

## Major Report



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## LHC forward physics

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We give here an introduction to the complete report that may be found at: [stacks.iop.org/jpg/43/110201/mmedia](https://stacks.iop.org/jpg/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  $10 \text{ pb}^{-1}$ ),
- medium luminosity (few  $100 \text{ pb}^{-1}$ ),
- high luminosity ( $100 \text{ fb}^{-1}$ ).

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](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.



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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.**