Astronomy

Tiny galaxy packs a wallop

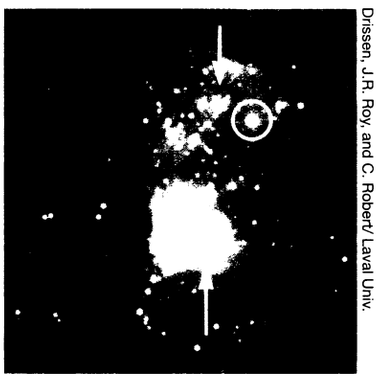
Big things sometimes come in small packages. That is especially true of the dwarf galaxy NGC 2366, which has a diameter one-seventh that of the Milky Way yet sports a star-forming region 10 times brighter and 10 times bigger than the largest in our galaxy.

Using the Hubble Space Telescope to take images and spectra of this mammoth stellar nursery, Laurent Drissen and his colleagues at Laval University in St. Foy, Quebec, found both a puzzle and a surprise.

Astronomers already knew that hydrogen gas in this nursery moves at more than 1,000 kilometers per second, but they didn't know what powers the gas. Drissen's team speculated that the winds blown either by bright, hot stars known as Wolf-Rayet stars or by old stars called red supergiants could have pumped up the gas. The shock wave generated when massive stars explode as supernovas might also have contributed.

However, the Hubble images, which for the first time reveal individual stars in this crowded region, show no red supergiants and only one Wolf-Rayet star. The data also indicate that the region is only a few million years old, too young for stars to have become supernovas. Drissen now believes that winds from young, massive stars might power the gas.

The images also provide an unexpected bonus. Comparing them to older, ground-based pictures, the researchers found a rare type of star called a luminous blue variable (LBV). This immense body, 30 to 60 times the mass of the sun, is in an explosive phase. Only four other LBV eruptions have ever been recorded, and the new eruption is the first for which astronomers have obtained spectra. The Hubble observations reveal that the star has grown 40 times brighter in just 3 years, reports Drissen's team in a December ASTROPHYSICAL JOURNAL LETTERS.



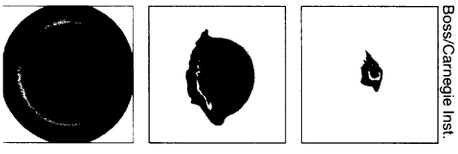
Drissen, J.R. Roy, and C. Robert/ Laval Univ.

Hubble image of a star-forming region shows clusters of newborn stars (arrows) as well as a luminous blue variable (circle).

A shocking way to trigger star birth

A star is born when a molecular cloud collapses, squeezing its gas to a density high enough to begin burning hydrogen. In the standard model, the birth occurs in isolation and the cloud collapses from the inside out. Yet many newborns arise in crowded regions where buffeting by neighbors may trigger a cloud to contract from the outside in. Chemical abundances in meteorites suggest that the birth of our own solar system may have been triggered by a shock wave from a supernova.

In the Sept. 10 ASTROPHYSICAL JOURNAL, Prudence N. Foster and Alan P. Boss of the Carnegie Institution of Washington (D.C.) describe simulations that determine the type of stellar wind and shock wave that could initiate a cloud's collapse. They find that the passage of relatively slow supernova shock waves—those with speeds of about 10 kilometers per second—as well as wind from elderly stars are strong enough to trigger collapse yet gentle enough to leave the cloud intact.



Boss/Carnegie Inst.

Simulation shows a slow shock wave striking a cloud core and causing it to implode, a first step in making a star.

Physics

Household appliance in space

Astronauts may someday microwave more than just the tasty rations NASA provides—they may cook their fuel as well. A prototype space thruster now undergoing tests uses scavenged parts from a conventional microwave oven to burn fuel more efficiently.

"We've been using the magnetrons, the tubes the microwaves come from, out of conventional microwave ovens," says engineering professor Michael M. Micci of Pennsylvania State University in State College. "They're inexpensive."

Micci and his students bombard a gaseous fuel in their prototype's combustion chamber with microwaves to create a superheated cloud called a plasma. The plasma ignites incoming fuel, which then shoots out of an ordinary rocket nozzle. Burning the fuel at a higher temperature increases combustion efficiency, says Micci. This thruster design could reduce by 50 percent the amount of propellant needed to keep satellites from drifting.

As spacecraft generate more electric power, propulsion devices like the microwave thruster are gaining popularity. Micci claims his microwave thruster exceeds other electric devices in lifetime and efficiency.

"The concept has merit," says James Sovey, an aerospace engineer at NASA's Lewis Research Center in Cleveland. The real problem with developing a new thruster today is not technology, he adds, but funding.

Mad physicists explode electrons

With a year to go before the hundredth anniversary of the discovery of the electron, one team of physicists is hard at work devising fireworks for the celebrations. These researchers used electrons to create bubbles in liquid helium, then exploded the bubbles with sound waves.

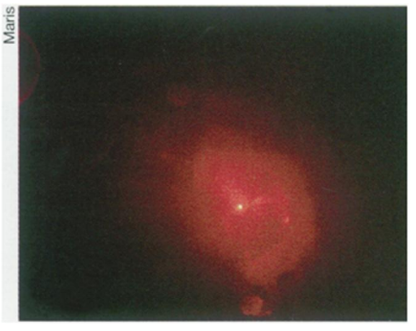
"We see red flashes," says Humphrey J. Maris of Brown University in Providence, R.I., of the research described in the Sept. 2 PHYSICAL REVIEW LETTERS.

Maris and his colleagues injected electrons into liquid helium, where the particles find themselves engaged in a shoving match. Helium atoms buffet the electrons, trying to keep them in place. However, each electron resists being pinned to any one position (SN: 5/25/96, p. 325) and surrounds itself with a 4-nanometer-wide bubble devoid of helium atoms.

"It sounds a bit like mad physicists at work," says Maris, "but we decided to blow the bubbles up." The researchers fired sound waves at a container of liquid helium holding millions of the bubbles. By abruptly raising and lowering the intensity of the sound, they rapidly varied the pressure within the liquid. Reducing the pressure made the bubbles expand. With "a large enough [reduction in pressure], the bubbles explode," says Maris. Each electron then escapes confinement with a flash of light.

Other physicists like the simplicity of using liquid helium to capture particles. "It's a very clever way to confine electrons," says Carlos R. Stroud of the University of Rochester (N.Y.). He suggests that an array of such bubbles could store information in a quantum computer (SN: 1/20/96, p. 38).

Maris is more impressed by his explosions than by any application of his group's method. "It really is an amazing thing to see something caused by a single electron."



Maris

White-centered red flash given off by an escaping electron.