

Revamped experiment could detect elusive particle, physicists say

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An experiment called "shining light through walls" would seem hard to improve upon. But University of Florida physicists have proposed a way to do just that, a step they say considerably improves the chance of detecting one of the universe's most elusive particles, a candidate for the common but mysterious dark matter.

In a paper that appears online today in the journal *Physical Review Letters*, physicists at the University of Florida and Lawrence Livermore National Laboratory propose a redesign of the experiment currently being attempted in various forms by several groups of physicists worldwide. Although theoretical at the moment, they say their design could make such experiments a billion times more sensitive in their goal of detecting axions.

Axions are elemental particles whose confirmation would shed light on several different conundrums in particle physics. These could include pinning down the nature of dark matter, the mysterious substance said to make up 30 percent of the universe but so far observed only indirectly by its effects.

"A half dozen groups want to do this experiment, and some of them probably will try this approach," said Pierre Sikivie, a faculty member in UF's physics department and an author of the paper. "It works in principle, but in reality it will take some effort to set this up right so that it can produce a result."

The unimproved experiment seeks to detect axions by shining a laser down the bore of a powerful superconducting magnet. A wall in the middle stops the laser cold, with the theoretical axions continuing through the wall and into the other side of the magnet. There, the magnet reconverts them into photons, or particles of light.

The detection of this light "reappearing" on the other side of the wall is what gives the experiment its iconic name.

Researchers in the U.S. and Europe are in various stages of conducting the experiment. The activity has been stimulated by a recent Italian experiment that claims to have discovered axion-like particles. The hope is to confirm the Legnaro National Laboratories' results or take them a step further.

Sikivie, UF physics professor David Tanner and Karl van Bibber, a physicist at the Lawrence Livermore National Laboratory, propose a redesign of the "shining light through walls" experiment to make it, in their words, "vastly more sensitive."

In a nutshell, they suggest placing pairs of highly reflective mirrors called Fabry-Perot cavities on both sides of the wall. The cavity on the laser light side of the wall would cause the light to bounce back and forth repeatedly, as though in an echo chamber. This action would produce many more of the hypothesized axions than a single beam of light, making them easier to detect on the other side of the wall.

"What happens is, because the light goes back and forth many times as it goes through the magnet, it produces more axions," Sikivie said.

The Fabry-Perot cavity on the other side of the wall would perform a similar function, producing even more photons from the added axions.

Sikivie said researchers are doing separate experiments to detect axions produced by the sun, which would seem to be an easier approach because the sun is a much more powerful source than any laser. But the modified experiment would at least in theory have a higher sensitivity than these solar-based experiments.

"With these two cavities on both sides, it actually gets better, by a factor of 10 maybe, than the solar axion experiments," he said.

Source: University of Florida

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