PATENTS

NIH to Limit Scope of Foreign Patents

More than 20 years ago, the U.S. National Institutes of Health (NIH) began supporting Australian researchers who discovered two cytokines that can boost the immune system of cancer patients. These drugs, marketed by companies such as Amgen and Schering-Plough, have saved lives and chalked up more than $1.5 billion a year in U.S. sales. Yet NIH now wants to revise the policy that allowed the Australian scientists' institutions to patent and license one of the drugs on the grounds that it could put U.S. companies at a "disadvantage." The move has sparked an uproar in Australia and even left U.S. university officials wondering how it might affect collaborations.

Unhappy down under. Donald Metcalf and other Australian scientists are upset about NIH plan to limit patent rights.

A notice on NIH's Web site says that the planned change, to go into effect by the end of the year, is in "the best interests of U.S. citizens" by making sure that they benefit fully from all NIH-funded research. Posted 14 March, the notice explains how NIH plans to limit the future patent rights of all foreign recipients of grants and contracts to the awardee's own country and have NIH retain the rights elsewhere. Institutions could ask for exceptions on a case-by-case basis.

George Stone of NIH's Extramural Inventions and Technology Resources Branch says that the new rule is intended to address the concerns of some members of Congress and the public but that it was not triggered by any particular incident. "There has just been a heightened awareness," he says. "We want to be proactive."

Few patents will likely be affected, Stone says. Only 13 of roughly 6000 inventions reported to NIH in the past 3 years included patent holders from other countries, he says, and in just two cases were the foreign grantees the only patent holders. The new policy would not have applied to the 11 joint inventorships, he says. An upcoming fact sheet will clarify the new policy, he adds.

Some foreign research institutions are quite concerned about NIH's plans. Alan Pettigrew, CEO of Australia's National Health and Medical Research Council, has complained to Stone, as have Donald Metcalf and Nicos Nicola of the Walter and Eliza Hall Institute of Medical Research in Melbourne, whose discoveries led to the cancer drugs. Discoveries are less likely to be commercialized if NIH holds the patent rights, they suggest, which "will actually decrease the health and economic returns to U.S. citizens." Canadian officials "are very much aware of" the NIH policy and are mulling over their response, says Janet Scholz, senior manager of the University Industry Liaison Office at the University of Manitoba in Winnipeg.

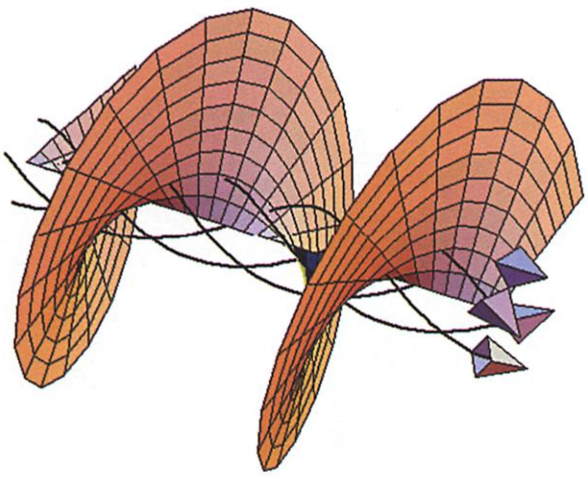
Scholz, who is also chair of the U.S.-based Association of University Technology Managers (AUTM), says that U.S. universities are concerned that the rule will discourage international collaborations by complicating patent filings and removing commercial incentives for the foreign partners. "To some extent, there isn't a border in science," says Scholz. The AUTM board plans to take up the matter this week.

Scholz says AUTM members are annoyed that NIH cannot cite examples of why the new policy is needed. "I just don't understand why they think that whatever they have now doesn't work," she says. —JOCELYN KAISER

OPTICS

New Twist Could Pack Photons With Data

The humble particle of light, the photon, is beginning to show that it has surprising depth. Photons have long been known to spin, but it is also possible to give them an additional form of angular momentum, a sort of twist. A team of physicists in the United Kingdom has now devised a way to measure the twisting of single photons—a "major achievement," according to physicist Keith Burnett of the University of Oxford. A photon's twist could be a handy information carrier: In principle, physicists could use it to load huge quantities of data onto a single photon, revolutionizing optical communications and quantum computing.



Helical harmony. A single "line of harmony" corkscrewing along a light beam. Arrows show energy flow, which can exert a torque on objects.

To envision light's angular momentum, freeze time for an instant and put an imaginary sheet of glass in the path of a laser beam. For a conventional beam, the light's electric field will have the same magnitude and direction all over the spot that the beam makes on the glass. Physicists visualize this with an array of little arrows whose sizes and directions show the field strength and direction; in this case, all the arrows will be the same length and point the same way. Ratchet time forward one notch, and all the arrows in the freeze-frame will turn in unison by a small amount. Keep moving time forward, and all the arrows will make one complete turn as the beam moves forward by one wavelength of the light. This is photon spin.

Over the past decade, physicists have realized that they can go beyond spin and add extra angular momentum to the beam, effectively imprinting a pattern onto the electric field so the arrows no longer all point the same way at the same time. In the simplest example, the arrows along a single radial line in the beam spot all point in a particular direction. Move time forward one notch again, and this "line of harmony" appears to move as an adjacent radial set of arrows snap to attention. In this way, the line of harmony sweeps around like a radar screen. This sort of rotation of the beam, which physicists call orbital angular momentum, describes a single helix in the beam as the beam moves forward. Even a beam consisting of a single photon can carry orbital angular momentum.

What has physicists most excited is that a lone photon can carry any number of spiraling lines of harmony simultaneously. Two lines give the familiar double helix, three lines a triple helix, and so on. These angular momentum spirals must obey quantum rules, so they bear whole-number labels that physicists can use as a bar-coding system for carrying information. The orbital angular momentum can in principle be "as high as you wish," says Anton Zeilinger of the University of Vienna. "So an individual photon can carry much more than a single bit."

Extracting the information has been the problem, but Johannes Courtial and his University of Glasgow colleagues Jonathan Leach and Miles Padgett, aided by theorists from the University of Strathclyde in Glasgow, have dreamed up a

CREDITS: (TOP TO BOTTOM) WEHI; M. PADGETT/UNIVERSITY OF GLASGOW way of sorting photons according to their orbital angular momentum. In the 24 June *Physical Review Letters*, the team members describe how they first prepared a laser beam containing photons with different amounts of orbital angular momentum. They then split the beam, giving the two branches a further twist of 180° relative to one another, and finally recombined them.

When they come together, because of that extra twist and the symmetry properties of orbital angular momentum, photons having an odd number value of orbital angular momentum exit one way from the recombination point, and those with even values exit at right angles to it. These two sorted beams are then individually fed into a second similar splitting, twisting, and recombining setup and so on, in a cascade. Successive levels sort photons according to different multiples of 2 in their orbital angular momentum. Padgett's team made a trial two-stage cascade, enabling them to sort photons having orbital angular momentum values of 0, 1, 2, and 3. "This is equivalent to reading two bits of data from each photon," says Courtial.

"We will be able with this new method to process information in new ways and perhaps make more secure communications," says Oxford's Burnett. For example, blending several quantum states onto a single photon might offer a new route to quantum computation. Although the system is unlikely to work in optical fibers, Padgett sees numerous commercial prospects in loading data onto a single photon, and he is already talking to communications companies. –**ANDREW WATSON**

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

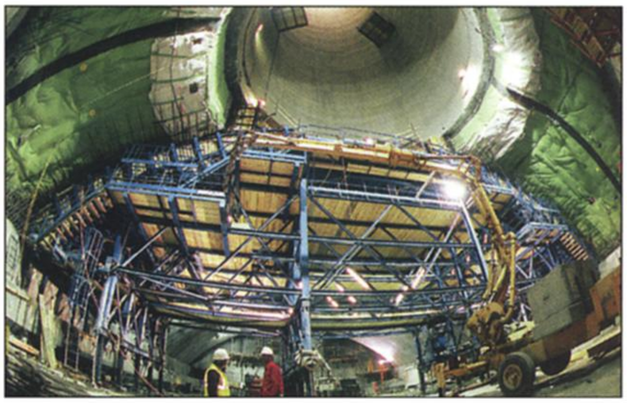
HIGH-ENERGY PHYSICS

CERN Panel Calls for Cuts and Shake-Ups

GENEVA—It's official: CERN must slash other research projects in order to finish the Large Hadron Collider (LHC). That's the conclusion of a group tasked with reviewing the $2 billion megaproject, under construction here at the European laboratory for particle physics, in the wake of cost overruns disclosed last fall (*Science*, 5 October 2001, p. 29). And non-LHC projects might not be the only sacrificial lambs: CERN is coming under pressure to shake up its senior management.

In December, CERN's governing council, outraged by LHC's increasing price tag, appointed a nine-member external review committee (ERC) to assess how best to complete the massive proton collider. In its report, presented last week at the council's biannual meeting in Geneva, ERC praised the design of LHC and the technical competence of CERN staff. But it blasted the lab for "serious weaknesses" in cost control, contract management, and financial reporting, and it called for steps to set things right. CERN council president Maurice Bourquin says the council has accepted ERC's recommendations.

The proposed remedies generally follow those in a medium-term plan that CERN proposed in March (*Science*, 29 March, p. 2341). The committee called on the lab to shift some $300 million from other operations into LHC and stretch out payments for the facility until 2010. Among numerous cost-cutting measures, ERC recommended that CERN shut down both of its existing proton colliders—the Proton Synchrotron and Super Proton Synchrotron—for all of 2005 and reshuffle staff from other accelerator projects to LHC. Finally, ERC's report laid out two models for a new organizational structure aimed at making CERN's management more efficient and accountable.



Depth charge. Underground construction of the Large Hadron Collider gave CERN's governors a case of sticker shock.

CREDIT: CERN-GENEVA

Such changes would be "a big step in the right direction," says Ian Halliday, a council member from the United Kingdom, adding that given the rift between CERN and its council, the negotiations that led to agreement on the report's conclusions "could have gone very badly wrong."

The council has given CERN's management until September to develop a short-term plan for putting most of ERC's recommendations into effect and until December to overhaul LHC's finances. The revision will include cost-to-completion estimates for LHC and a long-term budget and staffing plan for the entire lab. One key ERC recommendation—the call for a "new organizational structure"—although welcomed by council, "will take a bit longer" to implement, says Halliday. CERN director Luciano Maiani's term ends in December 2003, and particulars of the new organizational structure must be worked out in collaboration with his successor, whose name will be known in December 2002.

With a plan in place, the council agreed to release $22 million it had held back from the laboratory's 2002 budget when it launched the ERC investigation. It also approved the lab's proposed $805 million budget for 2003.

CERN's LHC push will hurt smaller projects such as the lab's Antiproton Decelerator, which will also be suspended for 2005. And although CERN will still provide a beamline to send neutrinos to Gran Sasso, Italy, it has withdrawn from the planned experimental portion of the project, which means a halt to neutrino physics for the lab. "Nobody likes it, that's for sure," says Dieter Schlatter, leader of CERN's experimental physics division. Yet most researchers agree that such cutbacks are the price to pay for LHC.

Indeed, all the good news was saved for LHC. Maiani announced that CERN is in the final stages of negotiating a bank loan for an additional $198 million toward the project's construction. He also reported happily that excavation of LHC's two new detector caverns, a major villain in the cost overruns, is now essentially complete. That puts the collider on track to begin operations in mid-2007—2 years late. That schedule is based on staffing levels that are not yet guaranteed, and it assumes that nothing else will go wrong, ERC notes.

Although it would be "dangerous" to think that CERN's problems are solved, Maiani says, the LHC picture is in sharper view than it was a year ago. "We know pretty well how much [LHC] will cost; we know pretty well who will make it; and we are even starting to know who is going to pay for it," he says. –**GISELLE WEISS**

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ASTRONOMY

Cosmic Lenses May Be Magnifying Quasars

Some objects in deep space are not quite as they appear. As their light zips across billions of light-years to Earth, the gravity of matter along the way stretches, splits, and contorts their images. Now, a new study predicts that these mirages, called gravitational lenses, are unexpectedly common for the most distant bodies that astronomers see: quasars near the fringes of the visible cosmos. Up to one-third of these remote beacons might be dramatically brightened by what Harvard University astronomer Abraham Loeb calls "natural telescopes" in the sky. The finding might help resolve a puzzle about these enigmatic