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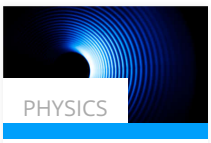

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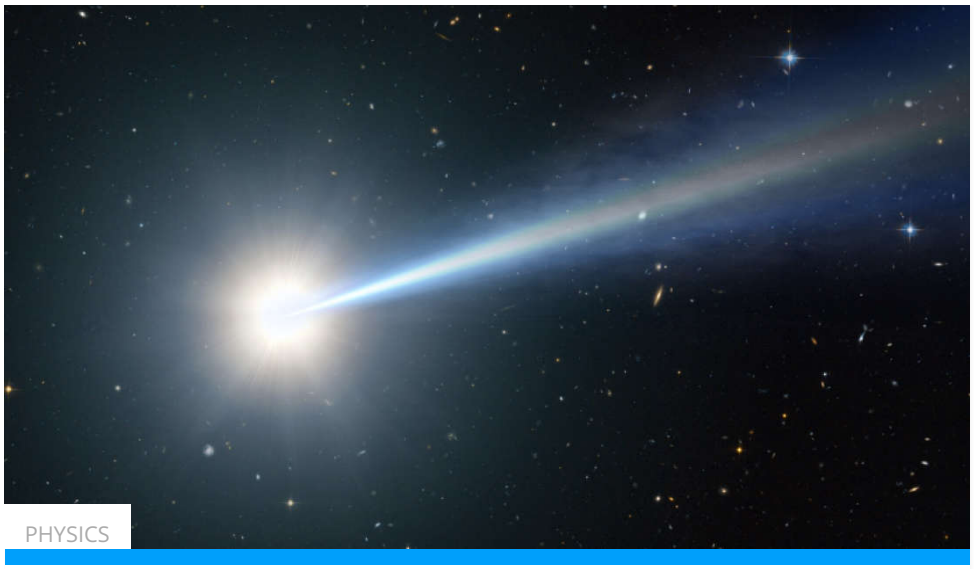

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ARTIST'S IMPRESSION OF A QUASAR. NASA/ESA/G.BACON, STSCI

Testing quantum mechanics phenomena often requires complex experiments and a great deal of human ingenuity. A particularly thorny issue, which has existed since the formative years of the discipline, is the concept of quantum entanglement. Now scientists have proved that the effect is real even 12 billion light-years away.

By Alfredo Carpineti

21 AUG 2018, 16:32

Entanglement is a unique type of interaction. Multiple particles are in a single quantum state, and any measurement of one influences the other instantaneously, even if they are at opposite sides of the universe. Einstein didn't like this and called it "spooky action at a distance". He believed that some hidden classical effect simply made it look like quantum entanglement.

But entanglement has been proven time and time again. Researchers have been trying to find classical explanations for the effect but have failed to do so. These approaches are the so-called "loopholes" of Bell's theorem, which states that no classical physics theorem can reproduce all the effects of quantum mechanics.

Researchers at the Massachusetts Institue of Technology (MIT) decided to look for loopholes not in labs but in space. Last

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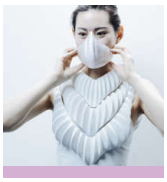

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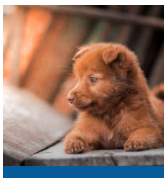

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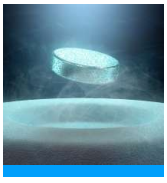

Viral Twitter Thread Exposes Scientists Trying To Fake A Major Physics Discovery

February,, they used the entangled photons from a star 600 light-years away. To explain entanglement, a classical effect must have started 600 years ago and somehow produced changes comparable to what quantum mechanics tell us.

The team decided to go further. As reported in Physical Review Letters, they took two quasars (bright active galaxies from the early universe), one located 7.8 billion light-years away and the other 12.2 billion light-years away. They measured over 30,000 entangled pairs of photons more precisely than is required to pass the test of Bell's theorem.

"If some conspiracy is happening to simulate quantum mechanics by a mechanism that is actually classical, that mechanism would have had to begin its operations – somehow knowing exactly when, where, and how this experiment was going to be done – at least 7.8 billion years ago," co-author Professor Alan Guth, from MIT, said in a statement. "That seems incredibly implausible, so we have very strong evidence that quantum mechanics is the right explanation."

Based on this experiment, the chance that quantum entanglement is not what it seems is of the order of 100 billion billions, so incredibly small. But the team think they can go smaller. By using the cosmic microwave background, the so-called light echo of the Big Bang, they could go all the way to 13.7 billion years ago.

"It is fun to think about new types of experiments we can design in the future, but for now, we are very pleased that we were able to address this particular loophole so dramatically," co-author David Kaiser, also from MIT, added. "Our experiment with quasars puts extremely tight constraints on various alternatives to quantum mechanics. As strange as quantum mechanics may seem, it continues to match every experimental test we can devise."

It's not just astronomy. Bell's theorem has been tested in a number of curious ways. Last November, scientists used 100,000 gamers to prove that Einstein was wrong about it.