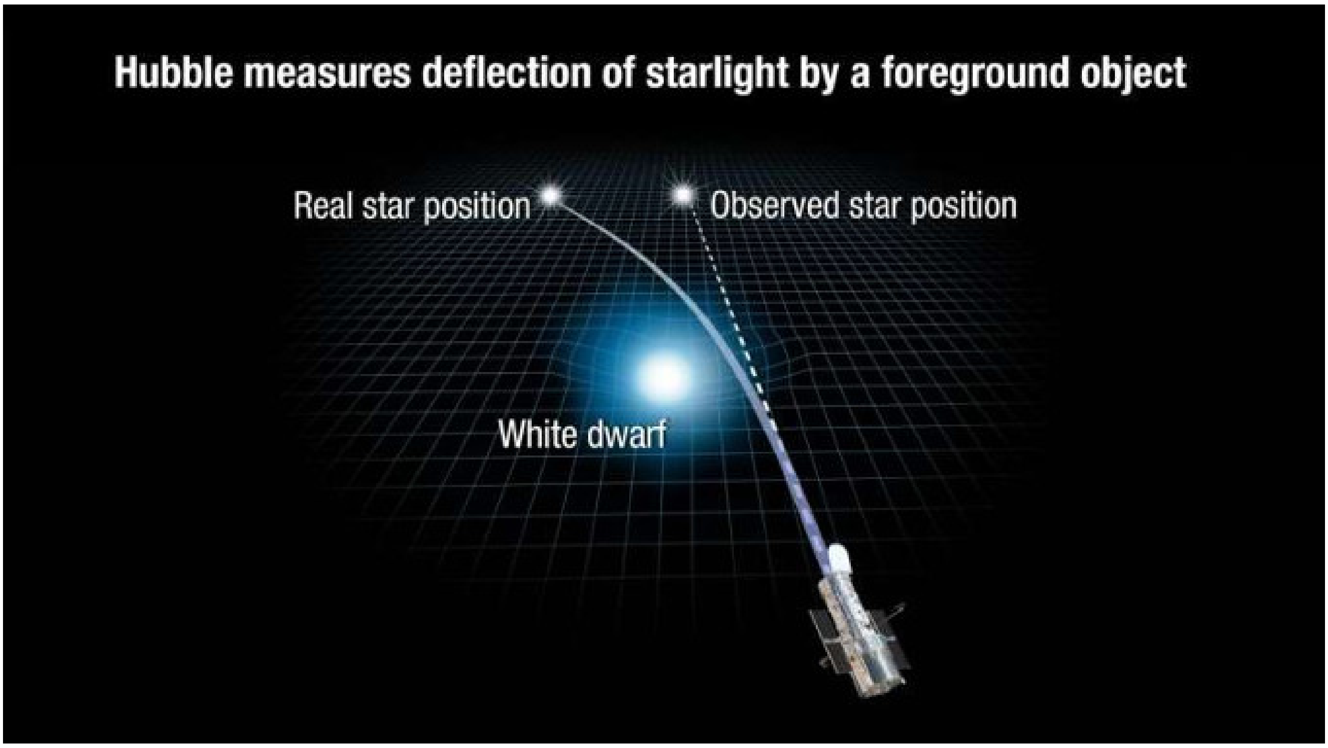
Einstein’s General Theory of Relativity Confirmed By Researchers Aided By a White Dwarf



This illustration reveals how the gravity of a white dwarf star warps space and bends the light of a distant star behind it. Credit: NASA, ESA, and A. Feild (STScI)

Source: phys.org

Albert Einstein predicted that whenever light from a distant star passes by a closer object, gravity acts as a kind of magnifying lens, brightening and bending the distant starlight. Yet, in a 1936 article in the journal *Science*, he added that because stars are so far apart “there is no hope of observing this phenomenon directly.”

Now, an international research team directed by Kailash C.

Sahu has done just that, as described in their June 9, 2017 article in *Science*. The study is believed to be the first report of a particular type of Einstein's "gravitational microlensing" by a star other than the sun.

In a related perspective piece in *Science*, entitled "A centennial gift from Einstein," Terry Oswalt of Embry-Riddle Aeronautical University says the discovery opens a new window to understanding "the history and evolution of galaxies such as our own."

More specifically, Oswalt adds, "The research by Sahu and colleagues provides a new tool for determining the masses of objects we can't easily measure by other means. The team determined the mass of a collapsed stellar remnant called a white dwarf star. Such objects have completed their hydrogen-burning life cycle, and thus are the fossils of all prior generations of stars in our Galaxy, the Milky Way."

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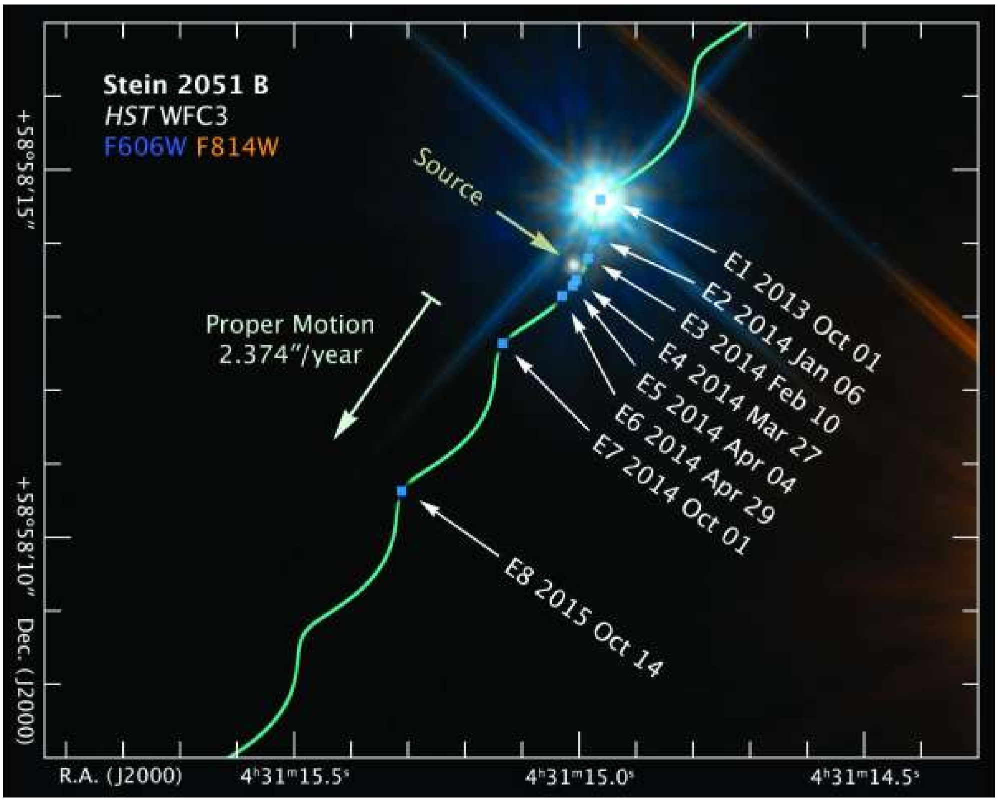
Understanding 'Einstein Rings'

The gravitational microlensing of stars, predicted by Einstein, has previously been observed. Famously, in 1919, measurements of starlight curving around a total eclipse of the Sun provided one of the first convincing proofs of Einstein's general theory of relativity – a guiding law of physics that describes gravity as a geometric function of both space and time, or spacetime.

“When a star in the foreground passes exactly between us and a background star,” Oswalt explains, “gravitational microlensing results in a perfectly circular ring of light – a so-called ‘Einstein ring.'”



Astronomers made the Hubble observations of the white dwarf, the burned-out core of a normal star, and the faint background star over a two-year period. Hubble observed the dead star passing in front of the background star, deflecting its …more

Sahu’s group observed a much more likely scenario: Two objects were slightly out of alignment, and therefore an asymmetrical version of an Einstein ring formed. “The ring and its brightening were too small to be measured, but its asymmetry caused the distant star to appear off-center from its true position,” Oswalt says. “This part of Einstein’s prediction is called ‘astrometric lensing’ and Sahu’s team was the first to observe it in a star other than the Sun.”

Sahu, an astronomer at the Space Telescope Science Institute in Baltimore, Maryland, took advantage of the superior angular resolution of the Hubble Space Telescope (HST). Sahu’s team measured shifts in the apparent position of a distant star as its light was deflected around a nearby white dwarf star called Stein 2051 B on eight dates between October 2013 and October 2015. They determined that Stein 2051 B – the sixth-closest white dwarf star to the Sun – has a mass that is about two-thirds that of the sun.

"The basic idea is that the apparent deflection of the background star's position is directly related to the mass and gravity of the white dwarf – and how close the two came to exactly lining up," explains Oswalt.

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