Let US physics commit to collaboration

A joined-up funding system is needed to enable the United States to make long-term pledges to major international projects, says **Barry Barish**.

Giant colliders, vast telescope arrays and challenging space missions are now essential for addressing problems at the forefront of physics and astrophysics. But the extent to which the United States is hosting or taking a leadership role in such large facilities is in decline.

This year, one of the most exciting physics discoveries of modern times — the evidence for a Higgs-like boson — was made at CERN, a European particle-physics laboratory. That discovery had been one of the main goals of a US supercollider that was never completed after its funding was cancelled almost two decades ago.

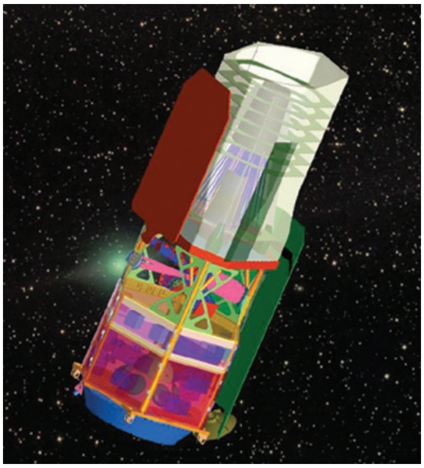
If the United States is to retain its lead in fundamental physics and astronomy, the government needs to devise new mechanisms for supporting international partnerships. This will not necessarily entail more investment or a shift in the size of the projects funded, but it does require a coordinated process that will allow US scientists to make more stable commitments to collaborations.

POOL RESOURCES

For much of the twentieth century, the rich United States did not need to partner with other countries to achieve its science goals. Its scientists made groundbreaking discoveries, including the first detection of cosmic radio waves by Karl Jansky at Bell Telephone Labs in New Jersey in 1933, and evidence for quarks at the Stanford Linear Accelerator Center in California in 1968. US researchers have won or shared 15 of the past 20 physics Nobel prizes, and 60% of the top 50 universities are located in the United States, according the 2012 *Times Higher Education* World University Rankings.

But physics research has changed. Important breakthroughs increasingly require multibillion-dollar instruments that are too expensive for one country to build alone. For example, the Higgs boson discovery at the Large Hadron Collider (LHC) at CERN near Geneva, Switzerland, is estimated to have cost US$13 billion in total, an expense shared mainly among CERN's 20 European member states.

Big physics projects such as ITER — an experimental fusion-energy reactor being built in Cadarache, France — are only feasible if the global science community pools its resources. International partnerships leverage the investments of individual countries, enabling their scientists to participate in a wider range of forefront science. And the researchers take skills and innovations back to their home nations.



NASA's WFIRST mission has been deferred, giving Europe the chance to lead on dark energy.

Scientists in the United States have a strong tradition of international collaboration. The country contributed more than $500 million to the LHC facility, and it is a 9% partner in ITER. Nevertheless, these projects are hosted and led by other countries. US participation in the Square Kilometre Array (SKA) radio telescope, the proposed International Linear Collider (of which I am director) and a planned dark-energy mission is currently uncertain. Even though these projects have been given the highest priority by their respective international science communities, there is no mechanism to prioritize them within the United States.

SHORT-TERM THINKING

The United States has gained a reputation overseas as an unreliable partner. Unpredictable funding is one reason why other governments are reluctant to collaborate with it. Countries that participate in large projects must make multi-year commitments to design, construct and exploit the facilities. But US budgets are determined one year at a time, so funding streams can suddenly disappear.

For example, after investments of nearly $2 billion, the US Superconducting Super Collider was cancelled by Congress in 1993 with no regard for the partner countries. They had been encouraged to contribute half of the projected budget, which had grown to more than $10 billion (in 1993 dollars). In a more recent example, in 2011 NASA decided not to fund LISA, a proposed US–European space mission to study gravitational waves. Because of other funding commitments, the agency has also deferred its Wide Field Infrared Survey Telescope (WFIRST), which aimed to detect dark energy; the move leaves Europe to take the lead with its own dark-energy mission, Euclid. These NASA missions were given the highest scientific priorities in the National Academy of Sciences' 2010 decadal survey of astronomy and astrophysics.

US agencies understandably want to keep a close eye on the projects that they fund, and have well-established procedures for doing so. This can result in an extra layer of oversight and reporting for large international projects, on top of the complex governance systems set up by partner countries. Decision-making and priority-setting for such projects need to be accomplished through joint procedures, and should not be skewed by one member.

In my opinion, the United States needs to bid aggressively in the coming decade to host or take lead roles in next-generation mega-scale international projects, such as the International Linear Collider, WFIRST or the SKA. To accomplish this, it must be in a position to make multi-year billion-dollar commitments across several US agencies.

Better defined and more central mechanisms are needed to evaluate and prioritize proposals for ambitious international facilities, perhaps through the White House Office for Science and Technology Policy and the National Academy of Sciences. These mechanisms could also consider the broader impacts of a proposed project on society, such as employment, skills, education and budget considerations.

There is no silver-bullet solution. However, the first steps are to recognize that there is a problem, and then to begin to make the necessary changes. ■

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