

GRAVITATIONAL LENSING Galaxy Cluster Abell 2218



A Cosmic Magnifying Glass

NASA's Hubble Space Telescope imaged a phenomenon called gravitational lensing in Abell 2218, a massive galaxy cluster some 2 billion light-years from Earth in the constellation Draco. The cluster was imaged in full color, providing astronomers with a spectacular view of the early universe.

The Abell 2218 cluster is so massive and compact that light rays passing through it are deflected by its enormous gravitational field, much as an optical lens bends light to form an image. The gravitational field magnifies, brightens, and distorts images of objects that lie far beyond the cluster. This provides a powerful "telephoto lens" for viewing galaxies that are so far away they could not normally be observed.

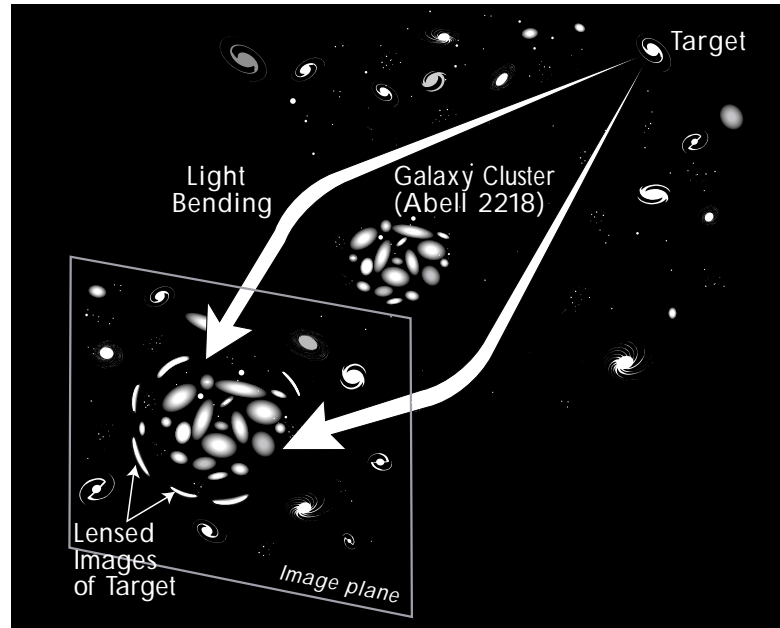
In this image, the arc-like pattern is caused by the cluster's powerful gravitational field. The arcs are actually distorted images of very distant galaxies—some 5 to 10 times farther away than the lensing cluster. These remote galaxies are being magnified by the gravitational lens. The arcs provide a direct glimpse of how star-forming regions are distributed in remote galaxies as well as other clues to the early evolution of galaxies. This picture also reveals multiple imaging, a rarer lensing event that happens when the distortion is large enough to produce more than one image of the same galaxy.

Why Study Gravitational Lenses?

Gravitational lenses provide access to galaxies so distant that they cannot be observed with existing telescopes.

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About the Image

The light rays (bent arrows) from the distant galaxy (labeled "target" in this image) are bent when passing the galaxy cluster in the center. After passing the large galaxy cluster, there is more than one image — and they are all elongated and bent (lensed images). The cluster has acted like a giant magnifying glass, or gravitational lens, in space — focusing, magnifying, and distorting the images of the distant galaxy behind it.

Credit: NASA, A. Fruchter and the ERO Team (STScI, ST-ECF)

Studies of remote galaxies viewed through gravitational lenses like Abell 2218 may reveal the nature of galaxies that existed when the universe was merely a quarter of its present age. In addition, gravitational lenses are being used to gain a better understanding of the total amount of matter in the universe. Hubble's observations of gravitational lenses show that the lensing clusters must have more matter than meets the eye.

This image was taken January 10-13, 2000, shortly after the space shuttle *Discovery* crew visited Hubble to restore it to full capability.

Definitions

Galaxy cluster: A collection of hundreds or thousands of galaxies. Galaxy clusters are thought to be the largest gravitationally-bound structures in the universe.

Gravitational lens: An astronomical effect in which massive astronomical objects act as a lens for light coming from more distant objects. The lens can produce two or more identical images of the more distant object.

Fast Facts

Location

In the constellation Draco

Distance from Earth

2 billion light-years

Hubble Online

Hubble Space Telescope images, information, and resources are available on [HubbleSite](http://hubble.stsci.edu).

Point your browser to:

<http://hubble.stsci.edu>.