Researchers study galaxy mergers

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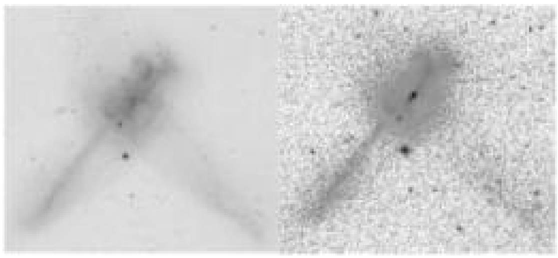

This is an optical (left) and infrared (right) image of an IR-bright merging galaxy. The center of the merger is obscured in the left image, but in the infrared (right) the central disk is very bright and easily seen. Credit: Optical image from the Hubble Space Telescope and infrared image from the University of Hawaii 88

Scientists at the Naval Research Laboratory (NRL) have solved a long-standing dilemma about the mass of infrared bright merging galaxies. Because galaxies are the largest directly observable objects in the universe, learning more about their formation is key to understanding how the universe works.

Dr. Barry Rothberg and Dr. Jacqueline Fischer, both of the Infrared-Submillimeter Astrophysics & Techniques Section in the Remote Sensing Division, used new data from the 8-meter Gemini-South telescope in Chile along with earlier results from the W. M. Keck-2 10-meter and University of Hawaii 2.2-meter telescopes in Hawaii and archival data from the Hubble Space Telescope, to solve the problem. They have published a paper on their research findings on galaxy evolution in the *Astrophysical Journal* (March 20, 2010 Volume 712).

Galaxies in the Universe generally come in two shapes, spiral, like our own Milky Way, and elliptical, in which the stars move in random orbits, Rothberg explains. The largest galaxies in the Universe are elliptical in shape and how they formed is central to our understanding how the Universe has evolved over the last 15 billion years. The long-standing theory has been that spiral galaxies merge with each other forming most of the elliptical galaxies in the Universe. Spiral galaxies contain significant amounts of cold hydrogen gas. When they merge, the beautiful spiral patterns are destroyed and the gas is converted into new stars. The more gas present in the spiral galaxies, the more stars are formed and with it, large amounts of dust. The dust is heated by the young stars and radiates energy at infrared wavelengths.

Until recently scientists thought that these infrared bright merging galaxies were not massive enough to be the precursors of most elliptical galaxies in the Universe. The problem lay in the method of measuring their mass. The conventional method of measuring mass in dusty IR-bright galaxies uses near-infrared light to measure the random motions of old-stars. The larger the random motions, the more mass is present. Using near-infrared light makes it possible to penetrate the dust and see as many of the old stars as possible. However, a complication occurs when spiral galaxies merge, because most of their gas is funneled to the gravitational center of the system and forms a rotating disk. This rotating disk of gas is transformed into a rotating disk of young stars that is also very bright at near-infrared wavelengths. The rotating disk of young stars both outshines the old stars and makes it appear as if the old stars have significantly less random motion. In contrast to this conventional method, Rothberg and Fischer instead observed the random motions of old stars at shorter wavelengths effectively using the dust to their advantage to block the light from the young stars. Their new results showed that the old stars in merging galaxies have large random motions, which means they will eventually become very massive elliptical galaxies.

The next step for NRL researches is to directly observe the stellar disks in IR luminous mergers using three-dimensional spectroscopy. Each pixel is a spectrum, and from this the researchers can make two-dimensional maps of stellar motion and stellar age. This will allow them to measure the size, rotation, luminosity, mass and age of the central disk.

Provided by Naval Research Laboratory

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