

Anyone for neutrons?

There is a strong case for constructing a major new neutron source somewhere in Europe. The obstacles to progress towards this goal reflect much that is problematic about the organization of European science.

A negative hydrogen ion accelerates down a linear accelerator to 90% of the speed of light and punches through a carbon sieve, which strips it of its two electrons. The remaining proton enters a ring 70 metres in diameter, in which it and other protons are accumulated in pulses to be fired many times a second in a 5-megawatt beam onto 1,000 litres of mercury. Inside the mercury target, in a process known as spallation, the protons interact with the mercury's atomic nuclei, exciting them so that they 'evaporate', each releasing up to 30 fast neutrons. Some 30% of these neutrons escape through gaps in the shields that surround the mercury target, to be beamed towards one of dozens of possible destinations. These would incorporate bits of matter, scattered neutrons from which can be used to analyse its physical or magnetic structure, and its atomic or molecular dynamics, with a precision that is unavailable at any other facility anywhere.

This is the vision that underlies the proposed European Spallation Source (ESS). The ambition, or something like it, has been shared by scientists from many disciplines for ten years. Yes, they already have nuclear reactors and spallation sources to produce neutrons, but the limitations of these — in both power and lifetime — are becoming all too apparent. Yes, they have synchrotrons, but the ESS would complement future synchrotrons or free-electron lasers in its ability to probe particular regimes of size, energy and dynamics. Moreover, neutrons are powerful in distinguishing between elements and between isotopes, and can probe magnetic materials.

This week sees what could be called a landmark: representatives of major European countries are to sign a memorandum of understanding in support of the ESS. Neutron scatterers shouldn't hold their breath, however. The document effectively says no more than that the ESS, with two mercury targets (one for long pulses, one for short), is an excellent idea, and that more work will be done to develop an engineering design and a firm proposal to build it. One implicit, but so far unanswered, question is: where should one then send such a proposal?

Problems recognized

What is envisaged, and indeed required at these energies, is a facility to serve researchers on a continental scale. The United States, after abandoning plans for a national reactor source in 1996, finally decided in 1999 to embark on the construction of the Spallation Neutron Source at Oak Ridge, Tennessee — a single-target, 2-megawatt facility that is expected to be operational in 2006. Politicians, not least the then Vice President Al Gore, recognized the need for the United States to avoid a neutron drought and to recapture the cutting edge in neutron sources. Europe, with its reactor at the Institut Laue-Langevin in Grenoble and many smaller reactors, has traditionally had a healthier supply of neutrons to play with. Japan, too, has decided to push ahead with a new 1-megawatt spallation source, which should come online in 2007. All of this is in line with recommendations made in 1999 by the Organisation for Economic Co-operation and Development's Megascience Forum (as it was then known) to develop the next generation of spallation sources.

The new memorandum might be seen by optimists as a belated

recognition by European countries of the need for such a facility. But the reality is that the ESS remains bogged down in a quagmire of conflicting national interests, combined with a vacuum of structural leadership at the European level. In particular, the ESS's situation highlights the chronic inability of Europeans to provide credible infrastructure for themselves at a scale that requires multinational effort. The fact that it has taken ten years to reach the present stage of the ESS is a scandal in itself — and it is not for want of trying by the scientific enthusiasts behind the project (see www.ess-europe.de).

Inspection of the forces at play highlights the nature of the problem. The European Commission's research commissioner Philippe Busquin endorses the project as precisely the sort of facility that is needed for his European Research Area, and will help to prime it by supporting research and development for the proposal. But ultimately he has no line of expenditure that can be dedicated to the construction and management of such a facility. The European Science Foundation lacks the clout to be anything other than a catalyst, and has so far not even assumed this role.

Fine words

European nation states are where the funds will ultimately need to be found — but the current state of play does not look promising, despite their fine words of support. Germany is undertaking a lengthy review of all future big research projects under the auspices of its strategic body the Wissenschaftsrat, and gives no impression that the ESS will be championed by anyone with leverage. The French government is devoting much attention to the possibility of hosting the next fusion facility, ITER, whereas France's two major funding agencies, the CEA and the CNRS, have differing interests, leading to a lack of tangible support. The United Kingdom is under tight financial restrictions from the government that ensure that it could take years for anyone to stand up and pledge hard currency for the project.

Back in the mid-1990s, when faced with inertia that hindered the development of biotechnology in Germany, the research minister Jürgen Rüttgers introduced a competition between the Länder, triggering an explosion of biotechnology growth founded on regional self-interest. Cannily, the ESS project's leaders have pursued the same strategy, holding a competition for bidders seeking to host the facility.

Thus the development of a continental facility for neutron research — which will benefit universities, industries, physicists, chemists, earth scientists, materials researchers and biologists — now hangs on local bids. These have been made by a county in England (Yorkshire), two Länder in Germany (North Rhine-Westphalia and Saxony-Anhalt), a research centre in Germany (Jülich), a consortium of several Scandinavian centres, and the Rutherford Appleton Laboratory in Oxfordshire, UK. The fact that the fate of such a facility hangs on these local enthusiasms highlights the inadequacies of Europe's present research area. If the ESS is to be operating by its planned target of 2011 (already several years after the US facility is set to come online), national representatives in Europe — politicians, administrators and scientists — will need to get their act together fast. ■