COSMIC BELL: TESTING QUANTUM MECHANICS AND BELL’S INEQUALITY WITH ASTROPHYSICAL OBSERVATIONS

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QUANTUM ENTANGLEMENT 101

Entanglement: Paired systems with correlated (or anti-correlated) properties

Measure #1, instantly know something about #2

Is quantum mechanics complete or just spooky?
CHOOSING DETECTOR SETTINGS

Anthony

Random Number Generator

Source of Entangled Particles

Random Number Generator

Isabella

Albert

Source of Entangled Particles

Quasar x

Source of Entangled Particles

Quasar y
Past light cones from random number generators overlap milliseconds before test. Past light cones from quasars don’t overlap since big bang, 13.8 billion years ago.
COSMIC BELL TEST

Let the Universe decide how to set up experiment!

Use quasars as cosmic random number generators
Isabella and Anthony helped Prof. Kaiser and I search the world database of over 1 million quasars for optimal candidate pairs!
COSMIC BELL IN THE NEWS

MIT News

Closing the ‘free will’ loophole
MIT researchers propose using distant quasars to test Bell’s theorem.

Quasar Experiment May Shed Light on Quantum Physics and Free Will

Quantic testing for quantum entanglement

Can the cosmos test quantum entanglement?

Albert Einstein hated the idea he called spooky actions at a distance, but astronomers now are hoping to illuminate some of these tricky quantum puzzles, by Andrew Friedman.

Quasic test for quantum physics’ last major loophole

The Universe Made Me Do It? Testing “Free Will” with Distant Quasars

By Andrew Friedman on Wed, 19 Mar 2014

Astronomy

Is Quantum Entanglement Real?

Gray Matter

By DAVID RAINER

The New York Times

Sunday Review

NOV, 14, 2014

Jennifer Chu, MIT News Office
February 20, 2014
ZEILINGER GROUP EXPERIMENTS

Prof. Anton Zeilinger
CANARY ISLANDS TELESCOPES

Teide Observatory on Tenerife

Roque de los Muchachos Observatory on La Palma
PROF. MEREDITH HUGHES
Wesleyan University, Department of Astronomy

“Planet Formation Through Radio Eyes”
REFERENCES

POPULAR ARTICLES


ACADEMIC PAPERS


MEDIA COVERAGE

Cosmic Test For Quantum Physics’ Last Major Loophole, Bruce Dorminey, Forbes, 6/18/14
Bell’s Theorem: Closing the Loopholes, Iulia Georgescu, Nature Physics, News & Views, 4/1/14
Cosmic Experiment Aims To Close Loophole In Quantum Theory: Distant quasars could help confirm ‘spooky action’ between particles, Charles Q. Choi, Inside Science, NBC News, 3/5/14
Cosmic light could close quantum-weirdness loophole: Distant quasars would decide whether quantum entanglement is an illusion, Zeeya Merali, Nature, News & Comment, 2/25/14
Is entanglement real or is there a super-deterministic cosmic conspiracy? Researchers use quasars to kill off the last of the quantum hidden variables, Matthew Francis, Ars Technica, 2/21/14
Closing the 'free will' loophole: MIT researchers propose using distant quasars to test Bell's theorem, Jennifer Chu, MIT News Office, 2/20/14

FREE WILL REFERENCES

The Quantum Physics of Free Will, George Musser, Scientific American blog, 2012
Do Electrons Have Free Will? The Conway-Kochen Free Will Theorem - Closing the Free Will Loophole, Cracking the Nutshell, Dolors, 2015
Programming the Universe, Seth Lloyd, Vintage, 2007
Violation of Local Realism With Freedom of Choice, Sheidl, Thomas S. et al., Proceedings of the National Academy of Sciences, USA, 107, 46, p. 19708-19713, 2010
Dance of the Photons, Anton Zeilinger, Farrar, Straus & Giroux; 1st Ed., 2010