# Can Europe Keep up the Pace in Condensed Matter Physics?

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The decade of the 1980s was an exciting and productive time for the entire field of condensed matter physics, but especially so in Europe. Three spectacular breakthroughs—all highlights of the decade—were made in Europe and were immediately recognized with Nobel Prizes: Klaus von Klitzing won in 1985 for the quantum Hall effect; Gerd Binnig and Heinrich Rohrer in 1986 for scanning tunneling microscopy; and Georg Bednorz and Alex Muller in 1987 for high-temperature superconductivity. With such an outstanding record of recent successes it would seem that all is well in European condensed matter physics. But the debate continues about whether this string of successes is a consequence of favorable science policies and whether it will continue.

The new European synchrotron x-ray source will complement the world's most powerful neutron source at Grenoble, France, and will come into operation in 1994. [Photo courtesy of A. M. Freund and A. Childéric]

These breakthroughs continue to dominate the agenda of condensed matter physics today. The discovery of radically new phenomena in small-scale semiconductor structures has blossomed into a major effort on mesoscopic physics that lies between the worlds of the microscopic and the macroscopic. A fascinating aspect of this field is that its origin and continued progress come from techniques that were developed for applications in the semiconductor industry. Yet it has yielded new fundamental physics and even laboratory realizations of new theories involving fractional quantum statistics. Developments in European basic research have so far continued to be at the forefront, but the lack of success of the indigenous semiconductor industry may well affect the future here. For example, Philips, which was the only European company to attempt a major research effort in this area, has recently scaled back.

Surface science has not been the same since the discovery of scanning tunneling microscopy. Following the initial breakthrough, other new types of microscopy have been developed again with European scientists playing a leading role. The atomic force microscope and the magnetic force microscope give pictures on the atomic scale of insulating and of magnetic surfaces. These atomic scale pictures are impressive even though the detailed understanding of the factors that control the contrast and resolution is still not at hand.

The feverish pace of a few years ago in high-temperature superconductivity research has slowed now. On the one hand, a large-scale effort has focused on understanding and controlling the factors that determine potential applications; on the other hand, researchers are still trying to unravel the puzzle of the mechanism of this spectacular phenomenon in a special subset of copper oxide materials.

These fields are all examples of small science where European physics has a more stable and secure system of funding and a better infrastructure for individual groups. For example, universities often fund equipment, machine shops, computing, secretarial help, and so forth—things which in the United States need outside contracts. This leads to a more leisurely pace and in turn to a greater willingness to take chances on longer term projects with less certainty of success. At least, this is the argument of those who see science policy as helping the successes along.

However, the harsher climate for scientific funding that exists in the United States and also to some extent in Japan leads to a more competitive environment and a greater pressure to enter new topics as they emerge. Of course this can be criticized as a tendency to follow fads and jump on bandwagons. Nonetheless, the more leisurely attitude easily can lead to a slowness to exploit breakthroughs. High-temperature superconductivity is a case in point. Although the initial discovery was made in Switzerland, the many other compounds that followed came from Japan and the United States and only rarely from Europe. There is a strong tradition and support for solid-state chemistry, so the fault must lie elsewhere. In the even more recent case of fullerenes, dubbed Molecule of the Year by *Science*, again the European laboratories are not especially conspicuous.

The big science part of condensed matter physics has not been neglected. On the contrary, a new era will begin in 1994 with the opening of the hard x-ray synchrotron at ESRF (European Synchrotron Radiation Facility) in Grenoble. About that time the refurbished nuclear research reactor at Institut Laue-Langevin should restart operations. The synergy from these two complementary facilities side by side will make Grenoble a focal point for condensed matter physics. Even more unique to Europe is the emphasis on spallation neutron sources allowing higher energy spectroscopy at Rutherford Laboratories in the United Kingdom and that under construction at the Paul Scherrer Institute in Switzerland.

The drive for political and economic integration in Western Europe is only weakly reflected in physics. For example, mobility between countries even for young researchers is limited so that one cannot speak of a European-wide job market. Perhaps that is why the experiment, now more than 10 years old, to have an equivalent of the American Physical Society March Meeting has never really caught on. The big countries like Germany or the United Kingdom have successful national meetings with little crossborder participation. They are large enough to be self-sufficient and it is the smaller countries like Belgium or Switzerland that generally are greater supporters of the European Physical Society. The striving of the politicians for European integration and a single European market by 1 January 1993 have not had the same consequences for science, which continues to orient itself either nationally or worldwide but not especially on a European scale.

To continue the successes of the past decade is clearly a difficult challenge but even this pales in comparison to the challenge posed by the rapid pace of change in Eastern Europe. Is there some way that the centers of excellence that existed in the large science establishments in these countries can be preserved? The very speed and gravity of this challenge has so far not been matched by efforts in Western Europe to meet it. This must surely pose the biggest and most important task for the future.

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