



U.S. DEPARTMENT OF
ENERGY

Office of
Science

International Science Collaborations and Science Infrastructure: Accelerating Scientific Discovery

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April 8, 2019

DOE Office of Science

A research funding agency and a steward of national research infrastructure.



- 25,000 Ph.D. scientists, graduate students, undergraduates, engineers, and technical staff supported through competitive awards
- 27 scientific user facilities serving more than 36,000 users each year
- The U.S. largest federal supporter of basic research in the physical sciences

Office of Science User Facilities



27 world-leading facilities serving over 36,000 researchers annually

- supercomputers,
 - high intensity x-ray, neutron, and electron sources,
 - nanoscience facilities,
 - genomic sequencing facilities,
 - particle accelerators,
 - fusion/plasma physics facilities, and
 - atmospheric monitoring capabilities.
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- Open access; allocation determined through peer review of proposals
 - Free for non-proprietary work published in the open literature
 - Full cost recovery for proprietary work

U.S. DOE International Agreements

- **SC Programs' international cooperation currently operates under 62 Office of Science International Agreements**
 - Spanning 16 foreign countries and partner entities (Brazil, Canada, CERN, China, EURATOM, France, Germany, India, IEA, Israel, Italy, ITER, Japan, Russia, South Korea, Sweden)
 - Includes Implementing Arrangements, Protocols, Cooperative agreements, project annexes, and statements of intent
- ***Under development: 17 international agreements between DOE Programs and foreign partner entities***
 - Presently extending to Czech Republic, Poland, United Kingdom
- **Many international collaborations through the DOE/SC National Labs**
 - Agreements, CRADAs, SPPs
 - All are approved through DOE/SC

U.S. DOE at the Large Hadron Collider

The U.S. continues strong collaboration in the Large Hadron Collider as part of our bilateral partnership with CERN

- **U.S. ATLAS represents ~19% of the international ATLAS Collaboration**
 - 41 universities, 4 national labs (Argonne, Brookhaven, Lawrence Berkeley, SLAC)
 - Brookhaven is host lab for U.S. ATLAS
- **U.S. CMS represents ~29% of the international CMS Collaboration**
 - 53 universities, 1 national lab
 - Fermilab is host lab for U.S. CMS
- **Participation in LHC proton program at ATLAS and CMS and heavy ion program at ALICE, ATLAS, and CMS**



States hosting members of the U.S. LHC experimental program



Large Hadron Collider Tunnel

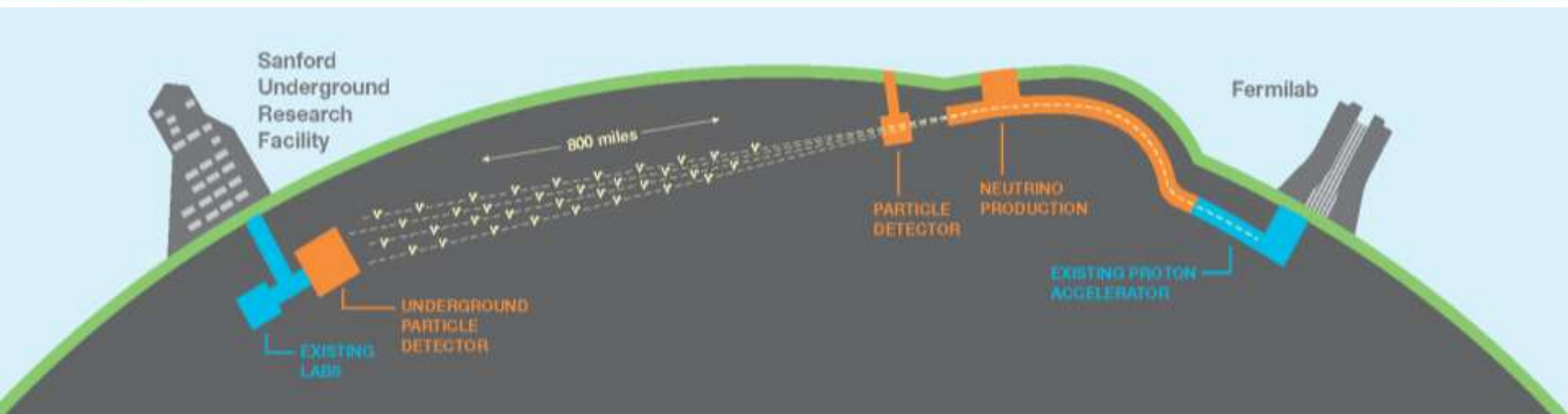


ATLAS Detector



CMS Detector

Long Baseline Neutrino Facility & Deep Underground Neutrino Experiment



The LBNF/DUNE project will be the first internationally conceived, constructed and operated mega-science project hosted by the Department of Energy in the United States

- **Combination of world's most intense neutrino beam, a deep underground site, and massive liquid argon detectors enables broad science program addressing some of the most fundamental questions in particle physics**
 - **Origin of matter.** Investigate matter-antimatter asymmetry. Are neutrinos the reason the universe is made of matter?
 - **Neutron star and black hole formation.** Ability to observe neutrinos from supernovae events and perhaps watch formation of black holes in real time.
 - **Unification of forces.** Investigate nucleon decay.

Now **1180 collaborators** from **184 institutions** in **32 nations**

Armenia, Brazil, Bulgaria,
Canada, CERN, Chile, China,
Colombia, Czech Republic,
Spain, Finland, France, Greece,
India, Iran, Italy, Japan,
Madagascar, Mexico,
Netherlands, Paraguay, Peru,
Poland, Romania, Russia,
South Korea, Spain, Sweden,
Switzerland, UK, Ukraine, USA



International Collaborations – Guiding Principles

Goal: to pursue mutually beneficial collaborations that advance and accelerate scientific discovery

- Quid pro quo – mutual benefit
 - Parity in intellectual and financial contributions
 - Scientific credit
- Mutual respect of intellectual property rights
- Openness, transparency, respect for individuals
 - Institutions, funding, people
- For peaceful purposes
- Community engagement and buy in – validated via peer review
- Use of rigorous project management, where appropriate
- Governed by formal, Government-to-Government Agreements when appropriate
 - Intellectual property, access, funding, national security



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