

**Memorandum of Understanding**  
**between**  
**VIRGO**  
**and the**  
**Laser Interferometer Gravitational Wave Observatory (LIGO) Project**  
**November 1, 1997**

The purpose of this Memorandum of Understanding (MOU) is to establish and define a collaborative relationship between VIRGO and the Laser Interferometer Gravitational Wave Observatory (LIGO) Project. VIRGO and LIGO detectors will use laser interferometry to measure the distortions of the space between free masses induced by passing gravitational waves. Both parties to this MOU share the joint goals of opening the field of gravitational-wave astrophysics, through the direct detection of gravitational waves, and later through their use as astrophysical probes by coincidence analysis from all the detectors. This MOU is intended to further these joint goals:

1. CNRS and INFN have signed an agreement concerning the realization of the Antenna for the detection of gravitational waves, VIRGO, on 27 June 1994 in Pisa. VIRGO consists of a three kilometers Fabry-Perot interferometric antenna aimed at the detection of gravitational waves in the frequency range 10-10000 Hz. VIRGO is to be built in Cascina, Italy. The validation phase of the central part of the antenna will start in 1999, while the full interferometer is expected to be operative during the year 2001. VIRGO presently involves 11 laboratories and about 200 physicists and technicians from INFN and CNRS. The realization of VIRGO is supervised by the VIRGO council foreseen in article 8 of the CNRS-INFN agreement.
2. NSF and Caltech have signed a cooperative agreement on May 1992 (cooperative agreement No PHY 9210038). LIGO is a system of three interferometric Fabry-Perot antennas, two of them 4 kilometers long and the third one 2 kilometers long, aimed at the simultaneous detection of gravitational waves in the frequency range 30-6000 Hz. LIGO is to be built in Hanford, Washington and in Livingston Parish, Louisiana (USA) and is expected to be operative during the year 2000. The design, construction, and operation of LIGO is being carried out by the California Institute of Technology (Caltech) and the Massachusetts Institute of Technology (MIT). The realization of LIGO is supervised by the LIGO oversight committee.
3. The Project Leader of VIRGO and the Principal Investigator of LIGO will serve as liaison between VIRGO and LIGO. In this capacity, they will identify issues that need to be considered by both VIRGO and LIGO, will facilitate study of these issues, will see that the results of these studies are communicated to both VIRGO and LIGO in a timely and effective manner and shall help implement the goal of optimizing scientific opportunity.
4. Both parties need to develop large and specific efforts in many fields as diverse as: active and passive seismic isolation, optical metrology and manufacturing, vacuum technology, materials

science (mechanical damping, dislocations, hysteresis), parallel computing, etc. Joint developments and sharing of technologies will improve the efficiency and quicken the achievement of the common goals.

- 5. VIRGO and LIGO will agree on Observatory operating modes, schedules, joint data protocols, data analysis and data sharing.
- 6. VIRGO and LIGO will share hosting of scientific meetings and shall invite each other to major meetings and reviews, agree to exchange documents and distribution lists, and agree to exchange team members in a helpful and collaborative manner.
- 7. Each party to this MOU continues to be responsible for obtaining all resources, and for all support of its staff including travel costs associated with the activities under this MOU. Exceptional support of travel by the other institution may be allowed for travel requested by that party.
- 8. In order to preserve the intellectual property rights of INFN, CNRS, and Caltech, the VIRGO project leader and the LIGO principal investigator will at once inform the VIRGO council, Caltech and the NSF of any invention emanating from joint actions which might lead to intellectual property right.
- 9. This Memorandum of Understanding will remain in force until the parties mutually agree to terminate it. Attachments will define specific activities to be carried out.

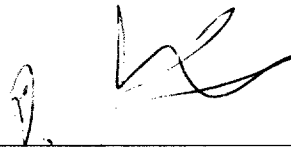
Approved:

*Barry Barish*

Barry Barish  
LIGO Principal Investigator

*19 Feb 98*

Date



Alain Brillet  
VIRGO project leader

*13 Feb 1998*

Date

approved by the VIRGO Council on 19/01 1998