are strong enough to cause "sparks" near the surface, like breakdowns above an ordinary electrode. Charged particles generated in these electrical storms could stream up the magnetic field lines and eventually act as a kind of antenna to send out the radio waves that are observed as the subpulses. Meanwhile, according to some well-known physics of charged particles in electric and magnetic fields, the microstorms—each about 100 meters high—would drift around the polar cap.

That picture has implications for the source of the main beam, says Harding: It suggests that the underlying physics could be similar and, she says, "argues for radio emission near the surface of the star." Ruderman, however, isn't convinced that the new work says anything about the main beam. "I personally don't see how it reflects directly on the mechanism for radio emission," he says. And among other criticisms, Arons argues that even the source of the radio hot spots may not lurk right at the stellar surface. The action could be taking place anywhere along the line of sight, he says.

Rankin replies that Ruderman and Sutherland's picture of electrical storms near the surface is the only reasonably complete explanation for the hot spots at the moment. "It would be absurd not to map these emission centers back onto the surface," she says. But she concedes that the real test will come in studies of the "weather maps" on other pulsars. Astronomers will be watching as closely as picnickers glued to their TV sets during a bad-weather weekend. —JAMES GLANZ

GERMANY

New Minister on a Mission to Modernize

Three months into her new job, Germany's research and education minister is stirring up the system, while promising not to go too Green

BONN—When Germany's new Social Democrat–led government swept into power last fall, after 16 years of rule by the conservative Christian Democrats, the nation's scientists greeted the change with mixed emotions. The new government, elected on a tide of high expectations, formed a coalition with the eco-friendly Green Party, and some scientists fretted that the Greens would be put in charge of the research and education ministry. After a few weeks of nail biting, however, they breathed a sigh of relief when the job went to Edelgard Bulmahn, the Social Democrat's parliamentary "shadow minister" for science and education. But that doesn't mean that the research community is in for a smooth ride.

In a wide-ranging interview with *Science* last week, Bulmahn made it clear that she intends to shake up the research system, with a long list of goals that include loosening bureaucratic restraints on German research institutes, modernizing the university system, bolstering programs to promote women and independent young scientists, and more closely linking research efforts at universities and independent research institutes. "We now have a research system that is supported by separate columns: Max Planck Society basic research institutes, applied research institutes, university research, and national research centers," Bulmahn says. "We must significantly strengthen the connections among these different research organizations."

Bulmahn has also inherited some thorny political problems from her predecessor, Jürgen Rüttgers, and some controversial policies of her new government are creating still more. The Social Democrats and their Green coalition partners have pledged to phase out nuclear power in Germany, prompting fierce debate over the future of the nuclear industry and nuclear research. A recent revival of militant animal-rights activism in Germany has led to demands for stricter laws in that area, while activists have threatened some prominent researchers. And federal and state officials continue to struggle over how to restructure the nation's troubled system of higher education and how to improve research.

"The number of women in leading scientific positions in Germany is too low."

—Edelgard Bulmahn

Bulmahn, who studied political science at the University of Hannover and then rose through Germany's political landscape, has so far drawn qualified praise from the research community. Although many scientists are wary of some positions being taken by the new government, she is given credit by research and university leaders for moving quickly to tackle some difficult problems. "She has the courage to try to modernize an old-fashioned system," says Klaus Landfried, president of the HRK, the conference of university rectors and presidents.

One reason for nervousness in Germany's laboratories is concern over how far the government will lean toward Green Party policies. Bulmahn has sought to reassure the scientific community that the Greens' presence will not lead to a sea change in research policy in fields such as biotechnology and nuclear fusion. "I don't foresee any fundamental change" in policy on gene technology, she says. "This government believes that biotechnology is a key technology for Germany." However, Bulmahn says the government feels that more research is needed into "the long-term impact of genetically modified plants and microorganisms on the environment." On the animal-rights issue, Bulmahn notes that "we already have strict laws about the treatment of animals in research," and says she does not support an effort by activists to amend the German constitution to guarantee animal rights.

The new government's stance on nuclear power is also causing jitters. Although the research ministry no longer has jurisdiction over applied research in nuclear energy and other energy sources, it remains responsible for federal policy on research reactors, including the controversial FRM-II neutron source in Munich (see sidebar), and for those facilities—mainly national research centers and Max Planck institutes—that carry out fusion research. Bulmahn says that, at present, she does not foresee any major change in Germany's support for the fusion research programs, in part because it is largely coordinated and partly funded by the European Union's Euratom program. "The budget for the new European research program already has been decided," she says.

That's reassuring to researchers such as Klaus Pinkau, director of the Max Planck Institute for Plasma Physics, who helps coordinate Germany's fusion research program.

CREDIT: FRANK OSSERINK/SYGMA

What to Do With FRM-II?

BONN—One of the thorniest issues on the slate of Germany's new research and education minister, Edelgard Bulmahn, is what to do about Munich Technical University's (TU's) planned neutron source, a research reactor dubbed FRM-II, now under construction in the Munich suburb of Garching. Many members of Bulmahn's Social Democrat party and the eco-friendly Green Party have for years opposed FRM-II's design because it will use highly enriched uranium (HEU) fuel. Use of HEU as a reactor fuel is now discouraged by most governments because the material is the key ingredient of some types of fission bombs.

When the two parties formed the nation's new coalition government last fall, activists pressed for a quick decision to delay or even cancel construction of the new reactor. But last month, the government opted to put off any action on FRM-II until a new "expert group" assesses whether it is technically and financially feasible to redesign the reactor to use low enriched uranium (LEU) fuel. The expert group, whose members were named last week, includes four German physicists and two nonproliferation experts.

The panel is expected to submit its findings this summer, and Bulmahn told *Science* that no decision on converting FRM-II will be made until then. "My ministry and the foreign ministry, which is responsible for nonproliferation policy, are discussing the details," she says. Also involved in that decision will be the environment ministry and the Bavarian state government, which strongly backs the project.

Meanwhile, construction of the $500 million neutron source continues, and TU officials confidently predict completion on schedule in 2001. Physicists in Garching say they believe the expert panel will agree with them that a redesign—now that construction of FRM-II is nearly two-thirds complete—would delay the project by several years, cost tens of millions of dollars, and result in a less desirable neutron source. "To use LEU fuel, we would have to double the power, and we would end up with a second-class neutron source," says Wolfgang Gläser, a prominent TU experimental physicist who helped develop the concept for FRM-II.

The Garching physicists have allies among U.S. neutron researchers, including Nobelist Norman F. Ramsey of Harvard University, who wrote recently in a letter to the president of TU that "many of [the FRM-II's] most interesting research applications are dependent on the use of highly enriched uranium." But experts at Argonne National Laboratory in Illinois have argued for years that FRM-II could be redesigned to use LEU fuel. Dave Baurac, an Argonne spokesperson, says "we are convinced that it is possible to build a research reactor that can meet all the FRM-II performance goals while using LEU fuel. But we have not been provided with the information required to assess what is technically or economically feasible" at this point in FRM-II's construction.

Heart of the matter. The reactor chamber of the partly built FRM-II neutron source.

Wolf-Michael Catenhusen, the German research ministry official who will lead the expert panel, told *Science* that the committee will likely "integrate Argonne's information and expertise" in its deliberations, but he noted that Argonne's previous recommendations had assumed a redesign before—rather than in the midst of—construction.

TU officials were a bit miffed that none of their scientists were included in the expert panel, but took heart that four prominent nuclear physicists with experience in converting reactors—including Eckehard Bauer of the ILL neutron source in France and Peter Armbruster of Germany's GSI heavy-ion research institute—will bring expertise to the group. Says Gläser: "This decision should be made on the basis of science, not politics." **–R.K.**

Pinkau told *Science* that the new government has not backed down on commitments that include the construction of an ambitious new fusion research facility in Greifswald. "Germany sees itself as an important part of the international effort on fusion research, and I am told the government has no intention of withdrawing from that effort," he says.

Bulmahn also has inherited Germany's substantial commitment to the international space station—at $1.5 billion, about 40% of Europe's contribution to the project. "I disagree with the decision to concentrate so many resources on crewed space projects," she says, but acknowledges that she has no choice but to stand by Germany's commitment. Her own preference, she says, is for robotic missions and Germany's own space projects.

Reforming the rigid higher education system—and related research—is also high on Bulmahn's agenda. Scientific research at some German universities is in difficult straits, partly because the number of students has grown faster than have public resources for new buildings and staff. In her first budget battle, Bulmahn convinced the Cabinet last month to approve a modest increase in federal funding for a program to improve the higher education infrastructure. She also backs the HRK's call for universities to have more flexibility in spending federal funds; in return, she wants research at higher education institutes to be subjected to outside evaluation. "We don't have a good evaluation system for universities," she says.

Sharing the concerns of other experts, Bulmahn worries that many talented young German researchers become frustrated during the difficult years between getting a Ph.D. and becoming a professor. In German-speaking Europe, that involves a long "Habilitation" process, during which postdocs do major research projects under the strict supervision of professors. Bulmahn and key allies, such as biochemist Ernst-Ludwig Winnacker—president of Germany's DFG granting agency—are pushing hard to switch to a U.S.-style "assistant professor" system, a step that the HRK has endorsed for natural science faculties. And the proposed new research budget includes about $18 million for a new DFG program to promote more independent research by postdocs.

Treading lightly on the male-dominated turf of Germany's scientific elite, Bulmahn also wants to ensure that women have a better chance to rise to leadership in science and higher education. "The number of women in leading scientific positions in Germany is too low—far lower than the numbers of women in such positions in the U.S., or even in Britain or in France," she complains. "We want to encourage scientific organizations to employ more women, and to give more women a chance to excel." **–ROBERT KOENIG**

CREDIT: TECHNICAL UNIVERSITY OF MUNICH