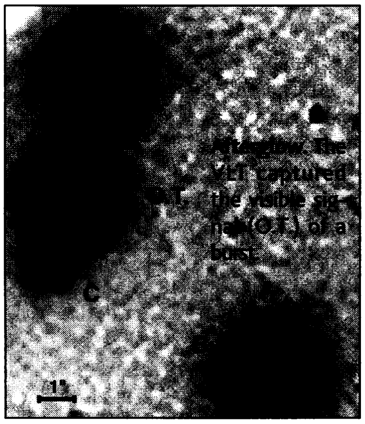
Shaw, "We're only beginning to understand the relationship between soil characteristics and weeds." Once agricultural researchers learn more, dandelions may not be the only weeds subject to this subtle kind of control.

–ANNE SIMON MOFFAT

ASTRONOMY

Giant New Telescope Bags Gamma Ray Burst

Early last week, another of the remote, powerful explosions called gamma ray bursts flared in the southern sky, in full view of the Southern Hemisphere's largest telescope, the new Very Large Telescope (VLT) in Chile. As it faded, the burst's visible afterglow provided what may be the strongest support yet for a budding theory that these mysterious blasts emit radiation in two opposing beams, which makes them visible at great distances when one of the beams happens to be directed at Earth.



Afterglow. The VLT captured the visible signal (O.T.) of a burst.

The first glimpse of the burst, now named GRB990510, came from two satellites, NASA's Compton Gamma Ray Observatory and the Italian-Dutch satellite BeppoSAX, which caught a bright flash of gamma rays on Monday, 10 May, about 08.49 universal time. Simultaneous x-ray observations by BeppoSAX pinpointed the sky position of the burst near the celestial south pole, and within 10 hours, astronomers had spotted a relatively bright but fading optical counterpart with the 1-meter Sutherland telescope at the South African Astronomical Observatory.

In the past, astronomers have relied on the 10-meter Keck telescope on Mauna Kea, Hawaii, to analyze such afterglows for clues to the distance of the burst. This one was located too far south to be seen from Hawaii. But astronomers can now get a comparable view of bursts in the southern sky with the VLT, commissioned just this spring. Titus Galama and Paul Vreeswijk of the University of Amsterdam, who are coordinating the follow-up observations of the burst, used Antu, the first of the VLT's four 8.2-meter telescopes, to collect a spectrum of the afterglow. The spectral lines had a redshift—a displacement caused by the expansion of the universe—of 1.61, implying that the burst took place more than halfway across the universe.

Theorists believe that gamma ray bursts signal stellar cataclysms—the collapse of a giant star or the collision of a pair of neutron stars. Even so, their brightness at great distances has been a puzzle. The latest burst provides a clue, say astronomer Shrinivas Kulkarni and his colleagues at the California Institute of Technology in Pasadena. A day and a half after the burst, data from a 1.25-meter telescope at Mount Stromlo Observatory in New South Wales, Australia, showed that the visible light from the afterglow started to decrease more rapidly than before—a break that happened simultaneously at different wavelengths, Kulkarni says.

"That's what you expect when a jet [of particles] moving toward you with almost the speed of light is slowing down," Kulkarni says. Such a jet would channel radiation straight down its axis, producing a searchlight beam visible at enormous distances. Although another burst earlier this year had shown similar behavior (*Science*, 26 March, p. 2003), he says, "this burst shows even better evidence for beaming."

–GOVERT SCHILLING

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

CREDIT: NASA/BEPPOSAX

SOLID-STATE PHYSICS

Picking Up Bits of the Electron's Charge

Although every science student is taught that the fundamental, indivisible unit of charge is that of the electron, physicists are now busying themselves collecting even smaller bits of charge. Two years ago, teams in France and Israel both found that in layers of electrons exposed to high magnetic fields at low temperatures, charge could shatter into "quasi-particles" that had one-third the fundamental charge. In this week's issue of *Nature*, the Israeli team announces it has now spotted one-fifth–charge quasi-particles.

The new results provide further confirmation for the theory put forward in 1983 by Robert Laughlin of Stanford University to explain the fractional quantum Hall effect, a phenomenon in which the tiny units of the quantum world have large-scale effects. Although the theory is widely accepted and Laughlin shared the 1998 Nobel Prize in physics for it, some physicists were not entirely comfortable until a fractional charge was positively identified. Says Laughlin, "I'm very happy" about the new results, "but I am not surprised."

The Hall effect, known since 1879, describes how applying a magnetic field perpendicular to a current-carrying wire creates a voltage across the wire's width, because the field causes the electrons to bunch up on one side. In the 1980s, physicists discovered that when electrons are trapped in a thin layer between two semiconductors at low temperature and high magnetic fields, the Hall voltage across the conductor increases in discrete steps rather than continuously. The size of the steps reflects the discrete charge of the electron or integer multiples of it. But to their surprise, physicists also discovered steps that could only be explained by fractions—or multiples of fractions—of that charge, 1/3, 2/3, 2/5, and 3/7.

To explain those fractional charges, Laughlin proposed that quasi-particles form in the electron layer when the electrons team up with magnetic vortices, tiny whirlpools of magnetism. In very simple terms, the vortices bound to an electron repel other nearby electrons and in effect "shield" part of their electron's charge. This has the effect of making the quasi-particle appear to have only a fraction of the electron's charge. Quasi-particles made up of an electron bound to two vortices would give rise to fractional charges of one-third; and at slightly lower magnetic fields, even smaller fractional charges could appear.

In September 1997, two groups, one led by Mordehai Heiblum at the Weizmann Institute of Science in Rehovot, Israel, and the other led by D. Christian Glattli of France's Atomic Energy Commission in Saclay, announced that they had found direct proof of the existence of one-third fractional charges in a quantum Hall setup (*Science*, 19 September 1997, p. 1766). Now the same team at the Weizmann Institute has refined its technique and spotted the more elusive one-fifth–charge quasi-particles.

To sieve these quasi-particles from the electron layer, they directed the charges toward a very narrow channel. The channel allowed the one-third–charge quasi-particles through, while reflecting a small number of one-fifth–charge particles back. The researchers then detected the reflected quasi-particles and their charges by the impulses they create in a very low noise amplifier. Because the signal generated by the one-fifth–charge quasi-particles is much weaker than that of the one-third charges, the team had to improve its amplifier. "We had to build amplifiers that work at the quantum limit," says Heiblum.

Laughlin is convinced that with further progress in measuring technology, even smaller charge fractions may soon be discovered. "All of these other fractions are just born out of the first one," he says.

–ALEXANDER HELLEMANS

Alexander Hellemans is a writer in Naples, Italy.