# Flash Physics: Starlight closes Bell loophole, elusive white dwarf pulsar, St Andrews champions gender equality

Feb 8, 2017 2 comments

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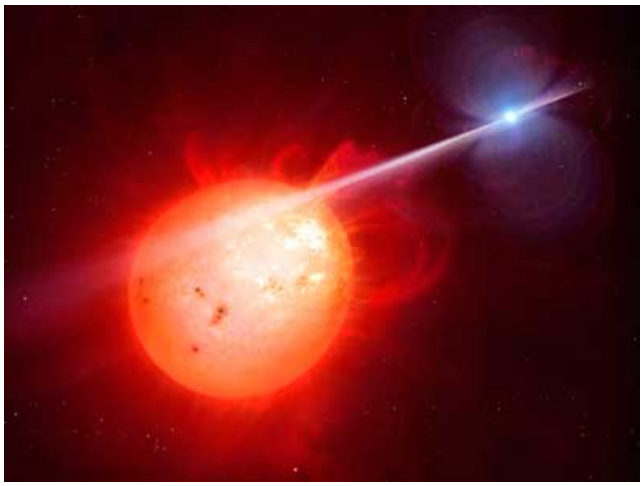
## Starlight closes Bell loophole

Cosmic Bell test: starlight closes a loophole

A Bell test of quantum entanglement that claims to use starlight to close the “freedom of choice” loophole has been done by an international team of physicists. Entanglement is a curious consequence of quantum mechanics that allows two particles to be connected in a way that cannot be described by classical physics. Entanglement is observed as correlations between measurements made on two particles (such as their polarizations) and in 1964 John Bell described his famous test of whether such correlations are stronger than those allowed by classical physics. Since then, physicists have done many Bell test experiments that confirm entanglement. However, no experiment is perfect and researchers have come up with a number of experimental “loopholes” that could allow purely classical phenomena such as faulty detectors to affect the outcome. In 2015, physicists were able to simultaneously close two important loopholes called “fair sampling” and “locality”. Freedom of choice is another important loophole that involves how the measurements are done. In a Bell test on entangled photons, a large number of measurements are made on different entangled pairs in which the direction of the polarization measurement is selected at random. If, for some reason, the polarization selection is not random but correlated to other aspects of the experiment, then the outcome of the Bell test could be affected. Now, Johannes Handsteiner and Anton Zeilinger of the University of Vienna and colleagues worldwide have used the random nature of starlight to close this loophole. Two telescopes at two locations separated by nearly 2 km were pointed at two different stars. The colour of the starlight changes in a random manner and this was used to decide how to set Bell test polarization detectors. The stars were chosen so that their light arrives at their respective telescopes first, before reaching other parts of the experiment. This, and the fact that the starlight light was created hundreds of years ago and very far away from Earth, allowed the physicists to conclude that there is no correlation between the choices of polarization measurement and the rest of the Bell test experiment. However, writing in *Physical Review Letters*, they point out that their experiment does not close the fair sampling loophole.

## Elusive white dwarf pulsar strikes out at red dwarf neighbour



Elusive pulsar: the first white dwarf pulsar discovered lashes out at its red dwarf companion

The first white dwarf pulsar has been discovered after half a century of searching. Astronomers at the South African Astronomical Observatory in Cape Town and the University of Warwick in the UK have identified an elusive white dwarf version of a pulsar within the AR Scorpii binary system. Traditionally, a pulsar is a neutron star that emits beams of radiation due to its strong magnetic field and rapid spin. From Earth, the highly directional beams are seen as pulses of radiation. While a neutron star is the collapsed core of a massive star, a white dwarf results from smaller stars and astronomers have been searching for a white dwarf pulsar for more than 50 years. The AR Scorpii binary system studied by David Buckley and colleagues contains a white dwarf that is a similar size to Earth but 200,000 times more massive, alongside a cool, low-mass red dwarf star. The two are around 1.4 million km apart (three times the distance between the Moon and Earth) and orbit each other in 3.55 h. The white dwarf spins every 1.97 min and emits powerful beams of electrical particles and polarized radiation that are created in a similar manner to neutron star pulsars. The researchers have also established that the high-energy beams strike the companion star, exciting and accelerating electrons in the atmosphere to nearly the speed of light. This causes further pulses of radiation, from ultraviolet to radio wavelengths, in time with the white dwarf rotation. This means the entire system seems to pulse when observed from Earth. The current work is presented in *Nature Astronomy* and the team hopes further studies will help determine the exact mechanisms of the red dwarf's atmospheric interactions as well as further disentangle the signals from the white dwarf pulsar and its companion.

## St Andrews named a champion of gender equality

The Institute of Physics (IOP) has named the School of Physics and Astronomy at the University of St Andrews as a Juno Champion. Project Juno is an IOP initiative to address the underrepresentation of women in university physics and encourage gender equality. The project rewards departments across the UK and Ireland for promoting an inclusive atmosphere, ensuring that both women and men have equal opportunities at all levels of academia and providing supportive and flexible working practices. St Andrews has become the 17th university to achieve Champion status, the highest of the three Juno awards after Supporter and Practitioner. “The school has worked hard to deliver on our goals for equality of opportunity and reward for all staff and students,” explains Graham Turnbull, head of the School of Physics and Astronomy at St Andrews. Other Juno Champions include physics departments at the University of Cambridge, the University of Birmingham and Imperial College London.

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**About the author**
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**2 comments**
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1 **M. Asghar**
Feb 8, 2017 8:18 PM

**600 light years!**

Beautiful work showing that the quantum entanglement of two photons is independent of the distance of 600 light years - the time the light of a star takes to reach the detectors on the Earth.

2 **nrdtx**
Feb 10, 2017 12:03 AM
Quote:

> *Originally posted by **M. Asghar***
> Beautiful work showing that the quantum entanglement of two photons is independent of the distance of 600 light years - the time the light of a star takes to reach the detectors on the Earth.

Since a photon travels at the speed of light, the time that the photon experiences to travel 600 light years is null, So I don't see how the loophole is closed.