



U.S. DEPARTMENT OF
ENERGY

Office of
Science

International Science Collaborations and Science Infrastructure: Accelerating Scientific Discovery

J. Stephen Binkley, Deputy Director
Office of Science
U.S. Department of Energy

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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
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- Free for non-proprietary work published in the open literature
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- Full cost recovery for proprietary work



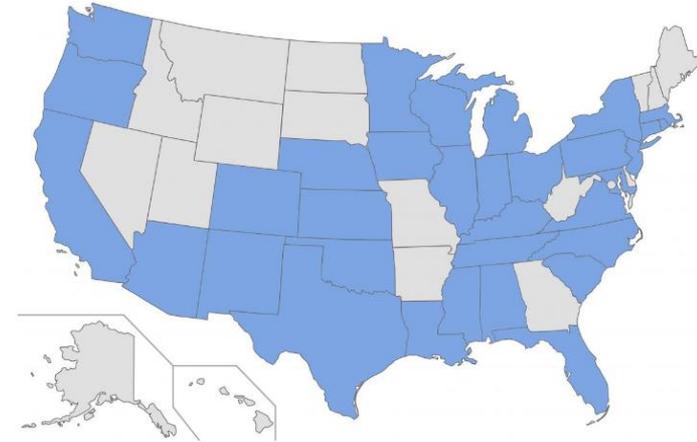
U.S. DOE International Agreements

- **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
- **Several of the SC International Agreements involve NP facilities, research, and program activities**
- ***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

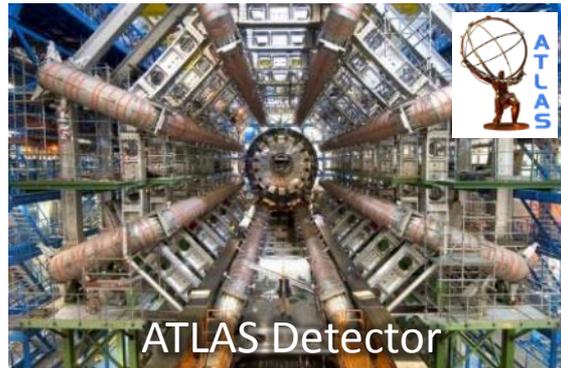
- **U.S. ATLAS represents ~19% of the international ATLAS Collaboration**
 - 41 universities, 4 national labs (Argonne, Brookhaven, Lawrence Berkeley, SLAC)
 - Brookhaven is host lab for U.S. ATLAS
- **U.S. CMS represents ~29% of the international CMS Collaboration**
 - 53 universities, 1 national lab
 - 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

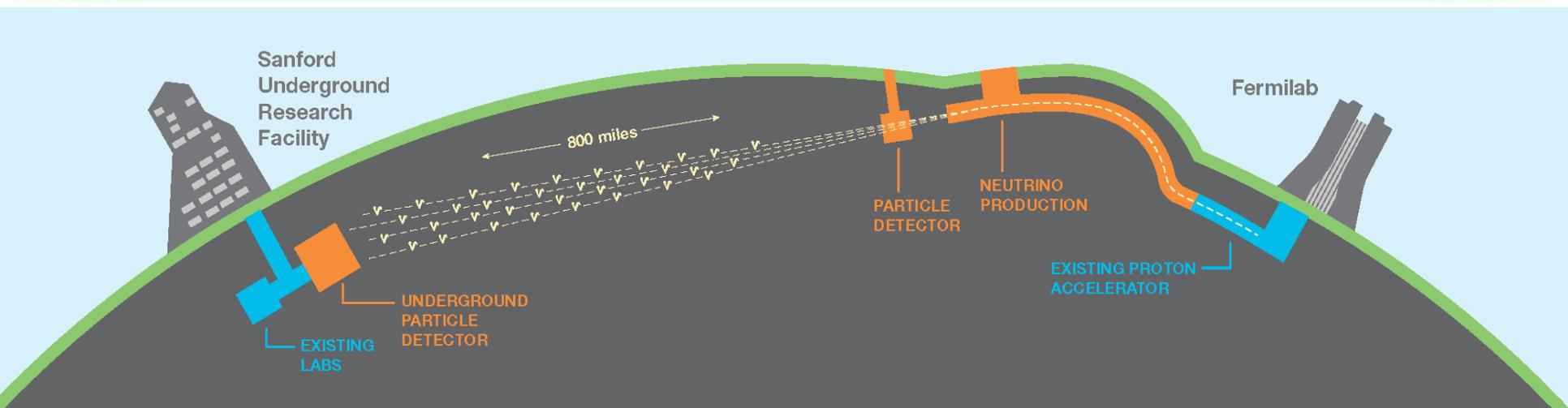


ATLAS Detector



CMS Detector

Long Baseline Neutrino Facility & Deep Underground Neutrino Experiment

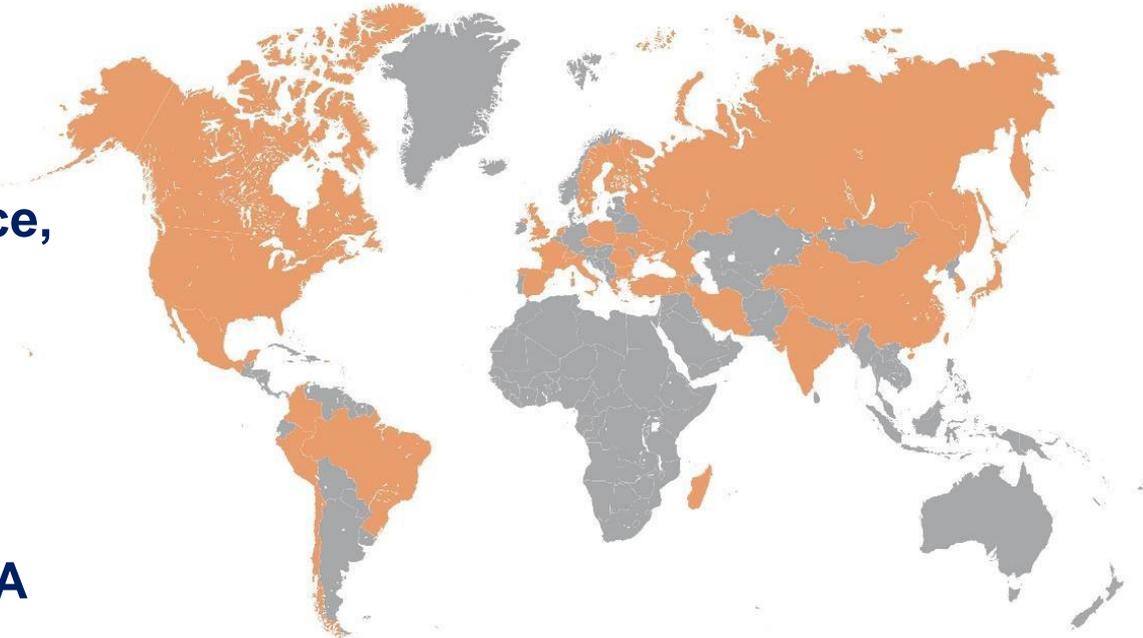


The LBNF/DUNE project will be the first internationally conceived, constructed and operated mega-science project hosted by the Department of Energy in the United States

- **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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