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USED FOR A QUANTUM EXPERIMENT

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God will not play dice, but the quasars will

Published on the Physical Review Letter the results of an unprecedented entanglement test, conducted with the help of two telescopes located in the Canary Islands, including the national Galileo Telescope dell'Inaf, and two very distant quasars - one at 8 and one 'another 12 billion light years from us - used as natural generators of random numbers

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An experiment conducted on the island of La Palma, in the Canary Islands, under the guidance of the research group of **Anton Zeilinger** of the Austrian Academy of Sciences and the University of Vienna, has used two large telescopes - the Galileo National Telescope of National Institute of Astrophysics (Inaf) and the William Herschel Telescope - to perform a quantum entanglement test using photons of distant astronomical objects. The results are published in the latest issue of *Physical Review Letters* .

The National Telescope Galileo (Tng) dell'Inaf, on the Island of La Palma, in the Canary Islands. Credits: Renato Cerisola / Inaf

In the experiment, pairs of *entangled* photons were created in a mobile laboratory in La Palma to be sent to receiving stations prepared by the researchers next to the two large telescopes. The telescopes, in turn, observing regions of almost opposite sky, have collected the light of two very distant quasars - two very bright active galactic nuclei at 8 and 12 billion light years from us. The variations of the "color" in the light of the quasars have been exploited to decide which type of measurements to perform on the pairs of *entangled* photons, with one photon of each pair sent to the receiver at the Galileo National Telescope and the other at the William Herschel Telescope , both located at the Roque de los Muchachos observatory . In particular, it was measured - following the "decisions" taken on the basis of the fluctuations of the light of the respective quasars - the polarization of each *entangled* photon.

But why resort to such a complex system, even two quasars, to "decide" what measurements to make? The reason lies in the fact that the measurement of a photon of an *entangled* pair has an immediate influence on the measurement result of the other photon: a quantum phenomenon of violation of the principle of locality that Einstein, reluctant to admit the existence, called " distance spectral action ". Now, so that the results of such experiments are valid, it is crucial to ensure that "decisions" on the type of measurements to be performed are completely independent, without any possibility of influencing a common cause. Just as happened in the experiment conducted at La Palma: entrusting the decision to fluctuations in the light coming from the two quasars so distant, so dating back to an era shortly after the Big Bang, a possible influence on both sources could have took place - scientists calculate - only in 4 percent of the known universe.

"The crucial challenge of the experiment was to make sure that the choice of polarization measures to be performed on each of the *entangled* photons was done completely independently of us and any environment, no matter how big," says **Dominik Rauch** , first author of the article. «This light, completely independent of us and almost all of our past, has allowed us to use the two remote quasars as generators of random cosmic numbers». An ideal light for this particular experiment, and at the same time an unprecedented method for obtaining random numbers.

To know more:

- Read on *Physical Review Letters* the article " Cosmic Bell Test Using Random Measurement Settings from High-Redshift Quasars ", by Dominik Rauch, Johannes Handsteiner, Armin Hochrainer, Jason Gallicchio, Andrew S. Friedman, Calvin Leung, Bo Liu, Lukas Bulla, Sebastian Ecker, Fabian Steinlechner, Rupert Ursin, Beili Hu, David Leon, Chris Benn, Adriano Ghedina, Massimo Cecconi, Alan H. Guth, David I. Kaiser, Thomas Scheidl and Anton Zeilinger

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Responsible director: Marco Malaspina

Editor: INAF Communication Office
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