Overview of Cooperation Agreements between CERN and the United States

High Energy Physics Advisory Panel (HEPAP) Meeting
Hilton Washington, DC / Rockville · December 5-6, 2024

https://science.osti.gov/hep/hepap/Meetings

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Office of High Energy Physics

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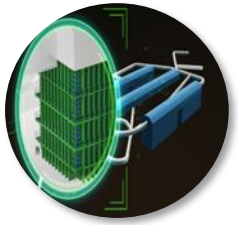


Cooperation with CERN + Other International Partners

U.S. DEPARTMENT OF ENERGY
Office of Science

Fostering and Strengthening International Partnerships

- Advancing fundamental science
- Driving technology innovation
- Supporting joint collaborative projects and initiatives
- Sharing of expertise, resources, and costs
- Training and education
- Facilitating program mission and strategic priorities

Outline

- General Overview of Cooperation Agreements
- Hierarchy Structure of International Agreements
- U.S. Government Processes for Preparing and Signing an Agreement
- Historical Partnership between the U.S. and CERN
- International Cooperation Agreement and Subsidiary Agreements with CERN
- Standalone Written Instruments with CERN and Partners
- Preparation of Future Agreements now In-progress

Overview of Cooperation Agreements

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Formal Government-to-Government Agreements facilitate cooperation under the following elements:

- Legal instruments that establish general framework for scientific & technical cooperation between countries and/or its entities
- Mutually beneficial collaborative partnerships that ensures openness and transparency among institutions, funding, and people; and that the science and any development of technology is done for peaceful purposes
- Specifies the treatment and protection of intellectual property (IP) as well as the general terms for exchanges of personnel and/or equipment between the parties

Typically, a hierarchy or "tree-level" structure exists for various agreements with a partner:

1. Highest level: Government-to-Government **Science and Technology (S&T) Agreement** [or with CERN: an overarching **International Cooperation Agreement (ICA)**] establishes the general framework of the cooperation, including provisions for IP
2. An **Implementing Arrangement (IA)** [or with CERN: a **Protocol**] sets up the specific domain of cooperation – *e.g.,* general scope for a topical activity in HEP, or within DOE: across different Office of Science programs
3. Specific details of a project or initiative – *e.g.,* terms of scope, resources, deliverables, and monetary value of contributions – are, in turn, implemented under the IA (or Protocol) through a **Project Annex** [or with CERN: an **Addendum to the Protocol**]

Each of the above subsidiary agreements is subject to terms and conditions of the higher-level agreement(s); and in the event of any conflict of respective provisions, the provisions of the higher-level agreement governs

Subsequent MOUs, completed between the parties, or for DOE: between a DOE national lab and the institutional partner, may reside under this structure to further specify the technical details of the activity

- Non-binding instruments that memorialize the cooperation under a best-effort basis with an understanding that continued success of the activity depends on each party adhering to the provisions of the MOU

International Cooperation Agreements

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Signed by an official of the U.S. Government

Science and Technology (S&T) Cooperation Agreement

Between the Governments of the United States and an International Partner Country
Established by the U.S. State Department (for the United States) and the Ministry of Foreign Affairs (for the International Partner)

Legally Binding

Signed by DOE

Agency-to-Agency [or Entity] Agreement

- Name of the agreement can vary – *i.e.,* Implementing Arrangement, [International] Co-operation Agreement, Protocol, Accord
- Refers to and is subject to the provisions of the [above] S&T Cooperation Agreement

Subsidiary Agency-to-Agency [or Entity] Agreement

- Name of the agreement can vary – *i.e.,* Project Annex, Protocol, Addendum to Protocol
- May be a DOE program office or project specific arrangement
- Lists participating DOE program(s) and DOE implementing agents – *e.g.,* a DOE national laboratory or facility
- Refers to and is subject to the provisions of the [above] Agency-to-Agency and S&T Cooperation Agreements

Legally Binding

Signed by DOE *or* DOE national lab

Statements *or* Letters of Intent and Memoranda of Understanding (MOUs)

- A general mechanism to express expectations, identify planned areas of cooperation, provide a framework for *best-effort* collaboration; project-specific planning; planning future cooperation; exchange of publicly available information; or coordinating workshops or meetings.
- These are not agreements but represent a general written instrument that *memorializes* a collaborative activity or initiative
- May refer to [above] written instruments to maintain alignment with provisions of the government- or agency-level agreements
- May be between DOE or a DOE national laboratory, on one hand, and international partner laboratory or institution, on the other hand

Non-Binding

U.S. Government Processes for Agreements

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- **Certain processes are required within the U.S. Government (USG) to prepare a written instrument (*i.e.,* agreement, MOU, …) and then negotiate with an international partner, prior to any signature**

- **Typically, agreements at the S&T Agreement (or ICA) and Implementing Arrangement (or Protocol) level require obtaining a U.S. State Department Circular-175 (C-175) authorization to negotiate and/or sign**
  - C-175 ensures the making of international agreements for the United States is within constitutional and other appropriate policy limits, and with appropriate involvement by the U.S. State Department
  - Prior to sharing draft with a partner, C-175 includes a review of the draft by various USG agencies – *e.g.,* for a DOE agreement, can include, but not limited to, State Dept., White House OSTP, and NSF – to ensure appropriateness of the agreement's subject
  - State's C-175 typically allows future subsidiary agreements (*i.e.,* Project Annexes or Addenda) to be negotiated without a need later for a C-175 authorization; but prior to signature of any subsidiary agreement, a review & clearance from State Dept. still required
  - Generally, long processing times to obtain a C-175 authorization

- **Once a DOE-level agreement draft is shared with a partner for their own review & feedback and prior to any signing, additional authorization is needed to obtain a "green-light" for a DOE or U.S. official to sign with the partner**
  - Includes routing draft for concurrences within DOE-SC, Office of General Counsel (GC), and Office of International Affairs

- **Given the above (lengthy) processes, when drafting & negotiating an agreement with a partner, DOE-HEP + other SC program offices coordinate regularly with DOE-GC to ensure the text is legally sound and compliant with U.S. law**

Written Instruments between DOE Lab and International Partner

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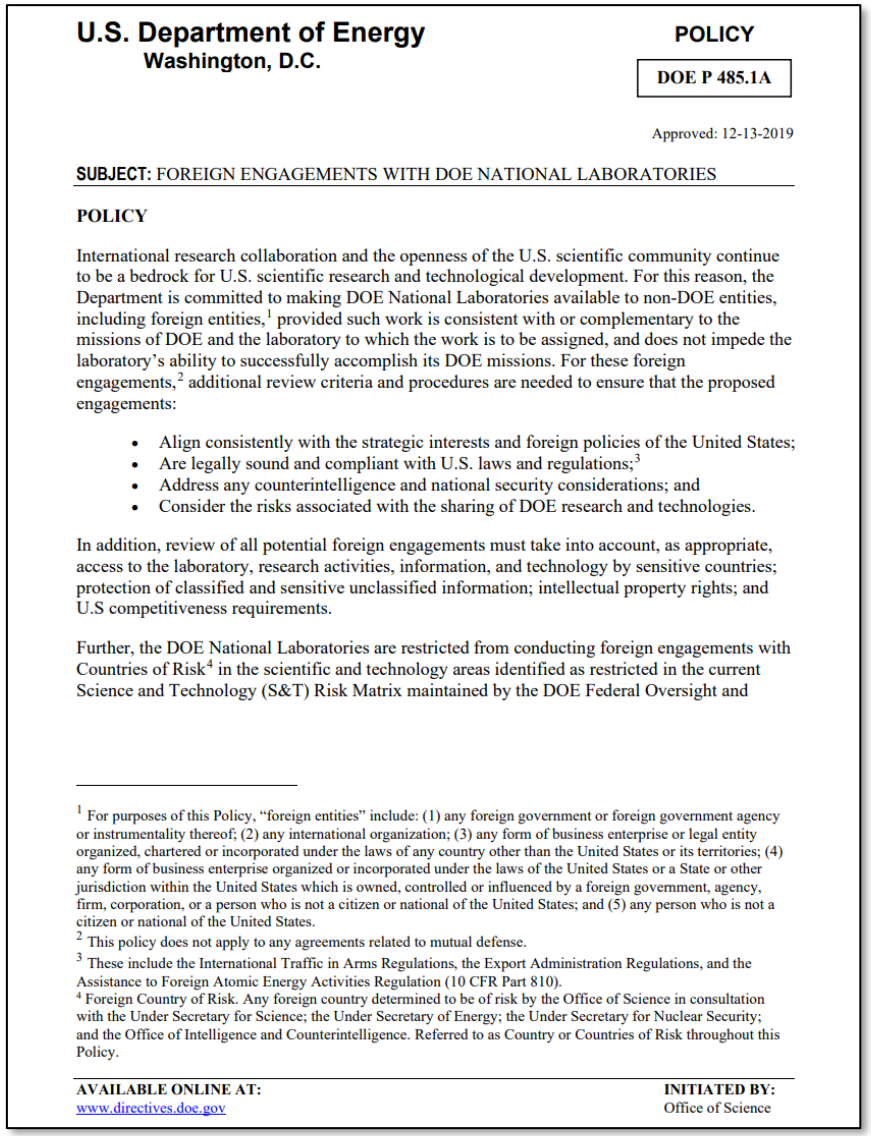
- **Written Instruments such as MOUs, CRADAs, SPPs, etc. between a DOE national lab and international partner (*e.g.*, CERN) require the lab to follow DOE Policy 485.1A**
- **DOE-agency wide policy that requires the final draft to go through various DOE offices to obtain approvals that "authorize" the lab to sign with international partner(s)**
  - Main objective is to align the written instrument with strategic interests and policies of the United States, and to ensure drafts are legally sound and compliant with U.S. laws and regulations
  - Process at the lab for obtaining concurrences is coordinated by the lab Site Office
  - When instrument reaches DOE headquarters for concurrences, the process is coordinated by DOE's Office of International Affairs
- **Once SC program office concurs, DOE's Office of International Affairs circulates the draft to DOE-GC and NNSA before itself concurring**
  - Given the number of offices reviewing draft, process can take at least 4-5 weeks to complete
- **Once every step is completed, lab is then authorized to sign with the international partner**



U.S. Department of Energy
Washington, D.C.

POLICY

DOE P 485.1A

Approved: 12-13-2019

SUBJECT: FOREIGN ENGAGEMENTS WITH DOE NATIONAL LABORATORIES

POLICY

International research collaboration and the openness of the U.S. scientific community continue to be a bedrock for U.S. scientific research and technological development. For this reason, the Department is committed to making DOE National Laboratories available to non-DOE entities, including foreign entities,[1] provided such work is consistent with or complementary to the missions of DOE and the laboratory to which the work is to be assigned, and does not impede the laboratory's ability to successfully accomplish its DOE missions. For these foreign engagements,[2] additional review criteria and procedures are needed to ensure that the proposed engagements:

- Align consistently with the strategic interests and foreign policies of the United States;
- Are legally sound and compliant with U.S. laws and regulations;[3]
- Address any counterintelligence and national security considerations; and
- Consider the risks associated with the sharing of DOE research and technologies.

In addition, review of all potential foreign engagements must take into account, as appropriate, access to the laboratory, research activities, information, and technology by sensitive countries; protection of classified and sensitive unclassified information; intellectual property rights; and U.S competitiveness requirements.

Further, the DOE National Laboratories are restricted from conducting foreign engagements with Countries of Risk[4] in the scientific and technology areas identified as restricted in the current Science and Technology (S&T) Risk Matrix maintained by the DOE Federal Oversight and

[1] For purposes of this Policy, "foreign entities" include: (1) any foreign government or foreign government agency or instrumentality thereof; (2) any international organization; (3) any form of business enterprise or legal entity organized, chartered or incorporated under the laws of any country other than the United States or its territories; (4) any form of business enterprise organized or incorporated under the laws of the United States or a State or other jurisdiction within the United States which is owned, controlled or influenced by a foreign government, agency, firm, corporation, or a person who is not a citizen or national of the United States; and (5) any person who is not a citizen or national of the United States.

[2] This policy does not apply to any agreements related to mutual defense.

[3] These include the International Traffic in Arms Regulations, the Export Administration Regulations, and the Assistance to Foreign Atomic Energy Activities Regulation (10 CFR Part 810).

[4] Foreign Country of Risk. Any foreign country determined to be of risk by the Office of Science in consultation with the Under Secretary for Science; the Under Secretary of Energy; the Under Secretary for Nuclear Security; and the Office of Intelligence and Counterintelligence. Referred to as Country or Countries of Risk throughout this Policy.

AVAILABLE ONLINE AT: www.directives.doe.gov

INITIATED BY: Office of Science

Historical Partnership of the U.S. at CERN

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- **The first ICA between the U.S. and CERN was signed in 1997, but our collaboration was already longstanding by that date**
- **Relations between the United States and CERN date back to the origins of the CERN Organization in the 1950s, when the movement to create a European laboratory aimed at bringing countries together for the joint and peaceful pursuit of scientific research, was co-proposed at UNESCO by Prof. Isidor Rabi**
- **In the 1960s, CERN assisted in building a linear accelerator (LINAC) at the then National Accelerator Laboratory, now known as Fermilab**
- **Collaborative participation of U.S. scientists continued in various experiments at CERN, including:**
  - Intersecting Storage Rings (ISR), 1971-1984
  - Super Proton Synchrotron (SPS), 1976-ongoing
  - Isotope mass Separator On-Line Facility (ISOLDE), 1967-ongoing
  - Antiproton Decelerator (AD), 2000-ongoing
  - All four Large Electron-Positron (LEP) experiments (1989-2000): L3, ALEPH, OPAL, and DELPHI
- **In late-1990s, to ensure U.S. participation and commitments to the accelerator and ATLAS and CMS detector projects at the Large Hadron Collider (LHC), an ICA was concluded between CERN, DOE, and NSF**

Cooperative Agreements with CERN: 1997 and 2014

U.S. DEPARTMENT OF ENERGY | Office of Science

DOE-NSF-CERN International Cooperation Agreement (ICA):


INTERNATIONAL CO-OPERATION AGREEMENT

between

THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

and

THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA

and

THE NATIONAL SCIENCE FOUNDATION OF THE UNITED STATES OF AMERICA

concerning

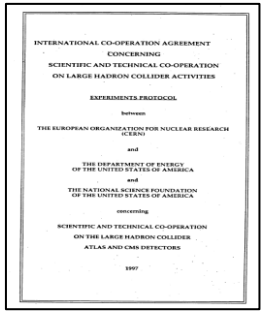
SCIENTIFIC AND TECHNICAL CO-OPERATION ON LARGE HADRON COLLIDER ACTIVITIES

1997

DOE-NSF-CERN
International Cooperation Agreement for Science and Technology Cooperation, signed December 8, 1997

[overarching cooperation agreement; LINK]

Protocols with CERN [Subject-based]:


INTERNATIONAL CO-OPERATION AGREEMENT CONCERNING SCIENTIFIC AND TECHNICAL CO-OPERATION ON LARGE HADRON COLLIDER ACTIVITIES

EXPERIMENTS PROTOCOL

between

THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

and

THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA

and

THE NATIONAL SCIENCE FOUNDATION OF THE UNITED STATES OF AMERICA

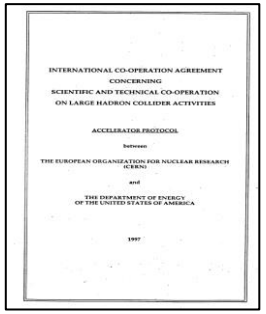
concerning

SCIENTIFIC AND TECHNICAL CO-OPERATION ON THE LARGE HADRON COLLIDER ATLAS AND CMS DETECTORS

1997

DOE-NSF-CERN
Experiments Protocol, signed December 19, 1997

[for original ATLAS and CMS detectors' construction by U.S. and U.S. participation in ATLAS and CMS; LINK]


INTERNATIONAL CO-OPERATION AGREEMENT CONCERNING SCIENTIFIC AND TECHNICAL CO-OPERATION ON LARGE HADRON COLLIDER ACTIVITIES

ACCELERATOR PROTOCOL

between

THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

and

THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA

1997

DOE-CERN
Accelerator Protocol, signed December 19, 1997

[for original LHC accelerator construction by U.S.; LINK]


INTERNATIONAL CO-OPERATION AGREEMENT

CONCERNING

SCIENTIFIC AND TECHNICAL CO-OPERATION ON LARGE HADRON COLLIDER ACTIVITIES

ACCELERATOR PROTOCOL II

BETWEEN

THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA

AND

THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

2014

DOE-CERN
Accelerator Protocol II, signed June 20 and July 11, 2014

[for LHC commissioning and consolidation activities, including LHC performance studies for higher energies and luminosities; and studies under U.S. LHC Accelerator R&D Program (LARP); LINK]

Cooperative Agreements with CERN: 2015 – 2020

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DOE-NSF-CERN International Cooperation Agreement (ICA):


CO-OPERATION AGREEMENT
between
THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA
and
THE NATIONAL SCIENCE FOUNDATION OF THE UNITED STATES OF AMERICA
and
THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
concerning
Scientific and Technical Co-operation in Nuclear and Particle Physics
2015

DOE-NSF-CERN Cooperation Agreement for Scientific and Technical Cooperation in Nuclear and Particle Physics, signed May 7, 2015

[renewed the overarching cooperation agreement; LINK]

Protocols with CERN [Subject-based]:


EXPERIMENTS PROTOCOL II
between
THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA (DOE)
and
THE NATIONAL SCIENCE FOUNDATION OF THE UNITED STATES OF AMERICA (NSF)
and
THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)
to
THE CO-OPERATION AGREEMENT
concerning
SCIENTIFIC AND TECHNICAL CO-OPERATION IN NUCLEAR AND PARTICLE PHYSICS
2015

DOE-NSF-CERN Experiments Protocol II, signed December 18, 2015

[for renewed U.S. participation in ATLAS and CMS; and participation in each detector's HL-LHC (Phase-II) upgrade; LINK]


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
2015

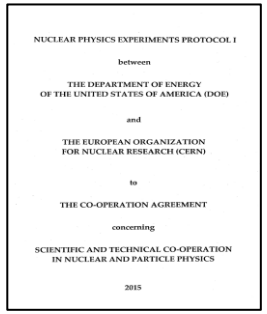
DOE-CERN Accelerator Protocol III, signed December 18, 2015

[for DOE's participation in the HL-LHC accelerator upgrade and cooperation in accelerator studies and R&D for future colliders; LINK]


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
2015

DOE-CERN Neutrino Protocol I, signed December 18, 2015

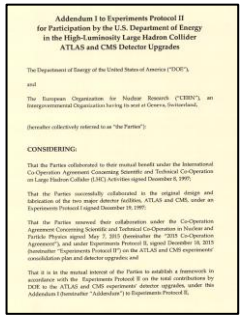
[for the CERN Neutrino Platform and CERN's participation in U.S.-hosted Short- and Long-Baseline Neutrino Programs; LINK]


NUCLEAR PHYSICS EXPERIMENTS 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
2015

DOE-CERN Nuclear Physics Experiments Protocol I, signed December 18, 2015

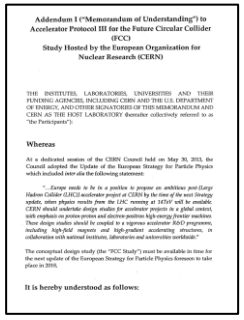
[for DOE participation in ALICE, ATLAS, and CMS Heavy-Ion Program; LINK]

Addenda to Protocols with CERN [Project- or Initiative-based]:


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

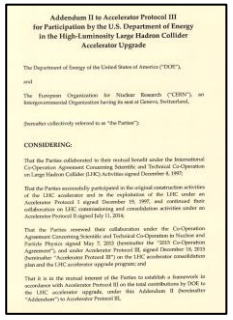
DOE-CERN Addendum I to Exp. Protocol II, signed May 2, 2017

[for DOE's scope and in-kind contributions to the HL-LHC ATLAS and CMS upgrades; LINK]


Addendum I ("Memorandum of Understanding") to Accelerator Protocol III for the Future Circular Collider (FCC) Study Hosted by the European Organization for Nuclear Research (CERN)

DOE-CERN Addendum I to Accel. Protocol III, signed Dec 18, 2015

[for DOE's cooperation in the Future Circular Collider (FCC) Design Study]


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

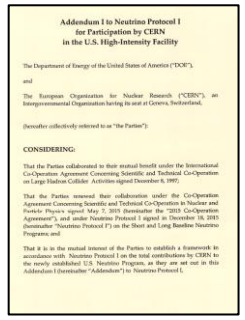
DOE-CERN Addendum II to Accel. Protocol III, signed May 2, 2017

[for DOE's scope and in-kind contributions to the HL-LHC accelerator upgrade; LINK]


Addendum III to Accelerator Protocol III for Participation by the U.S. Department of Energy in the Future Circular Collider Feasibility Study

DOE-CERN Addendum III to Accel. Protocol III, signed Dec 30, 2020

[for DOE's cooperation in the Future Circular Collider (FCC) Feasibility Study]


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

DOE-CERN Addendum I to Neutrino Protocol I, signed May 2, 2017

[for protoDUNE at CERN's Neutrino Platform & CERN's in-kind contributions to Fermilab's ICARUS and LBNF; LINK]

Note: Several of above agreements available (by year) at the US State Department's Treaties and Other International Acts Series [TIAS] site

Recap of 1997 and 2014 Agreements with CERN

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- **CERN and the United States, as a non-Member State of CERN, signed the 1997 DOE-NSF-CERN ICA establishing the overarching scientific, technical, and legal framework for U.S. participation in the CERN program**
  - Particularly at the LHC in the construction of the accelerator and ATLAS, CMS detectors, and subsequent physics exploitation
  - Established Observer status for the U.S. at the CERN Council
  - Signed with an initial duration of 20-years; thereafter, automatically renewed each year unless terminated through written notice between the parties

Dec 1997, The WH Indian Treaty Room (from left-to-right): NSF Director Neal Lane, Secretary of Energy Frederico Peña, CERN Council President Luciano Maiani, and CERN Director-General Chris Llewellyn Smith

- **1997 DOE-CERN Accelerator Protocol**
  - Framework for the scope and DOE-supported contributions (up to $200 million) for the construction of the LHC accelerator
- **1997 DOE-NSF-CERN Experiments Protocol**
  - Framework for the scope and contributions by DOE (up to $250 million) and NSF (up to $81 million) for construction of ATLAS and CMS detectors
  - Subsequent participation by U.S. scientists, engineers, and other professionals in the ATLAS and CMS collaborations
  - Membership of the U.S. agencies in the LHC Resources Review Boards (RRB) for the international experiments
- **2014 DOE-CERN Accelerator Protocol II**
  - Studies by DOE-supported institutions, including DOE national labs, for the LHC to reach its nominal energy and performance; and key technology research and development under U.S. LARP (LHC Accelerator R&D Program)

Renewed Cooperation between the U.S. and CERN

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- **ICA renewed in May 2015 and envisioned a broader scale of cooperation**
  - Collaborate in experimental and theoretical physics, accelerator and detector development, computing, and any related domains
  - In addition to U.S. participation at CERN, provided a platform for essential contributions by CERN to the U.S.-hosted science program, including LBNF/DUNE
- **2015 DOE-CERN Accelerator Protocol III**
  - Scope for U.S. HL-LHC accel. upgrade project (AUP) & CERN-hosted future collider studies
  - 2017 Addendum II, amended in 2023, documented up to $275 million of in-kind contrib. to the U.S. HL-LHC AUP ⇒ to align with the DOE project's CD-2/3 total project cost
  - U.S. cooperation in FCC studies thru 2015 Addendum I & 2020 Addendum III (*next two slides*)
- **2015 DOE-NSF-CERN Experiments Protocol II**
  - Renewed participation by U.S. in the ATLAS and CMS collaborations, incl. HL-LHC
  - 2017 DOE-CERN Addendum I, amended in 2023, documented up to $410 million (approx. split between ATLAS & CMS) for DOE's contributions to the HL-LHC [Phase-II] upgrades
- **2015 DOE-CERN Neutrino Protocol I**
  - Framework for collaboration at the CERN Neutrino Platform and CERN's associated participation in the U.S.-hosted international neutrino program ⇒ SBN (ICARUS) and LBNF
  - 2017 Addendum I, amended in 2022, documented CERN's contributions of the two large underground cryostats for the LBNF infrastructure

May 2015, The WH Indian Treaty Room (from left-to-right): DOE Secretary of Energy Ernest Moniz, CERN Director-General Rolf Heuer, and NSF Director France Córdova sign the 2015 ICA

Dec 2015, CERN (from left-to-right): U.S. Ambassador to UN Geneva Pamela Hamamoto and CERN Director-General Rolf Heuer sign the 2015 Protocols and Addendum I for FCC studies

Dec 2015, CERN: Group photo at signing – Cooperation between CERN and the United States

Future Circular Collider: Conceptual Design Study

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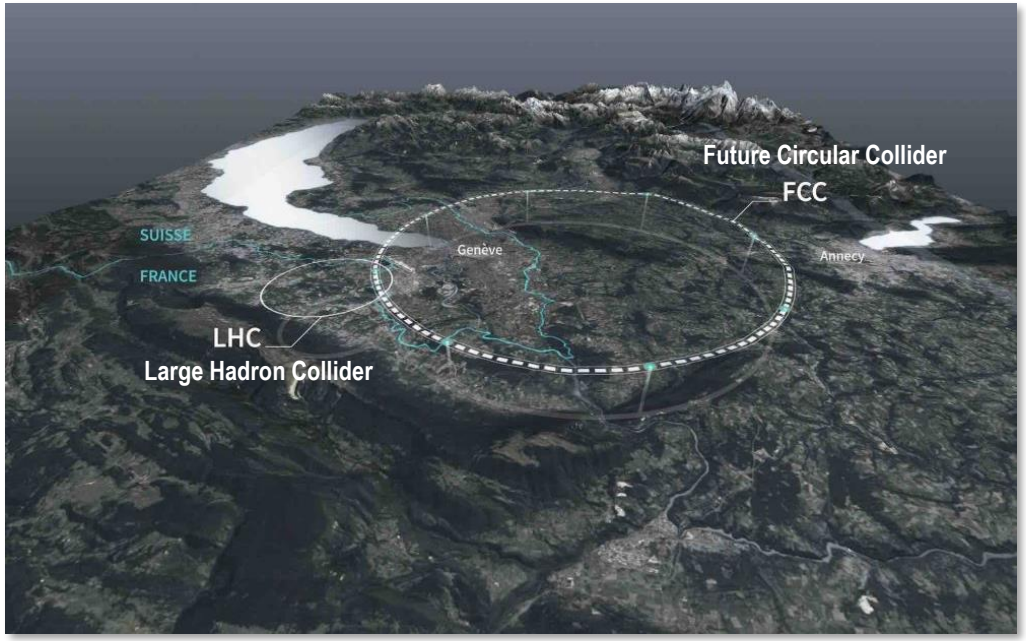
- **Following the 2013 update of the European Strategy for Particle Physics (ESPP), in 2015, DOE and CERN signed Addendum I to Accelerator Protocol III to collaborate with CERN and international partners in the FCC conceptual design study phase**
  - Long-term goal of a hadron collider (FCC-hh) with energies up to 100 TeV in a new 80-100 km tunnel; with a lepton collider (FCC-ee) and its detectors as a potential intermediate step towards the FCC-hh
  - Subject to funding, specific technical details by U.S. participants (*e.g.,* DOE labs) to be memorialized through subsequent MOUs under the Addendum



- **In 2019, efforts successfully led to the FCC Conceptual Design Report by CERN and international partners, which served as an input to the 2020 ESPP update process**

- **Four MOUs between DOE national labs and CERN were concluded under this 2015 DOE-CERN FCC Addendum**
  - **May 2016:** JLAB and CERN, on design and performance tests of SRF accelerator cavities for FCC-ee
  - **Oct 2016**: Fermilab and CERN, on safety studies within the underground FCC tunnel infrastructure
  - **Apr 2019**: Fermilab and CERN, for conceptual design of Nb_3Sn-based quadrupole magnets at FCC interaction regions
  - **Dec 2020**: BNL and CERN, for beam dynamics and design studies of FCC-ee interaction region focusing magnet systems

- **Various U.S. universities have also signed MOUs with CERN for FCC studies ⇒ completed under their respective university system, outside of DOE**

Future Circular Collider: Feasibility Study

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- **Following the 2020 update of ESPP, in December 2020, DOE and CERN signed Addendum III to Accelerator Protocol III to collaborate with CERN and international partners in the FCC feasibility study phase**
  - Near- to medium term (3-10 years) activities: overall FCC concept optimization, beam studies, and SRF and cryo-module development for FCC-ee
  - Longer-term (5-20 years): high-field magnet R&D for FCC-hh and design concepts of time- and cost-effective tunneling techniques
  - Similarly, subject to funding from DOE or other sources, specific details of activities by U.S. participants (*e.g.,* DOE labs) can be memorialized through subsequent MOUs under the Addendum

- **Thus far, two MOUs between DOE labs and CERN have been signed under this 2020 FCC Feasibility Study Addendum**
  - **May 2024**: BNL and CERN, on FCC-ee physics-driven detector designs and interaction region accelerator magnet systems
  - **Oct 2024**: Fermilab and CERN, for engineering designs of FCC technical and experimental surface sites
  - **Now in-preparation**: SLAC and CERN, for physics, MAPS and microelectronics R&D

May 2024, CERN (from left-to-right): BNL Director JoAnne Hewett and CERN Director-General Fabiola Gianotti sign the 2024 BNL-CERN MOU under Addendum III for FCC Feasibility Studies

- **All part of the broader U.S. collaborative efforts to help deliver the FCC Feasibility Report, now under preparation to be completed by March 2025**

U.S. Institutes under FCC MOUs

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Institutes that have signed an FCC MOU with CERN for the FCC Feasibility Study Phase

- Northern Illinois University
- The University of Iowa
- University of Houston
- Cornell University
- University of New Mexico
- University of California at Santa Barbara
- Brookhaven National Laboratory
- Fermi National Accelerator Laboratory

- U.S. Department of Energy: Addendum III to Accelerator Protocol III of International Cooperation Agreement between DOE and CERN, signed in 2020

Over 40 U.S. institutes expressed interest to join FCC during the last two U.S. FCC Workshops – in Apr 2023 at BNL; in Mar 2024 at MIT

Institutes that have signed an FCC MOU with CERN for the FCC Conceptual Design Phase

- Center for Accelerator Science and Education
- Duke University
- Jefferson Lab
- Fermi National Accelerator Laboratory
- Massachusetts Institute of Technology
- Northern Illinois University
- Stanford University
- University of California at Irvine
- University of California at Santa Barbara
- University of Houston
- The University of Iowa
- University of Michigan
- Brookhaven National Laboratory

- U.S. Department of Energy: Addendum I to Accelerator Protocol III of International Cooperation Agreement between DOE and CERN, signed in 2015

Cooperation in the U.S.-hosted Neutrino Program

U.S. DEPARTMENT OF ENERGY | Office of Science

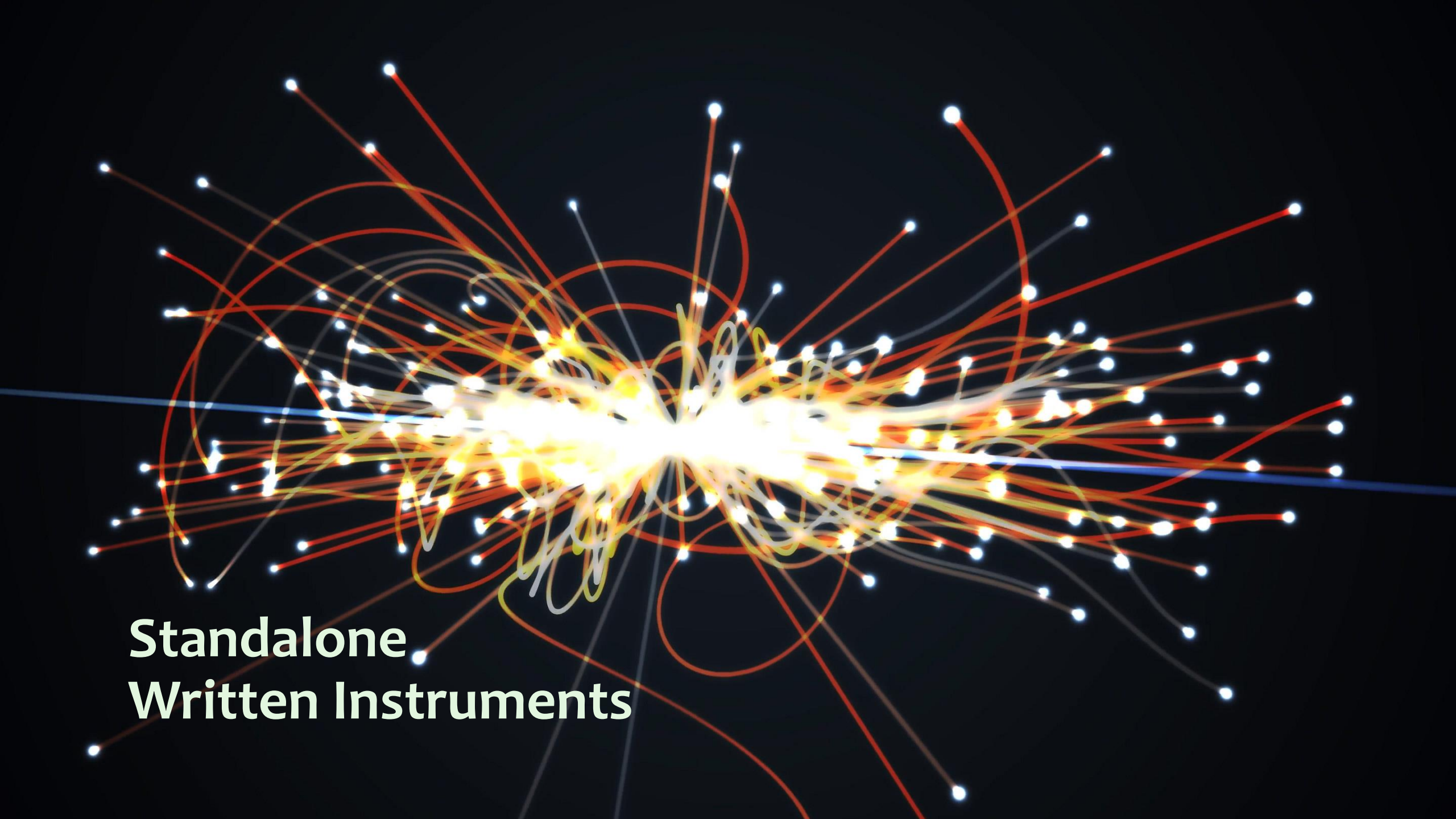
- **Similar to provisions in each DOE-CERN Addenda, the 2017 Neutrino Addendum to the 2015 Neutrino Protocol contemplates any specific technical details for a project or program to be covered by non-binding MOUs between a DOE lab and CERN**

- **Three MOUs with Fermilab and CERN for the neutrino program; with Fermilab as host-lab *and* "librarian" of the MOU**
  - **Feb 2022**: MOU for Collaboration in the SBN Program, in its construction, operations, and physics data analysis
  - **Sept 2023**: LBNF Project Planning Documents ("MOUs") that facilitate DOE's LBNF project reviews & provide specific details of Fermilab's and CERN's responsibilities plus CERN's technical deliverables, including project milestones, of the two large cryostats
  - **Nov 2023**: MOU for Collaboration in DUNE, including *shared* contributions by CERN and all partners to Far Detectors #1 and 2

- **While above MOUs for SBN and DUNE are multi-lateral – where other institutional partner contributions are memorialized – the overall DOE-CERN neutrino protocol agreement structure provides necessary legal framework for the cooperation**

Sept 2022, Group Photo at signing to amend Neutrino Addendum I at CERN (from left-to-right): P. McBride (FNAL), C. Warakaulle (CERN), L. Merminga (FNAL), M. Lamont (CERN), A. Berhe (DOE), F. Gianotti (CERN), H. Kung (DOE), J. Mnich (CERN), F. Lanni (CERN), and E. Tsesmelis (CERN)

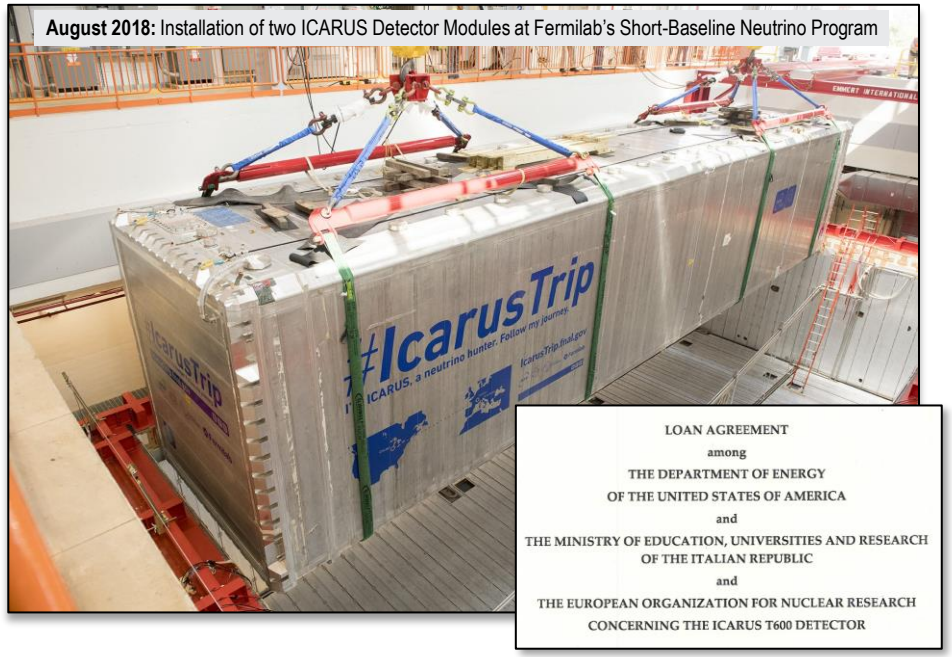
Nov 2023, Signing of Multi-Institutional DUNE MOU (from left-to-right): M. L. Moretti (UNICAMP, Brazil), R. Pain (IN2P3, France), L. Merminga (FNAL, USA), M. Pallavicini (INFN, Italy), M. Weber (University of Bern, Switzerland), and M. Thomson (UKRI-STFC, United Kingdom)


Standalone
Written Instruments

Standalone Written Instruments with CERN (I)

U.S. DEPARTMENT OF ENERGY | Office of Science

- **Loan Agreement among DOE, CERN, and Italy's Ministry of Education, Universities and Research concerning ICARUS, signed in May 2018**
  - ICARUS detector originally operated in Italy at INFN's Gran Sasso National Laboratory during 2010-2014
  - From 2014-2017, ICARUS underwent refurbishment at CERN ⇒ subsequently shipped from CERN to Fermilab in 2017 for the Short-Baseline Neutrino Program, at which time the detector is *on-loan* by INFN to DOE
  - Once the salient risks and responsibilities of the loan were established under this agreement, ICARUS was successfully installed at Fermilab in Aug 2018



- **In 2023, framework agreement signed between CERN and NASA to collaborate in Open Science**
  - Promote Open Science with objective of increasing reproducibility, inclusion, and accessibility of scientific knowledge; and awareness of its practices
  - Provides the ability for NASA-funded data sets to appear in Zenodo – a multi-disciplinary repository maintained by CERN for the preservation and making available of research, educational, and informational content

[Summit at CERN, July 2023]

Standalone Written Instruments (II):
Joint U.S.-CERN Statement of Intent, April 2024

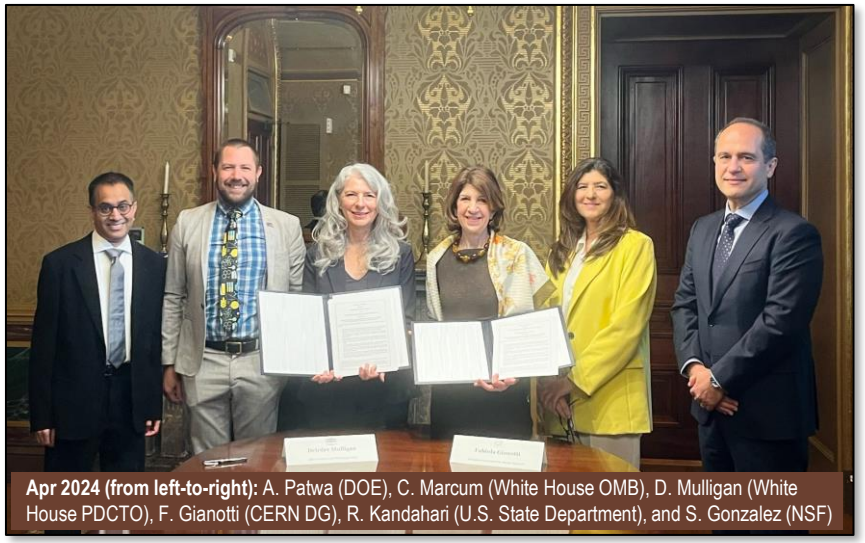
U.S. DEPARTMENT OF ENERGY | Office of Science

Statement of Intent between the United States of America and CERN concerning Future Planning for Large Research Infrastructure Facilities, Advanced Scientific Computing, and Open Science

- Signed on April 26, 2024, in a White House ceremony
- Recognized the historic, long-standing partnership between U.S. and CERN
- Acknowledged the importance of the European Strategy for Particle Physics Update and the U.S. P5 plan to guide the long-range strategies for Europe, CERN, and the United States; including the leading roles each have played in developing and executing one another's strategy
- Discuss potential collaboration on pilot projects to incorporate new analytics techniques and tools such as AI into particle physics research
- Reaffirmed the collaboration by the U.S. in the ongoing FCC feasibility study
- Subject to appropriate approvals, express intentions by the U.S. to collaborate in the FCC-ee construction and physics exploitation should the CERN Member States determine it is likely to be CERN's next world-leading research facility following HL-LHC

Statement available at: U.S. Department of State Remarks & Releases site

Apr 2024 (from left-to-right): The White House Office of Science and Technology Policy Principal Deputy U.S. Chief Technology Officer Deirdre Mulligan and CERN Director-General Fabiola Gianotti



Apr 2024 (from left-to-right): A. Patwa (DOE), C. Marcum (White House OMB), D. Mulligan (White House PDCTO), F. Gianotti (CERN DG), R. Kandahari (U.S. State Department), and S. Gonzalez (NSF)

Current Efforts for Future Agreements to-be Signed

Agreements Now In-Preparation

- **As described earlier, most of the agreements under the hierarchal DOE-CERN protocol agreement structure are topical – *i.e.,* based on a particular project or initiative (*e.g.,* CERN-based accelerators, LHC experiments, HL-LHC, neutrinos, etc.)**
- **Given certain initiatives are in domains outside these areas, DOE and CERN initiated discussions in 2019 to establish a more *generalized framework* for any future collaborative activity outside these specific domains**
- **Thereby, prepared a draft DOE-CERN General Operational Protocol (*at the 2nd "Protocol" level under the 2015 ICA*)**
  - Once such a multi-purpose Protocol is signed, then subsidiary Addenda – on a specific topic – can be concluded by DOE and CERN, which in turn, would allow the DOE labs to detail specific technical efforts via MOUs between the lab and CERN
  - U.S. State Department C-175 authorization provided in 2019 for DOE to negotiate the draft with CERN
  - The then-COVID pandemic led to challenges in timely converging on signing the Protocol
- **Recently, renewed interest to complete this Protocol ⇒ now being reviewed by DOE-GC, which, for instance, once signed would subsequently enable DOE and CERN to establish:**
  - An Addendum for the **CERN-hosted Detector R&D (DRD) collaborations**, under which (should funding allow) the DOE labs can complete subsidiary technical MOUs (work packages) with CERN
  - An Addendum for cooperation in the **BNL-hosted Electron-Ion Collider**, spearheaded by DOE/SC's Office of Nuclear Physics
  - Both Addenda now being prepared by CERN for DOE's review; other topical Addenda can be established later, if and as needed
- **In addition to LHC and FCC, the scope under the 2015 DOE-CERN Accelerator Protocol also includes *"[…] any other accelerator science studies relevant to future CERN accelerator initiatives"*, which provides a hook for the IMCC**
  - CERN preparing draft Addendum for DOE-CERN cooperation in the **CERN-hosted International Muon Collider Collaboration (IMCC)**
- **Aiming to complete and sign the above draft instruments during the next calendar year**

Closing Remarks

U.S. DEPARTMENT OF ENERGY | Office of Science

- **The United States and CERN continue to enjoy a strong and long-standing partnership in particle and nuclear physics to advance science, technology, and innovation**
- **To-date, at least 32 collaborative written instruments (*i.e.,* agreements, amendments, MOUs, Statements) have been signed between CERN and a U.S. agency or laboratory entity**
  - Not including the countless number of collaborative letters that have been exchanged over the years between CERN and U.S. entities
  - These instruments are in addition to many others between DOE and international partners around the world (*e.g.,* in Europe and Asia) that establish collaboration on key initiatives in HEP
- **The multi-purpose DOE-CERN General Operational Protocol, currently being prepared, is anticipated to help simplify the agreement structure**
  - Allows certain provisions to be included and uniformly applied to future collaborative projects or initiatives that are documented as subsidiary agreements under the Protocol, avoiding the need to re-invent the content on each occasion
- **DOE plans to carry its partnership with CERN far into the future**
  - We look forward to continuing our discussions with CERN to advance the development and realization of the future collider hosted at CERN
  - Once the next phase of the future collider is determined, DOE looks forward to engaging with CERN to prepare the corresponding agreements

DOE is deeply grateful to CERN and the U.S. Government entities for the continued support in advancing these international cooperative agreements and arrangements.

I personally would like to thank several colleagues over the last years for the excellent dialogue and preparation of these arrangements, which, in turn, led to signatures; particularly:

U.S. Department of Energy: Corey Cohn, Elizabeth O'Malley, Helena Fu, Michael Salamon, Maria DiGiulian, Thomas Reilly, Stephen Markus, Matthew Zogby, Whitney Begner, Adam Bihary, Claudette Rosado-Reyes(*), and Kaitlyn Schroeder-Spain(*)

U.S. State Department: Constance Arvis, Cole Donovan, Esha Mathew, Ambassador Pamela Hamamoto, Birgitta Hoggren, Jared Banks, Brett Makens, Julie Jolles, Jillian Mueller, and Gabriel Swiney

CERN: Fabiola Gianotti, Charlotte Warakaulle, Joachim Mnich, Eckhard Elsen, Mike Lamont, Frederick Bordry, Rolf Heuer, Rüdiger Voss, Sergio Bertolucci, Kirsten Baxter, Maarten Wilbers, Sofia Intoudi, Nicolas Houet, Jean-Michel Favre, Eva-Maria Groniger-Voss, Emmanuel Tsesmelis, Michael Benedikt, Frank Zimmermann, Patrick Janot, Francesco Lanni, and the ATLAS and CMS Collaborations

(*) Former AAAS Science & Technology Policy Fellow

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Ref. Laboratory Agreements and Arrangements

U.S. DEPARTMENT OF ENERGY | Office of Science

Signed by DOE National Labs

Contractual Types of Agreements

CRADA

Lab-to-Lab (Institutional)

- Cooperative Research And Development Agreement
- Facilitates collaborative work between partners on a project or initiative, one that includes cost or resource sharing (and in some cases the conduct of work)

SPP

Lab-to-Lab (Institutional)

- Strategic Partnership Project agreement
- Fully funded by the non-DOE partner for work conducted at a DOE national laboratory.

ACT

- Agreement for Commercializing Technology
- Fully funded by the non-DOE partner and also provide for a business-friendly framework with flexible IP and data rights, payment, and indemnification rules.

Non-Binding MOU

Lab-to-Lab (Institutional)

- A general, non-binding arrangement for memorializing collaborative activities on a best-effort basis. Covered initiatives may include information-sharing, people visits, and workshops; may express the intent to engage in future research and development projects under the framework of a separate binding agreement (*e.g.,* CRADA, SPP, ACT, *or* DOE-agency level agreements).
- Includes project planning documents or other project-specific collaborative MOUs, which refer to, and maintain alignment with, separate binding agreements (*e.g.,* CRADA, SPP, ACT, *or* DOE-agency level agreements)