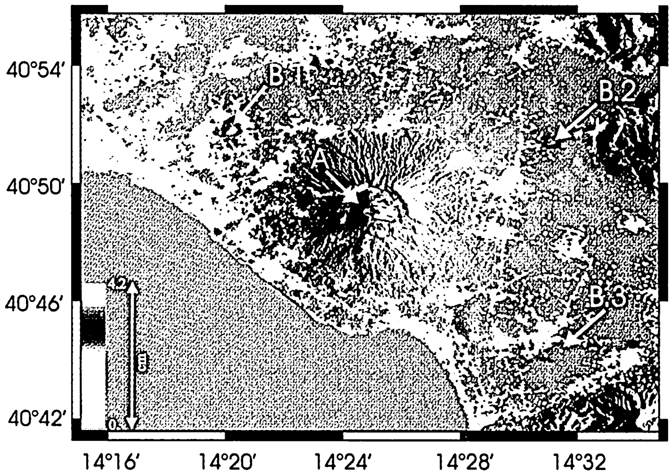

Sinking feeling. Areas of greatest subsidence are marked red.

Naples used radar interferometry to look for tiny ground deformations around the volcano. The European Space Agency's ERS-1 and ERS-2 satellites took radar images of the Vesuvius region repeatedly between 1992 and 2000. The images recorded microwaves that were emitted by the satellite and bounced back from the ground below. By comparing images taken at different times, researchers can spot small deformations in the level of the terrain.

For the current study, Lanari's team used newly developed software to detect minuscule deformations over shorter periods than previously possible. The team identified two key areas of subsidence, both of which are slumping by 3 to 8 millimeters per year. One is a ring circling the base of the volcano, whereas the other is within the central crater. "This is quite a spectacular image," says Steve Sparks of the University of Bristol, U.K.

Local researchers believe that the ring-shaped deformation is caused by the weight of the volcano on the underlying rock, the so-called carbonatic basement. The radar observations confirm earlier suggestions of this slumping using seismic tomography—bouncing sound waves off underlying rock. "We were able to see the spectacular effects of the volcano loading," says Giuseppe De Natale of the Vesuvius Observatory.

More intriguing is the subsidence in the central crater. Researchers had thought that the frequent minor tremors in the area—which seemed to come from directly below the crater—were due to molten magma welling up. But according to De Natale, the central subsidence confirms that a giant magma plug—a "high-rigidity anomaly" about 5 kilometers long—is sinking. The tremors are caused by the plug grinding against surrounding rock. Sparks thinks this makes sense. "It is sort of consistent with what people have been deducing from model experiments and theory," he says.

Although the technique is impressive, says Paul Lundgren, an earthquake and volcano specialist at NASA's Jet Propulsion Laboratory in Pasadena, California, more work is needed. The result "is not high enough above the noise that you get a really good crystal-clear picture of what is going on," he says. De Natale adds that radar and other geodesic methods may be useful for forecasting eruptions: Significant uplift could indicate that Vesuvius is waking from its sleep.

–ALEXANDER HELLEMANS

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ASTRONOMY

Pulsars Solve Mystery Of Missing Gas

By rights, clusters of stars should be swimming in gas. Stellar winds just like the solar wind blowing from our sun should fill the space between their stars. Yet decades of searches have failed to turn up interstellar gas in globular star clusters, and theorists have bent over backward to explain its absence.

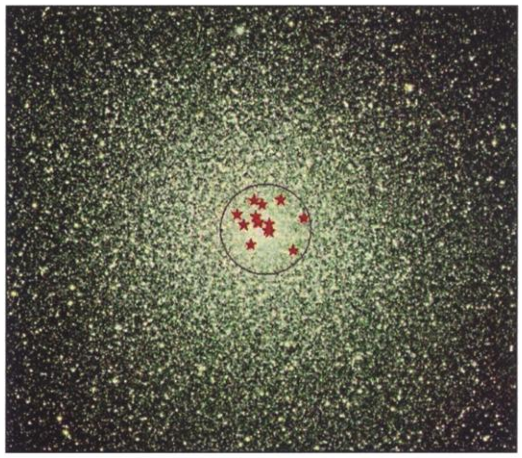
Now they can unbend. Meticulous observations using the 64-meter Parkes radio telescope in Australia have revealed that the globular cluster 47 Tucanae harbors about 100 times as much gas as its immediate surroundings. "It's a very nice discovery," says astrophysicist Frank Verbunt of Utrecht University in the Netherlands.

Globular clusters are spherical clumps of hundreds of thousands of old, low-mass stars, held together by the mutual pull of their gravity. To understand how such clusters evolve, astronomers want to know how much of the stellar wind escapes the cluster and how much remains trapped by gravity. "If the stellar wind velocity is larger than some 50 kilometers per second, the gas will leave the cluster altogether," says Verbunt. Numerous searches for radiation coming from trapped gas, however, revealed nary a whiff, and some astronomers proposed that starlight had blown it all away. "It has been suggested that the energetic radiation of the large number of pulsars in 47 Tucanae would have rendered the cluster devoid of any gas," says Michael Kramer of the Jodrell Bank Observatory at the University of Manchester, U.K.

Kramer and an international team of astronomers led by Paulo Freire, also of Jodrell Bank, detected the gas by carefully observing 15-millisecond pulsars—very compact, rapidly spinning stars that emit bursts of radio waves with clockwork precision. As the pulsars orbit the cluster center, Kramer explains, gravitational acceleration minutely alters the pulse frequency. By monitoring such changes over a couple of years, the team determined whether each pulsar lay on the near side of the cluster center, where its acceleration points away from us, or on the far side, where it points toward us. "We didn't expect the data to be precise enough [to observe this effect]," says Kramer, "but it turned out we could track it."

Next, the astronomers observed the radio pulses at a variety of wavelengths and found that the radiation from the farside pulsars was affected by more interstellar gas than was the radiation from the nearside ones. From these differences, they calculated the density of the intracluster gas. "People have been looking for this gas for over 60 years," says Kramer. "Now we've found it." The team reported its discovery in the 10 October issue of *Astrophysical Journal Letters*.

There's not much gas there, however: about one-tenth of a solar mass, spread out over the central parts of the cluster. The next step for astronomers is to figure out why it is so thin. Did most of it escape as high-velocity solar wind, did pulsars blow it away, or was it stripped out when the cluster made one of its periodic passes through the dense central plane of the Milky Way? Verbunt plans to look for answers in another globular cluster using the Westerbork Synthesis Radio Telescope in the Netherlands.



Starry, starry night. Some of the pulsars used to find gas in 47 Tucanae.

–GOVERT SCHILLING

Govert Schilling is an astronomy writer in Utrecht, the Netherlands.

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