

An 'Infinity of Dwarfs' --A Visible Universe of 7 Trillion Dwarf Galaxies

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Here's how astronomers breakout the visible Universe within 14 billion light years:

Superclusters in the visible universe = 10 million

Galaxy groups in the visible universe = 25 billion

Large galaxies in the visible universe = 350 billion

Dwarf galaxies in the visible universe = 7 trillion

Stars in the visible universe = 30 billion trillion (3×10^{22})

Astronomers realize that they may have underestimated the number of galaxies in some parts of the universe by as much as 90 percent, according to Matthew Hayes of the University of Geneva's Observatory, who led the investigation using the world's most advanced optical instrument -- Europe's Very Large Telescope (VLT) in Chile, which has four 8.2-meter (26.65-feet) behemoths. They turned two of the giants towards a well-studied area of deep space called the GOODS-South field.

In the case of very distant, old galaxies, the telltale light may not reach Earth as it is blocked by interstellar clouds of dust and gas -- and, as a result, these galaxies are missed by the map-makers.

"Astronomers always knew they were missing some fraction of the galaxies... but for the first time we now have a measurement. The number of missed galaxies is substantial," said Matthew Hayes of the University of Geneva's observatory, who led the investigation.

The team carried out two sets of observations in the same region, hunting for light emitted by galaxies born 10 billion years ago. The first looked for so-called Lyman-alpha light, the classic telltale used to compile cosmic maps, named after its U.S. discoverer, Theodore Lyman. Lyman-alpha is

energy released by excited hydrogen atoms. The second observation used a special camera called HAWK-1 to look for a signature emitted at a different wavelength, also by glowing hydrogen, which is known as the hydrogen-alpha (or H-alpha) line.

The second sweep yielded a whole bagful of light sources that had not been spotted using the Lyman-alpha technique. They include some of the faintest galaxies ever found, forged at a time when the universe was just an infant.

The astronomers conclude that Lyman-alpha surveys may only spot just a tiny number of the total light emitted from far galaxies. Astonishingly, as many as 90 percent of such distant galaxies may go unseen in these exercises.

"If there are 10 galaxies seen, there could be a hundred there," said Hayes. The discovery adds powerfully to knowledge about the timeline by which stars and then galaxies formed.

The image below shows the discovery of a previously unresolved population of galaxies in the GOODS fields and the first measurements of properties of galaxies in the almost unexplored far-infrared domain are among the first exciting scientific results achieved by Herschel's PACS and SPIRE instruments. These findings confirm the extraordinary capabilities of ESA's new infrared space observatory to investigate the formation and evolution of galaxies.

