Best yet test of Lorentz invariance

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The more crucial a physical law is, the more important it is to keep testing it. One of the most important laws formulated in the last century or so is Albert Einsteinəs principle of invariance, which says that there is no preferred reference system or orientation in the universe.

A hypothetical violation of this principle might come about through the intervention of some not-yet-known force field.

The field would manifest itself by the simultaneous violation of three basic symmetries in nature, called CPT: charge conjugation (a symmetry which says that nature treats matter and antimatter alike), parity inversion (which says that nature can't differentiate between left and right), and time inversion (a symmetry which holds that movies of microscopic interactions should look alike even if you reverse the order running from front to back).

In other words, looking for violation of Lorentz invariance is equivalent to looking for violations of CPT invariance.

Michael Romalis and his colleagues at Princeton look for the faint magnetic influence the hypothetical field would have on matter by watching two species of atoms – potassium and helium-3 – which are contained in a rotating vessel.

The whole lab is of course attached to the Earth, which itself rotates daily and orbits the Sun. All of these motions, carefully accounted for, should leave behind a trace of a difference for the two atomic species if

an extra field exists.

The result of the latest round of observations improves by a factor of 30 the constraint on the existence of the hypothetical Lorentz-violating field.

"This is a rather dramatic improvement in CPT and Lorentz tests," says Romalis. "Our new technique also has the potential for much larger improvements in the future, so there are more limits to come."

Michael Romalis will present the findings at Frontiers in Optics (FiO) 2010/Laser Science XXVI -- the 94th annual meeting of the Optical Society (OSA). The presentation, "New Limit on Lorentz and CPT Violation for Neutrons," will take place on Thursday, Oct. 28.

Provided by Optical Society of America

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