



Credit: S. Hildner, M. Duerdemiller, and P. Aniol



Credit: Rick Fienberg, TravelQuest International and Wilderness Travel



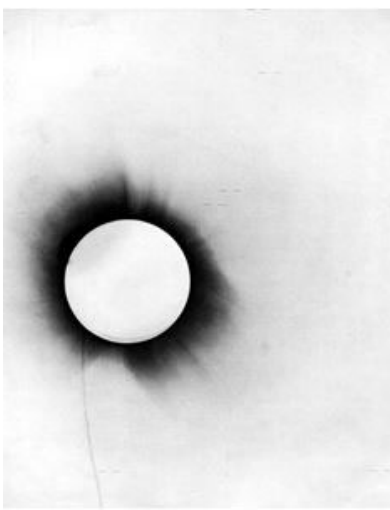
ECLIPSES AND RELATIVITY

Testing Einstein's Theory of Gravity

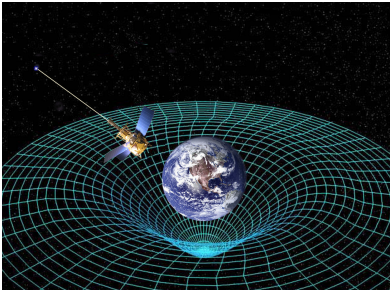
Solar eclipses have long been known as fortunate opportunities to study the Sun, but in 1919, a total eclipse of the Sun gave scientists an opportunity to confirm Albert Einstein's theory of General Relativity, a controversial and mind-bending description of space, time, and gravity. In this new theory, Einstein combined the concepts of space and time into an interlocked fabric called "space-time" which fills the universe. Objects with mass had the property of distorting space-time, resulting in the force of gravity. Einstein's theory was the first to correctly describe the orbit of Mercury, which had confounded astronomers for centuries. As Mercury orbits the Sun, the curvature of space caused by the Sun's gravity would cause the planet's orbit to shift very slightly, according to the theory. The curvature of space-time could explain the strange aspects of Mercury's orbit.

Einstein's theory met with both acclaim and skepticism, until 1919 when British astronomer Sir Arthur Eddington observed a total solar eclipse from the island of Príncipe off the west coast of Africa on May 29. The Sun was in the constellation Taurus and as darkness fell, a few stars in the Hyades cluster could be seen near the limb of the Sun. Einstein's theory of General Relativity predicted that the apparent positions of stars observed near the Sun would be shifted as their light bent through the curved space-time near the massive Sun. Eddington took photographs of the Sun during totality and carefully measured the positions of these stars. He then compared their positions to positions at night six months later, away from the influence of the Sun's mass. His analysis concluded that the stars did indeed appear to shift positions and by exactly the amount Einstein's theory predicted. The experiment was repeated during the total solar eclipses of 1922, 1953, and 1972, all with similar results. Einstein's theory of gravity was confirmed!

For more information, go to: eclipse2017.nasa.gov/testing-general-relativity



Eddington's photo of the 1919 eclipse for testing general relativity
Credit: Philosophical Transactions of the Royal Society of London. (1920)



Curved spacetime around a massive object accounts for the pull of gravity, and explains how objects orbit each other. NASA's Gravity Probe B mission studied this phenomenon from 2004-2010.