cilities are rare, it is the only way they can conduct their research. And for many, it provides valuable early career experience. An EU study carried out last spring found that more than half of LSF-supported researchers are aged 35 or younger, and two-thirds are first-time users of the facility concerned.

Lorella Franzoni, an Italian biophysicist from the University of Parma, is a typical beneficiary. She investigated the structure of proteins at a powerful nuclear magnetic resonance (NMR) spectrometer at Frankfurt University in Germany. "When I arrived here, I was new to the field of multidimensional heteronuclear NMR of proteins," Franzoni says. "I consider myself very lucky to have benefited from the EU funding. It is also fortunate for the group in Parma, because I will transfer that knowledge." Cortina-Gil also hopes to spread her newfound skills back in her homeland. When her position at GSI expires at the end of this year, she hopes to secure an academic position in Spain. But, she adds, "to continue my research I will have to keep contact with my former collaborators at GANIL and GSI, because I have no facilities to do my experimental work in Spain."

–SABINE STEGHAUS-KOVAC

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ASTRONOMY

Watching the Universe's Second Biggest Bang

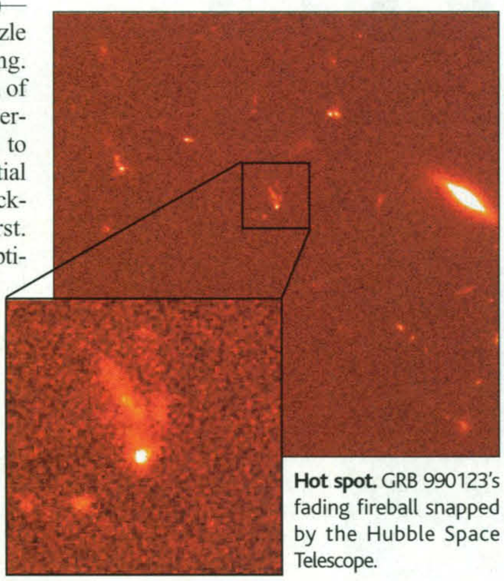
On 23 January, astronomers witnessed a cataclysmic event in a distant galaxy. The observations hold many lessons about the mysterious nature of gamma ray bursts

It happened long, long ago, in a galaxy far, far away: the most violent event ever observed in the universe. For billions of years, the aftershock of that event—a titanic flash of high-energy radiation—has hurtled through space at the speed of light. It swept past Earth 2 months ago, in the early morning of Saturday, 23 January. Astronomers specializing in gamma ray bursts (GRBs)—high-energy flashes that have been a puzzle for decades—were watching and waiting. And thanks to a sophisticated alert system of orbiting telescopes and Earth-bound observatories across the globe, they were able to catch the whole light show: from the initial gamma flash through to radio waves crackling days later from the site of the burst. They also caught, for the first time, an optical flash simultaneous with the initial gamma ray burst.

Its power and visible-light display have now made the modestly named GRB 990123 an astrophysical celebrity, the subject of no fewer than six papers in today's *Science* and next week's *Nature*. "It's a great discovery," says Martin Rees of Cambridge University, a leading GRB theorist. "This is the very first time that optical emission has been observed during the burst itself," adds Titus Galama of the University of Amsterdam. In the case of GRB 990123, despite the enormous distance of the source, the optical flash was bright enough to be easily visible with an amateur telescope or even binoculars.

The observations combine to give a complete portrait of GRB 990123, which is yielding new clues to the nature of the cataclysmic events that give rise to these flashes. In the *Science* and *Nature* papers, along with others posted on the Internet, researchers describe what they have learned so far, including the tantalizing suggestion that GRBs may appear so powerful because their energy is focused into narrow beams that we only see when they are pointing more or less in our direction.

Gamma bursts themselves cannot be detected from the ground because of atmospheric absorption. They were first spotted in the 1970s by U.S. military satellites, which were looking for gamma rays from Soviet nuclear explosions. A systematic hunt for them began in 1991, when NASA's Compton Gamma Ray Observatory (CGRO) was launched and began detecting GRBs at a rate of about one per day. Even then their origin remained mysterious because gamma ray detectors have very low positional accuracy and the bursts fade very fast. That changed in 1996 with the launch of the Italian-Dutch satellite BeppoSAX, equipped with wide-field x-ray cameras that can pinpoint the position of certain bursts. Astronomers set up an alert system so that ground-based observers could quickly point their instruments at each burst. Soon they were picking up x-ray, optical, and radio afterglows of the bursts—data that eventually made it clear that GRBs originate in very distant galaxies.



Hot spot. GRB 990123's fading fireball snapped by the Hubble Space Telescope.

CREDITS: ANDREW FRUCHTER/STScI AND NASA

By this time, theorists had built up a picture in which GRBs result from the collision of two high-density neutron stars or from a "hypernova"—the total collapse of a very massive star. Both kinds of events would form a central black hole and eject matter at close to the speed of light. This matter would collide with the surrounding interstellar gas, creating shock waves that travel both inward through the ejecta and outward into the interstellar medium, heating it into a fireball that would expand and cool to create a lingering afterglow.

GRB 990123 hit the astronomical headlines because for the first time the alert system acted fast enough to capture an optical flash as well as a gamma ray one. Once the gamma ray burst triggered detectors on BeppoSAX and CGRO, they dispatched a message to the Robotic Optical Transient Search Experiment (ROTSE), an automated camera at Los Alamos National Laboratory in New Mexico, which within 10 seconds started snapping pictures of the constellation Bootes. Just 22 seconds after the initial flash, it captured an image of the optical burst.

In an article in next week's *Nature*, Galama and his colleagues combine observations of the flash with data from other wavelengths—gamma, x-ray, infrared, submillimeter, and millimeter—to conclude that they are seeing the effects of three kinds of shock waves within the fireball. "The initial gamma ray burst is believed to be caused by internal shocks in the ejecta," says Galama. "The optical flash recorded during the burst is probably due to the short-lived reverse shock, while the afterglow arises from the forward shock."

But although the popular fireball model for the afterglows of GRBs is supported by the new observations, the tremendous energy release of GRB 990123 is a real puzzle. On page 2075, Michael Andersen of the Nordic Optical Telescope on La Palma in the Canary Islands describes his team's analysis of the spectrum of the optical component of the afterglow.

Their results, which a team at the Keck II telescope on Mauna Kea, Hawaii, has confirmed, indicate that the source had a redshift (a cosmological measure of distance) of at least 1.6—equivalent to a distance of several billion light-years. Hubble Space Telescope observations made on 8 and 9 February picked out the actual explosion site: the outskirts of a very distant irregular star-forming galaxy.

Such a distant source makes GRB 990123 the most luminous gamma ray burst seen so far, putting the energy of the explosion that created it second only to the big bang itself. Assuming that the explosion did burst with equal intensity in all directions, it must have generated a colossal 3.4×10^{54} ergs—the energy you would get if you took two stars the size of the sun and converted all of their mass instantaneously into energy. In visible light alone, the burst shone as bright as a million normal galaxies.

Theorists are at a loss to explain this prodigious output. Originally, some suggested that a concentration of mass somewhere between Earth and the source might have acted as a gravitational lens, brightening the burst (*Science*, 29 January, p. 616). Now, astronomers invoke beaming: If the blast preferentially emitted gamma rays in two opposite directions, and we happen to look down one of the two jets, less energy could account for the observed luminosity.

In another article in next week's *Nature*, Shrinivas Kulkarni of the California Institute of Technology in Pasadena and his colleagues claim that they see evidence for beaming in their multiwavelength studies of the afterglow of GRB 990123: About 2 days after the burst, the afterglow started to fade faster than before. This "break" in the light curve, which is also seen by Alberto Castro-Tirado of the National Institute of Aerospace Technology in Madrid and collaborators (p. 2069), is what you would expect when a relativistic jet points more or less in your direction and, once it has cooled a certain amount, suddenly starts to expand sideways, increasing the cooling rate.

Although theorists say this doesn't yet amount to a smoking gun, other hints of beaming have turned up. A group led by Jens Hjorth of the University of Copenhagen studied the polarization of the afterglow—a signature of magnetic fields at the light's source—with the Nordic Optical Telescope (p. 2073) and, to their surprise, didn't find any polarization at all. "This could mean that the field is tangled," he says, or it could mean that the field is coherent but the burst is strongly beamed, pointing exactly toward us.

Some theorists are now coming up with explosion mechanisms that would naturally produce beams of radiation—emerging, for example, from the poles of a spinning black hole (see story, p. 1993). But others are withholding judgment. "The theoretical evidence for beaming is quite compelling," says Rees, "but the observational evidence isn't very strong yet." Another titanic burst, and another haul of data, may change that.

–GOVERT SCHILLING

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HUMAN EVOLUTION

Did Cooked Tubers Spur the Evolution of Big Brains?

A controversial new theory suggests that cooking—in particular, cooking tubers—sparked a crucial turning point in human evolution

Potatoes, turnips, cassava, yams, rutabagas, kumara, manioc—these are just a few of dozens of underground tubers that sustain modern humans, who boil, bake, and fry them for lunch, dinner, and sometimes breakfast. Now, a small but enthusiastic band of anthropologists argues that these homely roots were also pivotal in human evolution. In work in press in *Current Anthropology*, Harvard anthropologist Richard Wrangham and his colleagues announce that tubers—and the ability to cook them—prompted the evolution of large brains, smaller teeth, modern limb proportions, and even male-female bonding.

Daily "bread." The diet of modern Africans includes a variety of nutritious tubers.

CREDIT: IRV DEVORE/ANTHRO-PHOTO

Already this work, which Wrangham has presented at meetings, has provoked skepticism, for it challenges the current dogma that meat-eating spurred the evolution of *Homo erectus*, the 1.8-million-year-old species whom some anthropologists say was the first to possess many humanlike traits. But the idea dovetails with another challenge to the primacy of meat-eating as an evolutionary force: the notion that gathering by females was crucial, which another team of anthropologists will present in the May issue of the *Journal of Human Evolution (JHE)*. And some researchers find the new perspective, based on a potpourri of data from both archaeology and modern human societies, quite refreshing. "Cooking as making such a difference is not something that I had previously considered," says Andrew Hill, a paleoanthropologist at Yale University. "It's nice to have this put forward."

But skeptics say there is a very good reason why this idea may be half-baked. If early humans did cook tubers, then they must have controlled fire about 1.8 million years ago—but the first clear evidence for hearths isn't until about 250,000 years ago. "The application of heat for food was a late thing," says C. Loring Brace, an anthropologist at the University of Michigan, Ann Arbor. "I think [Wrangham] is on the wrong track."

Invoking diet to explain the differences between *H. erectus* and earlier forms such as *H. habilis*, a species known only from fragmentary fossils, and our more apelike ancestors, the australopithecines, is nothing new. The size difference between males and females in *H. erectus* is narrower than it is in the australopithecines of half a million years earlier. And the brains of both sexes grew larger while their guts and teeth shrank; the most dramatic changes occurred between specimens assigned to early *Homo* species and those classed in *H. erectus*. "There's no other point [in time] when you get such large changes," says Wrangham.

The traditional dietary explanation, however, is a shift from nuts and berries to meat. Cut marks on animal bones suggest that humans had mastered meat-eating, perhaps by scavenging carcasses, by 1.8 million years ago. Many researchers have assumed that this high-quality food fueled the rise of *H. erectus*, enabling it to process food with smaller teeth and guts and nourishing larger brains and bodies. And with more food to go around, females began to catch up with males in size.

But Wrangham and his Harvard team think a range of evidence, from archaeology to studies of primates and modern human societies, argues against that scenario. They