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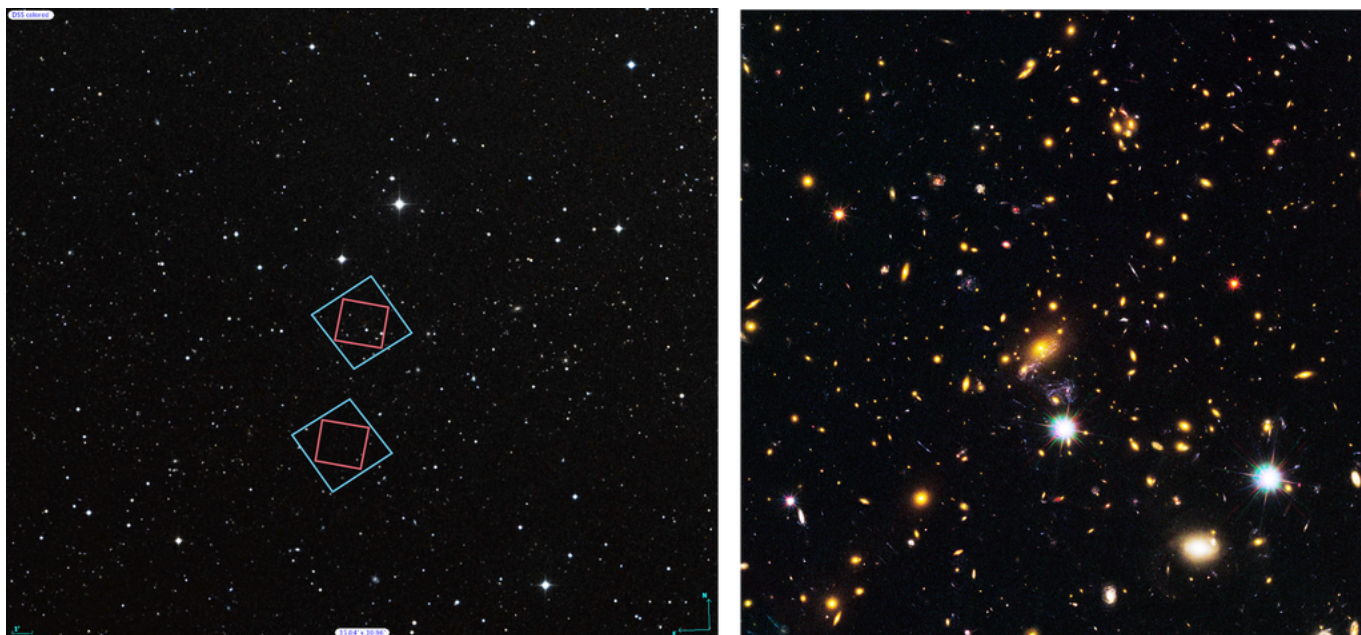
Frontier Fields

Pushing the Limits of the Hubble Space Telescope

Meet the Frontier Fields: MACS J1149.5+2223

The [gravitational lens](http://amazing-space.stsci.edu/news/archive/2014/01/ill-01.php) (<http://amazing-space.stsci.edu/news/archive/2014/01/ill-01.php>) created by the galaxy cluster MACS J1149 already has a record of stirring up excitement. In 2012, observations from NASA's Hubble and Spitzer space telescopes found the cluster had magnified a distant background galaxy. The galaxy turned out to be extremely far away — in fact, the light we detected from the galaxy likely began its intergalactic journey approximately 500 million years after the Big Bang¹. This galaxy appears to us as it looked when the universe was just 3.6 percent of its present age of 13.7 billion years — a baby picture of a (very) distant relative. Astronomers estimate that the gravitational lens of MACS J1149 magnified the brightness of this distant galaxy by 15 times; it would have remained undetected were it not for the help from one of nature's powerful lenses. This discovery bodes well for the deeper images of galaxy clusters being undertaken in the Frontier Fields program.

The Massive Cluster Survey (MACS) contains a sample of more than 100 galaxy clusters, measured by the ROSAT telescope to be bright in high-energy X-ray light. The goal of the MACS survey is to understand distant, massive galaxy clusters.



(https://frontierfields.files.wordpress.com/2014/01/combo_macs_j1149.png)

Left: The locations of Hubble's observations of the MACS J1149 galaxy cluster (top) and the adjacent parallel field (bottom) are plotted over a Digitized Sky Survey (DSS) image. The blue boxes outline the regions of Hubble's visible-light observations, and the red boxes indicate areas of Hubble's infrared-light observations. A scale bar in the lower left corner of the image indicates the size of the image on the sky. The scale bar corresponds to approximately 1/30th the apparent width of the full moon as seen from Earth. Astronomers refer to this unit of measurement as one arcminute, denoted as 1'.

Right: Hubble's view of the galaxy cluster is displayed using archival visible-light observations. Deeper Frontier Fields observations of MACS J1149 are planned for 2014 and 2015.

Left Credit: Digitized Sky Survey (STScI/NASA) and Z. Levay (STScI).

Right Credit: NASA, ESA, and M. Postman (STScI), and the CLASH team.

Estimated Dates of Observations: April-June 2014, November 2014-February 2015, and April-July 2015

The planned dates for Hubble observations of the Frontier Fields include observations approximately six months apart. This is the time it takes for the cameras on Hubble to swap positions so that both visible-light data and infrared-light data can be captured from the galaxy cluster field and the adjacent parallel field, as described in this post (<https://frontierfields.org/2014/01/10/cluster-and-parallel-fields-two-for-the-price-of-one-2/>).

Galaxy Cluster Redshift: 0.543

Redshift measures the lengthening of a light wave from an object that is moving away from an observer. For example, when a galaxy is traveling away from Earth, its observed wavelength shifts toward the red end of the electromagnetic spectrum. The galaxy cluster's cosmological redshift (http://webbtelescope.org/webb_telescope/science_on_the_edge/cosmological_redshift.php) refers to a lengthening of a light wave caused by the expansion of the universe. Light waves emitted by a galaxy cluster stretch as they travel through the expanding universe. The greater the redshift, the farther the light has traveled to reach us.

Galaxy Cluster Distance: approximately 5 billion light-years

Galaxy Cluster Field Coordinates (R.A., Dec.): 11:49:36.3, +22:23:58.1

Parallel Field Coordinates (R.A., Dec.): 11:49:40.5, +22:18:02.3

Constellation: Leo (<https://frontierfields.org/2014/03/18/locations-on-the-sky/>).

Related Hubble News:

- Frontier Fields: Hubble Goes Deep (science content reading for students & educators) (<http://amazing-space.stsci.edu/news/archive/2014/01>).
- NASA's Great Observatories Begin Deepest Ever Probe of the Universe (<http://hubblesite.org/newscenter/archive/releases/2013/44/>).
- NASA Telescopes Spy Ultra-Distant Galaxy Amidst Cosmic 'Dark Ages' (<http://hubblesite.org/newscenter/archive/releases/2012/31/>).
- Hubble Sees Supernova Split into Four Images by Cosmic Lens (<http://hubblesite.org/newscenter/archive/releases/2015/08/>).



Looking for Hubble data used by scientists?

- MACS J1149 – Hubble Frontier Fields Data (<http://archive.stsci.edu/prepds/frontier/>)
- MACS J1149 – Archived Hubble Data (http://hla.stsci.edu/hlview.html#Images|filterText%3D%24filterTypes%3D|query_string=MACS%20J1149.5%2B2223&posfilename=&poslocalname=&posfilecount=&listdelimiter=whitespace&listformat=degrees&RA=177.392920&Dec=22.395140&Radius=0.200000&inst-control=all&inst=ACS&inst=ACSGrism&inst=WFC3&inst=WFPC2&inst=NICMOS&inst=NICGRISM&inst=COS&inst=WFPC2-PC&inst=STIS&inst=FOS&inst=GHR&imagetype=best&prop_id=&spectral_elt=&proprietary=both&preview=1&output_size=256&cutout_size=12.8|ra=&dec=&sr=&level=&image=&inst=ACS%2CACSGrism%2CWFC3%2CWFC2%2CNICMOS%2CNICGRISM%2CCOS%2CWFC2-PC%2CSTIS%2CFOS%2CGHR&ds=).

References to science journal articles:

1: A highly magnified candidate for a young galaxy seen when the Universe was 500 Myrs old (<http://arxiv.org/abs/1204.2305>).

3 thoughts on “Meet the Frontier Fields: MACS J1149.5+2223”

1.  [March 20, 2014 at 12:19 pm](#)
Frontier Fields: Locations on the Sky | Frontier Fields 
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[!\[\]\(2bdfe261b986065ee0ac76460d6528c9_img.jpg\) Reply](#)

2. [!\[\]\(dfbd6b3763a6d1d9afaa974f64e2e4b5_img.jpg\) March 6, 2015 at 8:49 am](#)

A Stellar Explosion Seen Through a Lumpy Cosmic Lens | Frontier Fields [!\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)
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3. [!\[\]\(c694a3ff3b077d76910920a6a1593ab4_img.jpg\) January 29, 2016 at 2:10 pm](#)

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