From: Interactions <webmaster@interactions.org>
Subject: Daya Bay Collaboration - New measurements suggest 'antineutrino anomaly' fueled by modeling
Date: April 4, 2017 at 11:46:38 PM EDT
To: <parsa@bnl.gov>
Reply-To: Interactions <webmaster@interactions.org>

Analysis indicates missing particles problem may stem from uranium isotope

Results from a new scientific study may shed light on a mismatch between predictions and recent measurements of ghostly particles streaming from nuclear reactors—the so-called "reactor antineutrino anomaly," which has puzzled physicists since 2011.

The anomaly refers to the fact that scientists tracking the production of antineutrinos—emitted as a byproduct of the nuclear reactions that generate electric power—have routinely detected fewer antineutrinos than they expected. One theory is that some neutrinos are morphing into an undetectable form known as "sterile" neutrinos.

But the latest results from the Daya Bay reactor neutrino experiment, located at a nuclear power complex in China, suggest a simpler explanation—a miscalculation in the predicted rate of antineutrino production for one particular component of nuclear reactor fuel.

Antineutrinos carry away about 5 percent of the energy released as the uranium and plutonium atoms that fuel the reactor split, or "fission." The composition of the fuel changes as the reactor operates, with the decays of different forms of uranium and plutonium (called "isotopes") producing different numbers of antineutrinos with different energy ranges over time, even as the reactor steadily produces electrical power.

The new results from Daya Bay—where scientists have measured more than 2 million antineutrinos produced by six reactors during almost four years of operation—have led scientists to reconsider how the composition of the fuel changes over time and how many neutrinos come from each of the decay chains.

The scientists found that antineutrinos produced by nuclear reactions that result from the fission of uranium-235, a fissile isotope of uranium common in nuclear fuel, were inconsistent with predictions. A popular model for uranium-235 predicts about 8 percent more antineutrinos coming from decays of uranium-235 than what was actually measured.

In contrast, the number of antineutrinos from plutonium-239, the second most common fuel ingredient, was found to agree with predictions, although this measurement is less precise than that for uraninum-235.

If sterile neutrinos—theoretical particles that are a possible source of the universe’s vast unseen or “dark” matter—were the source of the anomaly, then the experimenters would observe an equal depletion in the number of antineutrinos for *each* of the fuel ingredients, but the experimental results disfavor this hypothesis.

The latest analysis suggests that a miscalculation of the rate of antineutrinos produced by the fission of uranium-235 over time, rather than the presence of sterile neutrinos, may be the explanation for the anomaly. These results can be confirmed by new experiments that will measure antineutrinos from reactors fueled almost entirely by uranium-235.

The work could help scientists at Daya Bay and similar experiments understand the fluctuating rates and energies of those antineutrinos produced by specific ingredients in the nuclear fission process throughout the nuclear fuel cycle. An improved understanding of the fuel evolution inside a nuclear reactor may also be helpful for other nuclear science applications.

Situated about 32 miles northeast of Hong Kong, the Daya Bay experiment uses an array of detectors to capture antineutrino signals from particle interactions occurring in a series of liquid tanks. The Daya Bay collaboration involves 243 researchers at 41 institutions in the U.S., China, Chile, Russia and the Czech Republic.

####

The collaborating institutions of the Daya Bay Reactor Neutrino Experiment are Beijing Normal University, the U.S. Department of Energy's (DOE) Brookhaven National Laboratory, California Institute of Technology, Charles University in Prague, Chengdu University of Technology, China General Nuclear Power Group, China Institute of Atomic Energy, Chinese University of Hong Kong, Dongguan University of Technology, East China University of Science and Technology, Joint Institute for Nuclear Research, University of Hong Kong, Institute of High Energy Physics, Illinois Institute of Technology, Iowa State University, DOE's Lawrence Berkeley National Laboratory, Nanjing University, Nankai University, National Chiao-Tung University, National Taiwan University, National United University, National University of Defense Technology, North China Electric Power University, Princeton University, Pontifical Catholic University of Chile, Rensselaer Polytechnic Institute, Shandong University, Shanghai Jiao Tong University, Shenzhen University, Siena

College, Temple University, Tsinghua University, University of California at Berkeley, University of Cincinnati, University of Houston, University of Illinois at Urbana-Champaign, University of Science and Technology of China, Virginia Polytechnic Institute and State University, University of Wisconsin-Madison, College of William and Mary, Xi'an Jiao Tong University, Yale University, and Sun Yat-Sen (Zhongshan) University.

A complete list of funding agencies for the experiment can be found in the scientific paper: "Evolution of the Reactor Antineutrino Flux and Spectrum at Daya Bay."***DATE ISSUED***

April 4th, 2017***SOURCE***

RELEASE TYPE

Press Release