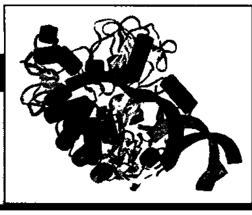
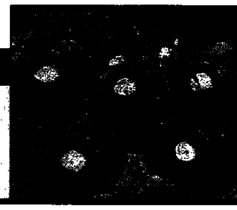


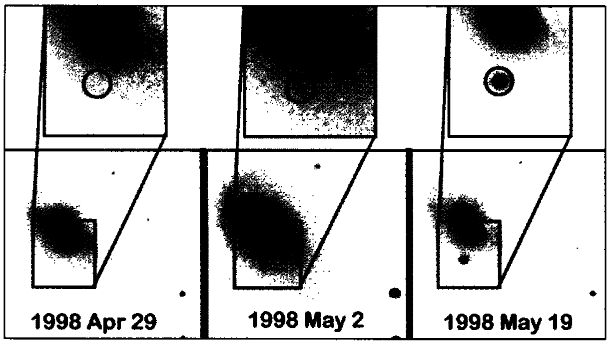


ASTROPHYSICS

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 Siding 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.



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

CREDIT: ADAM RIESS

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

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 times to build up devices, but creating fully 3D structures demands extremely precise alignment of the masks. The Harvard team, led by materials scientist George Whitesides, does away with the need for masks and alignment by defining the shape of the structures with a pattern of capillary channels pressed onto the surface.

The key to the technique is polydimethylsiloxane—otherwise known as silicone rubber. "The big advantage of that polymer is that it will come into tight contact with most surfaces," says team member Rustem Ismagilov. He and his colleagues create patterns of grooves in the surface of the silicone rubber by polymerizing the rubber sheet on a master with ridges on its surface, similar to the way vinyl records are made. Then they press the rubber sheet onto the flat substrate to create closed capillary channels. By passing different chemicals through these capillaries, the researchers can etch away the surface of the substrate or deposit material onto it, following the pattern marked out in the silicone rubber.

The researchers found that they could also deposit material at specific points within a capillary, creating features as small as 3 micrometers, which Ismagilov says does not compare badly with the 0.1 micrometer now possible with photolithography. They relied on laminar flow, a turbulence-free state that develops in fluids under certain conditions. "At the sizes of capillaries we have, it is almost impossible to create a flow that is not laminar," says Ismagilov. As a proof of principle, the researchers exploited laminar flow to deposit silver not across the whole width of the capillary, but just in a narrow strip down the middle.

They introduced the two components of a commercial silver plating solution as two parallel flows in a zigzag-shaped capillary. Because there was no turbulence, the two solutions flowed side-by-side without mixing. They reacted only at their interface, depositing a thin silver thread on the bottom of the capillary. The team went on to use the technique to create a three-electrode microelectrochemical detector inside a capillary: First, they deposited a gold strip on a surface, then etched away a stripe down the middle of it to form two electrodes, and, finally, deposited a silver reference electrode in between the two gold electrodes. Whitesides now has his sights set on making several other types of devices, such as very small detectors and light sources. "I'm hopeful that we can get these systems to lase," he says.

Marc Madou, a microfabrication researcher at the Ohio State University in Columbus, calls the technique "elegant." Both he and Whitesides agree that the technique does not have a great future in high-volume manufacturing because it requires intensive monitoring, for example, of the flows in the capillaries. But, Madou says, it is a "good laboratory tool" for making small experimental devices used in a wide range of research fields, including chemical and biochemical analysis and electrochemistry.

—ALEXANDER HELLEMANS

Alexander Hellemans is a writer in Naples, Italy.

CREDIT: (TOP) DELILAH R. COHN/CUSTOM MEDICAL STOCK PHOTO

HUMAN GENOME

A Good SNP May Be Hard to Find

Over the past 2 years, academic and corporate labs alike have been swept up in a human DNA gold rush. They have eagerly mined the human genome for minute differences between individuals, hoping to use the information to analyze common diseases and create powerful, custom-made drugs. The target: single-base variations in DNA—or single-nucleotide polymorphisms (SNPs)—that occur about once in every 1000 bases of the 3 billion bases in the human genome. Many researchers hope that random collections of these mutations will yield a shortcut to identifying the genes underlying such major diseases as asthma or cancer. But now, findings by a couple of major labs in this field suggest that the payoff of this strategy will not come any time soon, because the most common type of SNPs may not be the most informative.

This cool appraisal comes from two leading teams in SNP research, one headed by human geneticist Aravinda Chakravarti of Case Western Reserve University in Cleveland, Ohio, and the other by Eric Lander, director of the genome center at the Whitehead Institute for Biomedical Research in Cambridge, Massachusetts. Both groups published reports in the July issue of *Nature Genetics* based on SNP collections they gathered from about 200 different human genes. Their analyses suggest that a popular approach to SNP hunting—comparing entire genomes of just a few individuals to

SNP collector. Chakravarti's group learned that protein-altering SNPs are extremely rare.

ScienceScope

Ethically Acceptable? A presidential ethics panel is ready to endorse a tolerant federal policy on the use of human cells extracted from an embryo (below) or aborted fetus. This week, the National Bioethics Advisory Commission (NBAC) tentatively approved a draft report urging the government to permit both the use of embryonic stem cells and a controversial harvesting technique.

Stem cells are prized because they could be coaxed to develop into almost any body tissue. But Congress has banned federal funding of embryo-harming research due to moral concerns, though the National Institutes of Health interprets the law to mean that grantees may use stem cells from fetuses, or if someone else extracts them from embryos.

NBAC's draft says it should be "ethically acceptable" to use such cells, and to cultivate them from unused "embryos remaining after infertility treatments." Whether Congress will go along with that advice, however, isn't clear.

Property Rights Play Responding to concerns that it's slowing the flow of discoveries to market, the Japanese government may surrender claims to inventions produced by publicly funded research. Proponents hope rules similar to the 1980 U.S. Bayh-Dole law—which surrendered government rights to taxpayer-supported work—will energize Japan's computer and biotech industries.

Japan already gives academic researchers rights to work done under standard grant schemes. But the government still holds varying claims to discoveries made under some major R&D programs, including those run by the Ministry of International Trade and Industry (MITI). Those rights "should be given to the private sector," says Osamu Chisaki, executive director of the Japan Bioindustry Association, which last week pushed the government to relinquish all rights.

MITI officials like the idea and say they will deliver to the Diet a bill seeking to amend relevant laws. But they are still deciding how far it will go.

Contributors: Eliot Marshall and Dennis Normile