

## **Hubble goes to the 'eXtreme' to assemble the deepest ever view of the universe**

EurekAlert!

The Hubble Ultra Deep Field is an image of a small area of space in the constellation of Fornax (The Furnace), created using Hubble Space Telescope data from 2003 and 2004. By collecting faint light over one million seconds of observation, the resulting image revealed thousands of galaxies, both nearby and very distant, making it the deepest image of the Universe ever taken at that time.

The new full-colour XDF image is even more sensitive than the original Hubble Ultra Deep Field image, thanks to the additional observations, and contains about 5500 galaxies, even within its smaller field of view. The faintest galaxies are one ten-billionth the brightness that the unaided human eye can see [1].

Magnificent spiral galaxies similar in shape to the Milky Way and its neighbour the Andromeda galaxy appear in this image, as do large, fuzzy red galaxies in which the formation of new stars has ceased. These red galaxies are the remnants of dramatic collisions between galaxies and are in their declining years as the stars within them age.

Peppered across the field are tiny, faint, and yet more distant galaxies that are like the seedlings from which today's magnificent galaxies grew. The history of galaxies -- from soon after the first galaxies were born to the great galaxies of today, like the Milky Way -- is laid out in this one remarkable image.

Hubble pointed at a tiny patch of southern sky in repeat visits made over the past decade with a total exposure time of two million seconds [2]. More than 2000 images of the same field were taken with Hubble's two primary cameras: the Advanced Camera for Surveys and the Wide Field Camera 3, which extends Hubble's vision into near-infrared light. These were then combined to form the XDF.

"The XDF is the deepest image of the sky ever obtained and reveals the faintest and most distant galaxies ever seen. XDF allows us to explore further back in time than ever before," said Garth Illingworth of the University of California at Santa Cruz, principal investigator of the Hubble Ultra Deep Field 2009 (HUDF09) programme.

The Universe is 13.7 billion years old, and the XDF reveals galaxies that span back 13.2 billion years in time. Most of the galaxies in the XDF are seen when they were young, small, and growing, often violently as they collided and merged together. The early Universe was a time of dramatic birth for galaxies containing brilliant blue stars far brighter than our Sun. The light from those past events is just arriving at Earth now, and so the XDF is a time tunnel into the distant past when the Universe was just a fraction of its current age. The youngest galaxy found in the XDF existed just 450 million years after the Universe's birth in the Big Bang.

Before Hubble was launched in 1990, astronomers were able to see galaxies up to about seven billion light-years away, half way back to the Big Bang. Observations with telescopes on the ground were not able to establish how galaxies formed and evolved in the early Universe.

Hubble gave astronomers their first view of the actual forms of galaxies when they were young. This provided compelling, direct visual evidence that the Universe is truly changing as it ages. Like watching individual frames of a motion picture, the Hubble deep surveys reveal the emergence of structure in the infant Universe and the subsequent dynamic stages of galaxy evolution.

The planned NASA/ESA/CSA James Webb Space Telescope (Webb telescope) will be aimed at the XDF, and will study it with its infrared vision. The Webb telescope will find even fainter galaxies that existed when the Universe was just a few hundred million years old. Because of the expansion of the Universe, light from the distant past is stretched into longer, infrared wavelengths. The Webb telescope's infrared vision is ideally suited to push the XDF even deeper, into a time when the first stars and galaxies formed and filled the early "dark ages" of the Universe with light.

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## Notes

The Hubble Space Telescope is a project of international cooperation between ESA and NASA.

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[1] The faintest objects detected in the XDF are 31st magnitude.

[2] The total exposure time is approximately two million seconds, or 23 days. Because Hubble can only observe for about 45 minutes of every 97-minute orbit, the observations that make up the XDF represent 50 days of telescope time.

Image credit: NASA, ESA, G. Illingworth, D. Magee, and P. Oesch (University of California, Santa Cruz), R. Bouwens (Leiden University), and the HUDF09 Team

## Links

\* Images of Hubble:

<http://www.spacetelescope.org/images/archive/category/spacecraft/> [1]

\* NASA release: <http://hubblesite.org/news/2012/37> [2]

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[1] <http://www.spacetelescope.org/images/archive/category/spacecraft/>

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