Foreword

A 100 TeV pp collider is under consideration, by the high-energy physics community [1, 2], as an important step for the future development of our field, following the completion of the LHC and High-luminosity LHC physics programmes. In particular, CERN is considering 100 TeV pp collisions as the key target of a Future Circular Collider facility [1], built around a $\sim$100 km tunnel and designed to deliver pp, e^+e^- and ep collisions, in addition to a programme with heavy ion beams and with the injector complex. CERN is coordinating an international study tasked with the completion, by the end of 2018, of a Conceptual Design Report (CDR) for this facility.

This document presents the first results of the assessment of the physics potential of the hadronic part of this research programme (FCC-hh). The general considerations on the strengths and reach of very high energy hadron colliders were introduced long ago in the classic pre-SSC EHLQ review [3]. The main physics motivations for a 100 TeV pp collider, in the light of the status of high energy physics after the first years of LHC data, were recently discussed in [4]. Here, we take a more systematic look, collecting the results of many studies that have been carried out since the launch of the FCC initiative in 2014. The five Chapters of this Report address (i) the general features of Standard Model processes and observables at 100 TeV, (ii) the potential for precision and discovery physics in the electroweak symmetry breaking sector, (iii) the targets and prospects of the searches for physics Beyond the Standard Model, (iv) the goals of a heavy ion programme with collisions of Pb ions, and (v) a first overview of the potential of the collider injector complex. A first attempt at defining the luminosity goals of the 100 TeV collider was presented recently in [5]. The resulting targets, in the range of 20-30 ab^{-1}, are consistent with the preliminary luminosity estimates provided by the accelerator studies [1], and will be used throughout this report.

The studies presented here are mostly of phenomenological nature. The purpose is to illustrate the immense physics potential of the FCC-hh, in the light of the key questions that may be left still open after the completion of the LHC programme and of the other ongoing and forthcoming experimental efforts in high-energy physics worldwide. Work is now underway to define reference detector designs, and to evaluate them in detail simulating in a more realistic way some of the outstanding physics benchmarks that have emerged from this report. This work, and new ideas that are now emerging in the literature on a daily basis, will converge in the CDR, for a more complete and robust overall assessment of the preliminary projections discussed here.

Studies on the physics programme of the e^+e^- collider (FCC-ee) and of the ep collider (FCC-eh) are proceeding in parallel, and preliminary results are documented in [6] (for FCC-ee) and in [7] (for the LHeC precursor of FCC-eh). A global assessment of the overall complementarity and synergy of these three components of the FCC programme will be documented in the CDR.

I warmly thank all editors and authors of the five Chapters of this volume, for the dedication and enthusiasm that have driven their work over the two years of preparation of this Yellow Report.

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