ment for close to 20 years."

It is a fact of life in quantum mechanics that an observation or measurement alters or destroys the object that is being observed. But theorists know it need not be so. In principle it should be possible to observe a quantum system without destroying it, and repeat the observation later and get the same result. Achieving nondemolition is extremely difficult, however, because of the fragile nature of quantum states. Over the past decade or so, several teams have managed it using interferometry, a technique that involves blending two light waves in such a way that minute changes in either of the two beams modify the recombined beam. Such a setup can reveal the impact of a "signal" light beam that disturbs the path of one of the other two beams before they are combined. The signal beam continues unperturbed, but the imprint of its passing is recorded in the altered interference pattern.

> **"They have implemented one of the goals ... which has defined the field of quantum measurement for close to 20 years."**
>
> **—Wojciech Zurek**

This technique requires bright light beams. The ENS researchers wanted to see if they could achieve nondemolition with a single photon, much too feeble to disturb the path of a detection beam. Instead, they harnessed the sensitive quantum energy ladder of electrons around an atom. The first step is to trap a photon. The researchers built an open-sided cavity 3 centimeters long and 5 centimeters in diameter bounded at either end with spherical niobium mirrors, which reflect photons of the correct microwave wavelength. Then they cooled the trap to 1 degree above absolute zero, still warm enough to guarantee a single thermally induced microwave photon bouncing between the mirrors.

To detect the photon, the researchers shot a rubidium atom through the cavity. But before they sent it on its journey, the atom was pumped up with energy, so that its outermost electrons were not in their lowest energy states but in orbits far from the nucleus, a state known as a Rydberg atom (*Science*, 19 July 1996, p. 307). In this long-lived, bloated state, the atom is very sensitive to microwaves, guaranteeing the strongest possible interaction with any microwave photons lurking in the cavity.

The aim was to use the swollen Rydberg atom as a detector to see if a photon is resident, and if it is to leave it pinging around within the cavity in its original state. The cavity is just the right size, and the atom's speed carefully set, so that during its passage through the cavity there is just enough time for the atom to absorb the photon and reemit it before the atom reemerges.

At first sight, the exiting atom appeared unchanged from when it entered. "So you have the feeling that nothing has happened," says Haroche. But the cycle of absorption and emission does leave an imprint on the atom wave by altering its phase: The exiting atom was now out of step with its state on entry into the cavity. A separate system compared the phases before and after, revealing a half-wave phase shift—the signature of a cavity that contains a single photon. The researchers found that sending a second atom through the cavity produced the same result. "It shows that the first atom has made a measurement and left the photon behind for the second atom to read it," says Haroche.

Other physicists have lauded the technical skills of the ENS team. "It's an amazingly complex experiment, and there are several pieces of it, each of which is an amazingly complex experiment alone," says Zurek. "They have thought up some neat tricks to solve the experimental difficulties they're faced with," adds Oxford University's Andrew Steane. "It's a piece of work which probably no one else in the world could have done."

–ANDREW WATSON

Andrew Watson is a science writer in Norwich, U.K.

EUROPEAN UNION

Belgian Socialist Tapped To Head EU Research

Philippe Busquin, a Belgian Socialist Party official with a background in physics, has been selected to become the European Union's (EU's) new chief research executive. Romano Prodi, the European Commission's incoming president, last week presented his new team of commissioners, with Busquin as his candidate for research commissioner. After holding hearings, the European Parliament is scheduled to vote on Prodi's new team by mid-September.

In his new job, Busquin will lead the EU's research directorate—known up to now as DG-XII—and administer the 4-year, $17 billion Fifth Framework research program. The portfolio had previously included education, but—contending that research and technology "represent a full portfolio"—Prodi

ScienceScope

Mouse House West A leading purveyor of lab mice is going coast to coast. The Jackson Laboratory of Bar Harbor, Maine, announced this week that it will open a West Coast outpost in cooperation with the University of California (UC), Davis, in a bid to make genetically customized mice more easily available to researchers across the western United States. The new $10.6 million center, to be housed in several refurbished buildings, will raise up to 30,000 specially bred mice a year. The lab already ships about 2 million mice annually from its Maine headquarters, which stocks over 2300 varieties. The strains include "models" for many human diseases, from epilepsy to cancer.

Researchers at the host campus are looking forward to the rodent invasion. The school's medical and veterinary programs "will be greatly enhanced" by the ready supply of research subjects, says Stephen Barthold, director of the UC Davis Center for Comparative Medicine. The first colonies are scheduled to arrive early next year, once renovations—including the creation of special disease-free nurseries and air-cleaning systems—are complete.

Genomics Boom? France is poised to give a major boost to genome research. Government officials are hoping to give the nation's $46 million genome program about a 50% raise next year and launch at least four new gene research centers, or "genopoles," to complement an existing facility in the Paris suburb of Evry. The draft 2000 budget plan also calls for creating consortia teaming government agencies with private companies, especially biotech start-ups, which could ultimately hike total genome research spending to $150 million a year.

Gene jockeys won't know how much cash they will get until this fall, when Parliament votes on the 2000 budget. Still, "there is a lot of potential" for growth, says molecular biologist Pierre Chambon, president of the genome program's scientific advisory council. "The question is whether it is going to be supported at a proper level."

Contributors: David Malakoff and Michael Balter

CREDIT: THE JACKSON LABORATORY

decided to marry education with culture and has put forward Viviane Reding, a former Luxembourg journalist, to head this new directorate. But Prodi plans to shift agricultural research into Busquin's directorate.

The new commission is being formed now because of the mass resignation last March of the previous incumbents in the wake of a scathing report by a European Parliament investigative panel that had alleged cronyism and mismanagement among Brussels officials, with Busquin's predecessor, Edith Cresson of France, one of the most heavily criticized (*Science*, 19 March, p.1827). Prodi called the new candidates "a top-quality team in which jobs have been allocated to match the proven abilities and experience of each commissioner." He said he would demand that the commissioners streamline the Brussels bureaucracy, live up to high ethical standards, and "give clear direction and leadership."

Busquin, 58, is known mainly as the leader of the Socialist Party in Belgium's French-speaking region. He received a physics degree from the Free University of Brussels in 1962 and was an assistant physics lecturer at the university's medical faculty from 1962 to 1977. He studied ecology and environmental issues at the Free University in 1976, and was chair of the board of directors of Belgium's Institute of Radioelements from 1978 to 1980. He entered local Belgian politics in 1977 and later held various national and regional ministerial posts until becoming vice president of the Socialist International, a federation of socialist parties, in 1992. He was elected as a member of the European Parliament last month.

–ROBERT KOENIG

HUMAN GENOME PROJECT

Commercial Firms Win U.S. Sequencing Funds

Several new groups are joining the government's human genome sequencing project this month, including—for the first time—two commercial firms. The National Human Genome Research Institute (NHGRI) in Bethesda, Maryland, quietly awarded three yearlong grants totaling $15 million on 1 July. The winners can expect to be funded for at least two additional years at the current rate, NHGRI notices say. The objective is to scale up production of human DNA sequence and help deliver a 90% complete "working draft" of the human genome for public release next spring and a 99.99% finished version by 2003. NHGRI turned down some academic centers while funding commercial outfits, indicating that it is serious about rewarding efficiency.

The latest grants raise the total NHGRI kitty for human genome sequencing to nearly $100 million per year through 2002. The principal investigators (PIs) leading the newly funded teams are Maynard Olson at the University of Washington, Seattle ($7 million per year); Douglas Smith, co-director of the sequencing center at Genome Therapeutics Corp. of Waltham, Massachusetts, the first commercial firm to take part ($5 million); and Ronald Davis of Stanford University ($3 million). According to documents released by NHGRI, Olson expects to sign a contract with another company, Incyte Pharmaceuticals Inc. of Palo Alto, California, for about $3 million worth of DNA sequencing per year. NHGRI plans to continue funding these teams through 2002.

The newcomers join university-based groups that won larger NHGRI grants in March, including the Whitehead Institute/MIT Sequencing Center in Cambridge, Massachusetts, Washington University in St. Louis, and the Baylor College of Medicine in Houston, Texas (*Science*, 19 March, p. 1822). They are part of an international network that includes the U.S. Department of Energy's Joint Genome Institute in Walnut Creek, California, and the nonprofit Sanger Centre in Hinxton, U.K.

Smith says his group will work closely with the Sanger Centre, focusing mainly on sequencing chromosome 10. The Stanford group, says Davis's colleague Nancy Feldspiel, will contribute some DNA data but, more significantly, develop robotic instruments to make genome work more efficient. Olson will supervise a consortium that includes sequencers at Incyte focusing on chromosome 7 and on automated methods of finishing. All members of this network, including the companies, agree to release raw DNA data on a daily basis, refrain from patenting raw data, and publish finished data within 6 months of "validation."

Geneticist David Cox of Stanford University, whose lab did not get funded in this competition, says: "I think it's a great idea that we're looking for the most efficient ways to get high-quality sequence data."

–ELIOT MARSHALL

NEW RECRUITS

Institution and PI	Award
University of Washington, Maynard Olson	$7 million*
Genome Therapeutics Corp., Douglas Smith	$5 million
Stanford University, Ronald Davis	$3 million

* About $3 million will be subcontracted to Incyte Pharmaceuticals Inc.

IMMUNOLOGY

Keeping Bone Marrow Grafts in Check

Cancer patients who have received aggressive chemo- or radiotherapies often need bone marrow transplants, because the treatments wipe out their immune systems as well as their tumors. But bone marrow transplants (BMTs) often come at a price. Because the donor and recipient tissues usually differ genetically, about two out of three patients develop graft versus host disease (GVHD), in which donor T cells turn against their new host and wreak havoc in organs such as the skin, liver, and the intestines. Fever, rashes, and diarrhea ensue, and in severe cases GVHD can be lethal, making it the primary cause of death after BMTs.

Early warning. Rashes caused by donor T cells attacking and destroying skin cells of bone marrow transplant recipients are an early symptom of GVHD.

To curb GVHD, clinicians either sift out all the T cells from the donor marrow or treat recipients with powerful immunosuppressive drugs. Both approaches leave patients extremely vulnerable to infections, however. A report on page 412 now suggests another, and perhaps less dire, strategy. A team led by immunologist Stephen Emerson of the University of Pennsylvania School of Medicine in Philadelphia has found that GVHD can be suppressed in mice by inactivating the recipients' antigen-presenting cells, or APCs. APCs display snippets of foreign proteins to T cells, sparking an immune response. Suppressing these cells blindfolds the donor T cells toward host cells, the team found. In contrast, the T cells should still be capable of responding to viruses or other pathogens presented by donor APCs from the transplants.

The study "offers a new approach to tackle a problem that has pestered us for the last 25 years from an entirely different angle," says bone marrow transplant specialist Joseph

SOURCE: (LEFT) NHGRI; PHOTO: (TOP) BIOPHOTO ASSOCIATES/PHOTO RESEARCHERS