mihaila](#)
- BU Wuppertal [R. Harlander](#)
- Postdoctoral Researchers: 13
- PhD Student: 8
- ESRs: so far 3

Special Tasks:

- S. Moch (U. Hamburg): [Co-coordinator; manager WP 1: Precision](#)
- J. Blümlein (DESY): [Head: Education board; Contacts to the 3 industrial partners](#)
- R. Harlander (BU Wuppertal): [Manager WP 2: Discovery](#)
- G. Heinrich (MPI München): [Member: Education board](#)



Fellows

- [Dr. J. Ablinger](#) 09/2011-04/2012 [DESY](#); PhD JKU Linz,A, May 2012
- [Dr. C. Raab](#) 10/2012-09/2013 [DESY](#); PhD JKU Linz,A, September 2012
- [Dr. M. Dowling](#) 10/2012-09/2013 [DESY](#); PhD U. Alberta,CDN
September 2012

Topics:

- Special functions, Summation methods in Quantum Field Theory
- Integration of Feynman Integrals at Higher Order
- Top quark physics



Training at the Node:

Regular Training:

- DESY special seminars: Theory, Experiment
- LHC-Physics Paper Seminar: TH + ATLAS groups
- Special Lectures and Seminars at Universities [Quantum Field Theory, Particle Phenomenology, Mathematical Physics]
- PhD Student Research Seminars
- [Training at Special LHCPHENOnet Events](#)

Accompanying Research Networks:

- German Research Fund (DFG) SFB Transregio 9: Aachen-Berlin-Karlsruhe (~ 100 physicists)
- Different Graduate Schools at the various sites.



Training at Industrial Partners:

RISC Software GmbH,A:

- Radomir Sevilliano, [Katowice/PL](#) Oct-Dec 2012
- Michael Ochman, [Katowice/PL](#) Oct-Dec 2012

Wolfram Research, USA:

- Emanuele Bagnaschi, [NIKHEF/NL](#) Sept-Nov 2012
- Domenico Bonocore, [LPTHE/F](#) Sept-Nov 2012
- Roman Derco, [Debrecen/H](#) Sept-Nov 2012

MapleSoft, CDN:

- Xuan Chen, [Durham,UK](#) planned: 2013
- Lucia Hosekova, [Valencia,E](#) 2013



Special Events:

- Computer Algebra School, CAPP, Zeuthen/D, 2011
- Standard Candles for the LHC, Zeuthen/D, 2011
- Loops and Legs in Quantum Field Theory, Wernigerode/D, 2012
- School on Integration, Summation, and Special Functions, Linz/A, 2012



Publications

51 papers

- **Multi Leg Processes:** 11-026 11-043, 11-063, 11-065, 11-069, 11-072, 12-008
- **Top Production:** 11-006, 11-039, 11-052, 12-035, 12-042
- **Higgs Production, SM/BSM:** 11-051, 12-068, 12-087, 12-095, 12-096, 12-097, 12-098
- **Heavy Quark Corrections:** 11-013, 11-019, 11-035, 11-036, 12-036, 12-048, 12-052, 12-055
- **Parton Distribution Functions:** 11-001, 11-002, 11-016, 11-029, 12-002, 12-033, 12-039, 12-079, 12-086
- **BSM Physics:** 11-017, 11-045, 11-046, 11-048, 11-068
- **Precision in e^+e^- Physics:** 11-025, 11-034, 11-041, 11-067, 12-037
- **Mathematical Methods:** 11-003, 11-024, 11-100
- **Reviews:** 12-047, 12-056



Publications: Networking

Common Work inside LHCPHENOnet with:

- Node Austria [Linz]
- Node Italy
- Node The Netherlands [NIKHEF]
- Node Poland [Katowice]
- Node Spain [Valencia]
- Node United Kingdom [Durham,Liverpool]

Common Work with other Institutions:

- Belgium U. Louvain
- France U. Paris Sud
- Germany U. Bielefeld; RWTH Aachen
- India HRI Allahabad
- Japan KEK Tsukuba
- The Netherlands U. Leiden
- Poland U. Warsaw
- Russia MSU Moscow, IHEP Serpukhov
- USA JLAB, VA



The strong coupling constant $\alpha_s(M_Z^2)$

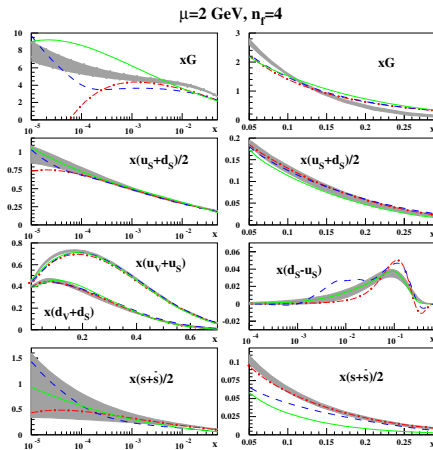
$\alpha_s(M_Z^2)$ from NNLO DIS(+) analyses

	$\alpha_s(M_Z^2)$	
BBG	$0.1134^{+0.0019}_{-0.0021}$	valence analysis, NNLO
GRS	0.112	valence analysis, NNLO
ABKM	0.1135 ± 0.0014	HQ: FFNS $N_f = 3$
JR	0.1124 ± 0.0020	dynamical approach
JR	0.1158 ± 0.0035	standard fit
MSTW	0.1171 ± 0.0014	
ABM	0.1147 ± 0.0012	FFNS, incl. combined H1/ZEUS data
ABM11 _J	$0.1134 - 0.1149 \pm 0.0012$	Tevatron jets (NLO) incl.
CTEQ	0.118 ± 0.005	
NNPDF	$0.1174 \pm 0.0006 \pm 0.0001$	
Gehrmann et al.	$0.1153 \pm 0.0017 \pm 0.0023$	e^+e^- thrust
Abbate et al.	$0.1135 \pm 0.0011 \pm 0.0006$	e^+e^- thrust
BBG	$0.1141^{+0.0020}_{-0.0022}$	valence analysis, N^3 LO

$\Delta_{\text{TH}}\alpha_s = \alpha_s(N^3\text{LO}) - \alpha_s(\text{NNLO}) + \Delta_{\text{HQ}} = +0.0009 \pm 0.0006_{\text{HQ}}$
 NNLO running of all coupling constants and masses in the SM and MSSM.



PDFs for the LHC

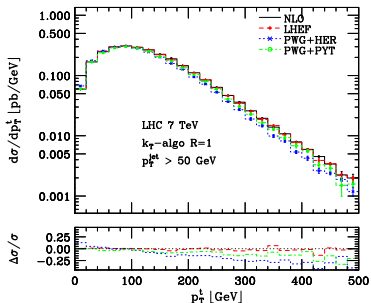
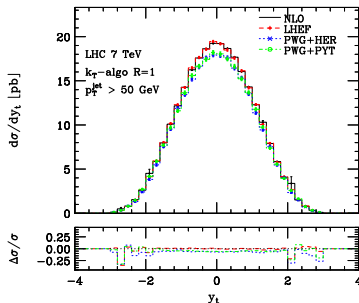


Recent ABM PDFset (Jan 2011): Comparison of ABM (grey) with MSW (red), JR (green) NNPDF (blue).



Incl. $t\bar{t}$ production at NNLO*; NLO $t\bar{t}$ + jet production including showers

$t\bar{t}$ cross section for the LHC + small-x and threshold resummation

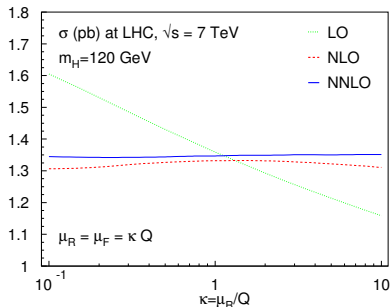
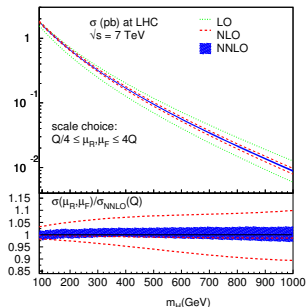


Realistic MC simulations, including FS showering. Implemented in **POWHEG**.
Development of a general NLO MC code to simulate LHC reactions **GOSAM**.



Higgs Cross Section

NNLO Higgs production cross section, including finite m_t effects (also in MSSM).



NNLO vector boson fusion contribution. $\sim 10\%$ of the cross section

Much improved scale dependence.

