Astronomers peer back to 'dawn of galaxies'

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Detailed analysis of Hubble Space Telescope images has allowed astronomers to determine a major event in the evolution of the universe. The astronomers used the Hubble Space Telescope's Ultra Deep Field (UDF) to peer 95 percent of the way back to the beginning of time – to 750 million years after the Big Bang – and they found a population of dim young dwarf galaxies whose collective light likely was responsible for **"reionizing" hydrogen in the universe, an event that led to major galaxy formation**.

Reionization is a critical period in the development of the universe, according to Rogier Windhorst, an ASU professor of astronomy.

"It lifted the veil of cold, primordial hydrogen, which was largely opaque when it cooled after the Big Bang," says Windhorst, a member of one of four teams of astronomers that analyzed Hubble UDF data. The four teams presented their findings at a Sept. 23 workshop in Baltimore.

"This is the dawn of galaxy formation," Windhorst says. "Before this, there were probably just star clusters and giant molecular clouds like the Orion nebula in our galaxy. There were big, massive stars but probably nothing like the shape of ordinary or even tiny galaxies."

NASA's new 6.5 meter James Webb Space Telescope, planned for launch in 2011, will peer even further back in time to the epoch of first light to see these first stars and star clusters.

In the past couple of decades astronomers have documented evidence

that we live in a reionized or “refried” universe. The reionization epoch was a critical watershed for the evolving universe. During that early time, cold hydrogen atoms drifting in space were pumped up with so much energy from ultraviolet starlight from newly formed, hot young stars that they were stripped of their electrons. The universe once again became transparent, like the Sun burning off an early morning fog.

This early period is called reionization because the primeval universe was initially ionized as a “soup” of hydrogen and helium nuclei and free-moving electrons, Windhorst said. As the universe cooled through expansion, these electrons were captured by hydrogen nuclei to make neutral hydrogen. But the electrons were lost again when the first fiercely bright stars fired up.

The reionization epoch is thought to have ended between 500 million and 1 billion years after the Big Bang (the universe is estimated to be 13.7 billion years old). Prior to the period of reionization, the universe was a very different place than today, which now includes billions of stars residing in billions of galaxies.

Using special instruments on the Hubble telescope, astronomers were able to discern the long sought, yet very faint galaxies that probably had enough energy among them to reionize the young universe.

The Hubble Ultra Deep Field images show that at about one billion years after the Big Bang, the early universe was filled with fledgling dwarf galaxies, but no fully formed galaxies like our Milky Way galaxy. After careful analysis, the astronomers were able to sort out between 54 and 108 dim red smudges sprinkled across the Hubble UDF image.

“Instead of some giant, pulling the trigger on a single gun, it turns out that all of these little galaxies produced all of the ultraviolet light and collectively lifted the hydrogen veil,” Windhorst said.

To look at it in a hierarchical way, he added, the universe at that time was filled with “mom and pop” stores, which eventually merged into businesses and later into giant corporations – the majestic galaxies we see today.

Windhorst worked with ASU alumnus Haojing Yan, now a postdoctoral fellow at the California Institute of Technology’s Spitzer Science Center, Pasadena, Calif., on the analysis. They published a paper on their work, “Candidates of z~5.5 – 7 Galaxies in the Hubble Space Telescope Ultra Deep Field,” in the Sept.10 Astrophysical Journal Letters.

Source: ASU