



U.S.-India Discovery Science Collaboration

The Indian Institutions and Fermilab Collaboration (IIFC) is paving the way toward a successful U.S.-India agreement on the joint design and construction of future physics and accelerator projects. The IIFC works with the U.S. Department of Energy (DOE) to develop world-class Intensity Frontier physics research facilities at DOE's Fermi National Accelerator Laboratory and accelerator projects at Indian Department of Atomic Energy (DAE) laboratories. These efforts will also enable U.S. companies to capture a significant share of the next-generation accelerator technology market by collaborating with the Illinois Accelerator Research Center at Fermilab and seizing business opportunities in India and elsewhere.

The Indian DAE has proposed to make significant in-kind contributions, valued at hundreds of millions of dollars, toward a new accelerator and physics research program at Fermilab in return for the joint development of the required accelerator and detector technology for physics and two accelerator projects in India.

While U.S. industry would like to play major roles in the Indian accelerator projects, they face tough competition from Europe, China and Japan. A close U.S.-India collaboration helps U.S. companies tremendously and is essential for the success of these large accelerator projects.

The IIFC, founded in 2006, develops the accelerator technologies that are critical to the accelerator plans of both the U.S. DOE and the Indian DAE. Fermilab also collaborates with U.S. industry on these accelerator technologies. Together, these efforts meet U.S. and Indian interests in technologies that are crucial to future accelerator projects and promise to have applications in discovery science, industry, energy production, medicine and other fields that rely on accelerator technology.

In the United States, the IIFC participates in Fermilab's plans to upgrade its accelerator complex through the construction of a new half-mile-long accelerator known as Project X. This accelerator will allow Fermilab to create a world-class research program at the Intensity Frontier of particle physics. India has signed up as the first dedicated international project partner, which is a major step toward attracting other international partners. Project X will also pave the way to future international collaborations on a future Energy Frontier accelerator, which would rely on the same accelerator technology as Project X. Fermilab is also developing a neutrino physics program at the Intensity Frontier.

The central technology for these accelerators is known as superconducting radio-frequency (SRF) acceleration, which has applications in many fields. Indian laboratories would like to have their scientific and engineering staffs participate fully in the R&D, construction and commissioning phases of Project X to develop their own capabilities.

In India, the IIFC and its development of SRF technologies are important for the Indian DAE and its plans for constructing not one but two SRF accelerators in the next 10 years for material science, energy and medical applications. These plans are part of the Indian 12th national plan.

The IIFC enables scientists in the United States and India to jointly develop and optimize the technologies for these two SRF accelerators. U.S. manufacturers would have an edge over competitors in Europe and Japan as they are learning these accelerator technologies from Fermilab.

Indian scientists in IIFC are participating prominently in the development of Fermilab Intensity Frontier research programs, including the Long Baseline Neutrino Experiment.

Major developments with regard to the U.S.-India collaboration:

- The DOE Office of Science has signed the Implementing Agreement on Discovery Science.
- The DOE Office of Science is working on two project annexes for the accelerator and physics collaboration with the Indian DAE laboratories and Indian Department of Science and Technology (DST) universities. This effort is part of the U.S.-India Joint Coordination Committee on Science and Technology and was discussed during the June 2012 meeting in Washington.
- Fermilab has worked with the Indian DAE-DST institutions to align their accelerator design to Fermilab's Project X to maximize the synergies between these two countries' projects and interests, lending a hand in U.S. recapturing leadership in the field of high-energy physics.

The U.S.-India Discovery Science Collaboration faces significant competition in both science and business opportunities. In particular, the competition for attracting international partners in particle physics research is intense. The European research center CERN has offered India the status of associate member. CERN continues to strengthen its international leadership by aligning its technology development and physics program with collaborating countries. The German laboratory DESY (which shares its SRF technology knowhow with Fermilab) has also approached India for collaboration on its XFEL project, which uses SRF technology. Indian DAE and DST institutions already collaborate with the German laboratory GSI on its nuclear physics research facility. The Belgian MYRRHA project, which focuses on demonstrating the feasibility of nuclear energy technology, has also approached India.

Accelerator collaboration: Indian DAE laboratories have been collaborating with Fermilab since 2007 on the R&D of SRF linear accelerators and related infrastructure development. The present R&D is focused on joint development of high-intensity proton accelerators in the United States and India. Under the current MOU between Fermilab and the Indian laboratories, the IIFC jointly develops and fabricates components for SRF accelerators and related infrastructures.

Physics research collaboration: Since 1990, Indian institutions have collaborated on the DZero collider experiment at Fermilab. Today, under IIFC agreement, eight Indian institutions participate in the operation, construction and planning of three neutrino physics experiments (MINOS, NOvA and LBNE) at Fermilab. Other Indian institutions are in the process of submitting proposals to join future experiments with Project X. Indian institutions have proposed to take leadership in LBNE at Fermilab. They would also assume the responsibility for detector construction and participate in R&D for the Project X experimental program.

The Collaboration under the DAE-DOE Discovery Science agreement is working to expand the collaboration in both accelerator and physics. The Indian DAE and DOE have discussed the possibility of significant DAE in-kind contributions toward the Fermilab LBNE and Project X accelerator and research program, for the joint and equal partnership development of programs in the United States and India.

More information:

Indian Institutions and Fermilab Collaboration: <http://iifc.fnal.gov/>

Project X: <http://projectx.fnal.gov/>

Long Baseline Neutrino Experiment: <http://lbne.fnal.gov/>