SCIENCE NEWS of the week

Galaxies in a Primitive State?

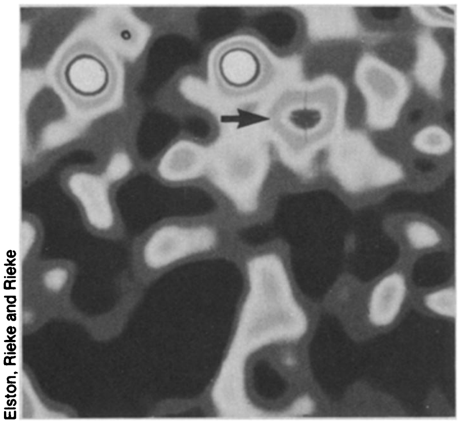
Astronomers' ability to see into the far reaches of the universe is limited by instrumental capabilities. As more and more sensitive imaging equipment comes into use, they find fainter and fainter objects, some of which are farther and farther away. Now it seems to be the turn of the new infrared imaging arrays to make a contribution. Such an array has found objects that may be galaxies in a very primitive stage of development.

"These may be way beyond the most distant things people believe are galaxies," says Richard Elston, a doctoral candidate at the University of Arizona in Tucson, who made the observation while operating the array in collaboration with faculty members Marcia Lebofsky Rieke and George Rieke. Elston believes they are galaxies just at the point of formation, at the time in their development when they are making most of their stars. But he cautiously calls them "candidate galaxies," because he is not entirely certain that they really are galaxies.

Elston estimates the redshifts in the light of these objects at 6 and their distance from earth at around 17 billion light-years. Recession due to the expansion of the universe imposes a shift to the red on the light of distant objects. The most distant objects seen in visible light so far are quasars, not galaxies, with redshifts up to 4.5. All galaxies previously seen have redshifts less than 2. The recession speed, which determines the amount of redshift, is related to the distance through the Hubble constant. However, since not everyone agrees on the value of the Hubble constant, astronomers instead compare distances by quoting the redshift numbers.

The newly found objects fit the theorists' picture of galaxies at the point of formation, when they are just beginning to make multitudes of stars. But Elston and the Riekes believe that more work is necessary to confirm that they are what they seem to be. Elston and the Riekes reported the finding last week at the meeting in Austin, Tex., of the American Astronomical Society.

Whatever they are, they appear to be fairly numerous in the sky. The observations sampled three areas of sky 8 minutes of arc square, Elston told SCIENCE NEWS. Because the astronomers were looking for extremely faint objects—up to 10,000 times dimmer in the infrared than the background sky itself—they looked in directions far removed from the plane of our galaxy, in which the competition from bright nearby objects is too strong. In their sampling areas they found these intrinsically luminous but faint-appearing and very red objects.



Elston, Rieke and Rieke

One of the primitive "candidate galaxies" is indicated by arrow.

In fact, they are very *infrared* objects, 20 times as luminous in the infrared as they are in the red. From this ratio, Elston says, comes the estimate that their redshifts are 6 or greater. From the number they saw in their sample areas, the astronomers estimate that there are about 1,000 such objects per square degree of sky.

The observations were made possible by the recent development of infrared array detectors, which provide something like a map of the infrared brightness of a piece of the sky. Until about two years ago, infrared observations in this wavelength range—2 microns—were done by pointing an infrared sensor—basically a heat sensor—at a direction in the sky and recording the brightness sensed. The observer then aimed the sensor in a slightly different direction. Years ago, a survey of a sizable portion of sky could take forever. George Rieke says: "If I had started this research with the detectors available when I started doing infrared astronomy 16 years ago, it literally would have taken the age of the universe to complete it."

Now, however, there are infrared array detectors, or cameras that give a picture analogous to those provided by the photographic plates or photoelectronic sensors used in visible-light astronomy. This one, developed by Marcia Rieke, has a grid of 64-by-64 heat-sensitive sensors mounted on a mercury-cadmium-telluride chip 1/8 inch square. Elston mounted it on a 61-inch telescope belonging to the University of Arizona's Steward Observatory and located in the Santa Catalina Mountains north of Tucson.

The array contains more than 4,000 detectors working simultaneously, and so, Elston points out, they could do in one night what would have taken 4,000 nights to accomplish in 1985 when only single-element detectors were available. They used a wavelength of 2 microns, the longest wavelength practical for use in infrared searches for faint distant objects.

After the discovery of the infrared objects, the astronomers followed up with visible-light observations with Steward's 90-inch telescope located on Kitt Peak. The "candidate galaxies" show up in red light as 23rd-magnitude objects, Elston says. Spectroscopy has not been possible so far, he says. Spectroscopy might pin down the exact redshifts, and could also show whether there are stars in the objects. — *D.E. Thomsen*

I.I. Rabi, 1898-1988

Isidor Isaac Rabi, known to generations of physicists as I.I. Rabi, died Jan. 11 at his home in New York City. He was 89.

For decades a member of the Columbia University faculty, he was known particularly as a teacher of great physicists and a kind of moral conscience of the physics community.

Having started out as a chemist, Rabi became a specialist in atomic and molecular physics and particularly in the magnetic interactions of atoms and molecules. He received the 1944 Nobel prize for physics for the invention of a very sensitive device for determining the magnetic interactions and the spins of atoms and molecules. The ability to determine such fundamental properties precisely helped make possible the development of such things as atomic clocks, laser, masers and nuclear magnetic resonance scanning.

Rabi was born July 29, 1898, in the town of Rymanow in what was then Austria-Hungary. He was a baby when his parents brought him to New York City and settled on the Lower East Side, where his father worked as a tailor. He always thought it miraculous that he could have come so far from such poor beginnings. He did his undergraduate work at Cornell University; his doctorate in physics came from Columbia University in 1927. For two years he worked in various European laboratories with famous physicists of that time. Then, in 1929, Columbia offered him a faculty position. He remained on the Columbia faculty basically for the rest of his active life. During World War II he worked on radar problems at the Massachusetts Institute of Technology and also on the Manhattan Project. Later he was a science adviser to President Dwight Eisenhower. — *D.E. Thomsen*