A meeting of parallel paths for US fusion?

Colin Macilwain

The United States is realigning its nuclear fusion programme to improve the integration of research into two rival approaches to fusion power: magnetic and inertial confinement. The task is a challenging one.

[WASHINGTON] A series of top-level reviews and scientific meetings will be carried out this year to try to find ways of integrating US research in magnetic and inertial confinement fusion. The move follows the country's withdrawal last year from the main global research collaboration aimed at achieving controlled nuclear fusion.

Magnetic confinement fusion has historically been supported in the United States by the Department of Energy's Fusion Energy Sciences programme, while inertial confinement fusion is supported by the department's nuclear weapons programme.

The Fusion Energy Sciences programme was sharply cut three years ago, as Congress appeared to lose patience with the feasibility of fusion as an energy source. This was followed last summer by US withdrawal from the International Thermonuclear Experimental Reactor (ITER) project, a global collaboration to build a test-bed for magnetic fusion (see *Nature* **394,** 511–512; 1998).

But, although Congress has cooled on magnetic fusion, it has been willing to support a major new inertial confinement fusion experiment: the $1.5 billion National Ignition Facility (NIF) at the Lawrence Livermore Laboratory in California.

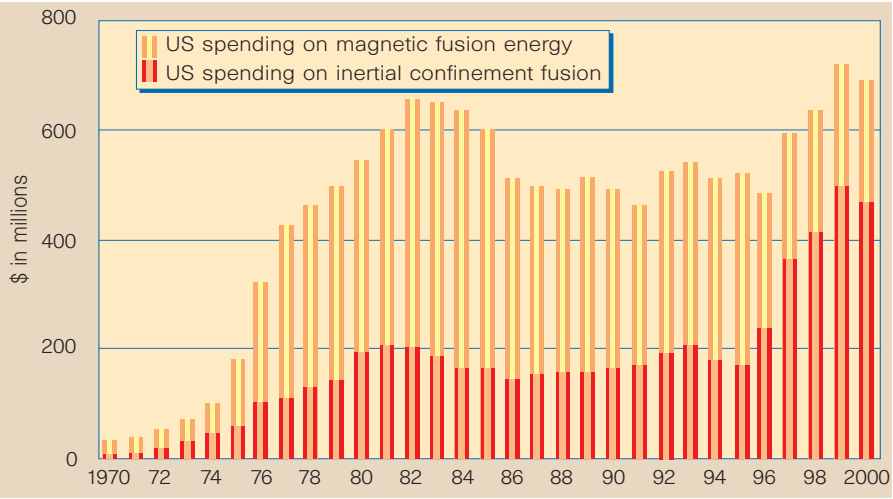
At NIF, ignition is obtained by compressing a tiny pellet of hydrogen fuel with X-rays — the principle behind the hydrogen bomb. Congress supports this work because it will enable scientists to improve their understanding of nuclear weapons without testing.

Any possible energy implications are seen as an incidental benefit. The result, however, is a reversal of the respective positions of the two programmes over the past few years. In 1995, the US spent $360 million on the magnetic confinement fusion programme, and a little over half that amount on inertial confinement fusion. This year, it will spend $500 million on inertial work and less than half of that on magnetic concepts.

The two programmes have many common technical needs, and the plasma physicists who lead them know each other well, having trained in the same places and attended scientific meetings together for years. But the rigid independence of the two strands of research, combined with the rapid changes in their respective fortunes, has raised questions about the balance of the overall programme as it now stands.

Last autumn, the Senate energy and water appropriations subcommittee asked the energy department to conduct a broad review of the entire fusion programme. The request produced a flurry of activity. Last month, for example, a sub-group of the Secretary of Energy's Advisory Board met in Washington to start a quick assessment of the "appropriate balance" between magnetic and inertial fusion.

The Fusion Energy Sciences Advisory Committee, chaired by John Sheffield of Oak Ridge National Laboratory in Tennessee, will report later this year on its priorities for the civilian science programme. The National Research Council is about to start an assessment of the quality of the research in the civilian programme. And in July, a two-week workshop at Snowmass, Colorado, will bring together most of the top scientists in both programmes to try to agree priorities for research and future facilities.



All this activity is unlikely to make much difference to the inertial confinement fusion work, which will continue to be supported primarily to meet the needs of the stockpile stewardship programme for maintaining nuclear weapons. But the implications for the fusion energy sciences programme could be profound: for example, bringing together inertial and magnetic fusion experts may produce a longer wish-list of research needs than the budget can bear.

With this in mind, leaders of the two communities have been working together to draw up a medium-term plan — a 'roadmap' in the parlance of the energy department — for the Fusion Energy Sciences programme.

Mike Campbell, associate director for lasers at Lawrence Livermore, has been working with Rob Goldston, director of the Princeton Plasma Physics Laboratory in New Jersey, to thrash out details of the plan. The two have called for the community budget to be increased from $223 million to $300 million "in the near term", with the new money split between work to support magnetic and inertial fusion.

The magnetic programme wants support for experiments at existing tokamaks, and for the investigation of other confinement experiments. It also wants support for the use of overseas experimental facilities, such as JET in the United Kingdom. Goldston says: "Maybe around 2003 or 2004 it will be time to address some major next-step facilities."

In his judgement, the international partners in the ITER project will not decide to build the experimental reactor before that time, although he adds that "there might be a 'no' on ITER" by then.

The roadmap calls for research into problems that need to be solved if inertial confinement fusion is to be tapped as a power source, but which the nuclear weapons programme will not support. Both approaches to fusion, the roadmap points out, stand to benefit from additional research in materials and technology development, computer simulation and basic plasma physics.

Campbell has joined with Goldston and other magnetic fusion leaders to submit joint testimony to congressional appropriations committees, asking them to go halfway to meeting the roadmap proposals by appropriating $260 million for the Fusion Energy Sciences programme next year.

Fusion advocates admit that such an increase is a tall order in this summer's round of appropriations, which promise to be at least as tough as previously. But without the extra money, the US magnetic fusion community will face another painful year in which to ask itself: if not ITER, what? □