# Europe Wants a 100-Tesla Magnet of Its Own

Europe's scientists need access to stronger magnetic fields. So says a recent report by the European Science Foundation, whose chief recommendation is that a 100-tesla pulsed magnet be built and running by 2003. But scientists are split over whether such a facility should be a multinational collaboration, as the ESF report favors, or be kept to the national scale. Meanwhile, an independent plan is in the works to build a 100 T facility near Dresden, Germany.

Magnetic fields are a fundamental physical quantity, like pressure or temperature. And, says Peter Wyder, who heads the French–German high-field magnet lab in Grenoble, "If you want to study nature, you must go to extremes—to high energies, low temperatures, high up in space and so on." The fractional quantum Hall effect, for which the Nobel Prize in Physics was won last year, is perhaps the best-known recent example of new physics being discovered through the use of large magnetic fields. But many disciplines make use of such fields, including solid-state physics, complex and simple fluids, materials science, medical and life sciences and chemistry. Notes Fritz Herlach, the former head of Belgium's magnet lab in Leuven, "Every time the magnetic field range has been enlarged, fundamental discoveries have been made that could not be predicted beforehand."

## Meeting the competition

The ESF report argues for setting up an international European Large Magnetic Field Facility (ELMF) that would provide both static fields up to 50 T and pulsed fields up to 100 T. Such a facility, says the report, "would restore Europe's position to be competitive with laboratories elsewhere, particularly in the USA and Japan." But, noting the upgrades planned for the static magnet labs in both Grenoble and Nijmegen (see box on next page), the report says new steady-state magnets can wait a few years, and that attention should go first to building a long-pulse (10 ms–1 s) magnet up to 100 T. (The report, *The Scientific Case for a European Laboratory for 100 Tesla Science*, is available on the Web at http://www.esf.org/PESC/News.htm; for a description of US high-magnetic-field activities, see PHYSICS TODAY, October 1998, page 21.)

To be sure, says Lawrie Challis, a physicist at the UK's University of Nottingham who chairs the ELMF's steering committee, "no one would prefer a pulsed magnetic field if they could have a steady field of the same strength. But there is no way at the moment to get above 45 or 50 T steady state." Pulsed fields are also much cheaper to produce than steady-state fields. So, focusing now on stronger pulsed fields "rather than spending a huge amount of money marginally increasing steady fields and then getting overtaken by technological developments" will buy time, Challis adds. "And a breakthrough in high-temperature superconducting magnets could lead to higher steady-state sources later."

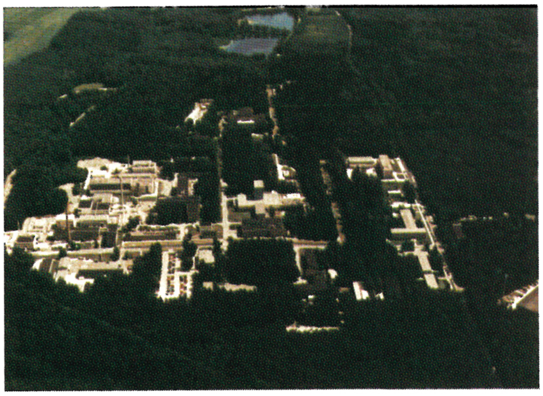
> Having established the research need for larger magnetic fields in Europe, the scientific community must still scope out where new facilities should be located, and how they should be organized.

No detailed design for a 100 T facility has yet been drawn up, but the ESF report puts the construction cost, including ten magnets and auxiliary instruments, at roughly euro 50 million ($59 million), and the annual operating budget at euro 5 million. The ELMF could consist of a single centralized lab; separate facilities for pulsed and continuous fields; or a network of sites, possibly with the national magnet labs that now dot Europe supporting very-high-field magnet facilities. The location, says Herlach, who sits on the ELMF steering committee, "will depend largely where the funding comes from, and this will be a political decision."

This past November, the ESF sent its report to more than 30 national research councils in 23 countries, and asked them to indicate by mid-February whether they are interested in participating in a European magnet lab, and what sort of guidance they'd want from the ESF. Notes the foundation's Hans Karow, "The '100 T' is a medium-scale facility, so it may not need an intergovernmental council—the national research councils could handle this, and things could go swiftly."

With funding from the European Commission, several labs are developing a prototype high-field pulsed magnet. Says Salomon Askenazy, who heads Europe's leading lab for pulsed magnets, the Service National des Champs Magnétiques Pulsés, in Toulouse, France, "If we can show that 80, 90 or 100 T can be done, then we will propose a new pulsed magnet program. And of course, I would be pleased if the long-pulse component of the ELMF could be in Toulouse."

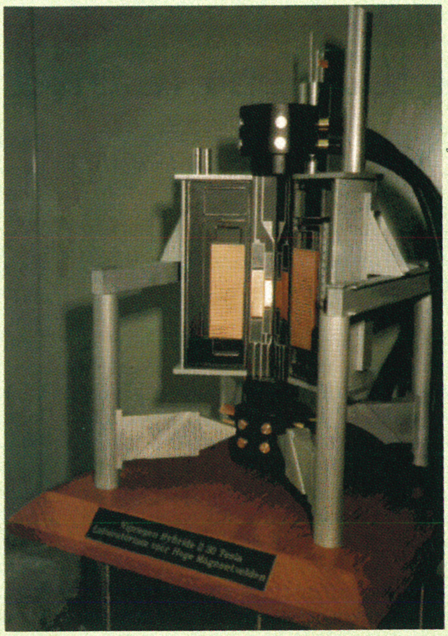
Indeed, there is broad support for bigger and better magnet labs, although the issues of location and format, and especially whether an international collaboration is really the best bet, are fraught. The ELMF is intended to be a multinational collaboration, but many scientists agree with magnet designer Guy Aubert, the former head of France's National Center for Scientific Research (CNRS) and now a science policy adviser to the French government, who says, "It would be a pity if Europe were not able to compete in this field, but at the level of funding for a high-magnetic-field facility—an order of magnitude lower than for a synchrotron or neutron source—it's not necessary to complicate the game by putting so many people around the table." For the 100 T lab, adds Aubert, "I don't really



FORSCHUNGSZENTRUM ROSSENDORF

THE ROSSENDORF RESEARCH CENTER, formerly an East German facility specializing in nuclear physics and radioisotope production, is being built up scientifically, with new research areas including materials science, nuclear medicine and reactor safety. The center may soon be home to a high-field pulsed magnet lab.

## Dutch Magnet Lab to Get DC Upgrade, Pulsed Magnets



UNIVERSITY OF NIJMEGEN

NIJMEGEN'S 30-TESLA HYBRID MAGNET (above) will soon be replaced by one that produces more than 40 T.

The Netherlands' High Field Magnet Laboratory at the University of Nijmegen is to get stronger steady-state magnets and also absorb the country's pulsed-magnetic-field research activities (now at the University of Amsterdam), according to a joint announcement issued in January by the University of Nijmegen and the Dutch Science Foundation, which will split the bill.

The upgrade, which will cost about 40 million guilders ($23 million) and is scheduled to be completed by 2001, will put the Nijmegen lab on a par with the world's top static magnet labs, located in Grenoble, France, where an upgrade is also under way; Tallahassee, Florida; and Tsukuba, Japan.

The Nijmegen lab will get a new building, and its power supply will be upped from 5 MW to 20 MW. Lab boss Jan-Kees Maan says the facility will produce static magnetic fields up to 34 tesla by using resistive magnets (up from 20 T now), and greater than 40 T (up from 30 T) by using hybrid magnets, in which a resistive magnet is nested in a superconducting coil.

In addition, the Nijmegen lab will take over pulsed-magnetic-field research from the University of Amsterdam, which decided in November 1997 to stop funding such activities. Development and construction of pulsed magnets, however, will continue at the Amsterdam lab, which will soon start building a short-pulse (5 ms), high-field (80 T) magnet for Nijmegen.

Paul Frings, a University of Amsterdam physicist who had been overseeing the design and construction of a 60 T long-pulse magnet until the university dropped the plan, says given the alternative of closing, the merger "is probably the best solution. It makes sense for high-field activity to be located at one site. It will become much more visible, and researchers will be able to easily switch over from DC fields and do experiments with higher, pulsed fields." TONI FEDER

believe we can make a consortium of more than two or three countries—probably the best being a joint venture between Germany and France."

### A 100 T contender

Frank Pobell, the director of the Rossendorf Research Center near Dresden, is among those who believe that a high-field magnet lab will more likely, and more quickly, be built if it's done on a national, rather than an international, scale. He should know: Pobell says he's aiming to submit a proposal this spring for DM 40 million ($25 million) to build a national magnet lab at Rossendorf by 2002.

If approved, the Rossendorf lab would start out with three magnets: a 100 T magnet, with a pulse length of 10–20 ms and a bore 20 mm in diameter (the space in which experiments can be performed); a 70 T magnet with a pulse length of 100–200 ms and a 24 mm bore; and a 60 T magnet with a pulse length of 1 s and a 50 mm bore.

Since 1992, following Germany's reunification, the Dresden area has been built up as a scientific center. And a key argument for siting a high-field magnet lab at Rossendorf is the prospect of using it together with a far-infrared free-electron laser that is scheduled to go on-line there next year. "The combination would be unique worldwide," says Pobell. "The radiation from our laser would match the magnetic excitations of many solids up to 100 T, so new high-field infrared spectroscopy experiments would become possible." The proposed magnet lab would be a joint undertaking of five local institutes: the Rossendorf Research Center, the city's two new Max Planck Institutes (for Physics of Complex Systems and for Chemical Physics of Solids), the Institute for Solid State Physics and Materials Research and the Technical University of Dresden.

The state government of Saxony has said it will pay half the cost of the magnet lab if the federal government will pony up the rest, says Pobell, adding that the chances for getting funding are "much better" under Germany's new Social Democratic–Green government, "because they promised more money for science and technology, particularly in the former East Germany."

Pobell sees Rossendorf someday becoming the European hub for pulsed magnetic fields. For that to happen, says Herlach, the German team "will have to work hard to acquire the necessary technology. But if their ambitious project is realized, they will certainly join the ELMF as a major partner." TONI FEDER

## Dorfan Will Lead SLAC into Next Century

On 1 September, Jonathan Dorfan will take the reins at the Stanford Linear Accelerator Center. He will succeed Burton Richter, who this past November announced he would step down after 15 years (see PHYSICS TODAY, January, page 54).

A native of South Africa, Dorfan earned his bachelor's degree in applied mathematics and physics in 1969 at the University of Cape Town before coming to the US, where he earned his PhD in 1976 at the University of California, Irvine. He's been at SLAC ever since, and became an associate director, in charge of the B Factory, in 1994.

Indeed, Dorfan says, the B Factory, which is scheduled to go on-line in May, was one reason he chose to head SLAC, rather than accept an offer for the top job at Fermilab, where John Peoples will step down at the end of June. (A successor to Peoples was still being sought as PHYSICS TODAY went to press.) "It was an agonizing decision," says Dorfan. But after 10 years of working on the B Factory, he wanted to stay around and see it produce physics.

Scientists hope that the B Factory—which is named for the "bottom" quark—will shed light on the dominance of matter over antimatter. Says Dorfan, "We will collide electrons with positrons to produce very large numbers of bottom and anti–bottom quarks, and then watch for decays that violate the *CP* process. The idea is to understand the theoretical underpinnings of *CP* violation."