LIGO and Virgo Join Forces In Search for Gravitational Waves

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The Laser Interferometer Gravitational-Wave Observatory (LIGO) and the Virgo interferometric gravitational-wave detector of the European Gravitational Observatory (EGO) near Pisa, Italy, have agreed to join in a collaborative search for gravitational waves from sources in and far beyond our galaxy.

The collaboration will link the three LIGO detectors, which are in the United States, and LIGO's partner, GEO600 in Germany, with the Virgo detector to increase the likelihood of detecting the elusive phenomenon first predicted over 90 years ago by Albert Einstein in his general theory of relativity, and pinpointing the source of the signals.

LIGO is funded by the U.S. National Science Foundation, Virgo is funded jointly by the Italian Istituto Nazionale di Fisica Nucleare (INFN) and the French Centre National de la Recherche Scientifique (CNRS) through the EGO Consortium, and GEO600 is funded jointly by the Max Planck Society in Germany and the Particle Physics and Astronomy Research Council in the United Kingdom. Peter Saulson of Syracuse University, spokesperson for the LIGO Scientific Collaboration, and Benoit Mours of the Laboratoire d'Annecy-le-Vieux de Physique des Particules, spokesperson for the Virgo Collaboration, guided the discussions that brought about this agreement. The LIGO and Virgo collaborations have collaborated in the past on more limited technical investigations, but this agreement is the first to involve full data sharing.

"This is a landmark agreement," Saulson says. "The members of both collaborations have overwhelmingly embraced this effort, recognizing that in spite of the hard work that it will take, the best science will come from collaboration."

LIGO, in the midst of a nearly two-year run functioning at its design sensitivity, is operating along with GEO600, while Virgo is making rapid progress toward its sensitivity goals. The agreement calls for data sharing to begin when the sensitivity and duty cycle of the interferometers allow a significant contribution to joint searches for gravitational waves. In the meantime, the two collaborations have begun to merge some of their data-analysis activities in anticipation.

Mours described the importance of this agreement. "Combining the data from the collaborations is a classic example of 'the whole being more than the sum of the parts.' The combined data will give us a much better chance of finding the first gravitational waves, and will allow us to have greater confidence in any detections. And, if we find something, the combined data will provide more information about the location of the source than either project alone could."

LIGO operates laboratories in Livingston, Louisiana, and Hanford, Washington. The project was designed and is operated by the California Institute of Technology and the Massachusetts Institute of Technology. Research is carried out by the LIGO Scientific Collaboration (LSC), a group of 500 scientists at universities around the United States and in eight foreign countries.

The LSC includes the members of GEO600, the German-British project that operates an interferometer near Hannover, Germany. Data from the GEO600 interferometer have been used in a number of observations by the LSC, and are expected to continue to play an important role in the global network once Virgo joins. Bernard Schutz, representing GEO,

welcomes Virgo's participation. "With this agreement we are pioneering a closer level of scientific cooperation between the USA and Europe. By completely pooling our data and coordinating our operations we greatly improve the sensitivity of all our detectors and agree to share equally in the scientific results of our hard work. Science is the big winner from this agreement."

The Virgo Collaboration comprises 180 scientists from 13 institutions in France, Italy, and the Netherlands.

This agreement lays the groundwork for future expansion of worldwide collaboration. It explicitly states that new detectors are welcome to join the international network of gravitational-wave detectors as the new detectors become operational at a sensitivity that would benefit the collective scientific capabilities of the network.

The LIGO, GEO600 and Virgo detectors are very similar in concept, though many aspects of the apparatus have different detailed implementation. All projects have L-shaped facilities with multi-kilometer-long arms (4 kilometers for LIGO, 3 kilometers for Virgo, 600 meters for GEO600) with evacuated tubes that contain laser beams monitoring the positions of precision mirrors using interferometry. According to Einstein's theory, the relative distance of the mirrors along the two arms changes very slightly when a gravitational wave passes by. The interferometers are set up in such a way that a change in the lengths of the arms as small as one part in ten to the 18th meters (a thousandth the diameter of an atomic nucleus) can be detected.

The next major milestone for LIGO, Advanced LIGO, funded by the National Science Foundation with British and German partners, is expected to start construction in 2008. Advanced LIGO, which will utilize the infrastructure of LIGO, will be 10 times more sensitive than the current LIGO detectors. Virgo scientists are also planning for a

comparable upgrade of their detector (Advanced Virgo), which will be made about the same time.

Additional information about the detectors can be found at www.ligo.caltech.edu , geo600.aei.mpg.de , www.virgo.infn.it .

Source: Caltech