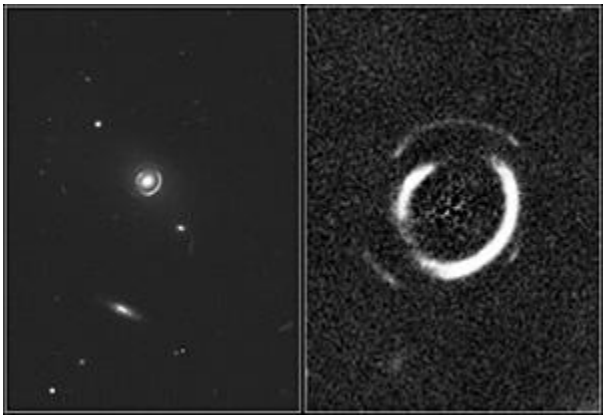
Astronomers Find Rare Double Einstein Ring

Finding three galaxies lined up one behind another is less likely than winning two consecutive bets on the same number in roulette. So when astronomer Tommaso Treu (University of California, Santa Barbara) and his colleagues found such a galaxy trio, they knew they'd hit the cosmic jackpot.



This Hubble image of the obscure galaxy SDSS J0946+1006 in Leo shows it encircled by two concentric rings. These are distorted images of background galaxies whose light was bent as it passed J0946 en route to Earth. In the right-hand panel, which is about 5 arcseconds wide, the foreground galaxy has been subtracted to show the rings better.
NASA / ESA / R. Gavazzi & T. Treu (UCSB)

At the American Astronomical Society meeting in Austin, Texas, Treu unveiled the first-ever image of a double Einstein ring. It shows an obscure galaxy in Leo, designated SDSS J0946+1006 for its coordinates in the Sloan Digital Sky Survey, encircled by two concentric glowing rings. These aren't part of J0946 itself, but are the strongly distorted images of more distant galaxies strung out behind it like beads on a string.

This is a spectacular example of a phenomenon called gravitational lensing. It's caused by the distortion of space-time by massive objects. While formulating his general theory of relativity, Albert Einstein realized that because of this warping, light won't always travel across the universe in straight lines. For example, if one galaxy lies almost directly behind another as seen from Earth, light from the more distant one will bend around the foreground galaxy and form multiple images — or, in the case of near-perfect alignment, an Einstein ring.

Astronomers have found nearly 50 examples to date, most of them in SDSS images. When Treu's team first looked at the ring around J0946, they thought it was like all the others. But when they shot a close-up with the Hubble Space Telescope, they discovered a broken second ring outside the first. "When I first saw it," recalls Treu, "I said, 'Wow, this is insane!' I could not believe it."

Treu and his colleagues were looking for Einstein rings because they can be used to map the distribution of mass in the universe — especially the unseen dark matter that seems to be many times more plentiful than the ordinary stuff that makes up the visible parts of galaxies. It works this way: from the distances of the galaxies and the shapes and brightnesses of the mirages, you can determine the amount and arrangement of mass in the foreground object (the "lens") needed to produce what you see.

With *two* rings rather than just one, you can map the mass in *two* galaxies: the lensing one and the next one out, whose light is stretched to form the inner ring.

In the double-ring system in Leo, the lensing (foreground) galaxy is about 2 billion light-years away, while the lensed (background) objects are 6 and 11 billion light-years distant. According to Treu, this means that J0946 has the mass distribution of a large spiral galaxy surrounded by a giant halo of dark matter — not unlike our own Milky

Way. The middle galaxy is a dwarf with a mass of only a billion Suns, and it's now the most distant dwarf galaxy whose mass has ever been measured.

For more information, see the press releases at the Space Telescope Science Institute and the European Space Agency's Hubble Information Centre.

Posted by Rick Fienberg, January 10, 2008
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