Memorandum of Understanding

between the GEO collaboration

and the Virgo collaboration

for the Development of the Advanced Virgo detector

April 28, 2008

The purpose of this Memorandum of Understanding (MOU) between the GEO collaboration and the Virgo collaboration (the 'Partners') is to establish and define the continued participation of GEO scientists in the development and construction of the advanced version of the Virgo antenna. This MOU which is not legally binding replaces MOU VIR-PLA-DIR-1000-220/GEO-XXXX, which covered only the activities until the end of the study phase of Advanced Virgo.

1. CNRS and INFN signed an agreement concerning the realization of an antenna, Virgo for the detection of gravitational waves on 27 June 1994 in Pisa. Virgo consists of a three-kilometer Fabry-Perot interferometric antenna aimed at the detection of gravitational waves in the frequency range 10-10000 Hz. The construction, exploitation and data analysis of the Virgoantenna is under the responsibility of the Virgo collaboration, which has been defined in its present form in December 2001, and is formed by about 200 physicists and technicians, from laboratories of CNRS, INFN and NIKHEF. The Virgo collaboration is represented by its Spokesperson. In December 2000, CNRS and INFN jointly founded the consortium EGO, European Gravitational Observatory, with the purpose, among others, of ensuring the operation of the antenna Virgo, its exploitation and its upgrade, as well as promoting an open co-operation in R&D. The relationship between Virgo and EGO is defined in a specific MOU (EGO-COU-47-2002). The Virgo antenna is located at the site of EGO in Cascina, Italy. The operation of the Virgo antenna and EGO is supervised by the EGO Council.

2. The GEO Collaboration (referred to as GEO in this document) is a scientific cooperation founded by the University of Glasgow, the University of Cardiff, the University of Hannover, and the Max Planck Institute for Gravitational Physics (Albert Einstein Institute), according to the MOU GEO-A2008-01. Additional members of GEO include the University of Birmingham and the University of the Balearics. GEO will: a. contribute to the building and operation of gravitational wave detectors, in particular GEO600 in Ruthe near Hannover and Advanced LIGO in the USA; b. analyse gravitational wave data; c. perform other scientific research in support of these activities; d. enter into agreements to collaborate with other research organisations where this can further the joint goals; and e. disseminate the results of its research. The scientific leadership of GEO rests in the GEO Lead Scientist and the GEO Executive Committee. The Executive Committee determines the scientific goals and policy of GEO, fixes the organisational structure of GEO, coordinates the research activities of GEO member scientists, and concludes certain

agreements with other research organisations.

3. GEO has a cooperation agreement with the Laser Interferometer Gravitational Wave Observatory (LIGO) that covers sharing of data and publication/dissemination of results of the analysis of the shared data (LIGO-M010188-00-M/GEO-E2001-01, LIGO-M040357-00-M). GEO is an active member of the LIGO Scientific Collaboration (LSC) and a partner in Advanced LIGO, with membership of the LIGO Oversight Committee. Virgo has a cooperation agreement with the Laser Interferometer Gravitational Wave Observatory (LIGO) that covers the sharing and joint analysis of data with the LIGO detectors and with GEO600 (LIGO-M060038-01-M/VIR-PLA-DIR-1000-223). The above agreements take precedence over the present agreement discussed here, which is not designed to supersede them. GEO members participating in this agreement remain members of the LSC, so long as the LIGO-GEO MOUs (LIGO-M010188-00-M/GEO-E2001-01 and LIGO-M040357-00-M) remain in effect.

4. The GEO600 detector participated in the S1, S3, S4, and S5 science data taking runs of the LSC. It is currently (April 2008) in Astrowatch mode, taking data in science mode with high duty cycle during the upgrade of the LIGO and Virgo detectors to their enhanced sensitivity levels. Beginning in this period but mainly after S6 commences (2009), several incremental upgrades using advanced technology, called GEO-HF, are planned to improve the sensitivity. By arrangement between LIGO and GEO, some of these technologies will also be provided to LIGO as part of GEO's partnership in Advanced LIGO.

5. The Virgo antenna collected data during its first science run (VSR1) which overlapped the S5 run. It is currently (2008) being upgraded to enhanced sensitivity level and it is anticipated that it will run in coincidence with the Enhanced LIGO detectors in the VSR2/S6 run, beginning in 2009. After a period of operation a major upgrade of the Virgo antenna is foreseen ("Advanced Virgo") aiming at a sensitivity improvement of one order of magnitude over the original Virgo design sensitivity. This upgrade is expected to be contemporaneous to the Advanced LIGO installation.

6. In the very long term, a third generation of antenna to follow the advanced version of the detectors is expected to be developed worldwide. After participating in the ILIAS-GW European program which offered support for coordination in the field of gravitational wave research and R&D for thermal noise reduction, Virgo and GEO member institutions are participating in the EU/FP7-funded design study for the third-generation "Einstein Telescope".

7. To contribute toward the goal of achieving maximum sensitivity for Advanced Virgo and subject to the availability of resources, relevant GEO scientists will participate in the development and construction of Advanced Virgo. Subject to ongoing commitments to GEO and Advanced LIGO being fully honoured, the GEO Collaboration undertakes to ensure that these scientists are able to fulfil their commitments to Virgo in a timely and effective manner. The individuals concerned and their responsibilities to Virgo will be defined in Addenda to this MOU. The updated list of GEO scientists participating in this activity will be agreed between the GEO collaboration and the Virgo collaboration on a regular basis.

8. The selected GEO scientists will participate in the Virgo Collaboration on the same basis as VIRGO collaboration members with regard to commitment and privileges, however are not members of the Virgo Collaboration. They could be appointed by the Virgo Steering Committee (VSC) to any Virgo coordination responsibility and/or Virgo boards like for instance the Virgo Speakers Bureau or Virgo Editorial Board. GEO will appoint a person to represent them on the "VSC-wide" part of the VSC meetings. At a later stage, this person could attend the VSC restricted meeting as observer. The VSC will nominate an observer who could attend the non restricted part of GEO executive meetings. The GEO scientists indicated as authors in the Addenda to this MOU could be authors of the regular Virgo talks and publications after the probation period defined in the Virgo publication rules. The GEO institutions to be listed in the publications will be defined in the Addenda. Any form of dissemination of any results that have had significant input from LSC members not in GEO must be made jointly with the LSC. Reciprocally, any form of dissemination of any results that have had significant input from Virgo members must also be made jointly with Virgo. It is expected that the LSC and the Virgo boards dealing with publications will provide common guidelines on publication rules.

9. The Parties acknowledge that any project results (including discoveries, inventions, materials, intellectual property, know-how) developed under this Memorandum of Understanding shall belong to the Party developing this. Each Party hereby provides the other Parties with a non-exclusive licence to use these results for internal, non commercial research and for the purposes of the collaborations.

10. 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.

11. Participants to the GEO Collaboration will make efforts to seek funding from relevant agencies in the UK, Germany and Europe for capital investment relevant to the work of this MOU. Any request for European funding will be coordinated with the Virgo Collaboration.

12. The Spokesperson of the Virgo collaboration and the Lead Scientist of GEO will serve as liaison between the Virgo collaboration on one side and GEO, on the other side.

13. This Memorandum of Understanding will remain in force for 5 years in the first instance or until the parties mutually agree to terminate it. If one party wishes to terminate the agreement 6 months notice of request for termination should be given, during which time any ongoing obligations should be discharged to the satisfaction of both parties.

Approved:

GEO Lead Scientist	Virgo Collaboration Spokesperson
16 May 2008	2 May 2008
Date	Date