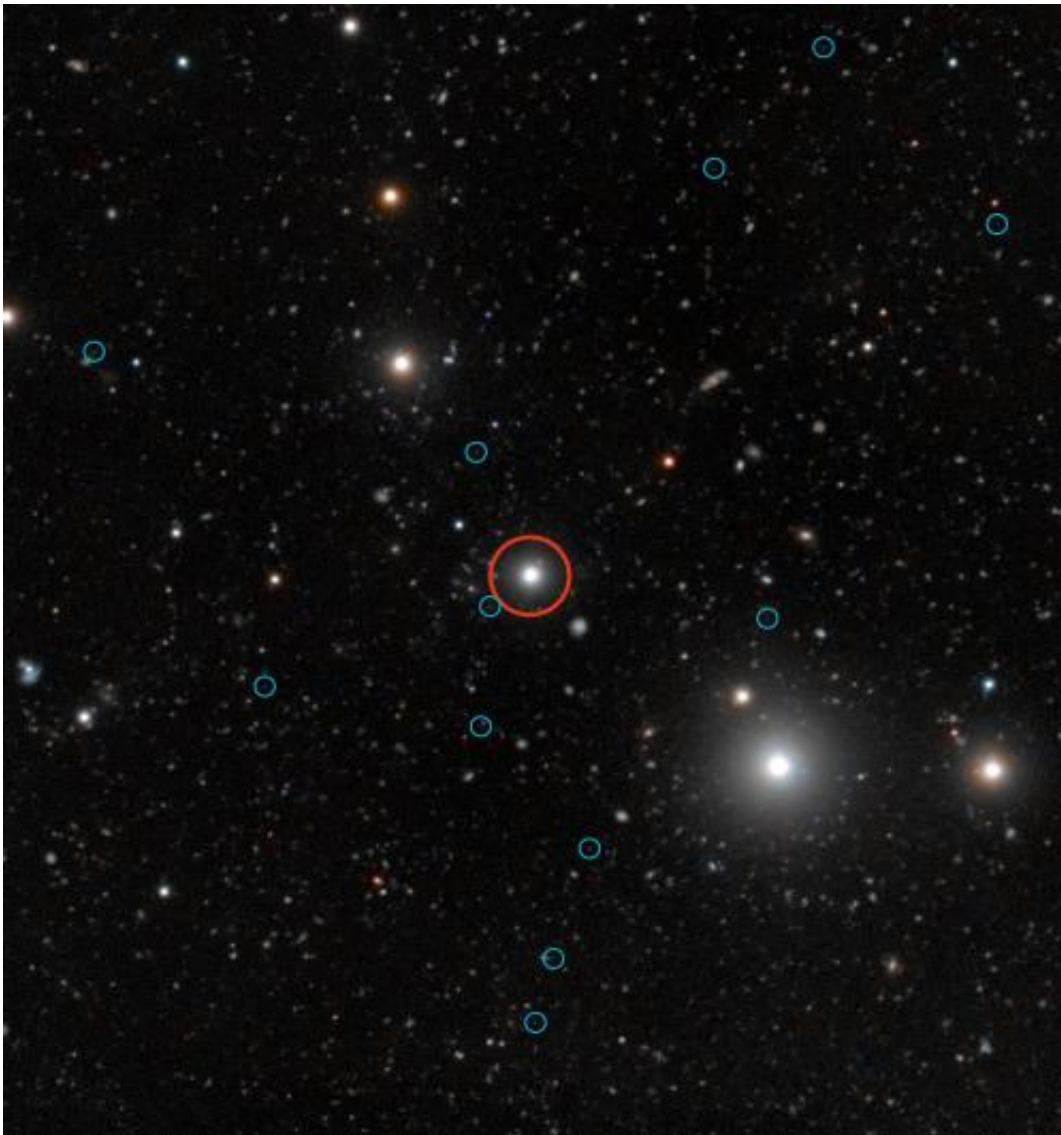


Dark galaxies of the early Universe spotted for the first time

July 11 2012



This deep image shows the region of the sky around the quasar HE0109-3518. The quasar is labelled with a red circle near the centre of the image. The energetic radiation of the quasar makes dark galaxies glow, helping astronomers

to understand the obscure early stages of galaxy formation. The faint images of the glow from 12 dark galaxies are labelled with blue circles. Dark galaxies are essentially devoid of stars, therefore they don't emit any light that telescopes can catch. This makes them virtually impossible to observe unless they are illuminated by an external light source like a background quasar. This image combines observations from the Very Large Telescope, tuned to detect the fluorescent emissions produced by the quasar illuminating the dark galaxies, with colour data from the Digitized Sky Survey 2. Credit: ESO, Digitized Sky Survey 2 and S. Cantalupo (UCSC)

(Phys.org) -- For the first time, dark galaxies — an early phase of galaxy formation, predicted by theory but unobserved until now — may have been spotted. These objects are essentially gas-rich galaxies without stars. Using ESO's Very Large Telescope, an international team thinks they have detected these elusive objects by observing them glowing as they are illuminated by a quasar.

Dark [galaxies](#) are small, gas-rich galaxies in the early Universe that are very inefficient at forming stars. They are predicted by theories of galaxy formation and are thought to be the building blocks of today's bright, star-filled galaxies. Astronomers think that they may have fed large galaxies with much of the gas that later formed into the stars that exist today.

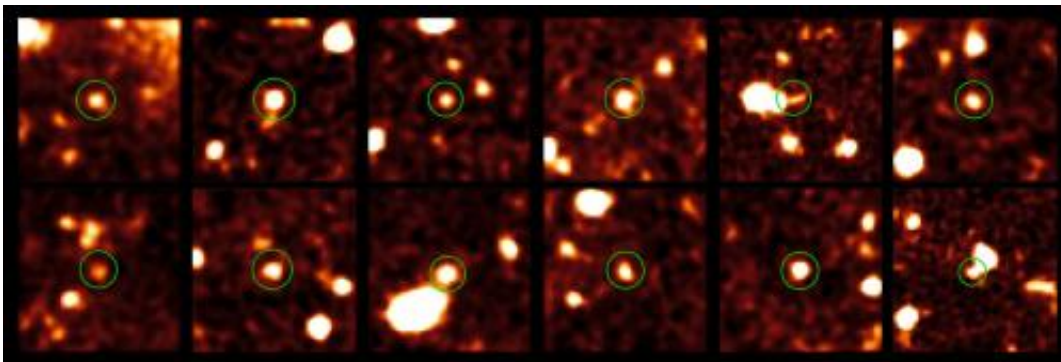
Because they are essentially devoid of stars, these dark galaxies don't emit much light, making them very hard to detect. For years astronomers have been trying to develop new techniques that could confirm the existence of these galaxies. Small absorption dips in the spectra of background sources of light have hinted at their existence. However, this new study marks the first time that such objects have been seen directly.

"Our approach to the problem of detecting a dark galaxy was simply to

shine a bright light on it." explains Simon Lilly (ETH Zurich, Switzerland), co-author of the paper. "We searched for the fluorescent glow of the gas in dark galaxies when they are illuminated by the ultraviolet light from a nearby and very bright quasar. The light from the quasar makes the dark galaxies light up in a process similar to how white clothes are illuminated by ultraviolet lamps in a night club."

The team took advantage of the large collecting area and sensitivity of the Very Large Telescope (VLT), and a series of very long exposures, to detect the extremely faint fluorescent glow of the dark galaxies. They used the FORS2 instrument to map a region of the sky around the bright quasar HE 0109-3518, looking for the ultraviolet light that is emitted by hydrogen gas when it is subjected to intense radiation. Because of the expansion of the Universe, this light is actually observed as a shade of violet by the time it reaches the VLT.

"After several years of attempts to detect fluorescent emission from dark galaxies, our results demonstrate the potential of our method to discover and study these fascinating and previously invisible objects," says Sebastiano Cantalupo (University of California, Santa Cruz), lead author of the study.



This image shows 12 close-up images of dark galaxies. These are essentially devoid of stars and would normally be invisible to telescopes. However, their gas

is being illuminated by the intense light from a nearby quasar, making them visible to the VLT. Credit: ESO, Digitized Sky Survey 2 and S. Cantalupo (UCSC)

The team detected almost 100 gaseous objects which lie within a few million light-years of the quasar. After a careful analysis designed to exclude objects where the emission might be powered by internal star-formation in the galaxies, rather than the light from the quasar, they finally narrowed down their search to 12 objects. These are the most convincing identifications of dark galaxies in the early Universe to date.

The astronomers were also able to determine some of the properties of the dark galaxies. They estimate that the mass of the gas in them is about 1 billion times that of the Sun, typical for gas-rich, low-mass galaxies in the early [Universe](#). They were also able to estimate that the star formation efficiency is suppressed by a factor of more than 100 relative to typical star-forming galaxies found at similar stage in cosmic history.

"Our observations with the VLT have provided evidence for the existence of compact and isolated dark clouds. With this study, we've made a crucial step towards revealing and understanding the obscure early stages of galaxy formation and how galaxies acquired their gas", concludes Sebastiano Cantalupo.

The MUSE integral field spectrograph, which will be commissioned on the VLT in 2013, will be an extremely powerful tool for the study of these objects.

More information: This research was presented in a paper entitled "Detection of dark galaxies and circum-galactic filaments fluorescently illuminated by a quasar at $z=2.4$ ", by Cantalupo et al. to appear in

Monthly Notices of the Royal Astronomical Society.

[www.eso.org/public/archives/re ... /eso1228/eso1228.pdf](http://www.eso.org/public/archives/re.../eso1228/eso1228.pdf)

Provided by ESO

Citation: Dark galaxies of the early Universe spotted for the first time (2012, July 11) retrieved 26 April 2024 from <https://phys.org/news/2012-07-dark-galaxies-early-universe.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.