MICROELECTRONICS

Europe Starts Search for Lone Electron

PARIS—The European Union (EU) last week launched a new $3.7 million research program that will link eight high-powered research labs around Europe in an effort to remove one of the main constraints for building more powerful computers: packing more memory onto a single chip. Chip designers are now working on prototypes that can hold up to 4 gigabits of information, but they are rapidly coming up against a technological wall: Fabrication methods are reaching the physical limit of how small they can create circuits on a chip, and energy consumption of chips is becoming excessive. The new program, dubbed Fabrication and Architecture of Single-Electron Memories (FASEM), aims to tackle this problem by creating a working chip in which each bit of information is stored with a single electron. Current memory chips store information as electrostatic charges—pools of large numbers of electrons.

The ultimate aim of the project, which is part of the EU's Esprit program for information-technology research, is to produce by 2015 a single-electron memory capable of storing 10^{12} bits of information. "With a single-electron memory, you can make a large memory with low power consumption, and yet keep the speed at roughly the same level as it is today," says Haroon Ahmed of Cambridge University's Cavendish Laboratory, one of the labs involved in the project. "This is one of the more visionary projects of our program of emerging technologies," says Kostas Glinos, the project coordinator at the European Commission, the EU's executive arm in Brussels. "And it is high-risk research as well."

The key components of such a memory will be tiny conducting "islets," typically only a few nanometers, or millionths of a millimeter, across (*Science*, 17 January, p. 303). To move data around, single electrons hop from one such islet to another one nearby through a process called single-electron tunneling (SET). This hopping is controlled by changing the voltage of the islets. Project coordinator Huguette Launois of the CNRS Microstructure and Microelectronics Laboratory near Paris warns that many hurdles lie ahead: "We are not yet certain that such memories will be usable one day. ... There are still problems we haven't solved yet, such as reproducible and controllable nanofabrication methods." The shape of islets and the distance between them are critical for SET to occur, and the distance between islets will have to be controlled with a precision of 1 nanometer, which is very difficult, she says.

The FASEM program has brought together a diverse collection of labs—in the United Kingdom, France, Germany, Belgium, and Greece—to tackle the problem. John Inkson and his team at Britain's Exeter University, the only theoretical group in the project, will "look at simulating the growth of gold dots on semiconductor surfaces," as well as semiconductor-on-insulator quantum dots and wires, says team member Mauro Boero. A major problem is that SET has so far been achieved only at about 77 kelvin, and the Exeter team will look at "optimizing the geometry and various parameters that characterize these structures in order to achieve room-temperature operation," says Boero.

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>
> **—Kostas Glinos**

Cambridge's Ahmed says that his team will deal with the fabrication and design of the single-electron memories, while Marc Van Rossum and his team at Belgium's Interuniversity Microelectronics Center in Leuven will be responsible for the silicon substrate that will carry the tiny islets as well as the circuits that will connect the single-electron memory cells to the outside world. The first step the consortium hopes to achieve during the initial 3-year contract is a 4×4 array of single-electron devices on a substrate of silicon. "It should include the circuitry for reading and writing, and this is the challenge," says Glinos.

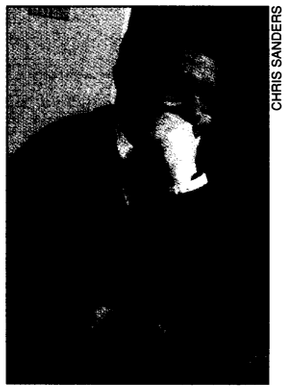
–Alexander Hellemans

Alexander Hellemans is a science writer in Paris.

SCIENTIFIC MISCONDUCT

The 'Gallo Case': Popovic Strikes Back

When an appeals board cleared AIDS researcher Mikulas Popovic of scientific fraud in November 1993, leading the government to drop all misconduct charges against his former boss, Robert C. Gallo, one of the most bitter and divisive sagas in science finally seemed to be over. But not quite: Now comes the epilogue. Last fall, Popovic filed a $5 million lawsuit against the United States and one of its employees, fraud investigator Suzanne Hadley, for pursuing a "baseless" investigation that caused him "severe emotional stress" and resulted in his "de facto forced exile from science for 4 years." On 31 January, the government submitted its formal response to the suit, arguing that it should be dismissed on technical grounds.



CHRIS SANDERS

Seeking damages. Popovic is suing the government.

The suit could be another grueling test for the Department of Health and Human Services' (HHS's) Office of Research Integrity (ORI), which has seen some of its highest profile cases ignominiously tossed out by the same appeals board that cleared Popovic. The case has also led to speculation that it could be the leading edge of a wave of suits from other scientists who were charged with research misconduct and later exonerated. Lawyers involved with misconduct cases say, however, that such suits are difficult to win, and they doubt that many researchers will want to reopen a painful chapter of their lives. Barbara Mishkin of the Washington, D.C., firm of Hogan & Hartson, who represented Popovic before the appeals board, says the Popovic case "is probably the strongest case to take against the government of any of them that went through ORI."

Popovic, a Czech immigrant who worked in Gallo's lab at the National Institutes of Health (NIH) in the 1980s, was first investigated for scientific misconduct in 1989 after allegations surfaced that Gallo had stolen the HIV virus from a French lab. Early on, the government dropped charges of misappropriation against the two scientists. But ORI concluded that Popovic and Gallo had made false statements in several 1984 AIDS articles in *Science*. In a scathing decision, however, the appeals board overturned the findings against Popovic, saying it had found no "residue of palpable wrongdoing" (*Science*, 12 November 1993, p. 981). That embarrassing setback led ORI to abandon its case against Gallo.

Popovic filed his suit with the U.S. District Court in Greenbelt, Maryland, under the Federal Tort Claims Act, which waives