which of several possible gene variants occurs on a given chromosome. The difficulty arises because each cell contains two copies of each chromosome, one from the mother and one from the father. At any location along the chromosome, geneticists can tell whether the two chromosome copies are identical—that is, whether they contain the same chemical letter—or different. But when the chromosomes differ—that is, contain a SNP—the researchers can't readily tell which letter belongs on which chromosome. And the exact spelling of each chromosome is essential information, because it may change a gene into a disease-causing form, says Housman.

Currently, explains Andrew Collins, a geneticist at Southampton University in the United Kingdom, researchers do family studies to look for disease genes. If they can't find suitable families, they look at the frequency with which different SNPs pop up in many individuals and then resort to statistical methods to infer the likely exact spelling of each chromosome. But this process is "prone to error," he says.

The nanotube-based AFM may change that by enabling researchers to forgo statistics and observe the SNPs on a chromosome directly. The researchers borrowed an idea from the standard sequencing method, which reveals the DNA's four chemical letters in living color by linking a different fluorescent dye molecule to each of them. But here, instead of using a fluorescent signal, the researchers added an oligonucleotide—a short strand of DNA designed to bind to a single complementary DNA fragment, in this case one surrounding a known SNP location. Each oligo was engineered to stick only when the SNP harbored a particular genetic letter—G, for example. To this oligo they hitched a reporter compound. As the AFM marched along the atomic hills and valleys of the DNA, when it hit the reporter compound the researchers knew they had found their G SNP. By adding several oligo-reporter combinations, then simply reading down a section of a gene of interest, they could readily decipher whether a series of SNPs of interest were present on the same chromosome. Says Collins: "That's a very useful thing to have."

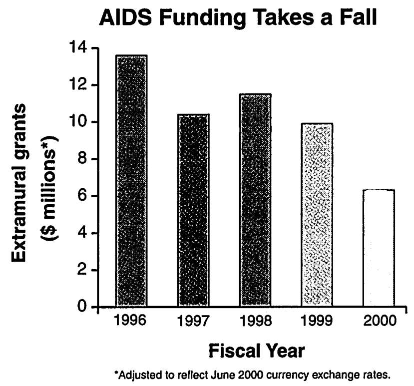
For now the Harvard researchers are looking at DNA strands around 1000 genetic letters long. That's on the short side for many geneticists trying to associate combinations of SNPs with disease. But Lieber says there's no reason the technique shouldn't work with sequences perhaps as long as 100,000 letters. Furthermore, by borrowing data-storage techniques, geneticists may be able to create arrays of hundreds of AFM tips working in parallel to carry out ultrafast haplotyping. If so, says Robert Waterston, a geneticist who heads the genome sequencing center at Washington University in St. Louis, Missouri, "[this] could be the start of something impressive."

–ROBERT F. SERVICE

AIDS RESEARCH

Italian Scientists Seek To Reverse Budget Cuts

PARIS—The closing session of the XIII International AIDS Conference in Durban, South Africa, next week will be a proud moment for Italy. That's when Italian researcher Stefano Vella becomes president of the International AIDS Society (IAS), which organizes these biennial conferences. But even as the Durban meeting highlights Italy's prominence in the AIDS community, the Italian government is gutting the country's national AIDS program.



Reduced effort. New cuts continue downward slide of AIDS funding.

The cuts, for the 2000 fiscal year beginning 1 July, mean a 36% reduction in funding for extramural grants from the current year. They continue a trend begun in 1997 (see chart). Italian AIDS researchers have known about the latest round of cuts for several months. But it is only after the appointment in late April of a cancer researcher, Umberto Veronesi, as Italy's new health minister and in the run-up to the Durban meeting that they have begun to speak out about their harmful effect.

"The national AIDS program is one of Italy's big success stories," says Vella, who directs the AIDS clinical research program at the Istituto Superiore de Sanità (ISS) in Rome, the agency that provides nearly all extramural funds for AIDS research. "We don't want everything we have accomplished to be lost." Their pleas have attracted international support. "Italian scientists are very important players in the global AIDS research effort," says Anthony Fauci, director of the U.S. National Institute of Allergy and Infectious Diseases in Bethesda, Maryland.

The 13-year-old Italian AIDS program first ran into trouble in 1997, when then–health minister Rosy Bindi froze AIDS funding for several months. The freeze was part of a government reordering of priorities that placed more emphasis on applied research (*Science*, 11 April 1997, p. 191). When the dust settled, the $13.6 million extramural program had been reduced to just over $10 million. And the decline has continued: The proposed budget for 2000–01 is only $6.3 million. "This will have a major impact," says AIDS researcher Guido Poli of the San Raffaele Scientific Institute in Milan, who depends on ISS grants for about 80% of his lab's funding. "I will have to severely reduce many of my current projects, and it will affect our ability to pay young researchers and to participate in meetings."

Italian AIDS researchers are now hoping that Veronesi, who replaced Bindi when a new Italian government took office this spring (*Science*, 5 May, p. 791), will be more sympathetic to their cause. Now that Veronesi has had time to get settled into his job, Vella and his colleagues say they are hoping to meet with the minister to discuss how to reverse the funding cuts. Veronesi was unavailable for comment.

If the cuts are not restored, the election of an Italian as IAS president may turn out to be a hollow reward. Says Fauci: "If [Italian researchers] are unable to pursue their scientific activities at full speed because of a lack of resources, the entire global AIDS research effort will suffer."

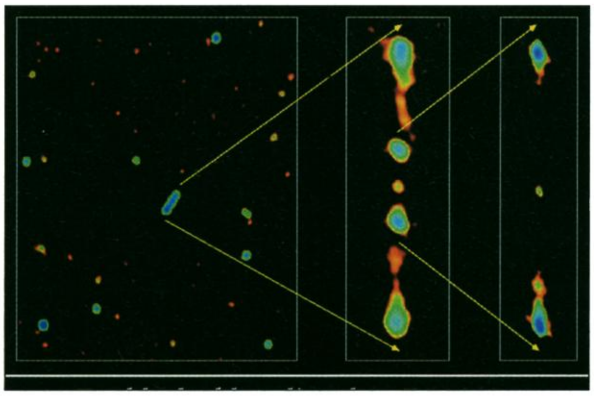
–MICHAEL BALTER

ASTRONOMY

Radio Galaxies Return From the Dead

Even for deep-space objects, radio galaxies are odd beasts—so odd that scientists have trouble explaining why they exist at all. Now astronomers in the Netherlands have deepened the mystery by discovering that some radio galaxies live twice.

The hallmark of a typical radio galaxy is a double blaze of radio energy, which erupts when thin jets of ionized matter shooting in opposite directions slam into intergalactic atoms at enormous speed, millions of light-years from the galactic core. The origin of the jets is still unknown. Most astronomers suspect that they stream from the poles of a whirling supermassive black hole, which sucks in nearby gases and spews part of them out again as plasma. But just how the black hole's engine



Born again. Radio galaxy B1834+620 shows an outer pair of lobes—evidence of an earlier incarnation.

works is anybody's guess.

The plot thickened when Arno Schoenmakers of the Netherlands Foundation for Research in Astronomy in Dwingeloo and colleagues found evidence that the jetmaking machinery can shut down and fire itself up again after millions of years. In the 21 June issue of the *Monthly Notices of the Royal Astronomical Society*, they report finding what they call double-double radio galaxies—classic double-lobed galaxies sporting a second, older pair of radio lobes much farther out than the first.

"Apparently, it's a very rare phenomenon," Schoenmakers says. So far, he and his colleagues have turned up just eight examples: three in a large radio survey of the northern sky, carried out with the Westerbork Synthesis Radio Telescope in the Netherlands, and five others in the astronomical literature. All are enormous, with outer lobes stretching 2.5 million to 8 million light-years apart—dozens of times the diameter of our Milky Way. By studying the energy distribution of the radio waves (higher energies fade faster than lower energies), the astronomers estimate that the outer lobes are 100 million years old, give or take a factor of 2 or so. There is no trace of a jet between the older and younger lobes; evidently the polar geysers stayed dormant for millions of years before erupting again.

What could give jets a new lease on life? Without a good theory of how jets form in the first place, astronomers can only speculate. According to David Merritt of Rutgers University in Piscataway, New Jersey, the jump-start might occur when two galaxies collide. "A merger could be responsible for the second jet," he says, "since mergers tend to bring gas into the center where they can fuel the 'engine' that drives the jet."

But Schoenmakers thinks that scenario is unlikely. Because mergers can occur at any time in a galaxy's history, he says, at least some merger-driven double-doubles would be expected to be smaller and younger than the lobes he observes. "There seems to be a relation with age," he says. "Something happens to the core when it has been active for a very long time."

Schoenmakers's favorite theory is that the central black hole is running out of fuel. Perhaps, after pulling a steady stream of gas into itself for millions of years, the black hole simply starts to exhaust the supply. "It's like your car is running out of gas," he says, "and the engine starts to sputter." If so, the radio galaxy's reincarnation may be a temporary hiccup before a final death.

If the sputtering model is correct, the depths of space might hold radio galaxies with three sets of radio lobes—triple-doubles. "That would be a major discovery," Schoenmakers says.

–GOVERT SCHILLING

ASTRONOMY

Neighborhood Gamma Ray Burst Boosts Theory

Titanic explosions that emit powerful flashes of energetic gamma rays are one of astronomy's hottest mysteries. Now an analysis of the nearest gamma ray burst yet detected has added weight to the popular theory that they are expelled during the death throes of supermassive stars.

Very large stars die spectacular deaths at a relatively young age. Some explode as brilliant supernovas; the most massive stars probably collapse into black holes. Computer simulations suggest that the birth of a black hole can be accompanied by the release of tremendous amounts of energy, so these "collapsars" are prime candidates for the source of gamma ray bursts. If so, the bursts should occur in star-forming regions, as massive stars die before they are able to escape from their cosmic cradle. Unfortunately, most galaxies where gamma ray bursts originate are billions of light-years away, so even the keen-eyed Hubble Space Telescope can't tell if gamma ray bursts occur in star-forming regions.

On 25 April 1998, however, a relatively faint gamma ray burst was detected much closer to home—in a galaxy just 140 million light-years away. Moreover, the burst coincided with a supernova, suggesting a link between gamma ray bursts and the deaths of massive stars (*Science*, 19 June 1998, p. 1836). Stephen Holland of the Danish Center for Astrophysics with the Hubble Space Telescope in Aarhus and his colleagues observed the host galaxy of this gamma ray burst in June with the Hubble.

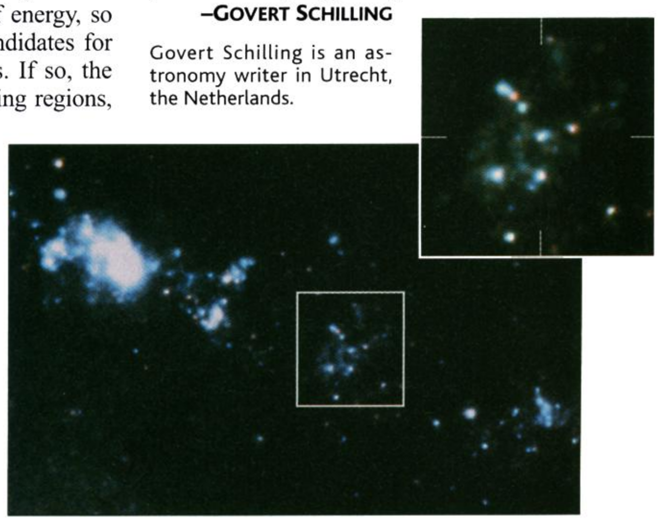
The Hubble images of the galaxy, known as ESO 184-G82, show that the burst indeed occurred in a giant star-forming region. According to Holland's team, which released the images on 27 June, part of the light at the exact burst position may be the fading glow of the supernova, but the surrounding bright objects are either young star clusters or very hot, massive stars.

The Hubble evidence would be even stronger, astronomers say, if the explosion in ESO 184-G82 weren't such a peculiar event. The supernova was much more powerful than average, but the gamma ray burst was only a fraction of a percent as intense as a normal burst. Team member Jens Hjorth of the University of Copenhagen in Denmark says he believes that "normal" gamma ray bursts also occur in star-forming regions. By analyzing light from the host galaxy of a more typical burst, which reached Earth on 23 January 1999, Hjorth and colleagues found evidence of knotlike structures that look like star-forming regions. But that galaxy was billions of light-years away—too far to get direct evidence of what lay inside it.

Titus Galama of the California Institute of Technology in Pasadena, who in 1998 discovered the supernova that accompanied the gamma ray burst of 25 April, says the Hubble observations are "not surprising. This is where you expect [gamma ray bursts] to occur." Hjorth agrees. "But we've had so many surprises in this field," he says, "that it's good to see that something we expect is actually happening."

–GOVERT SCHILLING

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



Rocking the cradle. Gamma ray burst in galaxy ESO 184-G2 took place in a region where stars are born.

CREDITS: (TOP TO BOTTOM) WSRT/ASTRON; ESA, S. HOLLAND, J. HJORTH, J. FYNBO