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ECHOS FROM AN OLD SUPERNOVA

Taking the long way around, light from a distant explosion has finally been recorded by the Hubble Space Telescope. Astrophysicists announced today in a result presented at the American Astronomical Society Meeting in Seattle that a light echo from a supernova explosion recorded in 1995 has been confirmed from high quality Hubble images. Only the third light echo discovered from an extragalactic thermonuclear supernova it is also the most distant light echo ever recorded. Peter Garnavich, Jason Quinn and Kevin Krisciunas from the University of Notre Dame, selected supernova 1995E in the galaxy NGC 2441 as a good candidate for a light echo based on Hubble Space Telescope images taken in 2001 and now have shown on Hubble pictures taken in September of 2006 that source is expanding at six times the speed of light which definitively confirms the light echo interpretation.

A light echo can occur when light from a bright astronomical flash, like a nova or supernova, is redirected towards the Earth by grains of dust in the host galaxy. We see the direct rays as the explosive event, but light that was heading in another direction can be scattered by dust toward the Earth. Just like a sound echo, the light echo is delayed in time and appears to come from a different location than the original flash. A non-stop flight from New York to Seattle will always beat the one with the plane change in Denver, and the light we see in the echo has made a longer trip than the direct rays from the burst.

Light echoes are not uncommon, but 1995E is only the third known light echo caused by the explosion of a "Type Ia" supernova, the thermonuclear destruction of a white dwarf star. These explosions are particularly bright and useful for cosmology. The discovery of the accelerating expansion of the universe by dark energy was made using Type Ia supernova as standard candles. The lead author of the study, Professor Garnavich said: "Light echoes are neat, but our real goal in studying them is to better understand the explosions of Type Ia supernovae which are powerful tools for cosmology". The size and expansion rate of the echo provides a way to study the connection between dust, star-formation and Type Ia supernovae and even map the three-dimensional position of the explosion in the host galaxy.

The astrophysicists began searching for Type Ia supernova light echoes back in 2000 with a Hubble Space Telescope program to image the locations of 35 old supernovae. While looking at the Hubble images Jason Quinn (then a graduate student) noticed a blob of light at the exact site of the 1995 eruption in the distant galaxy NGC 2441. Dr. Quinn said: "The source clearly didn't look like a star, but it could have been a close grouping of stars so we needed more proof that it was light from the 1995 explosion being deflected toward us". The opportunity for proof came in September when Hubble again directed its gaze toward the galaxy 150 million light years from the Earth.

The Hubble Space Telescope images taken with the Advanced Camera for Surveys in September of 2006, revealed that the source Dr. Quinn had identified increased in size by 30% over five years and the superb image quality of Hubble combined with ACS now resolved the source to be a small circle on the sky with a radius of 70 light years. This is actually what is expected for a light echo if the dust scattering the supernova emission lies about 200 light years from the site of the explosion. The circle appears to get larger with time as the supernova light is redirected by dust grains more distant from the explosion. For a ring to be 70 light years in radius only 11 years after the explosion means the expansion rate is 6 times the speed of light. But this is not breaking any cosmic speeding laws. Einstein's theory of relativity prohibits matter and energy from traveling faster than the speed of light. But an echo is a projection of light on to a screen of dust and no material is moving at high speed.

The poster presenting these results appears at the Seattle AAS Meeting on Tuesday, January 9 in session 150, This work is supported by a grant from NASA.

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