than entirely homegrown," he says. "Now we know of extrasolar planets, of complex organic molecules in interstellar clouds, of micrometeorites depositing carbon on Earth, and of microbes living in extreme environments, and there is evidence of water on Mars and on Jupiter's moon, Europa."

The budding pan-European approach to exo/astrobiology builds on efforts in individual nations. In France, for example, the nation's space agency and CNRS in 1999 formed a federation of 50 exo/astrobiology labs that ended their isolation. Spain has gone a step further, in 1998 launching the $8.6 million Centre for Astrobiology in Madrid, and the Italian Space Agency, for the first time, will have a specific line for exo/astrobiology in its 2002 budget. (The amount is under discussion.)

But in spite of this apparent enthusiasm for exo/astrobiology, the prospects for Aurora are uncertain. ESA may have a hard time extracting the additional money from member states, which are already tightfisted when it comes to ESA's regular budget. "There are many difficulties to resolve at ministerial level," admits ESA's Schmitt, who told workshop participants that the agency is seeking the backing of the scientific community on Aurora—something that will be essential for making a strong case to the ministers this fall.

–HELEN GAVAGHAN

Helen Gavaghan writes from Hebden Bridge, U.K.

U.S. CONGRESS

## New Leaders Emerge After Senate Shake-Up

A political earthquake has U.S. science advocates scrambling to survey a dramatically altered Washington, D.C., landscape. With Republican Senator Jim Jeffords's (VT) announced defection from his party, control of the Senate will switch to the Democrats. That power shake-up, say science lobbyists, could affect both research budgets and science policy.

Last November's elections left the 100-member Senate balanced on a knife's edge, with both parties controlling 50 seats. Republicans had the upper hand, however, because Senate rules allow Vice President Dick Cheney to break any ties. As a result, Republicans claimed the body's top leadership posts and the right to control the legislative calendar, choose committee leaders, and determine the makeup of panels that negotiate differences with the House of Representatives. Now that Jeffords has become an Independent, Democrats will have sway over all those decisions. Senator Tom Daschle (D–SD) is expected to replace Trent Lott (R–MS) as majority leader as early as 5 June; committees will also get new chairs (see table).

**THE EXPECTED LINEUP**

| Committee | In | Out |
|---|---|---|
| | **Appropriations** | |
| Full committee | Robert Byrd (D–WV) | Ted Stevens (R–AK) |
| Labor-HHS panel | Tom Harkin (D–IA) | Arlen Specter (R–PA) |
| VA-HUD " | Barbara Mikulski (D–MD) | Kit Bond (R–MO) |
| Energy " | Harry Reid (D–NV) | Pete Domenici (R–NM) |
| Defense " | Daniel Inouye (D–HI) | Stevens |
| | **Authorization** | |
| Armed Services | Carl Levin (D–MI) | John Warner (R–VA) |
| Commerce & Science | Ernest Hollings (D–SC) | John McCain (R–AZ) |
| Science panel | John Breaux (D–LA) | George Allen (R–VA) |
| Energy | Jeff Bingaman (D–NM) | Frank Murkowski (R–AK) |
| Environment | Jim Jeffords (I–VT) | Bob Smith (R–NM) |
| Health and Education | Ted Kennedy (D–MA) | Jeffords |

In many cases, the key science spending panels are expected to stay the course. Senator Barbara Mikulski (D–MD), an ardent supporter of a bigger budget for the National Science Foundation (NSF), is expected to replace the equally enthusiastic Kit Bond (R–MO) on the panel that oversees NSF and NASA. Similarly, Senator Tom Harkin (D–IA), a leading voice for doubling the budget of the National Institutes of Health (NIH), is in line to succeed fellow doubling advocate Arlen Specter (R–PA) as head of the panel that oversees NIH. Both senators also oppose possible moves by the Bush Administration to ban federal funding for research using stem cells harvested from human embryos.

**Incoming chairs.** Democrats Barbara Mikulski (*above*) and Tom Harkin await Senate posts.

CREDITS: (TOP TO BOTTOM) RICK KOZAK/AP PHOTO/CHARLIE NEIBERGALL

Other committees, however, could see changes in emphasis. Senator Pete Domenici (R–NM), known as St. Pete for his efforts on behalf of Los Alamos National Laboratory and several other large Department of Energy (DOE) research facilities in his state, will likely cede control over DOE funding to Senator Harry Reid (D–NV). Although Reid is friendly to science, he has criticized the planned Yucca Mountain nuclear waste repository in his state, as well as the $3.4 billion National Ignition Facility, a giant laser project at DOE's Livermore National Laboratory in California. Renewable-energy advocate Jeff Bingaman (D–NM) is expected to take over DOE's authorizing committee from Frank Murkowski (R–AK), a friend of the oil and gas industry. That switch virtually assures that the Senate will block controversial portions of the Bush Administration's new energy policy, such as a call to open Alaska's Arctic National Wildlife Refuge to drilling (*Science*, 25 May, p. 1462). A Democratic Senate is also likely to question Bush's plans to increase funding for missile defense, downplay controls on global warming gas emissions, and cut funding for environmental research.

Whereas most lobbyists are hedging their bets, Michigan State University's Howard Gobstein ventures that a divided government will be good for research. "Support for science is bipartisan," he says, and the new lineup gives both parties an incentive to take the lead.

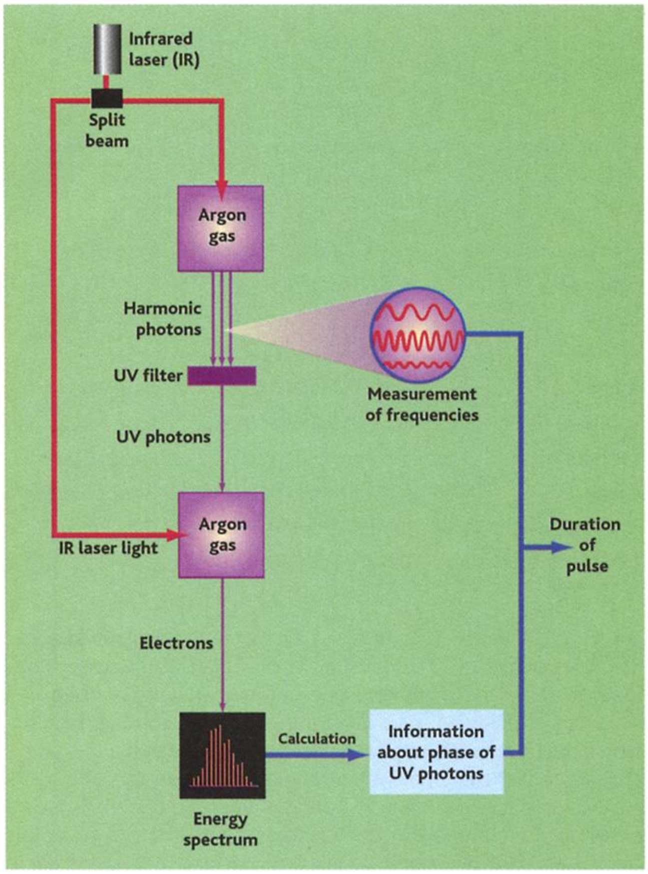
–DAVID MALAKOFF

ULTRAFAST LASERS

## Strobe Light Breaks the Attosecond Barrier

If you want to see Harm Geert Muller's latest handiwork, don't blink. On page 1689 of this issue, Muller—a physicist at the FOM Institute for Atomic and Molecular Physics in Amsterdam, the Netherlands—along with Dutch and French colleagues reports creating the fastest strobe light ever made, with individual pulses lasting just 220 attoseconds, or 220 billionths of a billionth of a second. These unimaginably short pulses are the first to be confirmed as breaking the attosecond barrier, a goal of high-speed-laser researchers for nearly a decade. Down the road, such pulses may one day serve as an ultrafast camera, allowing researchers to freeze action and perhaps to spot the gyrations of individual electrons whirling around an atomic nucleus.

"This is a great paper," says Paul Corkum, a pioneer in making short laser pulses and a physicist at the National Research Council of Canada in Ottawa, Ontario. Laser researchers have likely been making trains of attosecond pulses for years, says Corkum. But until now they've had no




**Quick study.** A novel experimental setup allows researchers to spot attosecond pulses for the first time.

way to spot such fleeting bursts: Electronic detectors are too plodding and simply record a blur of photons. "How do you know what you've got? That's been the struggle," says Corkum. Muller and his colleagues managed the feat not by detecting the photon bursts themselves but by tracking their ability to ionize atoms in a nearby gas jet—a technique that Corkum says "works very well."

Generating the short pulses in the first place is a comparatively simple task. Quantum-mechanical calculations show that if light waves spanning a broad range of frequencies are brought together under the right conditions, they can interact to produce an ultrashort pulse. Muller and his colleagues—including teams led by Philippe Balcou at the National School of Advanced Techniques (ENSTA-École Polytechnique-CNRS) in Palaiseau, France, and Pierre Agostini at the Saclay Research Center of France's Atomic Energy Commission—create this broad range of frequencies by a technique Corkum dreamed up in the mid-1990s (*Science*, 4 August 1995, p. 634). Starting with a short-pulse infrared (IR) laser that fires pulses lasting just 40 femtoseconds (a femtosecond equals 1000 attoseconds), the researchers split these light pulses and steer one portion toward a jet of gaseous argon atoms; the second portion is used in a later detection step. The intense light ionizes the atoms and generates an oscillating electric field that drives the freed electrons away from their parent atoms and then back again at high speed. Some of the surging electrons smash into their parent atoms, releasing energetic short-wavelength photons across a broad range of frequencies. Most of the photons cancel one another out as the peaks of some line up with the troughs of others, but a few of them—those at odd harmonic intervals of the initial laser light—survive.

Physicists have long calculated that these surviving photons would be produced in a staccato of attosecond pulses. But to confirm that's what they had, Muller's team needed to do two things. One was to get a precise accounting of frequencies produced and the amount of each one, both of which they could track easily with a device called a spectrophotometer. The other was to determine their relative phase, that is, whether the waves and crests marched in lockstep. "That's the key," says Muller. With the phases and frequencies in hand, the team could mathematically work out the pulse durations.

To get those phases, the French and Dutch researchers came up with a novel scheme. First, they used mirrors to filter out all of the harmonic photons except a band in the ultraviolet (UV) range. They trained the UV beam into a second gas jet of argon atoms. At the same time, the team zapped the gas with the second half of the original infrared laser beam. Under the double bombardment, the argon atoms absorbed photons and kicked out electrons. Using standard detectors, the researchers recorded the number of the electrons and their energy levels. Then they varied the phase of the incoming IR photons by passing them through a glass window that slightly slowed their progress. The changes in the IR phase altered the photons' ability to kick out electrons at different energy levels. By measuring how the distribution of electron energies changed and by crunching some numbers, the researchers were able to work out the phases of both the IR and UV photons that must be present at each position—information that enabled them to confirm the brief but notable lifespan of their record-setting pulses.

Muller and Corkum say the next race will be to use the pulses to track the blinding dance of electrons around nuclei, which are too fast for even today's femtosecond lasers to capture. As well, they say researchers will undoubtedly want to slice out single flashes from the attosecond pulse trains and try to shave each pulse down to just 10 or so attoseconds each, the theoretical limit for the methods now being used. "It's something we're working on. But it's still really science fiction at the moment," says Muller. Until this week, so were 220-attosecond pulses.

–ROBERT F. SERVICE

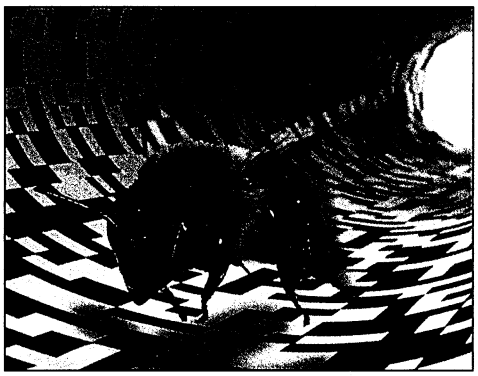
NEUROBIOLOGY

## Bee Dance Reveals Bee's-Eye View

Imagine a driver asked to judge the distance traveled by keeping track of the number of buildings, signs, and lampposts whizzing by. Now ask that driver to tell a friend how far to go based on those visual cues. That's exactly what honeybees do, says Harald Esch, a neurobiologist at the University of Notre Dame, Indiana. For years, bee biologists have argued about whether the dance that honeybees perform when they return to the hive communicates anything more than the general direction of the nectar source. Now Esch and his colleagues have settled this question by tricking a foraging honeybee into communicating the wrong information to its hivemates. The work, reported in the 31 May issue of *Nature*, shows that "bees really are getting [distance] information from the dances," says Thomas Seeley, a biologist at Cornell University in Ithaca, New York. The work also confirms that the bee measures distance in terms of "optic flow," the stream of visual cues encountered along a flight.

Over the past several years, experiments have suggested that honeybees know how far they've gone by how much they've seen—and not, as many researchers had

CREDIT: (RIGHT) MARCO KLEINHENZ



**Bee reckoning.** The tunnel's pattern alters the bee's visual "odometer."