NEWS

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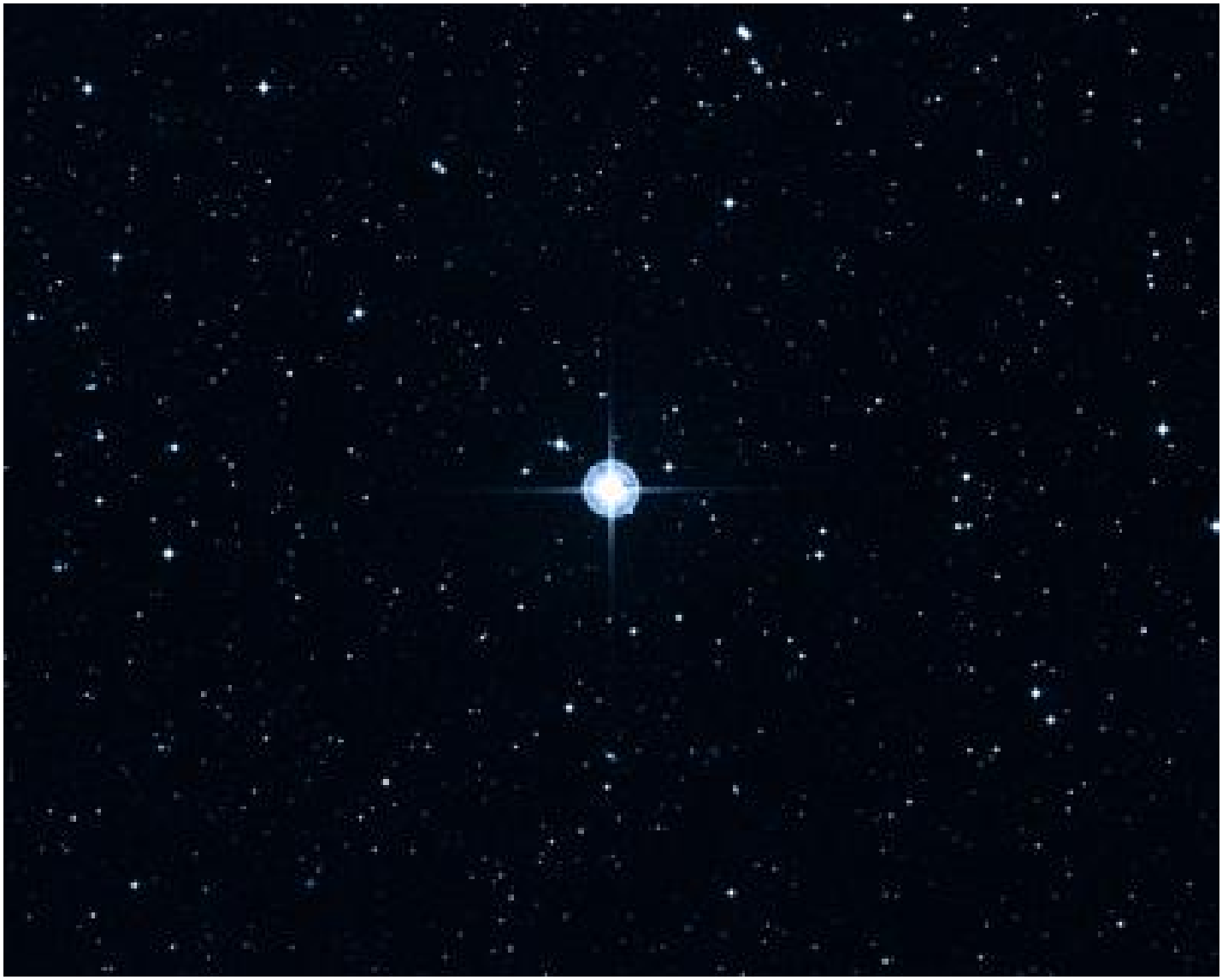

Quantum Entanglement is a Real Phenomenon, According to Starlight from the Other Side of the Universe

Physicists with MIT and the University of Vienna have conducted an experiment that pretty much proves that the phenomenon of quantum entanglement is real, and not the effect of a "loophole" that could be explained by classical physics. The experiments that were used in closing this loophole involved a combination of Earth-bound telescopes, 30,000 entangled pairs of entangled photons, and starlight nearly as old as the universe itself.

Quantum entanglement, the phenomenon where two particles share a quantum state, with any change in one particle being reflected by the other particle regardless of distance, tends to chafe some physicists because it appears to violate the theory of relativity, as the instantaneous communication between

process, called the "freedom of choice" loophole.

This new experiment however, eliminates the possibility that the entangled photons being experimented on not only aren't influenced by the scientists conducting the experiment, but it also eliminates the possibility of influence from anything having to do with the Earth, by using the light from quasars that emitted their light shortly after the universe was born.

In an earlier version of this experiment, the physicists used light from stars that were 600 light years away to measure the quantum states of entangled pairs of photons transmitted between two telescopes that were trained on said stars. The experiment found that the phenomenon of entanglement still occurred, meaning that if there was some hidden influence of classical physics, that mechanism would have to have been set in motion over 600 years ago.

This new experiment expanded the concept drastically, using the light from two quasars, one 7.8 billion light years away, and the other at the far side of the visible universe, 12.2 billion light years distant. After 30,083 pairs of entangled photons and a rigorous statistical analysis, the experiment was still found to have the same outcome, meaning that if this phenomenon were an effect of classical physics, the effect on this individual experiment would be nearly as old as the universe itself.

"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," explains study co-author Alan Guth, the Victor F. Weisskopf Professor of Physics at MIT. "That seems incredibly implausible, so we have very strong evidence that quantum mechanics is the right explanation.

"The Earth is about 4.5 billion years old, so any alternative mechanism—different from quantum mechanics—that might have produced our results by exploiting this loophole would've had to be in place long before even there was a planet Earth, let alone an MIT," adds Germeshausen Professor of the History of Science and professor of physics, David Kaiser, also at MIT. "So we've pushed any alternative explanations back to very early in cosmic history."

Part of the statistical analysis of the experiment's data included looking at the probability that the experiment's outcome was actually due to an effect of classical physics, with the odds coming to roughly one in one hundred billion billion (that's 10 with 20 zeros after it), "outrageously small," according to Guth. "We certainly made it unbelievably implausible that a local realistic theory could be underlying the physics of the universe."

Image Credit: **This is a Digitized Sky Survey image of the oldest star with a well-determined age in our galaxy ESA/Hubble via Wikipedia**

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