

# Ancient Neutrinos Could Put String Theory and Quantum Loop Gravity to the Test

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The distribution of ancient neutrinos may eliminate some of the most promising theories linking gravity and quantum mechanics, according to a theoretical analysis put forth at the Perimeter Institute in Canada. Many physicists believe that combining gravity and quantum mechanics into a single theory is one of the most important problems in science today.

Leading attempts to create a unified theory of gravity and quantum mechanics, such as string theory and loop quantum gravity, make sense in a universe in which gravity is subordinate to the laws of quantum mechanics. However, problems with these sorts of theories have led some to propose that gravity and quantum mechanics are equal contributors to the final unified theory.

According to this hypothesis, gravity breaks down the quantum nature of objects. The heavier the object, the quicker gravity leads to the breakdown — that is one reason that large objects, such as baseballs, obey the classical physics of Newton, while light objects such as electrons and other particles obey the counterintuitive laws of quantum mechanics. The new research suggests that this idea can be tested using neutrinos created in the early universe.

If gravity breaks down the quantum nature of neutrinos, this should be evident in ratios of the types of neutrinos detected at next generation neutrino experiments such as IceCube, a one cubic kilometer neutrino detector currently being built beneath the ice of Antarctica. Such a result

would require physicists to rethink popular theories including string theory and quantum loop gravity. It would also mean that the physics of the early universe was fundamentally different than it is today.

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