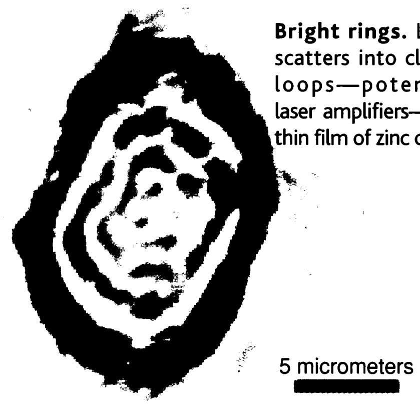
amplified; the powder had become a laser. "You are actually getting stimulated emission," says team member Eric Seelig. "Light travels in those loops, and each of these closed loops forms a cavity."

Righini says it's the first time researchers



Bright rings. Light scatters into closed loops—potential laser amplifiers—in a thin film of zinc oxide.

have demonstrated that laser amplification can take place in a powder. "The paper is rather convincing," he says, predicting "this research will trigger more experiments." One way to exploit the phenomenon, says Cao, might be to shrink the phosphor grains that emit light in flat-panel field-emission displays. In these displays, each pixel consists of a tiny electron emitter placed in front of a tiny screen. The electron emitter, says Cao, excites the atoms of the phosphor; in small enough grains, it might spark laser amplification and brighten the pixels. "We are working on that," she says.

—ALEXANDER HELLEMANS

Alexander Hellemans is a writer in Naples, Italy.

DENMARK

University Cash Crisis Blocks Career Paths

COPENHAGEN—A bitter row has broken out at the University of Copenhagen, which has been forced to cut its scientific staff to close a yawning budget gap. The university science department decided in January that, instead of assessing who were its least productive researchers and firing them, it would simply not fill any junior tenured positions that became vacant—in effect blocking the career path of young tenure-track researchers. As the consequences of that policy have begun to bite, aspiring young scientists say they now have little prospect of advancement and a whole generation of young researchers will either have to leave academic science or pursue a career abroad. "There is an atmosphere of hopelessness among students and postdocs whose possibilities for embarking on an academic career at the university now seem extremely limited," says plant molecular biologist Lars Østergaard, a postdoctoral fellow.

The crisis was precipitated late last year when the Danish government cut overall funding to Denmark's five universities. The science department at Copenhagen—the country's largest—was hit especially hard because it was already running a budget deficit. Forced to cut 15% of the tenured science positions—which translates into 70 people—the administration eliminated about 12 posts by offering early retirement to older faculty members and will cut the rest over time by not filling junior positions. "[It's] outrageous to prevent the necessary staff renewal and infusion of new ideas by forcing out young, talented, tenure-track scientists," says molecular biologist Olaf Nielsen, an associate professor.

The new policy is likely to exacerbate a simmering age problem in Danish universities. During the 1960s and '70s, the university system expanded rapidly and a large number of tenured positions were created. That generation of scientists is now approaching retirement age. "There will be an acute need for replacements when 30% to 40% of the currently tenured staff retire in 5 to 10 years," says associate professor of zoology Peter Arctander. "But because of what is happening now, there will be a lack of qualified young scientists."

Dean of science Henrik Jeppesen defends the policy. Although "it is sad that a number of young researchers have to leave," he says, "it would have created a very bad atmosphere to fire faculty members who have worked here for many years." This view is supported by university president Kjeld Møllgaard, who says it would be "an unfair personnel policy to simply get rid of the least productive as if it were a horse race." Jeppesen and Møllgaard both acknowledge, however, that the reaction of Denmark's powerful unions was a

"[It's] outrageous to prevent the necessary staff renewal ... by forcing out young, talented, tenure-track scientists."

—Olaf Nielsen

ScienceScope

2010 or Bust With researchers expected to finish sequencing the *Arabidopsis* genome sometime next year, the National Science Foundation (NSF) is already contemplating a more challenging goal for the next decade—understanding the function of every one of the plant's 20,000 to 25,000 genes.

Extracting that information could lead to improved yields for crops and other commercially important plants. But it will cost "at least as much" as NSF's existing plant genome project, currently $50 million a year, says Mary Clutter, the agency's biology chief. And a report due out soon from an NSF-funded workshop held last fall concludes that it will take a decade of research and training to do the job right.

Officials previewed the idea last week before the National Science Board, NSF's oversight body. They have dubbed the effort Project 2010 in preliminary talks on next year's budget request. Says Clutter: "This is something we definitely want to do. The only question is when."

Data Dump A new initiative may soon allow academics to sift through mountains of data collected by Canada's statistics agency. Currently, only employees of Statistics Canada have access to the trove of confidential surveys that the agency conducts in areas like health and education. To share this statistical wealth with university scientists and data-hungry policy-makers, the agency and Canada's Social Sciences and Humanities Research Council want the government to spend up to $10 million a year to set up 10 centers where specially designated researchers could crunch the numbers.

The proposed Social Statistics Research System would give $230,000 annually to interdisciplinary teams to produce reports on everything from health care to immigration. Such quantitative studies could help Canada "restructure our social policy," says J. Douglas Willms of the University of New Brunswick's Atlantic Centre for Policy Research. Before the keys to the data kingdom are handed out, however, the government must approve a funding plan, which will be submitted formally this fall.

Contributors: David Malakoff, Pallava Bagla, Richard Stone, Jeffrey Mervis, Wayne Kondro

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consideration. Per Clausen, president of the academics' union, the Magisterforeningen, says: "In principle we regard the science department's handling of the situation as the only proper response, but at the same time it is clear that blocking staff renewal will badly hurt the university and its research."

Indeed, research is already hurting. Several research groups have been reduced to the point that ongoing projects have effectively come to a halt. For example, one group in the department of genetics investigating the silencing of chromatin has been shut down after 4 years of successful work because the tenure of its leading assistant professor has been canceled. Science teaching will also be seriously hit, because courses are largely taught by assistant professors and junior associate professors. Leif Søndergaard, an associate professor of genetics, says that "because of the cuts, many courses will no longer be offered every year and others will be generating waiting lists."

Young researchers are now beginning to make their voices heard. Østergaard has sent a highly critical letter, signed by 90% of the graduate students and postdocs in the department of molecular biology, to the *Copenhagen University Journal*. Among other things Østergaard describes a widespread feeling that "the university is shooting itself in the foot by not identifying and getting rid of those researchers whose scientific contribution is minimal."

–LONE FRANK

Lone Frank is a writer in Copenhagen, Denmark.

PARTICLE PHYSICS

DESY Puts the Spin Into Gluons

In the microworld of subatomic particles, metaphors quickly reach their limits. Quarks, the building blocks of protons and neutrons, are held together by a haze of force-carrying particles referred to as subatomic "glue." But it now appears that, unlike any glue in the macroworld, these gluons have a property known—metaphorically, again—as spin.

The finding, reported last week at a Moriond meeting* in the French Alps by physicists from DESY, Germany's particle physics lab near Hamburg, is a step toward solving a long-standing puzzle about protons and neutrons, collectively called nucleons: What gives these particles their spin? The three quarks that permanently inhabit a nucleon only appear to contribute a small part of its spin. The swirling sea of "virtual" quarks, which flash in and out of existence inside each nucleon, seem to add even less, and the total contribution by all the quarks is only 30%. That leaves the gluons. "The question of how much of the proton spin is carried by gluons as compared to quarks has been at the forefront of people's minds for the last several years," says Frank Close of Britain's Rutherford Appleton Laboratory. Now, a new technique for reaching into protons and gauging the spin of their gluons has yielded evidence that gluons do indeed carry part of a nucleon's spin, although the precise amount isn't clear.

Studying the interior of nucleons is not easy, and some of the world's largest particle accelerators have been involved in this endeavor, including machines at the CERN particle physics center near Geneva, the Stanford Linear Accelerator Center in California, and DESY. Physicists use these accelerators to smash beams of leptons—pointlike charged particles such as electrons, positrons, and heavier electronlike muons—into targets containing protons. Occasionally a lepton exchanges a force-carrying photon with a quark inside a proton and scatters off it.

In these experiments, both the leptons and the protons are spin-polarized: Their spins are aligned in one specific direction. From the way the scattering probabilities change when the spin of the particle beam or the target is reversed, the physicists can calculate the spin contributed by the quarks. Until now, however, the gluons inside protons have escaped scrutiny simply because they are not charged and so cannot interact with leptons electromagnetically, via a photon.

Spin center. The HERMES detector at DESY first uncovered evidence that gluons have spin.

CREDIT: HEIKE THUM-SCHMIELAU/DESY

But the researchers who operate the HERMES detector on DESY's Hadron-Electron Ring Accelerator (HERA) reported at the Moriond meeting that they had followed a suggestion put forward by other European researchers and looked at a different interaction between gluons and a probe beam of positrons, known as photon-gluon fusion. As positrons enter a proton, some are strongly decelerated by its charge, causing them to shed high-energy photons in a process known as bremsstrahlung. "The photon comes in, materializes as a quark-antiquark pair, and one of these quarks scatters from the glue," says HERMES spokesperson Edward Kinney of the University of Colorado, Boulder. So a combination of electromagnetism and the strong nuclear force is responsible for the scattering.

Quarks can't be detected directly, but after scattering they disintegrate into a stream of other particles, which can be picked up by particle detectors. Because the quarks produced by the bremsstrahlung photons retain the polarization of the original leptons, their probability of being scattered in a given direction depends on the gluons' spin. The results so far—an analysis of collision data collected in 1996–97—indicate that gluons do carry spin. But so far, says Kinney, "we cannot conclude from our data what the total contribution of the glue is to the nucleon spin."

Dietrich von Harrach of Mainz University in Germany, one of the physicists who is studying similar data from the SMC collaboration at CERN, adds that interpretation of these streams of particles can be tricky. Instead of resulting from photon-gluon fusion, he says, they may be generated when one of the relatively low-energy positrons in HERA's beam exchanges a photon with a quark, which then emits a gluon, a process called Compton scattering. "The predominance of the Compton process over pair production may be a real problem," he says. However, von Harrach expects that the muon beams in CERN's COMPASS experiment, now under construction, will have high enough energies to remove that ambiguity and make a definitive measurement of the spinning glue of the microworld.

–ALEXANDER HELLEMANS

Alexander Hellemans is a writer in Naples, Italy.

* Rencontres de Moriond, QCD and High Energy Hadronic Interactions, Les Arcs, Savoie, France, 20 to 27 March.