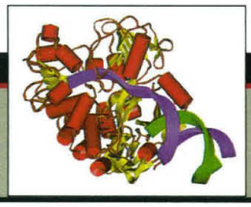
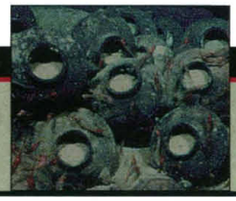




ASTROPHYSICS

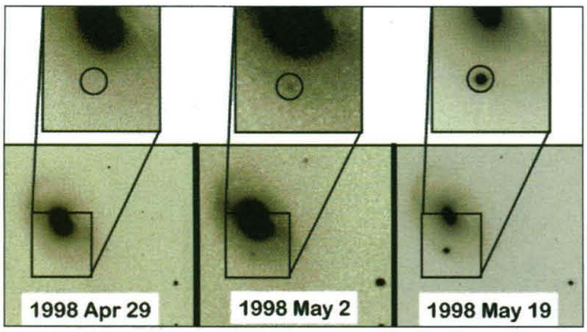
Has a Cosmic Standard Candle Flickered?

A team of astronomers says it has found slight, previously unnoticed variations among the exploding stars called type Ia supernovae. These explosions, thought to flare up to roughly the same brightness each time, have served the crucial role of cosmic "standard candles" whose apparent brightness, as seen from Earth, can serve as a measure of their distance. Unexplained variations in the explosions could, in theory, call into question the cosmic measurements based on them—among them the dramatic finding that the expansion rate of the universe is speeding up over time (see *Science*, 18 December 1998, p. 2156).

The discrepancies emerged when Adam Riess, Alexei Filippenko, and Weidong Li of the University of California, Berkeley, and Brian Schmidt of Mount Stromlo and Sidlished it. "I don't even know if [the difference] is going to hold water," says Berkeley astronomer Peter Nugent, a member of that team. And no one knows what, if anything, the difference in the supernovae's rise times might mean about their value as standard candles. "It's just an illustration that there is a bit more going on than in the simplest ... models," says Craig Wheeler, a theorist at the University of Texas, Austin.

Type Ia supernovae are prized as distance indicators not only because they seem to explode in nearly the same way each time, but also because astronomers can account for leftover brightness differences. Studies of supernovae at the same distance have shown that the rise and fall of brightness, which unfolds over several months, takes longer for slightly brighter explosions. But because the explosions are generally not spotted until they are well under way, astronomers had never examined in detail the interval between a supernova's appearance and its peak.

Now, Riess and his colleagues have filled that gap by drawing on a robotic telescope that Filippenko and others operate, as well as on observations by a team of supernova watchers at the Beijing Astronomical Observatory and by amateurs. Indeed, Riess says that Chuck Faranda, an amateur astronomer from Florida, spotted the freshest explosion using an electronic camera hooked to a small telescope in his back yard (see illustration). The Supernova Cosmology Project, whose analysis was led by Berkeley's Gerson Goldhaber, relied on surveys of many galaxies to spot large numbers of distant supernovae, catching some of them early in their history.



Slower burn. An amateur astronomer captured supernova 1998bu on 2 May 1998, 18.5 days before its peak brightness.

CREDIT: ADAM RIESS

ing Spring Observatory in Australia looked closely at the early phase of 10 nearby type Ia explosions. The team found that the time it took the explosions to reach their peak brightness was more than 2 days longer than the average for supernovae billions of light-years away as measured by a second group. "They're pretty strongly discrepant with one another," says Riess of the two data sets. "If it's true, it's extremely interesting," says Eddie Baron, an astrophysicist at the University of Oklahoma, Norman, who saw Riess's presentation at a workshop in Aspen, Colorado, on 17 June.

Astronomers on the Supernova Cosmology Project, the team that studied the distant supernovae, emphasize that they have not completed their own analysis, let alone pub-

The difference between the two sets of measurements, if it is meaningful, might ultimately provide a new "calibration" to correct for residual brightness differences. In the meantime, however, the possibility that distant supernovae are intrinsically different from nearby ones could raise questions about the most celebrated use of type Ia supernovae: studies of how the expansion rate of the universe has changed over time. Last year, the Supernova Cosmology Project and another group, called the High-z Supernova Search Team (of which Riess, Filippenko, and Schmidt are members), found that distant type Ia's were unexpectedly dim. Providing the explosions are truly standard, the dimness implies unexpectedly great distances caused by an acceleration of the expansion over billions of years. Despite the astronomers' best efforts, they have found nothing to challenge the conclusion until now.

"We're in a very early state," says Saul Perlmutter of Berkeley, leader of the Supernova Cosmology Project. "There is so much uncertainty regarding this result that I don't either believe or disbelieve it," adds Philip Pinto, an astrophysicist at the University of Arizona, Tucson, who also heard Riess's talk. But Pinto is pleased that astronomers are examining type Ia's from every possible angle in order to test their performance as standard candles. Says Pinto, "That's science working as it should." **–JAMES GLANZ**

MICROFABRICATION

Rubber Mold Carves a Path to Micromachines

Photolithography, the chemical printing process used to make the circuits of computer chips, has allowed manufacturers to shrink their devices to almost unimaginably small sizes. But while the process can easily handle the two-dimensional structures in an electronic circuit, it has much more difficulty with 3D structures like cavities and microchannels, the sort of things required by the new generation of micromechanical devices, such as transducers that capture sound waves, as well as miniature chemical plants and "labs-on-a-chip." Now, a team of researchers at Harvard University in Cambridge, Massachusetts, reports on page 83 that it has developed a technique for fashioning microstructures in 3D with the help of liquids passing through a network of channels, exploiting the flow patterns to deposit or etch away structures in layers of metals or other substrates, including crystals, ceramics, or organic polymers.

Photolithography makes poor 3D structures because it builds up many thin layers one at a time through a complicated process of shining light through a mask onto a photosensitive chemical on the surface, dissolving the light-exposed regions so that a pattern of bare surface is revealed, and then etching away or chemically treating the bare surface. This process can be repeated many