

**Memorandum of Understanding**  
**between**  
**KAGRA, LIGO and Virgo Scientific Collaborations**

**A. Purpose of the agreement:**

The purpose of this Memorandum of Understanding (MOU) is to establish a collaborative relationship between the signatories who are seeking to discover gravitational waves and pursue the new field of gravitational wave astronomy. The main scientific motivation is that the maximum return from gravitational wave observations is through simultaneous joint measurements by several instruments.

This MOU provides for joint work between the scientific collaborations of KAGRA, LIGO and Virgo. We enter into this agreement in order to lay the groundwork for decades of world-wide collaboration. When sensitive detectors are in operation, we intend to carry out the search for gravitational waves in a spirit of teamwork.

Details and extensions to this MOU will be provided in Attachments agreed by the parties.

**B. Parties to the agreement:**

**1. KAGRA**

KAGRA, previously called LCGT (Large-scale Cryogenic Gravitational-wave Telescope), is a 3-km laser interferometric gravitational wave antenna built at Kamioka underground site in Japan. One of its characteristic features is to be a cryogenic interferometer; the test-mass mirrors that form 3-km Fabry-Perot arm cavities are cooled down to cryogenic temperature of around 20K, so as to reduce the effect of thermal noises. Stable environment of the underground site and

cryogenic technologies will be helpful to obtain fruitful sciences in the field of gravitational-wave astronomy, both in the first detection era and in the subsequent era of gravitational wave astronomy.

KAGRA project is supported by MEXT (Ministry of Education, Culture, Sports, Science, and Technology) of Japan. KAGRA is hosted by Institute for Cosmic Ray Research (ICRR), the University of Tokyo and co-hosted by KEK and NAOJ. The KAGRA collaboration is composed of more than 180 individuals from more than 45 institutions. KAGRA membership is approved in KAGRA collaboration meetings held twice a year.

## **2. LIGO Scientific Collaboration (LSC)**

LIGO includes the LIGO Laboratory and the LIGO Scientific Collaboration (LSC). GEO is part of the LSC.

The Charter (LIGO M980279-05) of the LIGO Scientific Collaboration 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 includes the Laboratory Directorship and the LSC Spokesperson, who is elected by the LSC Council. In this MOU, the LSC is represented by its spokesperson. The German/British Collaboration for the Detection of Gravitational Waves (GEO600) is part of the LSC. We note that the proposal to develop LIGO-India is in process. LIGO-India will become part of the LIGO Lab when it is approved and implemented, and the Indian scientists will join the LSC.

The LSC is composed of more than 800 individuals from more than 75 institutions worldwide, including scientists and engineering personnel from the LIGO Laboratory. It is the policy of the LSC that all LIGO participants who have earned authorship rights be included as authors on any publication reporting on LIGO and GEO observations and astrophysics results. (This does not apply to technical papers.)

### **3. VIRGO Collaboration**

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.

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, the EGO consortium and its Director appointed by the EGO Council, are represented by the spokesperson appointed by the Virgo steering committee.

#### **C. Scope of the agreement:**

KAGRA, LIGO and VIRGO agree to plan a collaborative relationship to govern the joint data analysis work of the detectors' data to search for and study gravitational waves.

The planning process shall be jointly started by the parties after the signature of this agreement. All the parties shall work toward an agreement governing the cooperative scientific work

between KAGRA, LIGO and VIRGO to apply at the time all detectors' data can contribute to the search and study of gravitational waves. After the agreement, all the parties shall work cooperatively toward the scientific goals as defined above.

We encourage all possible ways to share technical information related to data access, data analysis methods, research and development, and detector technology, respecting all parties' existing internal procedures and other procedures established by MOUs.

Specific two or three party agreements on joint collaborative technical work will be included as attachments to this agreement.

**D. Relation with the existing agreements:**

This MOU complements, but does not supersede the previous agreement by VIRGO and LIGO LIGO M060038 and VIR-PLA-DIR-1000-223, and its attachments.

**E. Term of the agreement:**

This agreement will come into effect beginning at the signing date, and lasting three years from that date. It may be extended by unanimous agreement among KAGRA, LSC and VIRGO.

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Takaaki Kajita, KAGRA PI (Principal Investigator)

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Date

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Gabriela González, LSC Spokesperson

\_\_\_\_\_  
Date



ARTEMIS, Observatoire de la Cote d'Azur, Dec. 3rd 2012

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Jean-Yves Vinet, Virgo Spokesperson

\_\_\_\_\_  
Date