

Ultimate Precision at Hadron Colliders

Monday, 25 November 2019 - Friday, 6 December 2019

Book of Abstracts

Contents

Welcome / Registration	1
Introduction to the workshop	1
PDFs (long talk & discussion)	1
Informal discussions	1
Measurements of EW precision observables (long talk & discussion)	1
Excursion & dinner	1
Low-energy observables (long talk & discussion)	1
Higgs boson property measurements and high-energy probes (long talk & discussion)	1
Informal discussions	2
Excursion & dinner	2
Weak mixing angle at low Q^2 (JLab/Mainz experiments)	2
Weak mixing angle at low Q^2 (Theory impact)	2
Weak mixing angle from parity-violating-ep scattering PVES & V_{ud} from beta decay	2
Quark masses from lattice QCD	2
Discussion on CKM elements & quark masses	2
$g-2$ Fermilab E989 experiment: Status report	3
α at low- Q & MuonE experiment: Status report	3
Hadronic light-by-light (HLbL) from dispersive/analytic methods	3
Hadronic Vacuum Polarization (HVP) & extraction of α at low Q	3
HVP & HLbL from Lattice QCD+QED	3
Discussion on $g-2$	3
α_s from lattice QCD (FLAG)	3
α_s from tau decays and low mass e^+e^-	4

alpha_s from parton-to-hadron FFs	4
Discussion on alpha_s	4
VBS and VBF measurements at the HL/HE-LHC	4
VBS calculations for the HL/HE-LHC	4
VBS calculations for the HL/HE-LHC	4
Discussion	5
Diboson/triboson measurements	5
Diboson/triboson production : QCD and EWK corrections	5
Ancillary measurements wishlist	5
Calculations wishlist	5
Wrap up of sessions	5
Write-up	5
Relevance of precision measurements for the global EW fit	5
Measurement of m_W : experimental and theoretical requirements	6
Measurement of $\sin^2 \theta$: experimental and theoretical requirements	6
Towards high-precision PDFs : Experimental perspectives	6
Towards high-precision PDFs : Theory vision	6
Theory vision : PDFs	6
Theory vision : discussion on perturbative calculations	6
Theory vision : backgrounds	6
Experimental vision	7
Experimental vision	7
Role in global interpretation	7
Esperimental review	7
Beyond the benchmarks: off-shell Higgs production	7
Theory 2	7
PDFs from EIC and impact in LHC kinematics	7
Open-source tool for QCD analysis	7
Correlations of PDFs, α_s and m_q in QCD analyses	8
Correlations among global PDFs: toy data results	8

Combined QCD and BSM analyses at HERA	8
PDFs and SMEFT interplay	8
Compatibility of experimental constraints in precise QCD analyses	8
Stable covariance matrices for PDF fits	8
PDF analyses at CMS	8
PDF analuses at ATLAS	9
Combined fits PDF+EW parameters	9
Prospects for PDF combination and benchmarks	9
Treatment of theory uncertainties in the PDFs	9
PDF prospects at HL-LHC	9
EW corrections in PDF fits & photon PDF	9
Global PDF News : CT18	9
Global PDF News : ABMP	10
Global PDF News : NNPDF	10
Global PDF News: MMHT	10
Recent Progress in Theory tools for QCD analysis (ApplFast etc)	10
Forward LHC data in QCD analyses	10
PDFs from LHeC and impact in LHC kinematics	10
Interplay between Top quark and Higgs boson measurements¶	10
Future of precision measurements	10
State of the art of low-energy combinations	11
Global vision of electroweak measurements	11
Wish list from experiment to theory	11
Coffee	11
Wish list from a theorist to experiment	11
Interplay between Top quark and Higgs boson measurements	11
Top Higgs interplay Th	11
PDF and combinations Exp	12
Impact of PDFs on global interpretations	12
Higgs EFT and models of new physics	12

PDF and BSM effects in high-mass tails	12
Simplified Template Cross sections	12
Diboson Precision Measurements and EFT	12
Theorists' tools for global interpretations	12
Current global interpretation efforts - SM	13
Current BSM global interpretation efforts	13
Tools for global analyses and presentation of experimental results	13
Experimental challenges: high- vs low-pileup measurements	13
Discussion on sensitivity to hadronic uncertainties of individual observables	13
Revisiting the estimate of PDF uncertainties	13
Ultimate QCD tools	13
Discussion	14
Combination of MW / sin2theta final values obtained at different colliders/experiments .	14
Global EW fits: experimental and theoretical issues	14
Towards fully NLO-EW analyses	14
Discussion	14
Discussion	14
Discussion	14
Discussion	15
Parton Distribution Functions from Lattice QCD	15
Role in global interpretation	15
Discussion	15
High-mass Drell-Yan measurements	15
Discussion	15
Discussion	15
Higgs and Flavour: brief experimental overview and expectations	15
Discussion	16
Discussion	16
Discussion	16
Discussion	16

Discussion	16
$O(\alpha^2)$ initial state QED corrections in $e^+e^- \rightarrow f \bar{f}$	16
Experimental results on the EFT interpretations of Higgs boson measurements	16
Discussion	17
Discussion	17
Restaurant "Le Mangata", Bures-sur-Yvette	17
Restaurant "Le Gramophone", Orsay	17
Buffet at Institut Pascal	17
Restaurant "Le Gramophone", Orsay	17
Workshop objectives	17

1

Welcome / Registration

2

Introduction to the workshop

3

PDFs (long talk & discussion)

4

Informal discussions

5

Measurements of EW precision observables (long talk & discussion)

6

Excursion & dinner

7

Low-energy observables (long talk & discussion)

8

Higgs boson property measurements and high-energy probes (long talk & discussion)

9

Informal discussions

10

Excursion & dinner

Low-energy observables / 11

Weak mixing angle at low Q^2 (JLab/Mainz experiments)

Corresponding Author: maas@him.uni-mainz.de

Low-energy observables / 12

Weak mixing angle at low Q^2 (Theory impact)

Corresponding Author: erler.jens@gmail.com

Low-energy observables / 13

Weak mixing angle from parity-violating-ep scattering PVES & V_{ud} from beta decay

Corresponding Author: cseng@physics.umass.edu

Low-energy observables / 14

Quark masses from lattice QCD

Corresponding Author: andrew.lytle@roma2.infn.it

Low-energy observables / 15

Discussion on CKM elements & quark masses

Low-energy observables / 16

g-2 Fermilab E989 experiment: Status report

Low-energy observables / 17

alpha at low-Q & MuonE experiment: Status report

Corresponding Author: luca.trentadue@cern.ch

Low-energy observables / 18

Hadronic light-by-light (HLbL) from dispersive/analytic methods

Corresponding Author: gilberto.colangelo@gmail.com

Low-energy observables / 19

Hadronic Vacuum Polarization (HVP) & extraction of alpha at low Q

Corresponding Author: andreas.hoecker@cern.ch

Low-energy observables / 20

HVP & HLbL from Lattice QCD+QED

Corresponding Author: antoine.gerardin@desy.de

Low-energy observables / 21

Discussion on g-2

Low-energy observables / 22

alpha_s from lattice QCD (FLAG)

Corresponding Author: rhorsley@ph.ed.ac.uk

Low-energy observables / 23

alpha_s from tau decays and low mass e+e-

Corresponding Author: maarten@sfsu.edu

Low-energy observables / 24

alpha_s from parton-to-hadron FFs

Corresponding Author: redamperez@gmail.com

Low-energy observables / 25

Discussion on alpha_s

Higgs and High Energy Probes / 26

VBS and VBF measurements at the HL/HE-LHC

Corresponding Author: corinne.goy@cern.ch

Higgs and High Energy Probes / 27

VBS calculations for the HL/HE-LHC

Corresponding Authors: christopher.schwan@physik.uni-freiburg.de, christopher.schwan@mi.infn.it

Higgs and High Energy Probes / 28

VBS calculations for the HL/HE-LHC

Corresponding Authors: christopher.schwan@mi.infn.it, christopher.schwan@physik.uni-freiburg.de

Higgs and High Energy Probes / 29

Discussion

Higgs and High Energy Probes / 30

Diboson/triboson measurements

Corresponding Author: philip.sommer@cern.ch

Higgs and High Energy Probes / 31

Diboson/triboson production : QCD and EWK corrections

Corresponding Authors: jonas.lindert@gmail.com, lindert@mppmu.mpg.de, lindert@physik.uzh.ch

Higgs and High Energy Probes / 32

Ancillary measurements wishlist

Higgs and High Energy Probes / 33

Calculations wishlist

Higgs and High Energy Probes / 34

Wrap up of sessions

Higgs and High Energy Probes / 35

Write-up

Measurements of EW precision observables / 36

Relevance of precision measurements for the global EW fit

Measurements of EW precision observables / 37

Measurement of m_W : experimental and theoretical requirements

Corresponding Author: stefano.camarda@cern.ch

Measurements of EW precision observables / 38

Measurement of $\sin^2 \theta$: experimental and theoretical requirements

Corresponding Author: bodek@pas.rochester.edu

PDFs / 39

Towards high-precision PDFs : Experimental perspectives

Corresponding Author: glazov@mail.desy.de

PDFs / 40

Towards high-precision PDFs : Theory vision

Corresponding Author: lucian.harland-lang@physics.ox.ac.uk

Higgs and High Energy Probes / 41

Theory vision : PDFs

Corresponding Author: ubiali@hep.phy.cam.ac.uk

Higgs and High Energy Probes / 42

Theory vision : discussion on perturbative calculations

Higgs and High Energy Probes / 43

Theory vision : backgrounds

Corresponding Authors: pozzorin@physik.uzh.ch, stefano.pozzorini@cern.ch

Higgs and High Energy Probes / 44

Experimental vision

Corresponding Author: andrew.gilbert@cern.ch

Higgs and High Energy Probes / 45

Experimental vision

Corresponding Author: elisabeth.petit@cern.ch

Higgs and High Energy Probes / 46

Role in global interpretation

Higgs and High Energy Probes / 47

Esperimental review

Higgs and High Energy Probes / 48

Beyond the benchmarks: off-shell Higgs production

Corresponding Authors: n.kauer@rhul.ac.uk, nikolas.kauer@cern.ch

Higgs and High Energy Probes / 49

Theory 2

PDFs / 50

PDFs from EIC and impact in LHC kinematics

Corresponding Author: tjhobbs@smu.edu

PDFs / 51

Open-source tool for QCD analysis

Corresponding Author: francesco.giuli@cern.ch

PDFs / 52

Correlations of PDFs, a_s and m_q in QCD analyses

Corresponding Authors: sergey.alekhin@cern.ch, sergey.alekhin@desy.de, sergey.alekhin@ihep.ru

PDFs / 53

Correlations among global PDFs: toy data results

PDFs / 54

Combined QCD and BSM analyses at HERA

Corresponding Authors: oleksii.turkot@desy.de, oleksii.turkot@cern.ch

PDFs / 55

PDFs and SMEFT interplay

Corresponding Author: si292@cam.ac.uk

PDFs / 56

Compatibility of experimental constraints in precise QCD analyses

Corresponding Author: nadolsky@smu.edu

PDFs / 57

Stable covariance matrices for PDF fits

Corresponding Author: z.kassabov@cern.ch

PDFs / 58

PDF analyses at CMS

PDFs / 59

PDF analyses at ATLAS

PDFs / 60

Combined fits PDF+EW parameters

Corresponding Author: simone.amoroso@cern.ch

PDFs / 61

Prospects for PDF combination and benchmarks

Corresponding Author: e.nocera@nikhef.nl

PDFs / 62

Treatment of theory uncertainties in the PDFs

Corresponding Author: voisey@hep.phy.cam.ac.uk

PDFs / 63

PDF prospects at HL-LHC

Corresponding Author: shaun.bailey@wadham.ox.ac.uk

PDFs / 64

EW corrections in PDF fits & photon PDF

Corresponding Author: christopher.schwan@mi.infn.it

PDFs / 65

Global PDF News : CT18

PDFs / 66

Global PDF News : ABMP

PDFs / 67

Global PDF News : NNPDF

PDFs / 68

Global PDF News: MMHT

PDFs / 69

Recent Progress in Theory tools for QCD analysis (ApplFast etc)

PDFs / 70

Forward LHC data in QCD analyses

PDFs / 71

PDFs from LHeC and impact in LHC kinematics

Corresponding Authors: a.cooper-sarkar@physics.ox.ac.uk, amanda.cooper-sarkar@physics.ox.ac.uk

Global Interpretation / 72

Interplay between Top quark and Higgs boson measurements¶

Corresponding Author: maria.moreno.llacer@cern.ch

Global Interpretation / 73

Future of precision measurements

Corresponding Author: christophe.grojean@cern.ch

Global Interpretation / 74

State of the art of low-energy combinations

Global Interpretation / 75

Global vision of electroweak measurements

Corresponding Author: erler@fisica.unam.mx

Global Interpretation / 76

Wish list from experiment to theory

Corresponding Author: predrag.milenovic@cern.ch

Global Interpretation / 77

Coffee

Global Interpretation / 78

Wish list from a theorist to experiment

Corresponding Author: francesco.riva@cern.ch

Global Interpretation / 79

Interplay between Top quark and Higgs boson measurements

Corresponding Author: maria.moreno.llacer@cern.ch

Global Interpretation / 80

Top Higgs interplay Th

Corresponding Author: eleni.vryonidou@cern.ch

Global Interpretation / 81

PDF and combinations Exp

Global Interpretation / 82

Impact of PDFs on global interpretations

Corresponding Author: celine.degrande@cern.ch

Global Interpretation / 83

Higgs EFT and models of new physics

Corresponding Author: jose.santiago.perez@cern.ch

Global Interpretation / 84

PDF and BSM effects in high-mass tails

Corresponding Author: e.rizvi@qmul.ac.uk

Global Interpretation / 85

Simplified Template Cross sections

Global Interpretation / 86

Diboson Precision Measurements and EFT

Corresponding Author: hannes.mildner@cern.ch

Global Interpretation / 87

Theorists' tools for global interpretations

Corresponding Author: ken.mimasu@uclouvain.be

Global Interpretation / 88

Current global interpretation efforts - SM

Global Interpretation / 89

Current BSM global interpretation efforts

Corresponding Author: tty20@cam.ac.uk

Global Interpretation / 90

Tools for global analyses and presentation of experimental results

Corresponding Author: nicholas.wardle@cern.ch

Measurements of EW precision observables / 91

Experimental challenges: high- vs low-pileup measurements

Corresponding Author: joshbendavid@gmail.com

Measurements of EW precision observables / 92

Discussion on sensitivity to hadronic uncertainties of individual observables

Measurements of EW precision observables / 93

Revisiting the estimate of PDF uncertainties

Corresponding Author: emanuele.bagnaschi@psi.ch

Measurements of EW precision observables / 94

Ultimate QCD tools

Author: Thomas Gehrman^{None}

Corresponding Author: thomas.gehrmann@physik.unizh.ch

Measurements of EW precision observables / 95

Discussion

Measurements of EW precision observables / 96

Combination of MW / sin²theta final values obtained at different colliders/experiments

Corresponding Author: nansi.andari@cern.ch

Measurements of EW precision observables / 97

Global EW fits: experimental and theoretical issues

Corresponding Author: matthias.schott@cern.ch

Measurements of EW precision observables / 98

Towards fully NLO-EW analyses

Corresponding Author: mauro.chiesa@physik.uni-wuerzburg.de

Higgs and High Energy Probes / 99

Discussion

Higgs and High Energy Probes / 100

Discussion

Higgs and High Energy Probes / 101

Discussion

Higgs and High Energy Probes / 102

Discussion

PDFs / 103

Parton Distribution Functions from Lattice QCD

Corresponding Author: savvaslz@gmail.com

Higgs and High Energy Probes / 104

Role in global interpretation

Corresponding Author: christophe.grojean@cern.ch

Higgs and High Energy Probes / 105

Discussion

Higgs and High Energy Probes / 106

High-mass Drell-Yan measurements

Corresponding Author: aram.apyan@cern.ch

Higgs and High Energy Probes / 107

Discussion

Higgs and High Energy Probes / 108

Discussion

Higgs and High Energy Probes / 109

Higgs and Flavour: brief experimental overview and expectations

Corresponding Author: devivie@lal.in2p3.fr

Higgs and High Energy Probes / 110

Discussion

Higgs and High Energy Probes / 111

Discussion

Higgs and High Energy Probes / 112

Discussion

Higgs and High Energy Probes / 113

Discussion

Higgs and High Energy Probes / 114

Discussion

Measurements of EW precision observables / 115

$O(\alpha^2)$ initial state QED corrections in $e^+e^- \rightarrow f \bar{f}$

Corresponding Author: kay.schoenwald@desy.de

Global Interpretation / 116

Experimental results on the EFT interpretations of Higgs boson measurements

Corresponding Author: paolo.francavilla@cern.ch

Measurements of EW precision observables / 117

Discussion

Measurements of EW precision observables / 118

Discussion

Dinner / 119

Restaurant "Le Mangata", Bures-sur-Yvette

Dinner / 120

Restaurant "Le Gramophone", Orsay

121

Buffet at Institut Pascal

Dinner / 122

Restaurant "Le Gramophone", Orsay

Higgs and High Energy Probes / 124

Workshop objectives

Corresponding Author: maarten.boonekamp@cern.ch