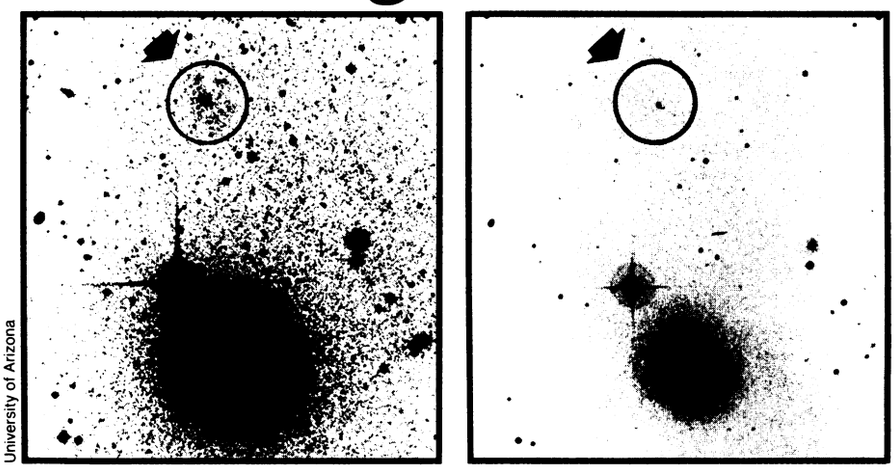
Dark Shadows Among the Galaxies

Has a galaxy been sitting in the dark for billions of years waiting for a burst of starlight that so far has not come? Or did a new galaxy form as recently as 715 million years ago? Either conclusion could be drawn from the discovery of a dark spiral galaxy by a group of four astronomers from the United States and Australia. Either conclusion would be upsetting in one way or another for current theories of the formation and development of galaxies and stars.

The object, a gassy cloud with a few faint stars in it, has the structure of a spiral galaxy, but it is at least 10 times larger and 100 times darker than the average spiral, according to its discoverers, Greg Bothun of the University of Michigan in Ann Arbor, Christopher Impey of the University of Arizona's Steward Observatory in Tucson, David Malin of the Anglo-Australian Observatory in Sydney and Jeremy Mould of the California Institute of Technology in Pasadena, who are publishing their results in the June ASTRONOMICAL JOURNAL. Known as Malin 1, the dark galaxy is located in the direction of the famous cluster of galaxies in the constellation Virgo, but it does not belong to that cluster, and lies in fact some distance beyond it — 715 million light-years from earth — in one of the recently discovered voids of space, where few or no galaxies appear to be.



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In normal photo (right) Malin 1 looks like a dwarf member of the Virgo cluster. Enhanced contrast (left) shows it as much less dwarfish.

Indeed, when first discovered late in 1985 as the group was using the United Kingdom Schmidt telescope to survey the Virgo cluster for dark dwarf galaxies, Malin 1 was thought to be part of the cluster. As the most promising dwarf galaxy candidate in the survey, it was singled out for further study. Early in 1986 the 100-inch telescope at the Carnegie Southern Observatory at Las Campanas, Chile, found that it has a bright nucleus and a spiral structure.

In May 1986 the 200-inch telescope at Mt. Palomar in California determined a redshift that showed it to be not part of the cluster, but far beyond it. This means that Malin 1 is also much bigger than the observers initially believed. They figure it is at least 770,000 light-years across. The biggest galaxy previously known measures to 640,000 light-years across. In work done with the radiotelescope at Arecibo, Puerto Rico, scientists have now verified the distance and determined the mass of the hydrogen in Malin 1, which they report is at least 100 billion times the mass of the sun.

Malin 1 thus has plenty of the material out of which stars form. The most widely accepted theory holds that all the galaxies formed in a short period near the beginning of the universe 10 billion to 20 billion years ago. If Malin 1 formed then, why didn't star formation turn on? On the other hand, Malin 1 could be new as we see it 715 million years ago. As Impey says, "It's not unreasonable to theorize that spiral galaxies might be forming now, in other words, very close to us."

— D. E. Thomsen

Current news about superconductors

One of the things that can destroy superconductivity is too much current. At the proper temperature a superconductor will convey electric current without resistance so long as the current density does not pass a limit that is an intrinsic characteristic of each individual material. For technological usefulness, a superconductor should be able to sustain sizable currents without switching back to normal conductivity or insulation. IBM now announces that scientists at its Thomas J. Watson Research Center in Yorktown Heights, N.Y., have managed to pass a current of 100,000 amperes per square centimeter through one of the new high-temperature superconductors.

This is a current density that opens up all kinds of technological possibilities, especially since it occurred at the temperature of liquid nitrogen, 77 kelvins. Superconductors now in technological use require refrigeration by liquid helium to 4 K. This current density is 100 times that previously reported for these materials, but in that case the people who had passed a current of 1,100 amperes per square centimeter through a sample of the material did not claim to have found any limit; at that current the contacts, which were normal conductors, burned out.

Specialists in the field had generally expected that these materials, which are ceramic compounds of copper oxide with rare-earth elements, would have the capacity to stand very high currents. However, most expected this achievement to take longer than it did, as it required the preparation of a single crystal of a pure form of the material on a substrate appropriate for the test. The crystal in this case is 1 micron thick (equal to 1/100 of a human hair) by 1 inch in diameter. IBM researchers have also made other crystals several millimeters thick.

At the same time, IBM studies have shown that these materials are anisotropic conductors. Household conductors — copper, for example — are isotropic, bulk or three-dimensional conductors; that is, they conduct electricity equally well in all directions. However, substances more exotic than common metals often conduct electricity preferentially in one direction or better in some directions than others. According to the IBM announcement, these high-temperature superconductors carry current 30 times more readily in one particular direction than they do in others. This anisotropic quality will be important to theorists trying to deduce the mechanism responsible for superconductivity in the materials, and also in the design of devices that will use them for practical purposes.

— D. E. Thomsen