

Scattered countries revive hope for European Spallation Source

In realizing the European Spallation Source—which even in its scaled-down form would be the world’s strongest neutron source—the partner nations hope to forge mechanisms for multinational decision making.

After having been left for dead a few years ago, plans for a European Spallation Source have gained renewed momentum. This time, though, Europe’s biggest economies are on the sidelines; if the ESS goes ahead, neutron users will have countries not typically in leadership roles to thank.

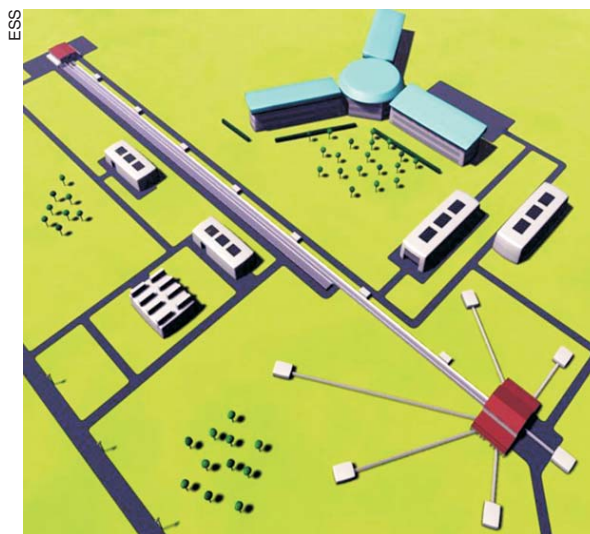
Planning for the ESS began in the early 1990s. By 2002 scientists had a design in hand and were raring to get started on construction of the world’s most powerful neutron source. But poor marks from the national science council in Germany left the ESS orphaned (see *PHYSICS TODAY*, November 2002, page 24).

A changing balance of power

“In some ways, the ESS was ahead of its time,” says Colin Carlile, former head of the highest-flux reactor neutron source, the Institut Laue–Langevin in Grenoble, France. “Europe is well endowed with neutron facilities. The three big countries took the view that it wasn’t necessary to proceed with building the ESS.” At the time of the ESS’s apparent demise, Germany was investing in the X-Ray Free-Electron Laser in Hamburg and in FAIR (Facility for Antiproton and Ion Research) in Darmstadt; France was angling to host ITER, the international fusion reactor; and the UK was planning to upgrade its spallation neutron source, ISIS.

But as the countries that were originally behind the ESS fell away, “other countries—ones that are not traditionally builders of large facilities—saw an opportunity,” says Carlile, who now coordinates Sweden’s bid to host the project. Moreover, he adds, “with the European Community growing all the time, the balance of power is changing.”

Sweden is vying with Spain and Hungary for the ESS, and it’s the three site bids that are driving the ESS’s revival. Scientists in the three countries not only convinced their governments to sign on to the project, but also, with the ESS collaboration board, lobbied successfully to get the ESS on the roadmap created by the European Strategy Forum on Research Infrastruc-



Revived plans for a European Spallation Source have been scaled down to have only one long-pulse target station.

ture (ESFRI) in 2006. Among some 200 projects across science that were considered, 35 made it onto the roadmap. “The ESS is one of the top projects,” says Carlile. “There is no numbering scheme, but everyone knows that even though the roadmap is not prioritized, there is a priority.”

Smaller but still strongest

The revived ESS has been scaled back and specialized. Instead of splitting 10 MW between a short-pulse and a long-pulse target station, it would now have only the 5-MW long pulse—with the pulse length of the protons that free the neutrons about 2 ms. The spallation sources in the US and Japan are lower power—1.4 MW and 0.5 MW, respectively—and they both create short pulses of neutrons (impinging proton pulse length about 1 μ s). So, says Research Center Jülich’s Dieter Richter, who leads Germany’s participation in the ESS, “if you don’t have enough money to do everything, then you have to try something different.” Keeping to only one target station cuts the cost by about €500 million (\$770 million); the total tab is expected to be about €1.4 billion.

Some measurements, such as powder diffraction and classical time-of-flight, are better with short pulses, Richter says. But with long pulses, “you get more integrated flux. Small-angle

scattering, neutron spin echo, and a number of other techniques gain proportional to the flux. Then there are ways to multiplex. That means you chop your beam and make a lot of short pulses out of it. You measure with one wavelength after another in one experiment. And you do it in a very clever way so that you can distinguish your results coming from different wavelengths.”

Because they have a magnetic moment, neutrons provide direct access to magnetic properties. “If you go to nanomagnetism—very small magnetic particles, you need really strong intensity,” says Peter Allenspach, a scientist at the Paul Scherrer Institute in Switzerland and chair of the European Neutron Scattering Association, which represents some 5000 neutron users. “You can do such experiments now, but it’s at the limit. A factor of 10 [in intensity] there goes from just feasible to really getting good data.” The same goes for biological molecules, Allenspach adds. “In present facilities, you can do protein investigations, but only in specific cases, and they are very tedious. Going to higher flux, you can attack molecules of higher complexity. You can look at the dynamics of atoms and see processes, not just structure.” Scientists also expect the ESS to make possible dynamic imaging of, for example, oil in a motor. “This is most obvious for industry,” says Allenspach. “Metal is quite transparent for neutrons. You can’t go into atomic detail, but [you can] shine through and see the engineering.”

For preparatory work, the ESS was awarded €5 million—money available competitively only to the projects on the ESFRI roadmap—by the European Commission.

A key to realizing the ESS is settling on a site. The host country would pay between €300 million and €400 million, and the contenders are all trying to attract partner countries to fully fund the facility. As Juan Urrutia, who leads Spain's bid to host the ESS, puts it, "We need to be very seductive."

Politics and science

Sweden's ESS site is in Lund, in the south of the country near Denmark and Germany. "It's a hidden jewel," says Carlile. "When I saw it I was stunned by the blend of ancient university and innovation." In April Denmark joined the Swedish bid, the first formal partnership for any of the sites.

Hungary is hoping to host the ESS in Debrecen, the country's second largest city. And the Spanish site is in the Basque city of Bilbao. Urrutia notes that Spain has created a national fund to pay for the ESS. "Once other countries have made their bids, the percentage they want to own, they can put that money in whenever they want," he says. That option to postpone payment "is the

main difference between our candidature and the others."

Even while their site bids are competing against each other, Spain and Hungary are collaborating: They share an ESS scientific director and international advisory board, and are comparing costing and other data.

"It is psychologically very important that small countries are taking the lead," says Allenspach. The ESS would be the largest scientific facility yet built in any of the contending countries. "Up to now, large facilities have been built with the initiative of large countries. It's funny for the large countries that they do not decide where to build the ESS," he adds. "I am sure that none of the countries who do neutron scattering can be absent from the project, because it will be orders of magnitude better than other sources in Europe and decisively better than the SNS [in the US] or [the spallation source under construction at] J-PARC in Japan." In Germany, adds Richter, "the position of our government at the moment is 'wait and see.' If [the ESS] happens, they will participate,

I presume, but not in a leading role."

"If [the site is] not decided in a year's time, we will lose steam and [the project will] fall back into a really deep sleep," says Allenspach. "The most important thing is to have it built. Where it is built is a second priority."

"In Europe there is no mechanism to decide on large-scale facilities," Allenspach continues. "As soon as you have a facility of a certain size, countries start bilateral negotiations. Somebody has to take the lead and try to get others on board." Adds Urrutia, "We are not only building a large scientific facility. We are building Europe and the way Europe takes decisions."

The new spallation sources in the US and Japan were also important in turning around the ESS's fortune, says Richter. "It's a mixture of politics and science which determines the situation at the moment. I thought [the ESS] would have been asleep for longer. I was surprised, but I can only welcome the development. I think there is a relatively good chance that this time it will work."

Toni Feder

Revamped grants program offers R&D funds for 'critical national needs'

The Technology Innovation Program replaces the controversial Advanced Technology Program for supporting high-risk R&D projects.

Exactly where would you spend taxpayer money if you were ordered by Congress to invest in R&D critical to the nation's future but you had only \$8 million?

That's the situation that faces Marc Stanley, who directs the Technology Innovation Program, a new cost-shared grants office housed in NIST. TIP replaces the 18-year-old Advanced Technology Program (ATP) and, like its predecessor, is meant to assist in the commercialization of high-payoff technologies that are considered too risky to attract private capital. Created by last year's America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act, TIP has been given the added mission of steering its investments into "areas of critical national need." NIST has since identified seven such areas: water, energy, manufacturing, civil infrastructure, personalized medicine, communications, and complex networks.

It's a tall order for a few million bucks. But dozens of ATP reviews and case studies have measured impacts out of proportion to the program's modest means. A 2005 analysis of 40 completed

ATP projects commissioned by the program's in-house economic assessment unit identified more than \$18 billion worth of expected present-value social benefits, an 8-to-1 return on the \$2.3 billion total the ATP had spent up to that point. A 2006 case study compared the fortunes of two manufacturers of microdisplays, one a 1994 ATP grantee, the other a nongrant. With its \$1.7 million ATP grant, the one company shortened its time to market by two years and realized \$5 million to \$7 million in measura-

ble net economic gains, according to the analysis.

Winners and losers

But partly due to concern with having the government pick winners and losers, the ATP was controversial from its inception. The Bush administration, and until last year the Republican-controlled Congress, has repeatedly targeted the program for termination. Opposition has always been along political and ideological lines; ATP

Historical statistics on ATP awards (1990–2007)

Number of proposals received	7530
Number of participants in submitted proposals	10 915
Total ATP funding requested	\$15 921 M
Total industry cost-sharing proposed	\$14 847 M
Number of awards	824
Single applicants	597
Joint ventures	227
Number of participants in awarded projects	1581
Total ATP funds committed	\$2408 M
Total industry cost-sharing	\$2206 M
Range of project awards	\$434 K–\$31 M

Source: NIST