Hubbles most sensitive images show distant galaxies

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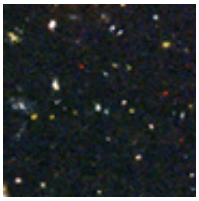

The recently released Hubble Space Telescope Ultra Deep Field (HUDF) - the most sensitive image of the distant universe ever obtained - has provided UK astronomers with a window on star formation **when the universe was young, revealing some of the earliest star forming galaxies yet detected.**

The research was led by Dr Andrew Bunker at the University of Exeter and graduate student Elizabeth Stanway at the Institute of Astronomy at Cambridge University. Their results have been accepted for publication in the journal 'Monthly Notices of the Royal Astronomical Society'.

This UK team was the first to analyse the Ultra Deep Field images, generating their results within a day of the data becoming available. Their work has been confirmed by other groups researching in the field, and is the subject of a NASA press conference at the Space Telescope Science Institute, Baltimore today (23 September 2004).

Bunker and colleagues identified fifty objects likely to be galaxies from the HUDF data that looked 95 per cent of the way back to the beginning of the Universe. The redshifts of these galaxies are about 6 - so far away that light from them has taken 13 billion years to reach us. This is more than twice the age of our Solar System, and the galaxies which the UK team have discovered existed when the universe was less than a billion years old.

"Intervening gas clouds absorbed visible light from these galaxies long before it reached Earth, but their infrared light can be detected," explained Elizabeth Stanway, "and it is their infrared colours which lead us to believe that these galaxies lie at such immense distances."

The astronomers turned to two of the largest telescopes in the world, the 10-metre Keck telescope, in Hawaii, and the 8-metre Gemini telescope in Chile to verify their findings with spectroscopic techniques. In some of these spectra they saw the hydrogen gas glowing as it was illuminated by hot, newly-born stars. "These galaxies are in the process of giving birth to stars - each year they convert a mass of gas more than that of our sun into new stars," said Professor Richard Ellis of the California Institute of Technology.

"Using the largest optical telescope, Keck, was very important as it showed that this population of objects discovered by the Hubble Space Telescope really are incredibly distant", added Andrew Bunker, who was also part of the team which did the observing in Hawaii.

But these discoveries pose a cosmic puzzle: on the basis of their sample, the UK team can calculate how fast stars are being born in distant galaxies at redshift 6. They have compared the answer with previous work looking at nearer galaxies, with redshifts around 3. "It seems that there are fewer of these galaxies early in the history of the Universe at redshift 6, compared to more recent times," said Andrew Bunker.

Richard McMahon, another of the Cambridge team, explained the importance of exploring these high redshifts: "At this early time in the history of the universe, a major phase change occurred. The space between galaxies was filled with largely neutral gas, but suddenly this was ionised - forming a plasma." The main candidate for what caused this is ultraviolet radiation, which can be generated as stars are born. Yet, the small number of star forming galaxies found in the Ultra Deep Field may not be sufficient to do this.

It is possible that the first stars and galaxies were born at even earlier times, and this will be explored by the successor to Hubble, the James Webb Space Telescope, which will operate in the infrared.

Redshift

The Cosmological Redshift is caused by the expansion of the Universe. As light travels through expanding space, it too is stretched, making its wavelength longer - or 'shifted' more towards the red end of the electromagnetic spectrum. The wavelength of light increases as it traverses the expanding universe between its point of emission and its point of detection by the same amount that space has expanded during the crossing time. The higher the redshift, the further away in distance and further back in time, the light is coming from.

Source: PPARC