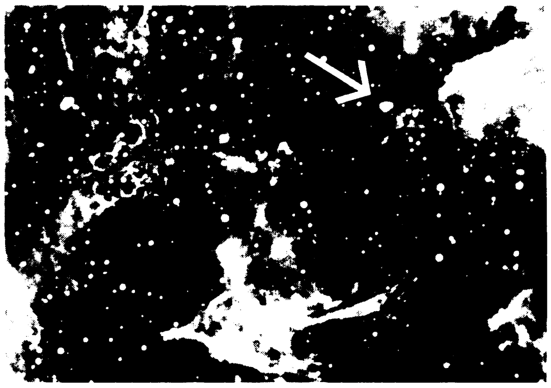
Honeycomb found in galaxy nearest us

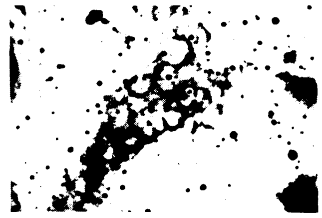
Like bees attracted to a field of wildflowers, swarms of astronomers over the past five years have been drawn to our nearest galactic neighbor, the Large Magellanic Cloud. Researchers have had good reason to study this galaxy, since it is home to supernova 1987A, the first such exploding star visible to the naked eye since 1604.

Now, however, Magellanic Cloud watchers are abuzz with other news about the galaxy: It harbors a remarkable honeycomb of gas bubbles 30 light-years wide by 90 light-years long.

Astronomers have seen gas bubbles – gas swept up in the aftermath of a stellar explosion or blown by a strong stellar wind – in the Large Magellanic Cloud and other galaxies many times before. But no other set of bubbles ever observed has a highly uniform, honeycomb shape, says Lifan Wang of the University of Manchester in England. Wang announced his findings earlier this month in a press release issued by the Royal Astronomical Society in London.

Most surprising, Wang notes, each of the 20-odd bubbles that form the honeycomb has roughly the same diameter – 10 light-years. In contrast, he says, astronomers have typically observed either individual "superbubbles" some 15 to 20 times larger or irregular clusters of smaller bubbles that have one-tenth the diameter.





Wang/ESO

Image of the Large Magellanic Cloud includes supernova 1987A (arrow) and an intriguing honeycomb shape at center left. Above: enlarged view of the honeycomb.

Wang speculates that the streaming motion of gas from a cluster of massive stars created winds strong enough to sculpt the honeycomb. In order to account for the network of similar-size bubbles, however, the stars must have formed at the same time, had the same initial mass, and have continued to evolve at the same rate. Wang suggests that a single violent event, such as a supernova explosion that occurred several thousand years earlier than supernova 1987A, could have triggered the simultaneous formation of massive stars. Wang notes that the honeycomb lies at the edge of a superbubble of gas that could have been produced by such a supernova.

The astronomer made his discovery last January while using the European Southern Observatory's New Technology Telescope in La Serena, Chile, to examine hydrogen gas surrounding supernova 1987A. Wang got his picture of the supernova, but he also noticed the unusual honeycomb structure in one corner of his image. He proposes that the outlines of the honeycomb were visible because radiation from massive stars ionized hydrogen gas at the edges of the bubbles. Wang plans to study the honeycomb further in January. *– R. Cowen*

Free-electron light for probing interfaces

After nearly a decade of development, free-electron lasers are beginning to live up to their promise as versatile, powerful tools for studying materials. Such lasers now operate at several institutions, and more advanced machines are already under construction.

At the free-electron laser center at Vanderbilt University in Nashville, Tenn., researchers have used intense infrared light precisely tuned to particular wavelengths to measure with high accuracy the discontinuity in the energy of conducting electrons at the interface between two dissimilar semiconductors. Norman H. Tolk and colleagues at Vanderbilt and the Federal Polytechnic Institute in Lausanne, Switzerland, report their findings in the Nov. 15 PHYSICAL REVIEW B.

"The experiment is the first application of a free-electron laser to interface work," the researchers say.

Conventional lasers work by exciting electrons in atoms to higher energy levels; the electrons then shed this extra energy as light of a particular wavelength. In contrast, free-electron lasers generate light by harnessing beams of accelerated electrons already stripped from atoms. By adjusting electron energy and other parameters, researchers can tune the laser's output over a range of wavelengths.

Tolk and his co-workers studied the "conduction band discontinuity" between such pairs of semiconductors as gallium arsenide and gallium aluminum arsenide by irradiating the interface with infrared light from the Vanderbilt free-electron laser. To find the energy difference, the researchers decreased the wavelength of the incoming infrared light until they could detect an electrical current between the two semiconductors.

"The free-electron laser is basically the only high-intensity, tunable infrared source available for measuring that offset directly," says Vanderbilt physicist Alan V. Barnes. "It was a long-standing problem. People had been using lots of indirect methods to measure this, but most of those methods . . . were very dependent on theory."

Such measurements aid researchers constructing and trying to understand better the behavior of layered semiconductors, which show potential as electronic devices and solid-state lasers. The Vanderbilt group is now extending these studies to other pairs of semiconductors and to more complicated interfaces.

"We're only a fraction of what's going on at the Vanderbilt Free-Electron Laser Center," Barnes notes. Researchers are exploring potential applications not only in materials science, but also in medicine, including laser surgery, and biophysics. *– I. Peterson*

See-and-touch 3-D molecule

Allied-Signal for the U.S. Dept. of Energy

Seeing may aid believing, but feeling aids understanding, especially when it comes to modeling complex molecules like this binding pocket of a mutant antibody. Michael Pique and Jim Emery of the Scripps Research Institute in La Jolla, Calif., converted X-ray data about the antibody's structure into a set of coordinates. Then Allied-Signal Aerospace Co. in Kansas City, Mo., used stereolithography (SN: 8/3/91, p.72) to build this true-to-life, copyrighted model. In the eight-hour-long 3-D printing process, a precisely aimed laser solidifies liquid plastic at specified coordinates. "It's an easy way to develop a physical intuition of what a molecule is like," says Sylvia J. Spengler, a biophysicist at the University of California, Berkeley.

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