

# PDF School 2009

## Welcome and introduction

Thomas Schörner-Sadenius  
(for the Analysis Centre)

Hamburg, 20 October 2009

**PHYSICS AT THE TERASCALE**  
Helmholtz Alliance

**20-23 October 2009**  
DESY, Hamburg

**Topics:**

- Basics of QCD
- Deep-inelastic scattering and the structure of the proton
- PDF fits
- Predictions for the LHC
- Global PDF fitting activities
- PDF error evaluation
- PDF libraries

The PDF school covers hard scattering reactions at colliders, both from the theoretical and the experimental side. Emphasis is put on the current information on parton distributions (PDFs) and their impact on predictions and measurements of cross sections at the Terascale.

The school consists of lectures targeted at Ph.D. students and young post-docs. In addition, practical exercises on the usage of PDFs, PDF error evaluation and on related issues will help to deepen the understanding of the lecture contents.

The final day of the school is devoted to a meeting of the PDF4LHC workshop at which the latest developments concerning PDFs at the Large Hadron Collider will be discussed. The initial three days of the school will prepare the participants for the understanding of these discussions.

Organizing Committee: J. Blümlein (DESY), A. Glazov (DESY), S.-O. Moch (DESY), T. Schörner-Sadenius (DESY)  
The registration fee will be 50 Euros. For further information and in order to apply see:  
<http://www.terascale.de/pdf2009>




































# WELCOME ...

... to the PDF school 2009!

- > The aim of the school: Provide deeper knowledge about parton distribution functions and their QCD basics :
  - Basics of QCD
  - $\alpha_s$  and PDF evolution
  - PDF fits
  - PDF error treatment, PDF libraries, etc.
- > Furthermore, a chance to get to know more people with similar interests (and problems)
  - facilitate building of networks across the Alliance.
- > Important / interesting for me: contacts between different experiments (ATLAS and CMS, HERA community etc.).
  - an important part of the whole “Alliance” idea.
- > Last but not least: PDF4LHC workshop on Friday!



# TIMETABLE

	Tuesday 20 October 2009	Wednesday 21 October 2009	Thursday 22 October 2009
AM	08:30   Registration	09:30   Introduction to QCD 3 - <i>Sven-Olaf Moch (DESY)</i> ( Sem Room 4 )	09:00   PDFs and Physics at Tevatron and LHC - <i>Joey Huston (Michigan State University)</i> ( Sem Room 4 )
	09:30   Welcome and Introduction - <i>Thomas Schoerner-Sadenius (DESY)</i>	10:30 --- Coffee ---	10:00 --- break ---
	09:35   Introduction to QCD 1 - <i>Sven-Olaf Moch (DESY)</i> ( Sem Room 4 )	11:00   Introduction to QCD 4 - <i>Sven-Olaf Moch (DESY)</i> ( Sem Room 4 )	10:30   PDF uncertainties and LHC predictions - <i>Alberto Guffanti (Freiburg University)</i> ( Sem Room 4 )
	10:30 --- coffee ---	12:00 --- Lunch ---	11:30 --- Lunch ---
	10:45   Introduction to QCD 2 - <i>Sven-Olaf Moch (DESY)</i> ( Sem Room 4 )		
	11:45 --- Lunch ---		
PM	14:00   Exercises: recursive methods for scattering amplitudes - <i>Simon Badger (DESY)</i>	14:00   Exercises: alpha_s Evolution - <i>Ulrich Langenfeld (HU Berlin)</i>  Maple file;  Slides 	14:00   PDFs in MC, PDF libraries - <i>Zoltan Nagy (DESY)</i> ( Sem Room 4 )
	16:00 --- Coffee ---	16:00 --- Coffee ---	15:00 --- Coffee ---
	16:15   QCD Fits - <i>Jon Pumplin (Michigan State University)</i> ( Sem Room 4 )	16:30   Deep Inelastic Scattering - <i>Amanda Cooper-Sarkar (Oxford University)</i> ( Sem Room 4 )	15:30   Exercises: PDF error evaluation
			17:00   Predictions and PDFs for the LHC - <i>Joey Huston (Michigan State University)</i>
			19:30   School Dinner



# ORGANISATION DETAILS

- > WLAN is provided → information on paper
- > For exercises:
  - With own laptop: Use school accounts to login to bastion.desy.de using ssh etc. Then move on to pdfschool cluster with the same account.
  - With DELL packs: log in using distributed school accounts.
  - MAPLE: start: xmaple13.s
- > Analysis Seminar on Thursday, 5 p.m. in this seminar room:
  - J. Huston (MSU): “Predictions and PDFs for the LHC”
- > Dinner on Thursday: In a small restaurant not far from here. We leave here at DESY at around 19:30 and walk together.
  - Who will NOT be here?



# SCHOOLS AND WORKSHOPS

**School on Fitting and Related Topics**

**PHYSICS AT THE TERASCALE**  
Helmholtz Alliance

30 March – 2 April 2009  
DESY, Hamburg Site

Determining parameters from fit to data will be a crucial task in analyses of the upcoming LHC data. This school aims at providing education on this topic from a basic to the more advanced level.

**Covered Topics:**

- constant, straight line, parabola & others fits
- clever choices of parameters
- normal equations
- parameter errors and correlations
- fit quality and outlier rejection
- non-linear fit: signal peak(s) on background
- Poisson vs Gaussian statistics
- binned vs unbinned fits
- standard fit
- (special) software tools
- nice physics examples

Organizing Committee: D. Böhler (DESY), F. Klingenberg (Hamburg), W. G. S. G. (DESY), C. H. (DESY), A. Schmitt (DESY), S. Schmitt (DESY), T. Schmitt (DESY), S. Schmitt (DESY), S. Schmitt (DESY)

Registration deadline: 10 March 2009. Please register via the website

<http://www.terascale.de/fitting>

**Monte Carlo School**

**PHYSICS AT THE TERASCALE**  
Helmholtz Alliance

20-24 April 2009,  
DESY Hamburg

**Topics:**

- Monte Carlo techniques and standard physics (S. Schmitt)
- Automated matrix element calculations (S. Schmitt)
- Monte Carlo event generators (S. Schmitt)
- PYTHIA (S. Schmitt)
- HERWIG (S. Schmitt)
- SHERPA (S. Schmitt)
- Exercises

The school covers Monte Carlo techniques and automated calculation of matrix elements. The focus of the school is on Monte Carlo event generators for simulation of processes beyond the standard model. The simulation of QCD and electroweak "background" will also be covered. In practical exercises, BSM signal processes as well as standard model background will be covered.

Registration deadline: 10 March 2009. Please register via the website

**Workshop on Detector Understanding with First LHC Data**

**PHYSICS AT THE TERASCALE**  
Helmholtz Alliance

29 June - 3 July 2009,  
DESY, Hamburg Site

**Topics:**

- Monte ID and reconstruction
- Data and detector simulation
- Tau ID and reconstruction
- Electron and photon
- Tracking, vertexing and b-tagging
- Trigger
- Alignment and calibration
- Monte Carlo simulation for detector reconstruction

The workshop is aimed at PhD students and young postdocs who wish to learn about the different physics groups, their reconstruction, tools and usage in the experiment specific software environment, and about related problems like calibration, alignment, alignment etc. The workshop consists of lectures, computer exercises, and invited talks on related topics.

**Invited talks:**

- The first 100 days of LHC
- Minimum Bias Physics and the Underlying Event at the LHC
- Physics with first data of the LHC

Registration deadline: 21.05.2009. Please register via the website

**Workshop on Advanced Methods in Statistical Data Analysis**

**PHYSICS AT THE TERASCALE**  
Helmholtz Alliance

12-14 October 2009,  
Karlsruhe University

Many searches for expected or unexpected new particles will be performed at the LHC. This workshop aims to provide help and education on some fields of statistical tools which are essential for such searches.

- separating signals and backgrounds using multivariate analysis techniques
- optimal searches, setting limits, making discoveries
- evaluating systematic uncertainties

It aims at PhD students and young Postdocs who have already gained some experience in statistical data analysis and are familiar with ROOT.

Registration deadline: 10 March 2009. Please register via the website

**Monte Carlo School**

**PHYSICS AT THE TERASCALE**  
Strategic Helmholtz Alliance

21-24 April 2008,  
DESY Hamburg

**Topics:**

- Monte Carlo techniques and physics (S. Schmitt)
- NLO Calculations (S. Schmitt)
- NLO and parton showers (S. Schmitt)
- Monte Carlo event generators (S. Schmitt)
- PYTHIA (S. Schmitt)
- HERWIG (S. Schmitt)
- SHERPA (S. Schmitt)
- Exercises (S. Schmitt)

The school covers Monte Carlo techniques and applications in NLO calculations as well as full hadron level Monte Carlo event generators. Participants coming from different generations will be supported in practical exercises and first steps for comparison with measurements will be shown in lectures.

Registration deadline: 10.03.2008. Please register via the website

<http://www.terascale.de/mcs2008>

**Workshop on Single-top physics and fourth-generation quarks**

**PHYSICS AT THE TERASCALE**  
Helmholtz Alliance

14 - 15 September 2009  
DESY, Hamburg Site

**Topics:**

- Theoretical and experimental overview of single top and 4th generation quarks
- Single top analysis at ATLAS/CMS
- Searches for 4th generation quarks at ATLAS and CMS
- Monte Carlo models
- Analysis techniques
- b-Tagging and trigger

The workshop is aimed at PhD students and young postdocs who wish to learn about the different physics groups, their reconstruction, tools and usage in the experiment specific software environment, and about related problems like calibration, alignment, alignment etc. The workshop consists of lectures, computer exercises, and invited talks on related topics.

**Invited talks:**

- The first 100 days of LHC
- Minimum Bias Physics and the Underlying Event at the LHC
- Physics with first data of the LHC

Registration deadline: 21.05.2009. Please register via the website

<https://indico.desy.de/conferenceDisplay.py?confid=2161>

**School on Statistics Tools**

**PHYSICS AT THE TERASCALE**  
Strategic Helmholtz Alliance

29 September - 2 October 2008  
DESY, Hamburg Site

Learn about statistical methods needed for the analysis of the LHC data. The program consists of plenary lectures, special topic talks and practical work on example problems in smaller groups.

**Covered Topics:**

- Optimal signal/background separation, multi-variate techniques
- Searching for signals, discoveries, limits
- Advanced likelihood fit techniques
- Special practical problems, e.g. data corrections (including systematic errors)

**Invited Lecturers:**

- Volker Blobel
- Glen Cowan
- Les Roscher
- Markus Schumacher
- Helge Voss
- Rainer W. Ziegler

Registration deadline: 10 March 2009. Please register via the website

<http://www.terascale.de/stat2008>



# UPCOMING EVENTS

- > Annual Meeting of the Helmholtz Alliance “Physics at the Terascale”, November 11-13, DESY (Hamburg)
  - > Meetings of LHC-D working groups, Alliance research topics (analysis, grid, detector, accelerator), Analysis Working groups, and numerous plenaries.
  - > Important for midterm evaluation of Alliance beginning of December.
  - > Social event!





# A WORD ON THE ANALYSIS CENTRE

and its efforts in education and training (and elsewhere):

- > We provide education events especially in the fields of MC, statistics, and PDFs (but also in others).
- > We depend on your input and feedback: Please
  - > Let us know what you liked and what could be improved
  - > Let us know what additional events you would like to have organised
  - Send an email to [anacen@desy.de](mailto:anacen@desy.de)
- I am very much looking forward to seeing you again in any other Alliance context – school, workshop, working group, ...



# THANK YOU!

- > To the many people who helped to put this school in place.
- > To the organisation: Michaela Grimm, Alla Grabowsky, Sasha Glazov, Johannes Bluemlein
- > To the lecturers and tutors: Sven Moch, Ulrich Langenfeld, Simon Badger, Jon Pumplin, Amanda Cooper-Sarkar, Joey Huston, Alberto Guffanti, Zoltan Nagy, ...
- > DESY IT
- > ... and, last but not least, to DESY and the Alliance for their financial and infrastructure support.

