Light may arise from relativity violations

March 22 2005

Light as we know it may be a direct result of small violations of relativity, according to new research scheduled for publication online Tuesday (March 22) in the journal *Physical Review D*.
In discussing the work, physics professor Alan Kostelecky of Indiana University described light as "a shimmering of ever-present vectors in empty space" and compared it to waves propagating across a field of grain. This description is markedly different from existing theories of light, in which scientists believe space is without direction and the properties of light are a result of an underlying symmetry of nature.

Instead the report, co-authored by Kostelecky with physics professor Robert Bluhm of Colby College, discusses the possibility that light arises from the breaking of a symmetry of relativity. "Nature's beauty is more subtle than perfect symmetry," Kostelecky said. "The underlying origin of light may be another example of this subtlety."

The new results show that this description of light is a general feature of relativity violations and holds both in empty space and in the presence of gravity. "In this picture, light has a strange beauty, and its origin is tied into minuscule violations of Einstein's relativity in a profound and general way," Kostelecky said.

The report also points out that this new view of light can be tested experimentally by studying the properties of light and its interactions with matter and gravity. All these have behavior that is predicted to deviate from conventional expectations in tiny but important ways.

"This is an alternative, viable way of understanding light with potential experimental implications. That's what makes it exciting," Kostelecky said.

Possible detectable effects include asymmetries between properties of certain particles and antiparticles, and cyclic variations in their behavior as Earth rotates. The effects can be sought using various experimental equipment ranging from giant particle colliders, such as the one at Fermilab in Illinois, to "tabletop" experiments with atomic clocks or resonant cavities. A number of such experiments are now under way.

A preprint of the paper to be published can be seen at arxiv.org/abs/hep-th/0412320