Searching for a twist in neutron spin axis, physicists find nothing—and that's something

March 7 2013

IU physicists Mike Snow and H. Yan conducted there experiment at the National Institute of Standards and Technology Center for Neutron Research, which ranks among the best research centers of its type in the world. Delivered via beamlines to 29 major analytical instruments—some without parallel in the U.S.—its neutron probes support the research of more than 2,000 scientists and students each year.

(Phys.org) —Besides understanding how much dark matter and dark energy there is—about 95 percent of the universe—scientists also want to know more about what dark matter and dark energy are not, as opposed to what they are. Indiana University's Mike Snow, a nuclear physicist who specializes in precision measurements using low energy neutrons, now has another "what they are not" to add to the list.

In new research published last week in *Physical Review Letters*, the professor in the IU Bloomington College of Arts and Sciences' Department of Physics reports that the most sensitive test ever—a new upper bound—conducted to identify a new force acting on neutrons as evidenced by a corkscrew motion of the neutron spin axis uncovered no such result. The piece of research also garnered Snow the journal's "Editor's Suggestion" selection, intended to highlight scientific papers which employ ideas from different subfields of physics.

"Despite improving on the sensitivity of previous searches by more than seven orders of magnitude, we saw nothing," Snow said. "That's OK though. Even seeing nothing still helps in eliminating possibilities for new forces. "

Snow and co-author H. Yan, a postdoctoral researcher at IU working with Snow at the Center for the Exploration of Energy and Matter, analyzed data from this IU-led experiment which sent intense beams of low energy, spinning neutrons through one meter of liquid helium to search for any interaction between the neutron and the helium atoms which could cause a twist of the spin axis. Of the four known forces of nature, three of them—gravity, electromagnetism and the strong interaction—cannot twist the spin, and the fourth—the weak interaction —was known to give a small effect in the regime where Snow and Yan were searching.

Snow said more sensitive searches beyond the new upper bound reported in the paper could be performed using neutron spin rotation measurements in heavy nuclei or through analysis of other experiments conducted using delicate measurements with spinning neutrons.

Slow neutron spin rotation is a very sensitive technique used to search for possible exotic long-range neutron interactions which violate parity, or the assumption that nature behaves identically when left and right are reversed. In parity, like interactions whose spatial configurations are switched, as if seen in a mirror, ought to be indistinguishable, but weak interactions allow for parity violations.

The experiment was conducted using the NG-6 beam line in the National Institute of Standards and Technology's Center for Neutron Research in Gaithersburg, Md. Funding for the research that produced the new paper, "New Limit on Possible Long-Range Parity-Odd Interactions of the Neutron from Neutron-Spin Rotation in Liquid 4He," came from the U.S. Department of Energy and the National Science Foundation.

Provided by Indiana University

Citation: Searching for a twist in neutron spin axis, physicists find nothing—and that's something (2013, March 7) retrieved 18 September 2024 from https://phys.org/news/2013-03-neutron-axis-physicists-nothingand.html