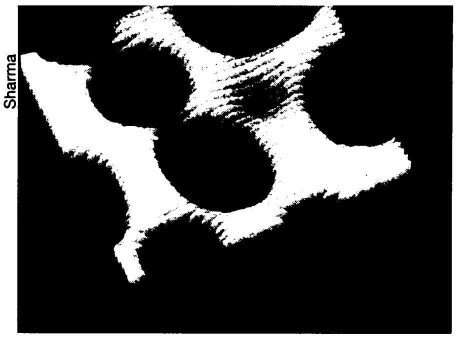
theories needed?

A new computer simulation, for example, predicts that the willy-nilly hole pattern expected from impurities could arise also from spinodal dewetting. Ashutosh Sharma and Rajesh Khanna of the Indian Institute of Technology in Kanpur discuss the simulation in the Oct. 19, 1998 PHYSICAL REVIEW LETTERS. Already, Herminghaus' group has independently noted in spinodal dewetting experiments a random hole pattern like that in the simulation, although they say this pattern is temporary.

"They don't have to invoke [defects in the film] to explain the holes. This is a sort of revelation," Karim says.

In the Oct. 30, 1998 SCIENCE, Herminghaus' team also describes a disintegration much like spinodal dewetting in liquid-crystal films. This disintegration, however, is modified by the strong tendency of the film's molecules to line up with each other. The molecular interaction forced the dewetting to penetrate only the top 12 nm of the film.

In a commentary in the same issue of SCIENCE, Reiter hailed Herminghaus' experimental foray into the more complex workings of dewetting as "a major achievement." Dewetting patterns may serve as a way to measure the strength and range of the intermolecular forces in liquid films for the first time, Reiter says.



Sharma

In a recent computer simulation of "spinodal dewetting," a thin film ruptures into a pattern of enclosed holes. In spinodal dewetting, waves that arise spontaneously in the film surface ultimately penetrate to the underlying substrate. Scientists previously thought that only dust or defects in the substrate caused this Swiss-cheese pattern.

In effect, dewetting patterns can act as a "thin-film force microscope," Sharma says. In a future issue of EUROPHYSICS LETTERS, he, Reiter, Khanna, and other researchers will report a study in which polymer films of different initial thicknesses dewet. By measuring aspects of the dewetting patterns—for instance, the number of droplets per square millimeter—the experimenters detected the signature of van der Waals forces.

While scientists struggle to define and understand spinodal dewetting, they also are looking for ways to do something practical with it. One of the phenomenon's attractions lies in the extraordinarily small size of droplets it generates. "There is hope that one can create patterns on substrates truly at the nanometer level," Karim says.

Controlled dewetting of magnetized films, for instance, might generate an orderly array of ultrasmall magnetic droplets, perhaps as data-storage elements. Reiter says he has been working on ways to control the patterns created by spinodal dewetting and has succeeded in transforming the typical jumbled patterns into something more orderly.

Most researchers say, however, that their immediate goal is a deeper understanding of dewetting. It may, in turn, allow a closer look at the intermolecular forces at work when films become beads. □

Astronomy

More evidence for a flat cosmos

According to inflation, a theory that seeks to explain the origin of structure in the universe, the cosmos underwent an episode of enormous expansion during the first fraction of a second of its existence. Like the surface of a balloon blown up to enormous proportions, any curvature to space-time was stretched out by the expansion (SN: 12/19&26/98, p. 392). In other words, the universe should be flat.

Astronomers have now found an additional hint that the universe indeed has zero curvature. The finding comes from studies of the cosmic microwave background, the whisper of radiation left over from the Big Bang.

Two telescopes at the South Pole have recorded variations in the intensity of the microwave background on different spatial scales. One instrument examined variations on scales of $^1/_4$ to $3^1/_2$ degrees, the other on scales of 1 to 10 degrees. Inflation predicts that the variations should be greatest in patches of the sky a half a degree across—the size of the full moon—and the combination of data from the two telescopes matches the predicted pattern.

One of the instruments, Python, recently ended its 5-year tour of duty. The other, Viper, began taking measurements last February, and researchers have now finished analyzing data taken during its first few weeks of operation, says Jeffrey B. Peterson of Carnegie Mellon University in Pittsburgh. The Python and Viper measurements "tie together beautifully," he says. Peterson and Kimberly A. Coble of the University of Chicago reported the findings last month in Paris at the Texas Symposium on Relativistic Astrophysics.

"While the data are consistent with a flat universe and inflation, I do not think that the data are strong enough to rule out alternative models," notes David N. Spergel of Princeton University. Over the next year or two, new ground-based and balloon experiments that will scan a larger area of the sky and explore a greater range of wavelengths "will [more] accurately measure the microwave background fluctuations," he says.

Spergel is working on the Microwave Anisotropy Probe, a NASA satellite set for launch in 2000. It "will make the definitive measurements of the background fluctuations," he says. *—R.C.*

Sun storm squeezes Earth's ionosphere

A spacecraft has found the first direct evidence that storms generated on the sun squeeze Earth's upper atmosphere, ejecting gases into space. A satellite called Polar found that the flow of ionized gas from Earth's poles increased dramatically just as a solar storm plowed into Earth on Sept. 24 and 25.

The storm originated on the sun as a magnetized cloud of ionized gas. A shock wave generated by the storm rammed into the magnetic shell that surrounds Earth, giving enough of a kick to gas trapped in the ionosphere, a layer of the upper atmosphere, to expel several hundred tons of gas, mainly oxygen.

Researchers already knew that hydrogen, helium, and oxygen ions from the ionosphere leak into space, but they had never correlated the flow with a solar storm. Trapped in the wake of the solar wind, most of the ejected gas eventually returns to Earth. The returning gas is accelerated and heated by the same processes that create Earth's radiation belts and spectacular auroras and helps supply the raw material for these displays.

Thomas E. Moore of NASA's Goddard Space Flight Center in Greenbelt, Md., reported the findings last month at a meeting of the American Geophysical Union in San Francisco.

Before Polar, astronomers had found it difficult to detect charged particles migrating from the ionosphere. The electrical charge that naturally builds up on the surface of spacecraft, due to ionizing radiation from the sun, interfered with observations. Polar's detectors use a plume of xenon ions and electrons to dispose of any charge that builds up, enabling the craft to track the flow of ions from the upper atmosphere. *—R.C.*