LHC forward physics

This content has been downloaded from IOPscience. Please scroll down to see the full text.

(http://iopscience.iop.org/0954-3899/43/11/110201)

View the table of contents for this issue, or go to the journal homepage for more

Download details:

IP Address: 131.169.49.181
This content was downloaded on 13/12/2016 at 10:16

Please note that terms and conditions apply.

You may also be interested in:

Women and Physics: What helps, what hurts: family and career
L McCullough

The LHCf experiment: modelling cosmic rays at LHC
A Tricomi, O Adriani, L Bonechi et al.

Physics Opportunity with an Electron-Ion Collider
Patrizia Rossi

From LHC physics to Dirac-Weyl materials
Alfredo Raya

The LHCf detector at the CERN Large Hadron Collider
The LHCf Collaboration, O Adriani, L Bonechi et al.

Upgrade of the CMS tracker
A Tricomi

The performance of the LHCf detector for hadronic showers
K Kawade, O Adriani, L Bonechi et al.

The TOTEM experiment: total cross-section measurement and soft diffraction at LHC
K Österberg
LHC forward physics

A Santoro$^{21}$, R Schicker$^{73}$, J Seger$^{54}$, S Sen$^{73}$, A Shabanov$^{35}$, W Schafer$^{25}$, G Gil Da Silveira$^{39}$, P Skands$^{74}$, R Soluk$^{28}$, A van Spilbeeck$^{9}$, R Staszewski$^{25}$, S Stevenson$^{75}$, W J Stirling$^{86}$, M Strikman$^{76}$, A Szczurek$^{25,38}$, L Szymanowski$^{77}$, J D Tapia Takaki$^{37}$, M Tasevsky$^{43}$, K Taesoo$^{78}$, C Thomas$^{75}$, S R Torres$^{79}$, A Tricomi$^{79}$, M Trzebinski$^{25}$, D Tsybychev$^{34}$, N Turini$^{1}$, R Ulrich$^{1}$, E Usenko$^{35}$, J Varela$^{37}$, M Lo Vetere$^{10}$, A Villatoro Tello$^{53}$, A Vilela Pereira$^{21}$, D Volyanskyy$^{84}$, S Wallon$^{13,85}$, G Wilkinson$^{75}$, H Wöhrmann$^{1}$, K C Zapp$^{5}$ and Y Zoccarato$^{24}$

1. Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany
2. Fermilab, Batavia, USA
3. INFN Torino, Italy
4. Università del Piemonte Orientale, Novara, Italy
5. AGH University of Science and Technology, Krakow, Poland
6. CERN, Geneva, Switzerland
7. Central China Normal University (CCNU), Wuhan, Hubei, People’s Republic of China
8. University of Hamburg, Germany
9. University of Antwerpen, Belgium
10. DESY, Hamburg, Germany
11. NIKHEF and GRAPPA, Amsterdam, The Netherlands
12. INFN Pisa, Pisa, Italy and Universita degli Studi di Siena, Siena, Italy
13. LPT, Université Paris-Sud, CNRS, F-91405, Orsay, France
14. SLAC National Accelerator Laboratory, Stanford University, Stanford, CA, USA
15. Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Prague, Czech Republic
16. Universita and INFN, Bologna, Italy
17. University of Glasgow, UK
18. Universidad Autonoma de Sialoa, Culiacan, Mexico
19. Pontificia Universidad Catolica del Peru (PUCP), Lima, Peru
20. Universita della Calabria, Cosenza, Italy
21. Universidade do Estado do Rio de Janeiro (UERJ), Rio de Janeiro, Brazil
22. Instituto de Fisica Teorica UAM/CSIC and Universidad Autonoma de Madrid, Cantoblanco, Madrid, Spain
23. LLR, Ecole Polytechnique, Paliseau, France
24. IPN, Institut de Physique Nuclaire, Université Claude Bernard Lyon-I, CNRS/IN2P3, Lyon, France
25. Institute of Nuclear Physics Polish Academy of Sciences, Krakow, Poland
26. The Rockefeller University, New York, USA
27. School of Physics and Astronomy, University of Manchester, UK
28. University of Alberta, Canada
29. Research and Development Institute of Power Engineering (NIKIET), Moscow, Russia
30. Department of Physics, University of Jyvaskyla, Jyvaskyla, Finland
31. Department of Physics, University of Helsinki, Helsinki, Finland
32. INFN Genova, Italy
33. ICTP South American Institute for Fundamental Research, Instituto de Fisica Teorica, Sao Paulo State University, Brazil
34. Stony Brook University, Stony Brook, New York, USA
35 Russian Academy of Sciences, Institute for Nuclear Research (INR), Moscow
36 Gruppo Collegato INFN of Cosenza, Italy
37 LIP, Lisbon, Portugal
38 University of Rzeszow, Rzeszow, Poland
39 High and Medium Energy Group, Instituto de Fisica e Matematica, Universidade Federal de Pelotas, Pelotas, Brazil
40 Department of Physics and Astronomy, University College London, UK
41 Instituto de Ciencias Nucleares, Universidad Nacional Autonoma de Mexico, Mexico
42 Centro de Investigacion y de Estudios Avanzados del IPN CINVESTAV, Dep. de Fisica and Dep. de Fisica Applicada, Mexico
43 Institute of Physics, Academy of Sciences, Prague, Czech Republic
44 IPM, Institute for Research in Fundamental Sciences, Tehran, Iran
45 Moscow State University, Moscow, Russia
46 Alikhanyan National Scientific Laboratory (ANSL), Armenia
47 Institute for Particle Physics Phenomenology, Physics Department, University of Durham, UK
48 Lawrence Berkeley National Laboratory, Berkeley, CA, USA
49 Instytut Fizyki Jadrowej Polskiej Akademii, Krakow, Poland
50 Institut de Physique Théorique, CEA Saclay, Gif-sur-Yvette, France
51 Centre de Physique Théorique, Ecole Polytechnique, CNRS, Palaiseau, France
52 University of Warwick, UK
53 Benemerita Autonomous University of Puebla, Mexico
54 University College Dublin, Dublin, Ireland
55 University of Athens, Greece
56 Dipartimento Inter-Ateneo di Fisica di Bari, INFN Sezione di Bari, Bari, Italy
57 University of Kansas, Lawrence, USA
58 Case Western Reserve University, Department of Physics, Cleveland, USA
59 Department of Physics and Technology, University of Bergen, Bergen, Norway
60 Departamento de Fisica, Universidade Federal de Santa Catarina, Florianopolis, Brazil
61 Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany
62 Theoretical High Energy Physics, Department of Astronomy and Theoretical Physics, Lund University, Sweden
63 Utrecht University and Nikhef, Utrecht, The Netherlands
64 Creighton University, Omaha, USA
65 Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, Brazil
66 ITEP, Moscow, Russia
67 Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil
68 Centro Studi e Ricerche ‘Enrico Fermi’, Roma, Italy
69 Petersburg Nuclear Physics Institute, Gatchina, St. Petersburg, Russia
70 STEL/KMI, Nagoya University, Nagoya, Japan
71 IRFU-SPP, CEA Saclay, Gif-sur-Yvette, France
72 Ruprecht-Karls-Universitaet Heidelberg, Germany
73 Hacettepe University, Ankara, Turkey
74 School of Physics and Astronomy, Monash University, Clayton, Australia
75 Department of Physics, University of Oxford, Oxford, UK
76 Penn State University, University Park, USA
77 National Center for Nuclear Research, Warsaw, Poland
78 Yonsei University, Seoul, Korea
79 University of Catania and INFN Sezione di Catania, Italy
80 Università degli Studi di Genova, Dipartimento di Fisica and INFN, Genova, Italy
81 Cracow University of Technology, Poland
We give here an introduction to the complete report that may be found at: stacks.iop.org/43/110201/mmedia

In early 2013 the LHC forward physics and diffraction working group (WG) was formed, as part of the activities of common interest to the LHC experiments organized by the LHC Physics Centre at CERN (LPCC, http://cern.ch/lpcc). The primary goal of the WG was to coordinate, across the experiments and with the theoretical community, the discussion of the physics opportunities, experimental challenges and accelerator requirements arising from the study of forward phenomena and diffraction at the LHC. The mandate of the group included the preparation of a report, to outline a coherent picture of the forward physics programme at the LHC, taking into account the potential of the existing experiments—including possible detector upgrades—the possible beam configurations and performance of the accelerator, and the optimization of the LHC availability for these measurements, in view of the priority need to maximize the LHC total integrated luminosity.

The WG was set up by the LPCC in coordination with the management of the ALICE, ATLAS, CMS, LHCb, LHCf and TOTEM experiments, which nominated their representatives in the WG steering group and the WG co-chairs. The steering group identified theory conveners, to oversee the relevant sections of the report, and created three subgroups to focus the WG activity, reflecting the physics goals appropriate to different LHC running conditions:

- low pileup and luminosity (few 10 pb$^{-1}$),
- medium luminosity (few 100 pb$^{-1}$),
- high luminosity (100 fb$^{-1}$).

All interested physicists were then invited to attend the 16 WG meetings held so far, and to contribute to the writing of this report, which hopefully represents the unanimous views of the broad forward-physics community. The detailed information about the WG, including the composition of the steering committee and of the subgroups’ conveners, the list of meetings, the link to the WG material and to its mailing list subscription, can be found in the WG web page at: http://cern.ch/LPCC/index.php?page=fwd_wg.

As requested by the LHC experiments committee (LHCC), and following the several presentations delivered to the committee in the course of the WG activity, this final report has been submitted to the LHCC, and forms the basis for its internal discussions and recommendations on the requests by the experiments for beam time and detector upgrades, related to forward physics, during Run 2 of the LHC and beyond. More in general, we trust that this report will promote the deeper understanding and appreciation of the value of this component of the LHC physics programme, and will encourage further progress and the development of new ideas, both on the theoretical and experimental fronts.
We give a comprehensive overview of the rich field of forward physics, with special attention to the topics that can be studied at the LHC. The report starts by presenting a selection of the Monte Carlo simulation tools currently available, chapter 2, then enters the rich phenomenology of QCD at low, chapter 3, and high, chapter 4, momentum transfer, while the unique scattering conditions of central exclusive production are analyzed in chapter 5. The last two experimental topics, cosmic ray and heavy ion physics are presented in chapters 6 and 7 respectively. Chapter 8 is dedicated to the BFKL dynamics, multiparton interactions, and saturation. The report ends with an overview of the forward detectors at LHC. Each chapter is correlated with a comprehensive bibliography, attempting to provide to the interested reader with a wide opportunity for further studies.

The chairs of the LHC Forward Physics working group.