Implementing Agreement between the U.S. Department Of Energy and the Department of Atomic Energy of India for Cooperation in the Area of Accelerator and Particle Detector Research and Development for Discovery Science

Press Release Questions and Answers

1. **What is the title of the agreement?**

The title of the agreement is "Implementing Agreement between the U.S. Department of Energy and the Department of Atomic Energy of India for Cooperation in the Area of Accelerator and Particle Detector Research and Development for Discovery Science."

2. **What forms of cooperation does the agreement cover?**

The agreement specifies the following forms of cooperation: conduct of joint or cooperative research projects and programs; establishment of facilities through joint effort; exchange of technical information, data and experience; exchange of technical and managerial personnel for visits and short-term assignments; exchange of equipment, materials and instrumentation; conduct of joint conferences, seminars or workshops; and such other forms of cooperation as the Parties may agree in writing.

3. **What is the Indian Department of Atomic Energy?**

The Department of Atomic Energy (DAE) is a department directly under the Prime Minister of India headquartered in Mumbai. The department is responsible for nuclear technology, including nuclear power and research. The Indian Atomic Energy Commission is a governing body functioning under DAE. The Chairman of the Atomic Energy Commission (who is also the Secretary of DAE) is Dr. Srikumar Banerjee.

4. **How can cooperation under this agreement lead to advances in clean energy and otherwise benefit society?**

While it's understood that most of the economic benefits from technological innovation, including advances in energy related areas, resulted from basic scientific research, it's difficult to predict how today's basic research can lead to future advances. Currently, there are about 30,000 accelerators in operation worldwide in areas ranging from diagnosing and treating disease to powering industrial processes. The beams produced by today's particle accelerators address many of the challenges confronting our nation in the 21st century: energy, the environment, jobs, health care, and national security. Joint cooperation under this agreement may lead to new scientific discoveries and have the potential to make still greater contributions to the nation's health, wealth and national security.

5. **What is a particle detector?**

A particle detector is a device used to detect, track, and/or identify high energy particles that can be produced by particle collisions in an accelerator, nuclear decay, and cosmic radiation.

6. **What is a 'top-quark' and what is the significance of its discovery?**

The top-quark, is an elementary particle and a fundamental constituent of matter. It was discovered in 1995 by the Collider Detector (CDF) and DZero experiments at Fermilab in Batavia, Illinois, USA. The discovery of the top-quark is significant to furthering the understanding of the fundamental constituents of matter and confirming one of the central theories regarding inter-particle interactions.

7. **What is a quark-gluon plasma and what is the significance of its formation at Brookhaven National Laboratory?**

The quark-gluon plasma is a phase that consists of free quarks and gluons, which are several of the basic building blocks of matter. At the Relativistic Heavy Ion Collider at Brookhaven National Laboratory, gold ions traveling at nearly the speed of light were collided resulting in the melting of protons and neutrons into a plasma of quarks and gluons. This plasma is theorized to have filled the universe a few microseconds after it came into existence 13.7 billion years ago. This research offers significant insight into the fundamental structure of matter and the early universe.

8. What is 'heavy ion physics'?

Heavy ion physics is the study of charged atoms heavier than helium often including carbon, silicon, copper, tungsten, gold, lead, and uranium.

9. What is 'superconducting radiofrequency (SRF) accelerator technology', and where and how will it be used?

Superconducting radiofrequency (SRF) technology is being developed as an improvement in how beams of particles are accelerated more efficiently using less laboratory space compared to most current accelerators. The SRF components are made of shiny, curved, virtually perfect cells made of superconducting niobium that are strung together and nestled in a helium-cooled vessel called a cryomodule and exposed to an oscillating electric field.

10. Will funds be transferred to India, or vice versa?

As the agreement states, unless otherwise agreed in writing, all costs resulting from collaboration under this agreement shall be the responsibility of the Party that incurs them.

11. Which U.S. and Indian institutes, labs, or organizations are expected to participate in joint cooperation under this agreement?

While the agreement lists the following U.S. and Indian institutes and laboratories, joint research with other institutes and laboratories (e.g., Brookhaven National Laboratory) can proceed with written agreement from both parties:

- Fermi National Accelerator laboratory, Batavia, (Fermilab)
- Thomas Jefferson National Accelerator Facility, Newport News, (TJNAF)
- Brookhaven National Laboratory (BNL)
- SLAC National Accelerator Laboratory (SLAC)
- Laboratory of Elementary Particle Physics, Cornell University
- Bhabha Atomic Research Centre, Mumbai, (BARC)
- Raja Ramanna Centre for Advanced Technology, Indore (RRCAT)
- Variable Energy Cyclotron Centre, Kolkata (VECC)
- Tata Insitute of Fundamental Research, Mumbai (TIFR)
- Saha Institute of Nuclear Physics, Kolkata (SINP)
- Inter- University Accelerator Centre, New Delhi (IUAC)

12. How long will this agreement stay in effect?

This implementing agreement is subject to and governed by the U.S-India S&T Agreement, and will stay in effect as long as the umbrella S&T agreement is in effect.

13. Are there limitations to this cooperation?

From a non-proliferation stand-point there are no limitations on cooperation in non-nuclear fields that further U.S.-Indian cooperation in basic science. However, DOE does require that any applied uses of joint work that

are nuclear related proceed in accordance with the terms of the U.S.-India 123 Agreement and specifically come under IAEA safeguards if involving any nuclear materials. DOE also, wants to ensure that cooperation and the results of cooperation are solely for peaceful purposes.

14. Fermilab has previously signed a memorandum of understanding (MOU) with Indian partners in 2006 and 2009. How does this agreement differ from the MOUs signed in 2006/2009?

The Memorandum of Understandings (MOUs) signed previously are not legally binding documents. This agreement provides a legally-binding framework for R&D cooperation. The scope of participating institutions and research areas covered under this agreement are broader.

15. Is this cooperation part of the U.S.-India Civil Nuclear Cooperation Agreement from 2008?

This agreement does not cover cooperation under the U.S.-India Civil Nuclear Cooperation Agreement. The U.S.-India civil nuclear cooperation agreement is a legal framework that allows for specific nuclear activities to take place in accordance with the US Atomic Energy Act of 1954.