infrared because they knew that such radiation, unlike visible light, can pass easily through the dust that cloaks the galaxy's core. In addition, infrared detectors pick out more low-mass stars – the dominant stellar population – providing a more complete view of the size and shape of the spiral arms. To make their observations, Zaritsky, Hans-Walter Rix of the Institute for Advanced Study in Princeton, N.J., and Marcia Rieke of the University of Arizona in Tucson used a state-of-the-art infrared array and the Steward Observatory's 90-inch telescope atop Kitt Peak near Tucson.

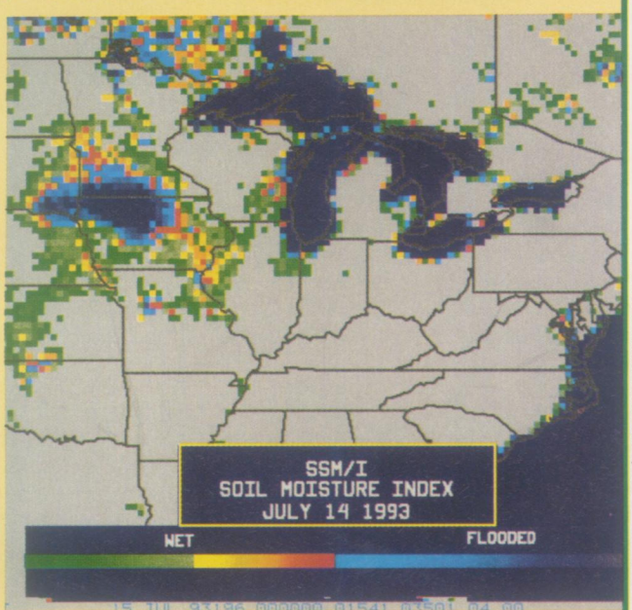
The leading theory to explain the formation of a "grand-design" spiral – a symmetrical pair of spiral arms like that in M51 – invokes the idea of a density wave. In this model, a disturbance in a rotating galaxy – akin to the ripples created by a rock tossed into a pond – causes gas and stars to pile up, producing regions of higher-than-average density. The galaxy's rotation then shapes these high-density regions into spirals. In one version of the theory, regions of high density move through the galaxy like ocean waves; in another version, the regions stay put.

But in either case, although "it's easy to explain how to get the basic spiral shape, no one has ever shown how you can get spiral arms [that make] three full revolutions," notes Kenney. Calculations suggest that M51's spiral arms can't penetrate as far into the galaxy's center as the new images show they do, says Zaritsky. Yet both he and Kenney caution that the discrepancies between modeling and observations don't mean that astronomers must discard their models about spiral galaxies; they may only need to refine them. Current theories, says Kenney, provide "an understanding of only the very simplest things about spiral galaxies."

Zaritsky notes that the gravitational tug of a companion galaxy, NGC 5195, may have helped form M51's spiral arms. But it remains unclear whether this outsider could have triggered the spiral pattern so near the nucleus, he adds. Zaritsky says that infrared observations of spiral galaxies that lack the complication of a companion may shed more light on how spirals take shape. *– R. Cowen*

Satellite sees extent of Midwest floods

A new technique for measuring soil wetness from space shows that flooding in the Midwest has spread far beyond the immediate vicinity of the Mississippi and Missouri rivers. Unlike photos taken from planes, this method can show the aerial extent of surface water over a broad region, according to scientists with the National Oceanic and Atmospheric Administration (NOAA) in Camp Springs, Md.



National Oceanic and Atmospheric Administration

To produce these images, NOAA meteorologist Rao Achutuni and his colleagues mapped data collected by microwave-sensing instruments on several Defense Department satellites. Because water emits less microwave radiation than dry ground does, the satellite information can distinguish soil moisture and flooded regions. Shades of green, orange, and red indicate progressively wetter soil, while flooded land and lakes appear in blue. The experimental technique cannot determine the depth of the water, so deep lakes and shallow puddles appear the same on the images. However, by combining images from several days, the scientists can discriminate between true flooding and temporary puddles that follow rain.

Because the satellite sensors have a resolution of 50 kilometers, they cannot distinguish individual rivers. They can, however, measure soil moisture in overcast conditions, because microwave radiation passes through clouds.

Achutuni and his co-workers are currently testing the technique to determine its accuracy. NOAA's Norman Grody says the system does best at sensing flooded regions, adding that it has a difficult time measuring soil wetness in land covered by crops or other vegetation.

Visible, UV-A light tied to skin cancer

Even with frequent applications of sunscreen, the millions of people now enjoying their summer outdoors may be putting themselves at increased risk of melanoma, the most serious skin cancer.

Some visible light, as well as a wide range of ultraviolet (UV) light, may fuel a series of changes in skin cells, leading to melanoma, says Richard B. Setlow, a biophysicist at Brookhaven National Laboratory in Upton, N.Y.

He and his colleagues use specially bred fish to study the effects of different types of light on cells that contain melanin, the skin pigment that colors moles brown. These studies have provided concrete evidence that not only UV-B – the rays with wavelengths between 280 and 320 nanometers that cause sunburn – but also light with longer wavelengths can induce cancer, says Setlow.

The fish are a cross between a swordtail and a hybrid of a swordtail and the platyfish, two popular tropical aquarium pets. When young, these heavily pigmented fish fit easily into the thimble-size glass tube of a spectrometer, which provides light of single wavelengths, and develop tumors after just one exposure to this light, Setlow explains. The pigment cells of the platyfish, like those of people, contain tumor-suppressing genes. Because the swordtail lacks such genes, some descendants of the cross possess just one tumor-suppressing gene and consequently less cancer protection.

Scientists have linked melanoma to damaged DNA because people who inherit a defect in their ability to repair DNA are more than 1,000 times more susceptible than others to this cancer. Many researchers had assumed that because DNA absorbs only UV-B energy, UV-B light caused the damage, says Setlow. Some suspected UV-A but lacked hard evidence of its role, he adds.

Then the Brookhaven group noticed that exposure to a wavelength of 365 nanometers – the UV-A used in black lights – resulted in tumors in 38 of the 85 fish tested. Furthermore, 30 of 124 fish not subjected to specific wavelengths but housed in a glass greenhouse as controls also developed melanoma, possibly due to sunlight, says Setlow.

Of 61 fish treated with violet light (405 nanometers), 18 developed melanoma. But only one of 20 control fish kept in subdued yellow light got cancer, they report in the July 15 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Setlow suggests that melanin absorbs light, which sets off a chemical reaction, producing compounds that then damage DNA. He urges that people protect themselves from all sunlight, something that sunscreens do not do. *– E. Pennisi*