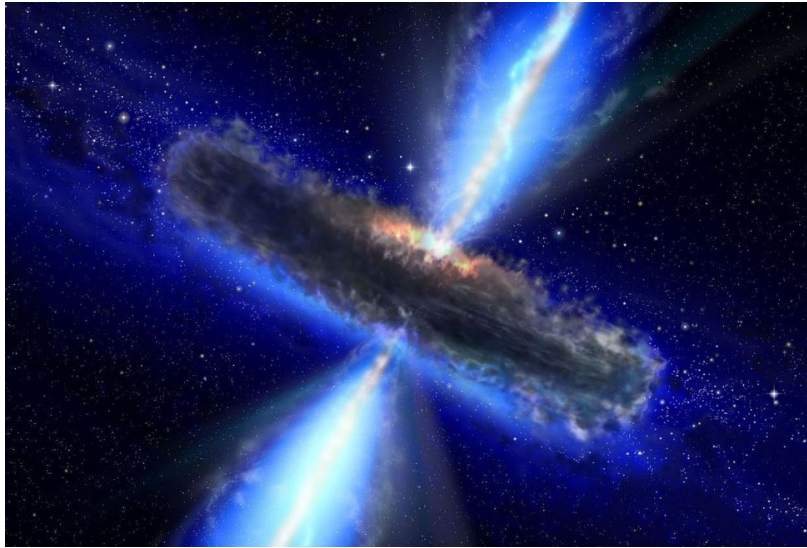
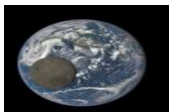


# 600-Year-Old Starlight Helps Physicists Address Quantum Theory Loophole

8 February 2017, 11:54 am EST By [Dianne Depra](#) Tech Times



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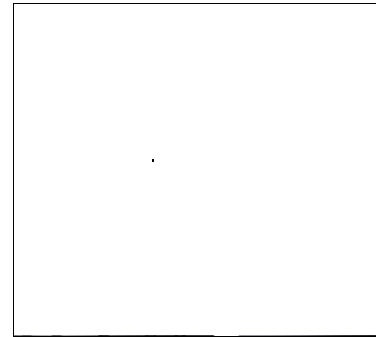


An international team of researchers just took on a quantum theory loophole, resolving the issue with some help from 600-year-old starlight. Their work

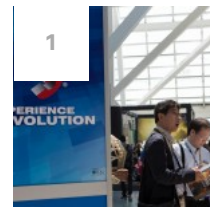
An international team of physicists has addressed a loophole arising from Bell's inequality tests, showing proof that [quantum entanglement is real](#).

Given two dust specks at the universe's opposite ends, quantum theory predicts that the specks of dust can experience entanglement no matter the distance between them. As such, whatever measurement made on one dust speck will instantly convey information regarding a future measurement to be carried out on the other, leading to highly correlated outcomes.

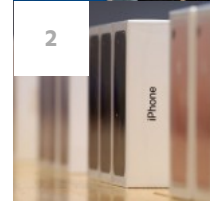
Albert Einstein himself viewed quantum theory with skepticism. According to him, the universe behaved with particles that have definite properties before they are measured, and local causes only



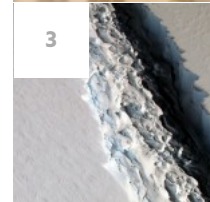
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specifically addressed the freedom-of-choice loophole in tests of Bell's inequality. (Christine Daniloff/MIT)

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yielded effects. This would mean then that measurements would have an upper limit, which physicist John Bell quantified more than 50 years ago. This upper limit is what is referred to as "Bell's inequality."

However, numerous experiments have resulted in correlations exceeding the limits defined by Bell's inequality. Although these experiments support quantum theory, they were subject to various loopholes that could be used to explain the correlations observed.

In a study published in the journal *Physical Review Letters*, researchers took on one of these loopholes, the freedom-of-choice loophole, presenting strong proof of quantum entanglement even when the loophole's vulnerability is restricted significantly.

"We haven't gotten rid of it, but we've shrunk it down by 16 orders of magnitude," said David Kaiser, one of the study's authors.

Sixteen orders of magnitude is equivalent to the difference between a millionth of a second and 600 years' worth of seconds.

### Freedom-Of-Choice Loophole

According to the freedom-of-choice loophole, researchers have complete freedom regarding their choice of experimental setup, from the particle types they will be entangling down to the measurements that will be used on the particles.

Physicists have tried addressing the loophole before using experiments in extremely controlled environments where an entangled photon pair is produced from one source and then sent to two different detectors for measurement.

To rule out hidden variables that can potentially influence results, earlier works utilized random number generators at both detectors to choose which photon property will be measured. This selection process will occur in the split second it takes for the photon to be produced at the source and sent to a detector.

What if someone insisted that the correlations were not due to particle behavior being guided by quantum mechanics? This is what the researchers for the current study wanted to address.

### 600-Year-Old Starlight To The Rescue

In a 2014 study, Kaiser and some of his colleagues proposed using quasars or stars instead of random number generators to determine how entangled photons will be measured. Cosmic light arrives on Earth after being sent from light-years away so if hidden variables were to cause interference, they would have to have been set in motion before starlight left its source.

By using a stellar photon generated 600 years ago, the researchers pointed out that if a hidden variable were to interfere with their experiment, it should have already been in place 600 years ago to affect experiments carried out today.

Study co-author Alan Guth added that their work pushes back the latest time that a conspiracy could have been initiated.

TAG Quantum Entanglement , Quantum Theory , Loopholes

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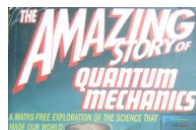
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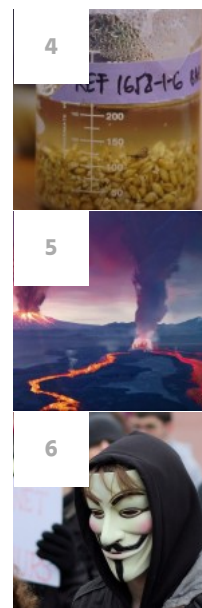
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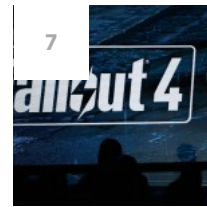
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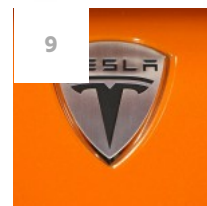
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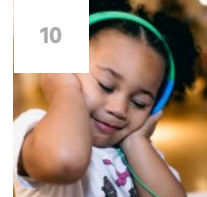
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