Young Galaxies Were Hostile To Life

March 17 2006

Scientists said Tuesday they have found evidence that the earliest galaxies in the universe could have been extremely hostile environments for life.

Using NASA's Spitzer Space Telescope, a team led by graduate student Yanling Wu of Cornell University in Ithaca, N.Y., reached this conclusion after studying the formation and destruction of polycyclic-aromatic-hydrocarbon molecules in more than 50 extremely distant blue compact dwarf galaxies. The organic molecules, comprising mostly hydrogen and carbon, are thought to have been among the first building blocks for life.

"One of the outstanding problems in astronomy today is whether complex organic molecules of hydrogen and carbon, similar to those responsible for life on Earth, are present in the early universe," Wu said.

Mature and massive galaxies such as the Milky Way probably formed from the merging of smaller galaxies, about the size of nearby BCD galaxies. Current technology is not yet sensitive enough to identify and study in detail the universe's first galaxies, so scientists must infer the physical properties of the early structures by observing similar nearby BCDs.

"We believe that BCD galaxies are similar to the universe's first galaxies because they are infant galaxies, actively forming stars, and are not very chemically polluted," Wu explained.

Reporting in the March issue of the Astrophysical Journal, the team wrote that because most atomic elements other than hydrogen and helium originated from the death of stars, most scientists think that, in the first few million years after the Big Bang, galaxies lacked the heavier elements necessary to form organic molecules. In astronomy, such galaxies are said to have low metallicity.

The blue glow from BCD galaxies reveals they are actively forming massive stars, but their low metallicity also signifies they are young as galaxies go and almost devoid of the possibility of organic molecules. The findings Wu's team confirmed this by revealing that the nearby BCD galaxies with lowest metallicity also display little or no polycyclic aromatic hydrocarbons.

As the galaxies become more enriched with heavier elements, however, more traces of PAHs can be found. She considers the phenomenon logical, because elements such as carbon are formed from the death of stars, and some BCD galaxies might just be too young to have produced enough carbon to create PAHs.

More interesting, the Spitzer data show that in some of the BCDs where conditions seem to allow the formation of PAHs, the molecules are being destroyed by intense ultraviolet radiation from the young massive stars.

"Because BCD galaxies are metal poor and very compact, the intense ultraviolet radiation from young stars will destroy PAH molecules even if they are formed," Wu said. "The threshold for when these PAH molecules stop being destroyed is still uncertain."

The situation leads to "an interesting paradox, where the young stars responsible for the formation of PAHs may also be the main culprit of their destruction," wrote co-author Vassilis Charmandaris of the

University of Greece, Heraklion.

"Yanling has made significant progress in a research area first opened by (Spitzer)," said Jim Houck, Wu's academic adviser at Cornell and another co-author of the paper. "With Spitzer, Yanling is able to extend BCDs observations to a much larger sample; the new results provide a glimpse into the formation of galaxies in the early universe."