UCR astronomer sets her sights on massive, permanent collections of galaxies for secrets of the universe

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UC Riverside astronomer Gillian Wilson calls them "the biggest, baddest babies in the nursery."

They're galaxy clusters: Massive, permanent collections of galaxies that offer clues to the past and future of the universe.

Wilson, an associate professor of physics and astronomy, is leading a team of 26 scientists from eight countries who recently completed the largest ever survey of galaxy clusters as seen during the early universe.

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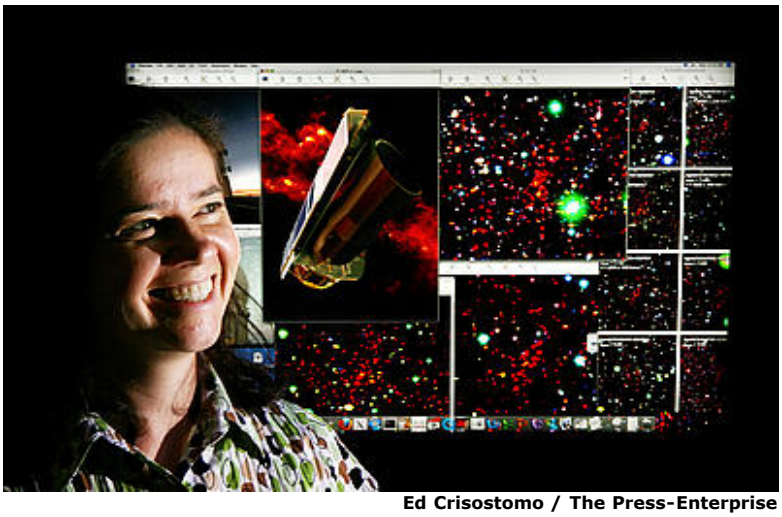

Ed Crisostomo / The Press-Enterprise
UCR's Gillian Wilson shows images of examples of newly discovered distant galaxy clusters, which provide a look at the universe as it existed billions of years ago.

The survey discovered about 200 galaxy clusters, which are areas in the universe consisting of dozens or hundreds of galaxies with trillions of stars, hot gas and invisible dark matter.

Researchers on the team will spend at least five years thoroughly studying 10 to 20 of those clusters. That will help them deduce characteristics about the others, which will allow scientists to make broader conclusions about the entire universe.

The images scientists are analyzing are a look at the universe as it existed billions of years ago, taken by an infrared telescope that floats in outer space. The clusters are so distant that it takes billions of years for their light to arrive to the telescope.

"It's like taking a snapshot of the universe at 200 points in time," Wilson said.

There are thousands of known galaxy clusters, but most of those previously studied were photographed as they appeared only a few billion years ago. The Wilson-led study looks at clusters as they existed at least 7.7 billion years ago, meaning the clusters were formed between the time of the creation of the universe and when the universe was six billion years old. Scientists believe the universe is 13.7 billion years old.

Knowledge of the early years of the universe, and how galaxy clusters formed and behaved then, will help scientists forecast what will happen in the future.

"We're trying to understand the ultimate fate of the universe," Wilson said.

Other projects have looked at very old clusters, but never so many, she said. With more clusters to analyze, scientists can make broader conclusions. By looking at one cluster, they can't tell whether its characteristics are typical of clusters or just a fluke. If up to 20 clusters have similar characteristics and evolutions, scientists can better determine what is typical, Wilson said.

They can tell which clusters are oldest by a quick glance at the images, which are a mix of brilliant red, green, yellow, orange, blue and white dots and blotches against

a black background. Most of the red dots are galaxies in the clusters. The darker the shade of red on the image, the more distant--or earlier in time--the galaxy cluster.

As scientists analyze the clusters, they will determine when the galaxies within the clusters formed. They will also measure orbits of galaxies and more closely study the mysterious invisible dark matter that forms most of the mass of clusters.

"We don't know what it is," Wilson said. "It's likely to be some undiscovered fundamental particle. We know it's there because of its gravitational influence on the orbits of the galaxies."

The dark matter binds the galaxies together in the cluster. If it weren't for the dark matter, the galaxies would fly off on their own.

Scientists theorize that galaxy clusters contain the universe's oldest, most massive galaxies.

The study will also give scientists more insight into how environment affects all galaxies, said Adam Muzzin, a research scientist in Yale University's astronomy department and coauthor with Wilson of two papers on the survey published in The Astrophysical Journal.

Galaxies in clusters are generally less active and less likely to form stars than galaxies not in clusters, he said. That suggests that something in the environment of clusters--perhaps the hot gas in the center of all clusters through which galaxies are constantly whizzing through--alters the behavior of galaxies, Muzzin said.

The study will help determine the reasons, Muzzin said. Studying clusters when the universe was young helps eliminate environmental factors, because the galaxies had less time to interact with the environment and change, he said.

If the environment in the clusters does not alter galaxies, it could mean that the types of galaxies that formed into clusters are intrinsically different.

"Understanding how the environment affects how galaxies form and evolve is important in understanding our own Milky Way and how it came about and formed," he said. "It's all related."

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