

ADDENDUM I

to

NEUTRINO PROTOCOL I

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 Neutrino Protocol I
for Participation by CERN
in the U.S. High-Intensity Facility**

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 Activities signed December 8, 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 Neutrino Protocol I signed in December 18, 2015 (hereinafter “Neutrino Protocol I”) on the Short and Long Baseline Neutrino Programs; and

That it is in the mutual interest of the Parties to establish a framework in accordance with Neutrino Protocol I on the total contributions by CERN to the newly established U.S. Neutrino Program, as they are set out in this Addendum I (hereinafter “Addendum”) to Neutrino Protocol I,

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

- 1.1 The purpose of this Addendum is to define the framework under which CERN shall participate in the U.S. Neutrino Program to be implemented by DOE and its national laboratories (DOE and such national laboratories hereinafter collectively referred to as the "U.S. Participating Organizations"). In its initial phase, the U.S. Neutrino Program aims to significantly extend the scientific knowledge on accelerator-based Neutrino Physics, on Solar Neutrino Physics, on Proton Decay research and on Supernova Physics understanding. CERN's participation shall include the design, research and development, prototyping, and construction of technologically advanced detector components.
- 1.2 As foreseen in Article 7.2 of Neutrino Protocol I, insofar as CERN's European partner agencies elect to memorialize their contributions to the U.S. Neutrino Program in appropriate legal instruments to be concluded with CERN (CERN and such European partner agencies hereinafter collectively referred to as the "CERN Participating Organizations"), their contributions shall be received and integrated by CERN as appropriate.

**Article 2
Scientific Goals**

The scientific goals of the Parties' co-operative activities in the U.S. Neutrino Program include, but are not limited to, the following:

- (a) Provide unprecedented insights into the Oscillation Neutrino Physics using the highest intensity Neutrino beams in the world;
- (b) Measure Neutrino parameters such as the CP-violating phase δ_{CP} , resolve the Mass Hierarchy and precisely measure the oscillation angles Θ_{23} and Θ_{13} ; and
- (c) Search for particles and interactions that signal physics beyond the Standard Model, possibly based on Sterile Neutrinos, which in itself constitutes a monumental discovery.

Article 3

Scope

- 3.1 The CERN Participating Organizations plan to contribute to the following Neutrino activities that are of mutual interest to the Parties:
- (a) Construction, testing and operation for physics of the Short Baseline Neutrino program (hereinafter "SBN") at the Fermi National Accelerator Laboratory (hereinafter "Fermilab"), with active participation in the reshaping at CERN of the existing ICARUS detector. ICARUS will be moved to Fermilab in 2017, installed and commissioned. The infrastructure part of this activity includes cryostats and liquid Argon (hereinafter "LAr") cryogenics.
 - (b) Construction and testing with cosmic rays and with charged particle beams of two large Time Projection Chamber (hereinafter "TPC") prototypes (hereinafter "protoDUNEs"), which constitute the basis for the construction, installation and operation of the future large Deep Underground Neutrino Experiment (hereinafter "DUNE")/Long Baseline Neutrino Facility (hereinafter "LBNF") far detectors. These large detector prototypes will demonstrate two different TPC technologies, as an engineering process towards the DUNE far detectors construction. The incident CERN charged beams will allow an assessment of their performance at a considerably refined level. The infrastructure part at CERN of this activity includes a new experimental hall, cryostats and cryogenics.
 - (c) The aforementioned detectors will make use of LAr as the Neutrino interaction and recording media. The construction of the necessary Large Cryostats will require access to a technology used in the transport of liquefied natural gas, which is new in the field of particle physics. A full set of such cryostats will be assembled to match the final need of DUNE and be operated. A new type of LAr cryogenics will be developed to satisfy the stringent LAr purity requirements.
 - (d) Once the detectors for SBN and DUNE/LBNF respectively are installed, a significant contribution to the commissioning and subsequent physics exploitation is envisaged.

- 3.2 Specific to the activities under this Article, CERN grants to DOE a nonexclusive, nontransferable, irrevocable, paid-up license in and to any intellectual property rights of CERN, which are incorporated into the SBN and LBNF/DUNE facilities as a result of this Addendum to the extent that the facility is not restored to the condition existing prior to the Addendum (1) to practice or to have practiced such intellectual property rights by or for DOE at the facility, and (2) to transfer such licenses with the transfer of that facility. CERN shall be responsible for ensuring that the same license shall be granted to DOE in respect of any intellectual property rights of the other CERN Participating Organizations for the above purposes. The acceptance or exercise by DOE of the aforesaid rights and licenses shall not prevent DOE at any time from contesting the scope of, or title to, any intellectual property rights herein licensed.
- 3.3 Final responsibilities and detailed delivery schedules for the activities identified in Article 3.1 of this Addendum shall be specified in Memoranda of Understanding (hereinafter "MOUs") in accordance with Articles 5 and 7 of Neutrino Protocol I.

Article 4

CERN Funding of Participation in the U.S. Neutrino Program

- 4.1 CERN shall provide total funding up to CHF 8,800,000 (CERN core accounting) to cover its activities, and by way of contribution to the activities of the other CERN Participating Organizations, during design, research and development, prototyping and construction phases of the SBN. If expressed in total cost following the standard DOE accounting practice, the overall figure¹ is \$22,000,000, which includes all costs related to manpower, infrastructure, logistics and contingency. The operation costs at Fermilab related to cryogenic

¹ For the purpose of this Addendum, CERN's contribution is expressed as CERN core accounting in CHF and as DOE full cost accounting in USD, using a conversion factor of 2.5 between these two values. CERN core accounting reflects standard CERN practice for establishing investment costs, which does not take into account the cost of CERN manpower and contingencies. The Parties have agreed to fix the values given in this Addendum on the basis of the state of their knowledge of the project in 2015.

liquids shall be based on the principle of "reciprocity between host lab responsibilities" and fall under Fermilab responsibility.

- 4.2 In respect of the protoDUNE program, CERN shall provide total funding up to CHF 33,500,000 (CERN core accounting) to cover its activities, and by way of contribution to the activities of the other CERN Participating Organizations, which include the construction at CERN of a new experimental hall, two large cryostats, the associated cryogenics plants, detector components and, subject to capacity, the computing facilities (including data acquisition, detector control system, and Tier-0). If expressed in total cost following the standard DOE accounting practice, the overall figure is \$83,750,000, which includes all costs related to manpower, infrastructure, logistics, contingency and associated operation costs. The operation costs include all expenses related to cryogenic liquids, based on the principle of reciprocity between host lab responsibilities.
- 4.3 In respect of the LBNF infrastructure program, CERN shall provide total funding up to CHF 32,500,000 (CERN core accounting) to cover its activities, and by way of contribution to the activities of the other CERN Participating Organizations, which include in particular the funding, design, construction and installation of the first large LBNF cryostat. If expressed in total cost following the standard DOE accounting practice, the overall figure is \$81,250,000, which includes all costs related to manpower, infrastructure, logistics and contingency but excludes any associated operation costs, in particular the cryogenic liquids.
- 4.4 The funds identified in Articles 4.1, 4.2, and 4.3 of this Addendum, for a total of:
- \$187,000,000 (total cost)
- or, expressed in CERN core accounting, of CHF 74,800,000, shall only be used for those CERN responsibilities that are in accordance with Neutrino Protocol I, Article 3 of this Addendum, and the associated MOUs. The administration of these funds shall be managed by the CERN Neutrino Platform project office at CERN.
- 4.5 The protoDUNE program, including its schedule, as well as related activities of the U.S. Participating Organizations under the program, shall be managed in accordance with the requirements of the CERN scientific program, as well as CERN safety and access procedures.

- 4.6 The LBNF and DUNE projects, including their schedules, as well as related activities of the CERN Participating Organizations in the United States under the projects, shall be managed in accordance with the requirements of the U.S. Participating Organizations' scientific programmes, as well as their safety and access procedures.
- 4.7 Components, assemblies and other items (hereinafter "deliverables") shipped from Europe to the United States, or from the United States to CERN, shall be designed and constructed in accordance with the European safety standards and codes (including, as the case may be, the CERN safety standards and codes) if constructed or procured in Europe, and of the United States if constructed or procured in the United States. European and U.S. safety standards and codes shall be accepted as equivalent under the principle of reciprocity, it being understood that, with respect to non-standard components and assemblies, each Party shall, within available resources, provide reasonable assistance towards the other Party's efforts to establish equivalent levels of safety.

Article 5

Membership of Committees

In addition to Article 4 of Neutrino Protocol I, 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 Neutrino Protocol I 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 receiving U.S. Participating Organizations.

- 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, 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 Neutrino Protocol I remain in force.

Article 9

Amendment

The Parties may amend this Addendum at any time by mutual written consent, so long as the 2015 Co-Operation Agreement, Neutrino Protocol I, 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. and CERN Participating Organizations 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 8 of Neutrino Protocol I and is subject to and governed by the terms of the 2015 Co-Operation Agreement and Neutrino Protocol I.
- 10.3 The provisions of the 2015 Co-Operation Agreement, Neutrino Protocol I, 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 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, Neutrino Protocol I, 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 Participating Organization, directly or by its contractors, that the granting of access to its facility by the receiving Participating Organization shall be subject to the latter's administrative and technical supervision and control, as well as to compliance with its 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 Participating Organization concerned shall execute all documents required by the receiving Participating Organization acknowledging and agreeing to comply with such applicable rules, failing which the receiving Participating Organization may, without prejudice to any

other legal or contractual rights, issue an order stopping all or any part of the Participating Organization's or its contractor's activities at its premises.

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

**FOR THE DEPARTMENT
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