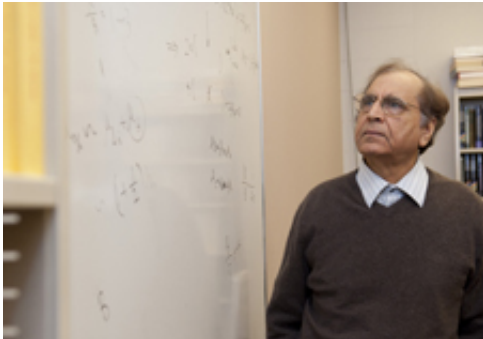


Physicists push for underground testing facility

February 2 2012



Northeastern professor Pran Nath talks about why he and more than 40 colleagues are urging the U.S. Department of Energy to fund an underground facility for particle physics research. Photo by Casey Bayer.

Pran Nath, the Matthews Distinguished Professor of Physics at Northeastern University, is among a group of leading theoretical physicists who have asked the Department of Energy to develop a large underground neutrino facility to maintain U.S. leadership in the frontier of particle physics. We asked Nath to explain the facility and its value.

What is the Long Baseline Experiment (LBNE) and why is an underground facility essential to its success?

[Neutrinos](#) are mysterious objects that hold the key to understanding

many [natural phenomena](#), including why our universe is made up of matter instead of anti-matter. Neutrinos also play a key role in supernova explosions, which are responsible for the origin of heavy elements and, thus, life itself.

LBNE will seek to unravel the mysteries of the neutrino. It will produce neutrinos at Fermilab in Illinois and direct them to a multipurpose detector at Homestake gold mine, 1,200 kilometers away in Lead, South Dakota. U.S. physicist Raymond Davis, who won the Nobel Prize in Physics in 2002, conducted another neutrino experiment at Homestake starting in late 1960s.

The underground facility would also allow us to determine if protons live forever or eventually die or disintegrate. The proton disintegration would verify the Grand Unified Theory, in which the strength of all natural forces unify at high scales close to the Big Bang time, when the universe was born. Such a discovery would be a milestone in the history of physics.

Cosmic rays, radiation coming from outer space, can spoil neutrino experiments in aboveground facilities. If the experiment is done deep underground, the cosmic rays are absorbed before they reach the detector, thus giving more accurate results.

Why did you and your colleagues choose to issue this letter to the Department of Energy at this particular time?

With Europe, China and Japan pulling ahead of the United States with new generations of experiments on the high-energy frontier, the country stands to lose its leadership role in this area of science, unless immediate, vigorous action is taken. A few [theoretical physicists](#),

including myself, discussed the possibility of writing to DOE in support of a large neutrino facility while at a workshop on underground physics in Lead last spring. After the letter was completed, it was circulated among colleagues and received support from more than 40 leading high-energy theorists in the United States, including three Nobel Laureates and several members of the National Academy of Sciences. Since the DOE is expected to make a decision on LBNE in the next few months, we chose to issue the letter now as a further recommendation for the underground facility.

Why is the DOE hesitant to develop this facility and how would you and your colleagues respond to their reservations?

LBNE has a high projected cost of \$1 billion to \$1.5 billion and DOE currently has many expensive projects under consideration. Moreover, we are a signatory to the \$23 billion International Fusion Experiment in France. Thus, there are many competing demands for DOE resources.

We do, however, believe that a large underground facility, which would also allow the possibility of smaller experiments such as the next generation experiments for identifying the nature of dark matter in the [universe](#), is of urgent national interest. Developing such a facility, which would also serve as a training ground for the next generation of scientists and students and contribute to enhancing the country's scientific culture, is critical to maintaining America's leadership in the high-energy frontier.

Provided by Northeastern University

Citation: Physicists push for underground testing facility (2012, February 2) retrieved 19 April

2024 from <https://phys.org/news/2012-02-physicists-underground-facility.html>

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