ADDENDUM I

to

EXPERIMENTS PROTOCOL II

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 I to Experiments Protocol II for Participation by the U.S. Department of Energy in the High-Luminosity Large Hadron Collider ATLAS and CMS Detector Upgrades

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 collaborated in the original design and fabrication of the two major detector facilities, ATLAS and CMS, under an Experiments Protocol I signed December 19, 1997;

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 Experiments Protocol II, signed December 18, 2015 (hereinafter "Experiments Protocol II") on the ATLAS and CMS experiments' consolidation plan and detector upgrades; and

That it is in the mutual interest of the Parties to establish a framework in accordance with the Experiments Protocol II on the total contributions by DOE to the ATLAS and CMS experiments' detector upgrades, under this Addendum I (hereinafter "Addendum") to Experiments Protocol II,

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") detector upgrades being carried out by the ATLAS and CMS collaborations (hereinafter the "Collaborations") under the auspices of CERN. These activities shall include the design, research and development, prototyping, and construction of technologically advanced detectors in order to take full advantage of the increase of the LHC accelerator's integrated luminosity by a factor of ten. The resulting increase in capabilities facilitates the continued participation of the large United States particle physics community that is supported by DOE to engage at the LHC during the HL-LHC running period.

Article 2
Scientific Goals

The scientific goals of the Parties' co-operative activities in the HL-LHC physics program that motivate areas of study by the ATLAS and CMS Collaborations 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 ATLAS and CMS detector upgrade activities that are of mutual interest to the Parties. In the following list of activities, the term "system" comprises the various components of a specific detector, including its front-end electronics.

(a) An upgrade of the current tracking system and the triggering capabilities, which will be damaged by radiation caused by particles produced at the collision point under intense LHC beam environments, thereby severely compromising tracking performance. Entirely new finely segmented inner trackers will replace the present detectors and will include a new readout system to handle the increased data rates expected during the HL-LHC running period;

(b) Upgrades to the muon detector systems and their triggering capabilities to handle increased event rates at the higher LHC luminosities;

(c) Replacement of portions of the calorimeter systems to sustain high radiation levels and increased data rates, which will result from the intense HL-LHC proton beam collisions and enormous number of particles originating at the interaction point. Upgrades to the calorimeter systems will include selective triggering capability in the higher luminosity environment;

(d) Upgrades to the detectors' trigger and data acquisition systems, motivated by the need to retain trigger capability at low thresholds to maintain acceptance of physics signals for the scientific program detailed in Article 2 of this Addendum, and which are designed to handle increased data rates and efficient data flow; and

(e) Common items of the detectors as identified by the Collaborations, which may include those related to the common infrastructure, electronics, cabling, gas and cooling systems, tooling equipment, safety mechanisms and protocols, and integration at CERN.

3.2 The exact distribution and final responsibilities for activities identified in Article 3.1 of this Addendum, including the timeline for deliverables of the detector components, shall be specified in Memoranda of Understanding (hereinafter "MOUs") in accordance with Article 5 of Experiments Protocol II, including in particular the MOUs governing the HL-LHC ATLAS and CMS detector upgrades.

Article 4
Funding of U.S. Participation in the HL-LHC ATLAS and CMS Detector Upgrades

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 ATLAS and CMS detector upgrades, DOE shall provide total funding, established following the standard DOE accounting practice, up to $350,000,000 (which includes contingency). The DOE funding is intended to be split approximately equally between the two detectors. Funding for the HL-LHC ATLAS and CMS detector upgrades 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 ATLAS and CMS detector upgrade project offices at the host DOE national laboratory for the U.S. HL-LHC ATLAS and U.S. HL-LHC CMS detector upgrade projects, respectively. The management of each project, including schedules, as well as all activities conducted by the U.S. Participating Organizations under the HL-LHC detector upgrade projects, 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 detector 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 Experiments Protocol II, Article 3 of this Addendum, and the associated MOUs.

Article 5
Membership of Committees

In addition to Article 4 of Experiments Protocol II, 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 Experiments Protocol II 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 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 a mutual written decision of the Parties, or a decision for project completion of the U.S. HL-LHC ATLAS and U.S. HL-LHC CMS detector upgrade projects 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 Experiments Protocol II remain in force. For purposes of this Article, the decision for project completion of the U.S. HL-LHC ATLAS and U.S. HL-LHC CMS detector upgrade projects 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 Research and Computing.

Article 7
Amendment

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

Article 8
Final Provisions

8.1 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.

8.2 This Addendum is done pursuant to Article 11 of Experiments Protocol II and is subject to and governed by the terms of the 2015 Co-Operation Agreement and the Experiments Protocol II.

8.3 The provisions of the 2015 Co-operation Agreement, Experiments Protocol II, this Addendum and any associated MOUs, including in terms of intellectual property, ownership and shipment of components and assemblies, 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, Experiments Protocol II, this Addendum and any associated MOUs shall prevail over the provisions of such subsidiary agreements.

8.4 Notwithstanding and without prejudice to Article 8.3 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 by CERN or the U.S. Participating Organization to its facility 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 regards 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:

Theodore Allegra

Chargé d'Affaires a.i. of
the United States of America
to the United Nations and Other
International Organizations in
Geneva

Date: 2nd May 2017

FOR THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH:

Fabiola Gianotti

Director-General
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Date: 28th April 2017