

ADDENDUM II

to

ACCELERATOR PROTOCOL III

between

**THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA (DOE)**

and

**THE EUROPEAN ORGANIZATION
FOR NUCLEAR RESEARCH (CERN)**

to

THE CO-OPERATION AGREEMENT

concerning

**SCIENTIFIC AND TECHNICAL CO-OPERATION
IN NUCLEAR AND PARTICLE PHYSICS**

2017

**Addendum II to Accelerator Protocol III
for Participation by the U.S. Department of Energy
in the High-Luminosity Large Hadron Collider
Accelerator Upgrade**

The Department of Energy of the United States of America (“DOE”),

and

The European Organization for Nuclear Research (“CERN”), an Intergovernmental Organization having its seat at Geneva, Switzerland,

(hereafter collectively referred to as “the Parties”):

CONSIDERING:

That the Parties collaborated to their mutual benefit under the International Co-Operation Agreement Concerning Scientific and Technical Co-Operation on Large Hadron Collider (LHC) Activities signed December 8, 1997;

That the Parties successfully participated in the original construction activities of the LHC accelerator and in the exploitation of the LHC under an Accelerator Protocol I signed December 19, 1997, and continued their collaboration on LHC commissioning and consolidation activities under an Accelerator Protocol II signed July 11, 2014;

That the Parties renewed their collaboration under the Co-Operation Agreement Concerning Scientific and Technical Co-Operation in Nuclear and Particle Physics signed May 7, 2015 (hereinafter the “2015 Co-Operation Agreement”), and under Accelerator Protocol III, signed December 18, 2015 (hereinafter “Accelerator Protocol III”) on the LHC accelerator consolidation plan and the LHC accelerator upgrade program; and

That it is in the mutual interest of the Parties to establish a framework in accordance with Accelerator Protocol III on the total contributions by DOE to the LHC accelerator upgrade, under this Addendum II (hereinafter “Addendum”) to Accelerator Protocol III,

HAVE AGREED AS FOLLOWS:**Article 1
Purpose**

The purpose of this Addendum is to define the framework under which DOE, the U.S. funding agency, and U.S. universities, national laboratories, and other organizations (hereinafter collectively referred to as the "U.S. Participating Organizations"), shall participate in the High-Luminosity LHC (hereinafter "HL-LHC") accelerator upgrade program being carried out under the auspices of CERN. These activities shall include the design, research and development, prototyping, and construction of technologically advanced accelerator components in order to enable an increase of the LHC accelerator's integrated luminosity by a factor of ten. The resulting increase of the LHC luminosity aims at extending significantly the physics reach of the LHC to the benefit of the large United States particle physics community engaged in activities at the LHC.

**Article 2
Scientific Goals**

The scientific goals of the Parties' co-operative activities in the HL-LHC physics program that are enabled through upgrades of the LHC accelerator complex include, but are not limited to, the following:

- (a) Provide unprecedented insights into the elementary particles and their interactions using the highest energy collider in the world;
- (b) Precisely measure the properties of the Higgs boson, and use the Higgs particle as a tool for discovery of new physics;
- (c) Look for new particles and interactions, which could provide evidence for physics beyond the Standard Model, well beyond the reach of the LHC program; and
- (d) Identify the nature of dark matter, or significantly constrain theoretical models predicting its composition.

Article 3

Scope

3.1 The U.S. Participating Organizations plan to contribute to the following HL-LHC accelerator upgrade activities that are of mutual interest to the Parties:

- (a) Construction, test and delivery of superconducting quadrupole focusing magnets with large apertures that have the capability to reduce the transverse size of the proton beams at the interaction point and thereby significantly increase the beam luminosity. These next generation magnets will be made employing niobium-tin superconductors that can reach higher peak magnetic fields than those currently used in the LHC; and
- (b) Construction, test and delivery of superconducting radio-frequency crab cavities, capable of generating transverse electric fields to rotate each proton bunch longitudinally as a means for the bunches to collide effectively head-on and thereby result in an increase in the luminosity at the collision points.

In addition to the activities specified in paragraphs (a) and (b) of this Article 3.1, which are in the HL-LHC accelerator upgrade project baseline, the Parties may consider extending their co-operative activities to other items of equipment such as:

- (c) Hollow-electron lens for particle halo control and removal from the main LHC beam in a controlled manner via the collimation system; and
- (d) Other accelerator equipment and beam diagnostic systems.

3.2 Final responsibilities and detailed delivery schedules for activities identified in Article 3.1 of this Addendum shall be specified in Memoranda of Understanding (hereinafter "MOUs") in accordance with Article 3 of Accelerator Protocol III.

Article 4

Funding of U.S. Participation in the HL-LHC Accelerator Upgrade

- 4.1 To enable the U.S. Participating Organizations to meet their responsibilities during design, research and development, prototyping and the construction phases of the HL-LHC accelerator upgrade, DOE shall provide total funding, established following the standard DOE accounting practice, up to \$250,000,000 (which includes contingency) to a nationally co-ordinated U.S. HL-LHC accelerator upgrade project. Funding for the HL-LHC accelerator upgrade shall be subject to the availability of appropriated funds.
- 4.2 The administration of the funds identified in Article 4.1 of this Addendum shall be managed by the HL-LHC accelerator upgrade project office at the Fermi National Accelerator Laboratory, the host DOE national laboratory for the U.S. HL-LHC accelerator upgrade project. The management of the project, including its schedule, as well as of all U.S. Participating Organizations conducting activities under the project, shall follow DOE program and project requirements and procedures for the acquisition of capital assets in accordance with DOE Order 413.3B. The application of these funds to pay for accelerator upgrade costs shall follow standard DOE accounting practices.
- 4.3 The funds identified in Article 4.1 of this Addendum shall only be used for those U.S. responsibilities that are in accordance with Accelerator Protocol III, Article 3 of this Addendum, and the associated MOUs.

Article 5

Membership of Committees

In addition to Article 4 of Accelerator Protocol III, it is agreed that representatives from DOE or CERN shall be able to serve as members of any committee, council, board, task force, or other similar group (hereinafter "committee") that may be convened by the other Party, respectively, on any matters related to Accelerator Protocol III and this Addendum. Membership in a committee shall take effect upon written confirmation from the receiving Party in response to a written request by the other Party, where the designated representative has agreed to serve on the committee.

Article 6

Entry and Exit Arrangements

- 6.1 The Parties' duty to facilitate the entry and exit of personnel and deliverables, as set out in Article 7 of the 2015 Co-Operation Agreement, shall extend to the U.S. Participating Organization(s).
- 6.2 Except as agreed otherwise by the Parties, ownership of and all risks related to deliverables owned by the shipping Party shall transfer to the receiving Party upon delivery and successful completion of a visual inspection, as attested by a written report by the receiving Party.
- 6.3 Disposal of deliverables upon completion of their use shall be the responsibility of the Party owning such deliverables at the time of their disposal.

Article 7

Liability

- 7.1 Each Party's participation in the work covered by this Addendum is on a best-effort basis and without any warranty.
- 7.2 In the event that damages are incurred in the course of, or arising out of, the execution of this Addendum, the Parties shall consult on appropriate methods of settlement.

Article 8

Entry into Force, Duration, and Termination

This Addendum shall enter into force upon signature of the last of the Parties to sign. This Addendum shall remain in force until the completion of all activities under this Addendum is confirmed by mutual written decision of the Parties, or a decision for project completion of the U.S. HL-LHC accelerator upgrade project has been approved, whichever is earlier, unless a written notice of termination is given by one Party to the other Party at least six months prior to the date of termination, so long as the 2015 Co-Operation Agreement and Accelerator Protocol III remain in force. For purposes of this

Article, the decision for project completion of the U.S. HL-LHC accelerator upgrade project shall be made by the DOE Project Management Executive in accordance with DOE Order 413.3B regarding program and project management for the acquisition of capital assets and in coordination with the CERN Director for Accelerators and Technology.

Article 9 Amendment

The Parties may amend this Addendum at any time by mutual written consent, so long as the 2015 Co-Operation Agreement, Accelerator Protocol III, and this Addendum remain in force.

Article 10 Final Provisions

- 10.1 Each Party's participation in the activities contemplated by this Addendum is subject to the availability of appropriated funds, personnel, and other resources. The U.S. Participating Organizations and CERN shall each be responsible for their own personnel and contractors, in particular as far as salaries, allowances, social and health insurance coverage and travel costs are concerned.
- 10.2 This Addendum is done pursuant to Article 7 of the 2015 Accelerator Protocol and is subject to and governed by the terms of the 2015 Co-Operation Agreement and Accelerator Protocol III.
- 10.3 The provisions of the 2015 Co-operation Agreement, Accelerator Protocol III, this Addendum and any associated MOUs, including in terms of intellectual property, ownership and shipment of deliverables, export control, liability and dispute settlement, set out the entire and exclusive understanding in the subject matter. The foregoing is without prejudice to each Party's entitlement to conclude such subsidiary agreements between the Parties or with U.S. Participating Organizations as they may mutually decide to conclude, it being understood that should any conflict arise, the provisions of the 2015 Co-Operation Agreement, Accelerator Protocol III, this Addendum and

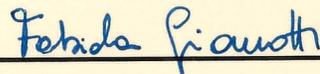
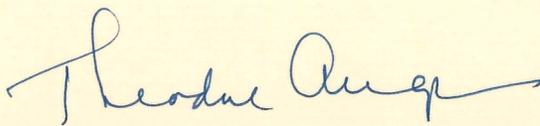
any associated MOUs shall prevail over the provisions of such subsidiary agreements.

10.4 Notwithstanding and without prejudice to Article 10.3 of this Addendum, it is agreed in respect of deliverables provided and work executed by a U.S. Participating Organization or CERN, directly or by its contractors, that the granting of access to its facility by CERN or the receiving U.S. Participating Organization shall be subject to the receiving entity's administrative and technical supervision and control, as well as to compliance with the receiving entity's applicable rules with regard to admission to and use of the premises, including safety, operating and health-physics procedures, environmental protection, access to information, cyber-security, hours of work, and conduct. Employees, contractors and representatives of the U.S. Participating Organization concerned or CERN shall execute all documents required by CERN or the receiving U.S. Participating Organization acknowledging and agreeing to comply with such applicable rules, failing which CERN or the receiving U.S. Participating Organization may, without prejudice to any other legal or contractual rights, issue an order stopping all or any part of the U.S. Participating Organization's or CERN's activities, or those of its contractors, at its premises.

DONE at Geneva, Switzerland, in duplicate in the English language.

**FOR THE DEPARTMENT
OF ENERGY OF THE UNITED
STATES OF AMERICA:**

**FOR THE EUROPEAN
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Date: 2nd May 2017

Date: 28th April 2017

