



# PDF4LHC Working Group Report

## *Run II measurements for PDF fits*

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PDF4LHC Meeting

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# Albert at PDF4LHC in May

## From last meeting...

It is time to think of a coordinated effort aiming at laying out a possible plan for key measurements to be done in the future, in order to **reduce PDF systematics with LHC data**, using present experience.

Michelangelo suggested having, for example, a small document, that could stimulate the experiments to give higher priority to the relevant QCD and EW measurements.

The PDF4LHC steering fully agrees with this goal and will take Initiative in this direction. We would make this the main theme for our next meeting. But we can start now.

People or groups that are interested in contributing/participating should contact us (eg [deroeck@mail.cern.ch](mailto:deroeck@mail.cern.ch))

-> We will put up a twiki page with the input received for discussion.

LHC data from Run I - Public results		
Process	Data	Theory
Inclusive W, Z production	ATLAS 2010 data <a href="#">arXv:1109.5141</a> <a href="#">WZinclusiveData</a>	Differential predictions at NNLO QCD <a href="#">WZinclusiveTheory</a>
Inclusive W,Z production	LHCb 7 TeV 37pb-1 (mu) <a href="#">arXv:1204.1620</a>	
Inclusive Z production	LHCb 7 TeV 940pb-1 (e) <a href="#">arXv:1212.4620</a>	
Inclusive W/Z production	CMS 8 TeV 19pb-1 (e/mu) <a href="#">arXiv:1402.0923</a> CMS 7 TeV 36pb-1 (e/mu) <a href="#">arXiv:1107.4789</a>	Inclusive cross section at NNLO
W lepton charge asymmetry	CMS 7 TeV 840pb-1 (e) <a href="#">arXiv:1206.2598</a>	
W lepton charge asymmetry	CMS 7 TeV 5fb-1 (mu) <a href="#">arXiv:1312.6283</a>	
Top quark pair production	ATLAS 7 TeV 5fb-1 ATL-PHYS-PUB-2013-056	
Top quark pair production	ATLAS 7 TeV and 8 TeV data CMS 7 and 8 TeV data <a href="#">TTbarData</a>	Inclusive cross-sections at NNLO Differential distributions at NLO+NNLL, full NNLO in progress <a href="#">TTbarTheory</a>
Isolated photon production	ATLAS 7 TeV data from 2011 run <a href="#">arXiv:1311.1440</a> <a href="#">DirectPhotonData</a>	Differential distributions at NLO <a href="#">DirectPhotonTheory</a>
Isolated photon production	CMS 7 TeV 36pb-1 <a href="#">arXiv:1108.2044</a>	
Isolated photon + jet	CMS 7 TeV 2.1fb-1 <a href="#">arXiv:1311.6141</a>	
W production in association with charm	ATLAS 2011 data <a href="#">arXv:1402.6263</a>	
W production in association with charm	CMS 7 TeV 5fb-1 <a href="#">arXiv:1310.1138</a>	
Z production in association with charm	LHCb 7 TeV 1fb-1 <a href="#">arXv:1401.3245</a>	
Z rapidity and transverse momentum	CMS 7 TeV 36pb-1 <a href="#">arXiv:1110.4973</a>	
Z transverse momentum	ATLAS 7 TeV 4fb-1 <a href="#">arXiv:1211.6899</a>	
Inclusive jet production	ATLAS 2011 2.76 data <a href="#">arXv:1304.4739</a>	
Dijet production	ATLAS 2011 data <a href="#">arXv:1312.3524</a>	
Inclusive jet and dijet production	CMS 7 TeV 5fb-1 <a href="#">arXiv:1212.6660</a>	
3/2 jets ratio	CMS 7 TeV 5fb-1 <a href="#">arXiv:1304.7498</a>	
Z + jets	LHCb 7 TeV 1fb-1 <a href="#">arXv:1310.8197</a>	
Z + jets	ATLAS 7 TeV 4fb-1 <a href="#">arXv:1304.7098</a>	
Single top production		
Low-mass Drell-Yan	ATLAS 2011 and 2010 data <a href="#">arXv:1404.1212</a>	
High-mass Drell-Yan	ATLAS 2011 data <a href="#">arXv:1305.1122</a>	

- Aim for a write-up as requested by the LPCC chair on the LHC PDF data experience/anticipated precision etc by **fall 2014** Aim for a first draft in September... Volunteers for editorial work?
- The whole community is **invited to join** this project
- We want to foster discussion among the PDF fitters and the experiments regarding the **presentation of the systematic errors** in such a manner that the data can be of greatest use in the PDF fits, especially with data sets for the same processes at different energies; and discussion among the PDF fitters and the experiments regarding **data sets for the same process from different experiments** that may lead to different conclusions regarding specific PDF determinations
- The  $W+c$  data channel --being discussed among the experiments now-- could be a first good case to prepare & try combination of ATLAS+CMS data...
- APPLGrid files of the experimental data? Aim for public web pages with that information



# Towards the write-up

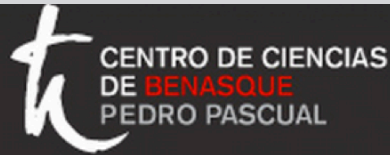
- 🗣 It is now timely to begin to write down this information into a **coherent write-up**, which should contain:
  - ✅ **Overview of LHC Run I measurements with PDF sensitivity**, both published and in preparation
  - ✅ **Plans for PDF-related measurements** at Run II from ATLAS, CMS and LHCb
  - ✅ **Whishlist from the PDF fitting community** to prioritize these measurements in order of relevance
  - ✅ Recommendations about how to **optimize presentation and delivery of PDF-sensitive measurements** from the LHC experiments to the PDF community: data in HepData, correlated systematics, theory input, fast NLO grids, ....
- 🗣 I can **coordinate the write-up**, but need help to properly cover all the points above from both the LHC experiments and for the theory community
- 🗣 Ideally, **contact persons** for this write-up should be identified in **ATLAS, CMS and LHCb**. Mandy and Claire have already volunteered from the ATLAS side, but the more people involved, the sooner the document will be completed
- 🗣 I can coordinate **the input from interested parties from the theory / PDF fitting community**, please send ideas/suggestions/requests to me
- 🗣 The plan is to have a **first draft before the end of the year**, which then can be circulated, edited and fine-tuned, with **final delivery in early 2015**. Perhaps finalize it during the **Benasque PDF workshop**?
- 🗣 This document would be published in **Journal of Physics G**

# Towards the write-up

- ☪ Most of this work will be bookkeeping and accountancy, specially for Run I measurements, but it is really essential to guide the experiments now that **preferences for Run II measurements are being decided**
- ☪ Also this is the right time to request **special run conditions**, like low pile-up runs for instance
- ☪ We will have a table that summarizes all relevant Run I measurements, and where they have been used for PDF studies, to have an **overview of the global status of PDF measurements at the LHC**

Measurement	$\sqrt{s}$ , $\mathcal{L}_{\text{int}}$	Motivation	Reference	Use in PDF fits
ATLAS				
$W, Z$ rapidity	7 TeV, 36 pb <sup>-1</sup>	quark flavor separation strangeness	[27]	[6, 10]
$W, Z$ rapidity	7 TeV, 5 fb <sup>-1</sup>	quark flavor separation strangeness	early 2015	-
$W + c/D$ production	7 TeV, 5 fb <sup>-1</sup>	strangeness	[19]	[19]
Inclusive jets	7 TeV, 36 pb <sup>-1</sup>	large- $x$ gluons/quarks	[28]	[10]
Dijets	7 TeV, 36 pb <sup>-1</sup>	large- $x$ gluons/quarks	[28]	-
Dijets	7 TeV, 5 fb <sup>-1</sup>	large- $x$ gluons/quarks	[29]	-
CMS				
$W$ asymmetry	7 TeV, 36 pb <sup>-1</sup>	quark flavor separation		
$W e$ asymmetry	7 TeV, 880 pb <sup>-1</sup>	quark flavor separation		
$W \mu$ asymmetry	7 TeV, 5 fb <sup>-1</sup>	quark flavor separation	[15]	[15]

# Perhaps the right venue to finish this Run II document?



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DE BENASQUE  
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## SCIENTIFIC ACTIVITY

PRESENT

2014

2015

PREVIOUS

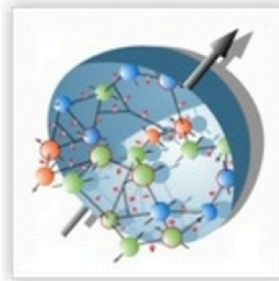
## ORGANIZERS

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## Parton Distributions for the LHC

2015, Feb 15 -- Feb 21

Organizers:

J. Rojo (CERN / University of Oxford)

## Benasque Center for Science, Spain

With the recent discovery of a Higgs-like particle at the Large Hadron Collider (LHC), high-energy physics has entered a new era that emphasizes detailed studies of the properties of this new particle and exploration of the energy frontier in search for Beyond the Standard Model (BSM) dynamics. To fully exploit the LHC potential, theoretical predictions for many processes must be provided with unprecedented accuracy. A crucial ingredient of these theoretical predictions are the Parton Distributions of the proton (PDFs). While much progress has been achieved in the last years towards improved determinations of PDFs, the requirements for the upcoming 13 TeV Run II at the LHC require further development of the existing directions in PDF physics, as well as the exploration of completely new avenues, such as PDFs with electroweak effects or PDFs for NLO Monte Carlo event generators. In addition, exploiting the full power of PDF physics to improve BSM prospects requires a direct interaction between PDF and BSM phenomenology.

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### CONFERENCE DATA

Application deadline for this conference is November 30.

APPLICATION FORM

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ACCOMMODATION RATES

LIST OF PARTICIPANTS

