RESEARCH FACILITIES

U.S. Physicists Eye Australia for New Site of Gravitational-Wave Detector

U.S. physicists hope that the offer is too good for Australia to refuse.

They want to take parts from their massive twin gravitational-wave detectors and use them to build a third detector near Perth in western Australia. Adding a detector down under would greatly enhance the ability of the Laser Interferometer Gravitational-Wave Observatory (LIGO) to pinpoint sources of gravitational waves, should such waves ever be spotted. The cost to Australia would be $170 million, the price tag for building and maintaining the new site. In return, Australian physicists would gain full participation in the half-billion-dollar experiment.

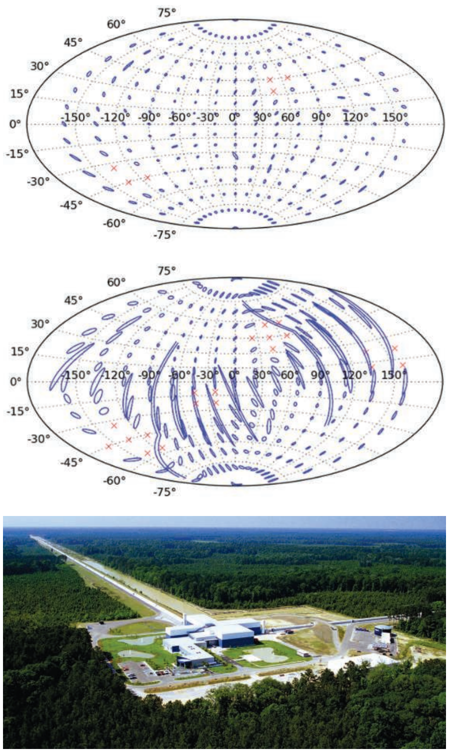
"It's absolutely a win-win situation," says David Blair, a physicist at the University of Western Australia (UWA) in Crawley. But the Australian government must decide in the next year. "We're asking a lot of Australia," says Stanley Whitcomb, a physicist at the California Institute of Technology (Caltech) in Pasadena and LIGO's chief scientist. "I don't think there's anybody who thinks there's better than a 50-50 chance of this happening."

LIGO Executive Director Jay Marx hatched the idea last October after a workshop in Shanghai, China, as a way to greatly enhance LIGO's performance as a gravitational-wave telescope as well as a detector. Built for $294 million by the U.S. National Science Foundation (NSF), LIGO aims to detect tiny ripples in the fabric of space and time set off when, for example, two massive neutron stars spiral into each other. To sense those ripples, LIGO uses huge optical motion sensors called interferometers in Hanford, Washington, and Livingston, Louisiana.

LIGO already works in concert with a European detector, called VIRGO, in Cascina, Italy, near Pisa. By comparing the times at which the three detectors sense a pulse of gravitational waves, scientists should be able to locate the waves' source to within a couple of degrees in some parts of the sky. But LIGO and VIRGO cannot pin down sources that lie in the plane defined by the locations of the three detectors. Adding a fourth station in Australia would create other planes and enable researchers to locate a source to within a degree or so across the entire sky (see figure.)

In fact, a third LIGO detector is already running in the background at the Hanford site. Each LIGO station consists of two 4-kilometer-long vacuum chambers arranged in a gigantic L. Light from a high-power laser bounces between the mirrors at either end of each tube, or "arm," and by comparing the two streams of light scientists can detect changes in the relative lengths of the arms as small as 0.001 times the width of a proton. At Hanford, a second set of mirrors and equipment in the same building forms a 2-kilometer interferometer that serves as a crosscheck for the bigger device.

But there's now a chance to move that third detector somewhere else, says Albert Lazzarini, a physicist at Caltech and deputy director of LIGO. Two years ago, LIGO scientists began a $205 million upgrade to all the detectors that, when it's completed in 2015, should make them 10 times more sensitive. The original plan for Advanced LIGO was to stretch the smaller Hanford detector to a full-size one at its current site. But it does not have to sit atop the first detector to serve as a crosscheck, Lazzarini says.



Clearly better. These sky maps—smaller ellipses denote higher precision—show that the addition of another detector in Australia (*top*) would greatly improve physicists' ability to pinpoint gravitational-wave sources under the current plan (*above*). LIGO's Louisiana site is pictured.

So in the new scheme, parts for that detector would be shipped to Australia to build a new detector in Gingin, 80 kilometers north of Perth. "We would basically be asking the NSF to deliver one set of hardware to another continent," Lazzarini says.

That's a radical change of plans, and it would have to happen fast: Researchers plan to start taking apart the current LIGO detectors in October and installing the new equipment next year. But NSF likes the idea of putting a detector in Australia so much that it's willing to rock the boat, says Beverly Berger, program director for gravitational physics at the agency. "It's project management 101 that you don't change a major project once it's under way unless you've got a compelling reason to do so," she says. This week, NSF officials pitched the plan to the agency's governing National Science Board.

NSF officials are not willing to pay more for Advanced LIGO, however, so the burden will fall on the Australian government. Building the site would cost about $125 million, says Robyn Owens, vice president for research at UWA, and running it for 10 years would cost another $45 million. If all goes well, the Australian detector could start taking data in 2017.

Australian physicists have been trying for decades to persuade their government to build a similar detector. "We really think that this collaboration could make all the difference," Blair says. Whitcomb notes that Australia has by far the most robust gravitational-wave community in the Southern Hemisphere.

The road to approval may be tricky, however. It will begin with a proposal to Australia's National Research Infrastructure Committee, but beyond that there is no protocol for getting such an expensive project approved, Owens says. Instead, researchers must simply convince politicians that the idea is worth funding. And that may have just gotten a bit harder. Australia's Labor Party lost its parliamentary majority in national elections last weekend, while the more-conservative Liberal/National coalition, which has promised to cut spending, gained seats. One party or the other will likely form a coalition government.

Still, Owens and colleagues are hopeful that politicians in both parties will recognize the opportunity. "This project has the ability to capture people's imagination," she says. Time is short: The Australians have only a year or so to claim their prize before LIGO researchers start installing the hardware at Hanford.

–ADRIAN CHO

CREDITS (TOP TO BOTTOM): *REPORT OF THE COMMITTEE TO COMPARE THE SCIENTIFIC CASES FOR AHLV AND HHLV*, R. WEISS *ET AL.*; (PHOTO) NSF/LIGO