Memorandum of Understanding

between

VIRGO

on one side

and the

Laser Interferometer Gravitational Wave Observatory (LIGO)

on the other side

Purpose of agreement:

The purpose of this Memorandum of Understanding (MOU) is to establish and define a collaborative relationship between VIRGO on the one hand and the Laser Interferometer Gravitational Wave Observatory (LIGO) on the other hand in the use of the VIRGO, LIGO and GEO detectors based on laser interferometry to measure the distortions of the space between free masses induced by passing gravitational waves.

We enter into this agreement in order to lay the groundwork for decades of world-wide collaboration. We intend to carry out the search for gravitational waves in a spirit of teamwork, not competition. Furthermore, we remain open to participation of new partners, whenever additional data can add to the scientific value of the search for gravitational waves. All partners in the collaborative search should have a fair share in the scientific governance of the collaborative work.

Among the scientific benefits we hope to achieve from the collaborative search are: better confidence in detection of signals, better duty cycle and sky coverage for searches, and better source position localization and waveform reconstruction. In addition, we believe that the intensified sharing of ideas will also offer additional benefits.

This MOU supersedes the MOU LIGO-M060038-02-M between the VIRGO and LIGO Projects, established in May 2007, however all the agreements done under it or under Amendments No. 1 or 2 remain valid.

Details of and extensions to this MOU will be provided in Attachments agreed to by LIGO and VIRGO.

Parties to the agreement

1. VIRGO denotes the Virgo Collaboration and the European Gravitational Observatory (EGO) consortium.

CNRS and INFN signed an agreement on 27 June 1994 concerning the realization of a three kilometer Fabry-Perot interferometric antenna aimed at the detection of gravitational waves in the frequency range 10-10 000 Hz, named Virgo, located at Cascina, Italy. This agreement was superseded by the Agreement between CNRS and INFN, founding the "European Gravitational Observatory "Consortium under Italian law (EGO), signed on 11 December 2000, completed by the agreement signed with the Nikhef on July 2009, the Netherlands becoming an associated member.

The main purpose of EGO is to ensure the end of the construction of the Virgo antenna, its commissioning, its operation and its upgrade, as well as to promote an open co-operation in R&D. The Consortium is supervised by the EGO Council. The implementation of the above is performed via the involvement of the Virgo Collaboration in the framework of the Memorandum of Agreement between the Virgo Collaboration and EGO Consortium, signed on 20 November 2002.

The Virgo collaboration is composed of approximately 200 scientists and technicians coming mainly from CNRS and INFN laboratories, which have signed an Agreement on 19 December 2001, as well as from EGO, the Netherlands, Poland and Hungary. Decisions are taken by its steering committee. The overall scientific exploitation of the Virgo antenna is under the responsibility of the Virgo Collaboration

In this MoU the Virgo collaboration is represented by the spokesman appointed by the Virgo steering committee and the EGO Consortium by the director of EGO appointed by the EGO council.

2. LIGO denotes hereafter the LIGO Laboratory and the LIGO Scientific Collaboration (LSC).

LIGO was built under a Cooperative Agreement between the National Science Foundation (NSF) and Caltech signed in May 1992 (No. PHY9210038). LIGO is a system of three interferometric Fabry-Perot antennas possessing 4 kilometer arm lengths, aimed at the simultaneous detection of gravitational waves in the frequency range 10-6000 Hz. LIGO observatories have been built in Hanford, Washington and in Livingston Parish, Louisiana (USA) and began observations in the year 2002. The design and construction of LIGO was carried out by the California Institute of Technology (Caltech) and the Massachusetts Institute of Technology (MIT). Caltech and MIT jointly operate LIGO Laboratory for the NSF under a Cooperative Agreement between NSF and Caltech, with MIT participating through subaward to Caltech. The LIGO Oversight Committee supervises the realization and exploitation of LIGO.

The LSC is composed of approximately 900 individuals from more than 70 institutions worldwide, including scientists and engineering personnel from the LIGO Laboratory. LSC membership includes all of the scientists and engineers in the GEO project. These scientists and

engineers have the same rights and privileges as any other LSC members with regard to the provisions of this MOU.

The LSC Charter establishes the functions, organizational structure and responsibilities of the LSC as well as its role in the research of the LIGO Laboratory, and the release of scientific results. The LIGO leadership consists of a Directorate that includes the LIGO Executive Director, the LIGO Laboratory Deputy Director, and the LSC Spokesperson. The LSC Collaboration Council, with proportional representation from each group, votes on issues of importance to the collaboration, and elects the Spokesperson.

The German/British Collaboration for the Detection of Gravitational Waves (GEO) has built a detector of arm length 600m (GEO600) near Hannover in Germany, with the purposes of joining in a worldwide search for gravitational radiation from astronomical sources and of developing advanced interferometric and suspension technologies for later gravitational wave detectors. The design, construction and operation of the GEO600 system is being carried out by scientists and technologists at the University of Hannover, the University of Glasgow, and the Max Planck Institute for Gravitational Physics (Albert Einstein Institute) in Hannover and Golm. Data acquisition and analysis are carried out by the Albert Einstein Institute (AEI), Cardiff University, the University of Glasgow and Birmingham University The project is funded in Germany by the State Government of Niedersachsen, the Max Planck Gesellschaft (MPG), and the Bundesministerium für Bildung und Forschung (BMBF) in Germany, and by the Science and Technologies Facilities Council (STFC) in the UK.

The agreement LIGO-M040357-00-M (dated November 5, 2004) between LIGO and GEO states, "All such agreements to share data with external projects will be made jointly by LIGO/LSC and GEO leadership, with the goal that, wherever it makes scientific sense, provisions for sharing data will treat data from LIGO and GEO equivalently." Thus, this agreement applies equally to data from any of the three LIGO interferometers and to data from the GEO 600 interferometer. The signature of the GEO600 Principal Investigator for Data Analysis on this MOU is in accord with LIGO-M040357-00-M and constitutes their endorsement of this collaboration.

By virtue of this agreement, the term LIGO as used in this MOU includes GEO as well.

Scope of the agreement:

3. This agreement governs cooperative scientific work between VIRGO and LIGO. The parties agree that all of the data analysis work that they do will be carried out under the framework of this agreement, however, each Collaboration retains the ownership of and control over its own data. Agreements involving gravitational wave data sharing with other parties will be initiated and carried out jointly with LIGO and VIRGO, in a spirit of teamwork.

The terms governing other forms of collaborative work with non-gravitational wave data are not exclusive: VIRGO and LIGO may each make agreements with other parties, as long as such agreements respect analysis and publication agreements established in this MOU, and they do not involve sharing of data of the other Collaboration.

4. The agreement described herein represents a scientific collaboration between independent projects, not a merger. Each project will maintain its own separate governance. Decisions on issues that bear on all collaborative work will be made in discussion among the leadership of the projects, each representing their Collaborations' position as determined according to their own governing structures. If Collaboration leaderships cannot come to agreement on issues that bear on collaborative work covered under the terms of this agreement, each Collaboration may use its own data for its own scientific purposes. Specific procedures for defining and resolving conflicts are detailed in Section 18.

5. Goals for joint data analysis will be proposed by LSC/Virgo collaboration Joint Data Analysis Groups, will be discussed jointly by both Collaborations and will be approved by each Collaboration according to their own governing structures. The specific mechanisms for the coordination of the data analysis activities are described in an Attachment to this MOU.

6. The sharing of commissioning experience and R&D done by the Collaborations is encouraged, respecting all parties' publication and intellectual property rules. Joint work on commissioning and advanced R&D may be proposed by the technical working groups; this, too, will be approved by the leadership of both Collaborations.

7. All acquired data will be open and made available to both collaborations, to be used in the framework of Joint Data Analysis groups. All gravitational wave data analysis will be carried out under the umbrella of this agreement between LIGO and VIRGO; there will be no LSC-only or Virgo-only gravitational wave data analyses while this agreement remains in force. (However, each Collaboration may use its own environmental data freely, outside the framework of this agreement.)

All collaborative data analysis work with projects other than LIGO or VIRGO will be negotiated by and carried out by the LSC and VIRGO together as described in Section 3.

Coordination between VIRGO and LIGO

8. Scientists of LIGO and VIRGO will meet regularly to exchange information on detector status and the progress of joint data analysis, and to share plans for future data collection, instrument repairs, and detector enhancement. Data analysis will be carried out jointly, and progress will be reported to the Collaborations regularly. The leaders of the projects will work to coordinate those plans, with the goal of optimizing the science done with the network of instruments.

9. The LSC and the Virgo Collaborations will each appoint (according to their governing structures) representatives to joint committees to coordinate detection assessment, data analysis planning, run planning, and computing, as detailed in the Attachment A to this MOU. The makeup of these committees will be decided by mutual agreement between the projects.

Organization of joint data analysis:

10. All data analysis activities will be open to all members of the LSC and Virgo Collaborations, in a spirit of cooperation, open access, full disclosure and full transparency with the goal of best exploiting the full scientific potential of the data.

Data analysis projects and activities will be organized in joint Analysis Groups, comprising members of the LSC and Virgo. Every data analysis project shall be affiliated with at least one of the Analysis Groups.

Participation in the Analysis Groups will be open. Instrument experts will be active members of all Analysis Groups and Review Committees, to ensure appropriate use and interpretation of the data.

The organization and operation of the Analysis Groups are detailed in Attachment A to this MOU.

Review and publication of observational results:

11. An Analysis Review Committee will be attached to each Analysis Group. It will be responsible for carrying out the detailed technical review of analysis results and to vet claims made in talks and papers.

The organization and operation of the Analysis Review Committee, as well as other aspects of the review process, are described in Attachment A to this MOU.

All data and their interpretation will be held strictly within the membership of the Collaborations until the review processes outlined below are complete and both Collaborations have given their permission for public release. This is to be interpreted that no discussion of results or pre-prints may take place with scientists who are not members of the Collaborations or with members of the media, until the leaderships of the Collaborations have approved the release of the information. Willful dissemination of information in contradiction of these rules may be a basis for expulsion from the collaboration in question.

12. Author lists are to be separately established according to the rules of each Collaboration, and maintained by them. Observational results papers will be published with one single alphabetical list of authors, referred to as "The LIGO Scientific Collaboration and the Virgo Collaboration".

Organization of collaborative technical research

13. We encourage all possible ways to share technical information, whether related to commissioning of present interferometers or R&D on future interferometers. We will encourage visits (both short-term and long-term) of scientists to the observatories and/or to the campus research facilities of the other project. We also encourage specific joint research and development projects whenever feasible. The leadership of LIGO and VIRGO need to be informed of all collaborative work; they may require an Attachment to the MOU be negotiated if significant commitments are required.

Meetings of instrument science working groups of one Collaboration will be open to members of the other Collaboration. In addition, periodic joint collaboration-wide meetings will be held, to facilitate the exchange of knowledge and ideas. Documentation of technical developments will be made available to both collaborations.

A joint review process will be established for instrument science and technical papers to ensure fairness to authors, the quality of papers, and timely publication. All publications and presentations which come about due to the work of the joint collaborative effort or from sharing of ideas in the context of the joint collaboration shall be submitted to the joint review process, whether or not authorship includes members from both collaborations. A final version shall be circulated to both Collaborations before submission.

Coordination with governing bodies and sponsors:

14. 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 party may be allowed for travel requested by that party.

15. In order to preserve the intellectual property rights of their respective institutions and sponsors, the Virgo Collaboration Spokesperson, the EGO Director and the LIGO Executive Director will promptly inform each other of any invention resulting from joint actions which might lead to intellectual property rights. Each of them will be responsible to further notify their respective governing bodies as well as relevant institutions and sponsors from their collaboration with any possible interest in those intellectual property rights.

16. The LIGO Laboratory is responsible for obtaining NSF approval of collaborative Memoranda of Understanding where required. All attachments will be provided to NSF for their information.

17. The Virgo spokesperson and the EGO Director are responsible for obtaining the EGO council approval of collaborative Memoranda of Understanding and the CNRS, INFN endorsement, where required. All attachments will be provided to EGO council for its information.

Conflict resolution:

18. The LSC and Virgo will make every effort to come to agreement on issues bearing on collaborative work covered under this agreement. In the event that a conflict between Virgo and

the LSC cannot be resolved through discussions between Collaborations' governing bodies, each Collaboration may act independently using their own data. Neither Collaboration shall impede the work of the other Collaboration. The Collaborations will continue joint activities on projects that are not affected by the conflict.

Such conflicts include but are not limited to issues related to publication or presentation of data analysis or instrument science results or discoveries, access to data from non-collaboration members, selection of data for analyses, or use of data by collaboration members. In the event of conflict, the Collaboration proceeding with the project involving conflict will continue to share information on the progress of that project with the other Collaboration. In general, the other Collaboration is welcome to participate in corresponding working group meetings, unless it is inappropriate.

As stated in section 3, agreements involving gravitational wave data sharing with other parties will be initiated and carried out jointly with LIGO and VIRGO, in a spirit of teamwork. However, if one Collaboration establishes an agreement with a third party involving the use of its own data, the other Collaboration maintains the right to access and use those data. The Collaborations will share information on arrangements made with third parties including those in conflict, unless it is inappropriate or objected to by the third party.

Term of agreement:

19. This agreement will come into force after the endorsement by NSF and the EGO Council. It covers collaborative work beginning on April 1, 2014 (or after the signing date if later) and lasting for three years from that date. It may be extended by mutual agreement between LIGO and VIRGO. Cessation of any data exchange may take place at the request of either LIGO or VIRGO. Data collected under the terms of this agreement (prior to its cessation), on-going analyses of them, and any publications and presentations using them are governed by the terms of this MOU and its attachments indefinitely, unless both LIGO and VIRGO agree to a change.

Approved:

David Reitze
LIGO Executive Director and LIGO Principal Investigator
20 MARCH 2014
Date

Albert Lazzarini
LIGO Laboratory Deputy Director
20 March 2014
Date

Gabriela González
LSC Spokesperson 3/20/14
Date

Bernard Schutz
GEO 600 Principal Investigator for Data Analysis
20 March 2014
Date

Federico Ferrini
Director of EGO
Date 20 March 2014

Jean-Yves Vinet
Virgo Collaboration Spokesperson
Date 20/03/2014