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Big science, big photonics

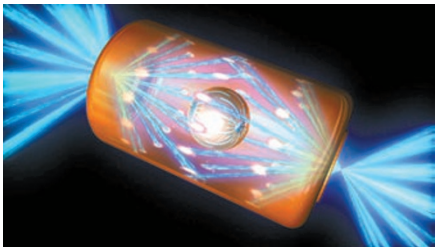
Although large research facilities are sometimes criticized for the colossal amounts of funding they consume, the lessons that are learnt from the 'extreme' science that they perform benefit labs of all sizes.

For many years, multimillion-dollar national facilities have been the preserve of nuclear and particle physicists. But the idea of focusing funds and know-how in one place for the benefit of an entire research community is now igniting the imagination of photonics researchers as well.

On page 3 of this issue[1], Ed Moses updates us on the progress of one of the most ambitious laser projects ever attempted. The National Ignition Facility (NIF) in the US will, when it is completed, be the most powerful laser in the world, producing short pulses of light that are intense enough to compress hydrogen atoms to the point that they fuse together. Achieving controlled nuclear fusion in the lab is arguably one of the biggest goals in physics today. Not only would it enable us to investigate the inner workings of our most important light source, the Sun, but it also promises a route to a relatively clean energy source at a time when the environmental impact and the availability of existing energy supplies are high on political and scientific agendas.

Achieving fusion without such large, expensive facilities would, of course, be the ideal solution. But claims that this is possible have been, on more than one occasion, the subject of intense controversy and passionate debate. Unless these alternative approaches really do prove themselves, and this seems increasingly unlikely, it is probable that large reactors of one type or another will be the only way of achieving the quantities of energy that the modern world craves.

But the road so far has not been smooth for the NIF. When Moses, now the director, joined in 1999, the project was already late and over budget. Add to this the ever prickly issue of nuclear weapons and you have a very good example of how such a massive logistical project can go very wrong and the large amount of money required to get things back on track. But over the past seven years, Moses and his colleagues have been slowly creeping towards their final goal. "We have met all of our schedules, milestones and budgets without fail. Yes, we did have a rocky start, nothing that we are proud of or that we are hiding either. But I think the world has come to an understanding that this is a successful endeavour at this point."[1]



NIF

And it is not just Moses and the US Department of Energy and the US Congress (who approved the allocation of the $3.5 billion needed to build the NIF) that can see the long-term potential of such large-scale facilities. The European Strategy Forum on Research Infrastructures (ESFRI) was established in 2002 to provide "a coherent approach to policy-making on large research facilities in Europe, and to act as an incubator for international negotiations about concrete initiatives"[2]. In 2006, ESFRI compiled a shortlist of 35 projects[3], from across the biological and physical sciences, that they thought were worthy of the financial support of European governments. Of these, six have a significant photonics component. In addition to a number of projects that use optical systems such as LIDAR for environmental monitoring, the proposals include a European version of the NIF (HIPER), a free-electron laser at wavelengths from the infrared through to soft X-rays (IRUVX-FEL), the European Extremely Large Telescope, and a high-intensity laser that generates optical pulses a million times shorter than those of he NIF (ELI, ref. 4).

Of course, it is important to acknowledge the knock-on effects on smaller-scale research as such facilities soak up a sizable proportion of the available funding. But such centres are crucial for sparking new research themes that can, in the future, be studied in an average-sized university lab. New advances in high-intensity optical components that result from research at the NIF will ensure that many scientists are able to enjoy the benefits that such a technological marvel can provide. Hopefully, when the first experiments begin at the NIF, probably in 2010, it will become clear that despite the set backs that are almost inevitable with projects of this size large-scale collaboration does yield long-term achievements.

References

1. Jenkins, A. *Nature Photon.* **2,** 3–5 (2008).
2. *The European Strategy Forum on Research Infrastructures* <http://cordis.europa.eu/esfri>.
3. *European Roadmap on Research Infrastructures (Report 2006)* <ftp://ftp.cordis.europa.eu/pub/esfri/docs/esfri-roadmap-report-26092006_en.pdf >.
4. Gerstner, E. *Nature* **446,** 16–18 (2007).