FACING GALAXIES HEAD-ON

'Deprojecting' images of galaxies enables scientists to view them face-to-face for the first time

By DIETRICK E. THOMSEN

Nature has strewn galaxies around the universe. According to the latest observational results, that scattering is probably not random, but the attitudes in which the galaxies are found seem to be. Only some of the galaxies present themselves face-on to an observer from earth. Most are at angles; many are edge-on.

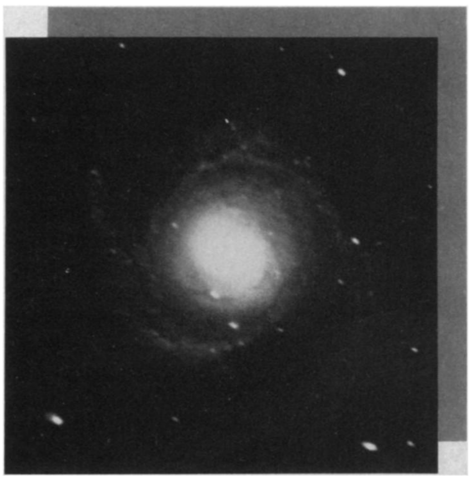
Astronomers often would like to get a face-on view of galaxies they see at angles. This would be especially useful in attempts to gather statistics about particular astrophysical processes — for example, the way new stars form.

It was precisely such an interest that motivated Philip E. Seiden, Debra M. Elmegreen, Bruce G. Elmegreen and Ayman Mobarak of the IBM Thomas J. Watson Research Center in Yorktown Heights, N.Y., to devise a computer program to "deproject" the images of galaxies and turn them face-on.

According to Seiden, the deprojector and the image stretcher are all part of the standard processing package. It took just a little custom work to get the system to interpret properly what it was doing. "The one major block," he says, "is that you have to have the money to buy a good imager, one with the resolution and color capabilities to show you what you've got."

With this mostly off-the-shelf system, Seiden says, observers can concentrate on astronomy. In previous work of this kind, people had to start from scratch, building up the whole computer system themselves. The present arrangement should be practical for many astronomers, he believes. Any of several brands of computer ware could be used, he says.

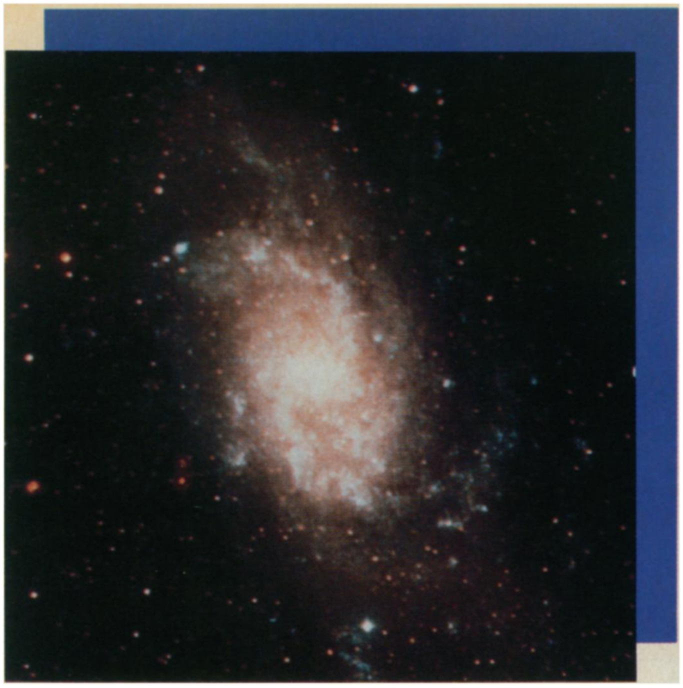
M 81 normal (above) and deprojected (below).



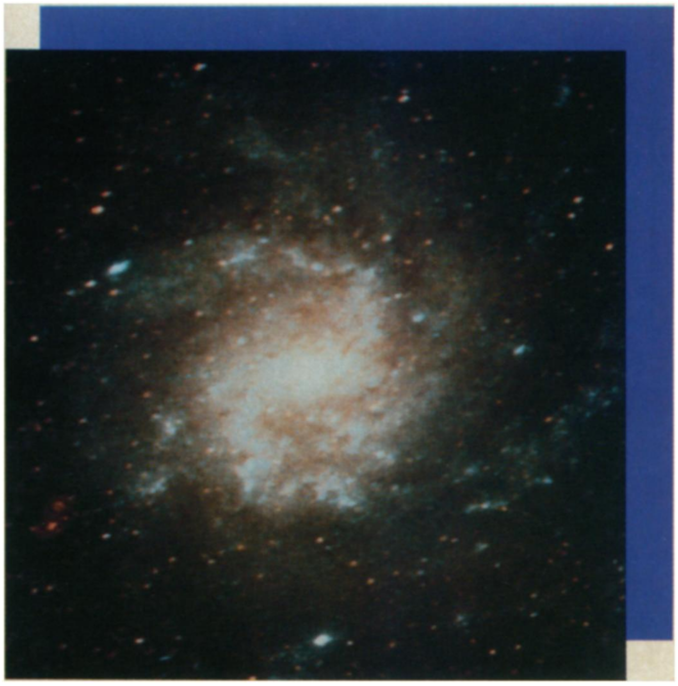
To deproject the oblique image of a galaxy, the system must know the angle at which the image is projected. This information comes from photometric studies. By comparing galaxies seen face-on with those seen obliquely, astronomers have a good idea what projection at different angles does to the light of a galaxy. With the angular information, the computer system can then do a basically trigonometric procedure for turning the image face-on. It can work with inclination angles up to 55° or 60°. Beyond that, too much information is lost.

The system also adjusts contrast and color. In searching for regions where new stars are forming, astronomers are looking for relatively faint and blue areas. Such regions tend to be washed out by bright areas, particularly near the center of a galaxy, and by the overall redness of the brighter and older stars. To the naked eye a galaxy would look yellow-orange, Seiden says.

The system takes pictures of the galaxy made through red and blue filters and combines them in a manner analogous to color printing or color television. First, however, it multiplies the intensity of the blue image compared with the red. Of the several possible ways to do this, Seiden and his collaborators chose to take the central nine pixels (the picture elements, or little squares into which the machine divides the images for computation and



M83 normal (left), deprojected (below) and deprojected and averaged (bottom).



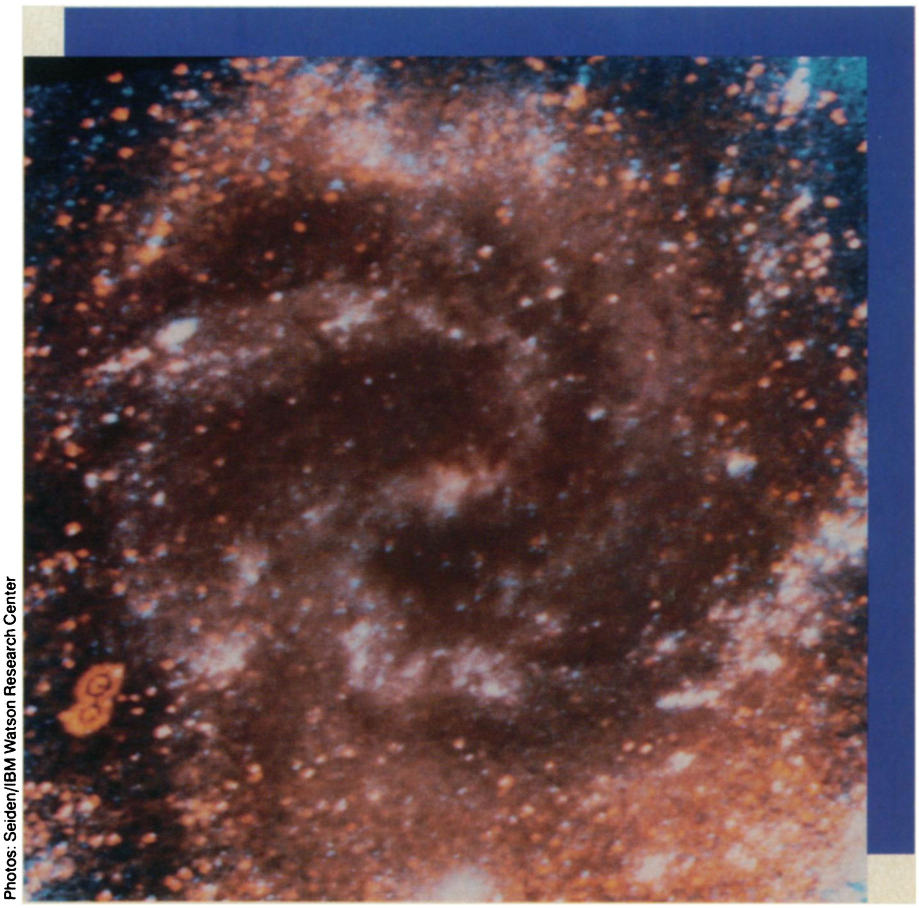
printing) and make the blue and the red equal. The whole blue image is then multiplied by the factor necessary to bring about that central equality.

In this way the group has found spiral arms of galaxies that start closer to the centers of the galaxy and wind around farther than unadjusted photographs would lead astronomers to believe. One such arm, in NGC 628, is more than 500° long — that is, it winds about one and a half times around the galaxy. This seems to be a record for known spiral arms.

Such a finding may tell something about a particular theory of star formation known as stochastic self-propagation. The scenario starts with one star that grows old and explodes as a supernova. The explosion sends a shock wave into the gaseous matter that pervades interstellar space in the galaxy. The shock triggers formation of clumps of this interstellar material, and these clumps are the nuclei around which new stars form. Some of these new stars then evolve to supernovas, sending out shock waves that trigger more clumps, and so on. This process forms a blob of stars. As the galaxy rotates, the blob is stretched out to form a spiral arm.

Another theory of star formation and spiral arms holds that the arms are made by density waves, cyclic fluctuations of the density of matter in the galaxy. The arms are where the matter is densest, and where the matter is densest is where new stars form. M61 and M81 are galaxies that show evidence of such waves.

So far the IBM group has rectified and examined the images of 15 galaxies. They are not yet ready to say anything definitive about preferring one theory of star formation or the other. □



Photos: Seiden/IBM Watson Research Center