

for: Matters of Gravity (electronic newsletter of APS Topical Group on Gravitation)
author: Peter Saulson

LIGO-T070203-00-Z

LIGO/GEO/Virgo begin working together in the search for gravitational waves

The past year has seen outstanding progress in the global search for gravitational waves. The three LIGO interferometers have been carrying out nearly continuous observations at their design sensitivity for the 5th Science Run (S5), joined for substantial periods by the GEO 600 interferometer. S5's goal of one year's worth of coincident data will soon be achieved. Meanwhile, discussions were held between the LIGO Laboratory and the LIGO Scientific Collaboration (which includes the members of GEO) and Virgo and EGO (the European Gravitational Observatory which operates the Virgo interferometer) on arrangements for joint observing and data analysis. Those discussions came to a successful conclusion, as marked by two events in 2007: the signing of a Memorandum of Understanding laying out the agreement to observe and analyze data together, and then, on 18 May 2007, the start of the first Virgo Science Run (VSR1) in coordination with LIGO's S5.

The agreement serves as a model for global network analysis of data from all gravitational wave detectors, as they come on line. The basic structure is not a merger, but instead a commitment from independent projects to work together on both the operation of their detectors and on data analysis. The collaboration on data analysis is especially close. Except for closing out of papers on pre-agreement observations, all analysis will be carried out by joint teams, and will be published in papers bearing the names of the members of all of the projects.

To make this agreement a reality, members from the various projects have begun working together through a variety of structures. Data analysts from the LSC and from Virgo now work together in joint Data Analysis Groups (one for each of the major signal categories: bursts, inspirals, pulsars, and stochastic background.) These data analysis groups will have joint review committees attached to them to vet observational results. On the operational side of things, a joint Run Planning Committee coordinates plans for observing, maintenance, commissioning, and upgrades. Collaboration meetings are now joint meetings between the two collaborations. Two will be held each year in Europe, and two in the U.S. The inaugural joint meeting was held in Baton Rouge on 19 – 22 March; followed by another in Pisa on 21 – 24 May, coordinated with the start of VSR1. A subsequent joint meeting was held on 23 – 26 July at MIT, and another will be held in Hannover on 22 – 25 October.

As important as this present work is, perhaps even more important are the plans for the future. The science runs S5 and VSR1 will finish this fall. Then, LIGO and Virgo will each undertake a program of incremental upgrades. LIGO, for example, will upgrade two of its interferometers (the 4-km interferometers at the Hanford and Livingston sites) with new lasers and readout optics. These Enhanced LIGO interferometers are hoped to achieve a sensitivity twice as great as they had in their original state. Virgo plans to upgrade its 3-km interferometer to become Virgo+, with similar sensitivity to Enhanced

LIGO. While those upgrades are taking place, GEO will operate the GEO 600 interferometer, and LIGO will operate the 2-km interferometer at Hanford with as high a duty factor as it can, consistent with the upgrade work on the 4-km interferometer. TAMA, in Japan, also plans to be on the air; discussions are under way to bring it under the umbrella of the LIGO/Virgo agreement. In addition, the bar detectors AURIGA and those operated by the Rome Group (EXPLORER and NAUTILUS) will be collecting data; discussions are also under way with those groups.

It is hoped that this upcoming upgrade phase will be completed in less than two years, to be followed by a substantial (of order 1 year) science run of the upgraded interferometers. Time pressure comes from the happy prospect of the start of construction of Advanced LIGO in the U.S. (and, in parallel, Advanced Virgo with comparable sensitivity.) Advanced LIGO is designed to have sensitivity ten (or more) times greater than initial LIGO. At that sensitivity, it is expected that signals will be detected regularly (once/month or perhaps even more frequently.) Those detectors, to come on line around 2015, will inaugurate the era of gravitational wave astronomy. On that time scale, there are also good prospects for detectors of similar sensitivity in Japan (LCGT) and Australia (AIGO.)

Funding for the start of Advanced LIGO is in the NSF budget bills now making their way through both houses of the U.S. Congress. Assuming successful passage and signing of those bills, Advanced LIGO hardware is expected to be ready for installation at the LIGO observatories at the end of 2010.