

**Attachment Number 5 to the
Memorandum of Understanding (LIGO-M970009-00-M)
between the
TAMA Project, Japan
and the
Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory
June 23, 2000**

This amendment to Attachment No. 5 to the Memorandum of Understanding LIGO-M970009-00-M between the TAMA Project and the Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory, describes cooperative research effort to be undertaken by the TAMA Project and the LIGO Laboratory. The research will focus on investigation and demonstration of seismic attenuation technology (SAS). Respective obligations and responsibilities on the part of the TAMA and LIGO collaborators are indicated in the attached SAS R&D Program Plan. The period of performance for the activities in this agreement is from April 1, 2000 to March 31, 2001. This period may be modified by agreement to a revision of this Attachment No. 5.

1. The TAMA SAS development effort will be under the direction of Kimio Tsubono. The LIGO SAS development program is under the direction of Riccardo De Salvo.
2. K. Tsubono and R. De Salvo will be responsible for coordination of the effort in this agreement on the part of their respective research teams.
3. The constitution of the TAMA and LIGO research teams is indicated in the attached SAS R&D Program Plan.
4. The TAMA and LIGO collaborators will fully share their respective research results and technical information. The progress of research will be reported and discussed as part of informal weekly teleconferences between the two research teams and in technical progress reports keyed to the critical program milestones.
5. The SAS development is an on-going program. It is projected to continue beyond to term of this agreement. The tasks planned for the period April 1, 2000 through March 30, 2001, and involving the TAMA collaboration, are as follows:
 - a) Prototype design, construction and ambient testing. This effort will take place at the LIGO/ Caltech facilities and will be under the direction of R. De Salvo.

The current LIGO SAS conceptual design will be modified for possible use on TAMA.

A number of prototype configurations will be constructed and subjected to ambient testing. Performance parameters will be demonstrated. The viability of SAS technology for further investigation and for possible use on TAMA will be investigated.

b) TAMA SAS prototype design, construction and in-vacuum testing. This effort will take place at the TAMA facilities in Japan, and will be under the direction of K. Tsubono.

The LIGO SAS baseline design will be modified, based on the prototype testing to date, for possible use on TAMA.

Two TAMA SAS prototypes will be constructed and subjected to in-vacuum and integrated system-level testing. All performance parameters will be demonstrated. The objective of this task is to demonstrate the viability of SAS technology for TAMA.

6. The development of a novel SAS control scheme, merging the inertial and position sensors, is critical to reaching the challenging TAMA seismic attenuation goals.

This research task will be the subject of a Doctoral thesis on the part of Akiteru Takamori, University of Tokyo exchange student, on LIGO research assignment at Caltech. The research assignment and A. Takamori 's association with Caltech are subject to the Memorandum of Understanding (MOU) between the Department of Physics, Graduate School of Science, The University of Tokyo, Japan and the Division of Physics, Mathematics and Astronomy, California Institute of Technology, and the Attachment Number 1 to this MOU.

7. TAMA Science

The installation of TAMA SAS into the TAMA300 will be decided after this R&D program is finished, taking into account also other TAMA circumstances at that time. If TAMA proceeds to the SAS installation, R. De Salvo and additional key LIGO scientific contributors to the SAS technology development (to be named afterward based on mutual agreement between LIGO and TAMA) will be considered full TAMA collaborators for a period of two years, commencing with the completion of the possible installation of TAMA SAS into TAMA300. As such, these scientists will have the following rights:

- a) to have access to and to analyze the data, which are taken during the two-year period, under the direction of the TAMA executive committee, and
- b) to be entitled to co-authorship on major TAMA instrument and scientific publications.

8. Intellectual Property

In order to preserve intellectual property rights of TAMA, Caltech and the NSF, any invention emanating from joint actions under this agreement which might lead to intellectual property rights will be disclosed to all other collaborating parties in a timely manner. Final disposition

of said intellectual rights matters will be subject to mutual agreement between the parties of interest.

9. Resource Sharing

LIGO Laboratory will:

Provide accommodations for TAMA investigators while on research assignment at LIGO/ Caltech, and as indicated in Item No. 5 above.

Supply test facility and technical support personnel for ambient testing of SAS prototypes.

Supply mechanical components for construction of SAS prototypes to be tested for possible TAMA application.

TAMA will:

Provide accommodations for LIGO investigators while on research assignment at TAMA, and as indicated in Item No. 5 above.

Reimburse Caltech/LIGO Laboratory for material costs to be incurred in the production of two TAMA SAS prototypes that will be installed and remain at the TAMA 3m interferometer.

Pay for travel expenses to be incurred by the LIGO investigators while at TAMA participating on the TAMA 3m interferometer integration and system testing.

Supply test facility and technical support for in-vacuum and system level testing of TAMA SAS prototypes.

Approved:

Barry C Barish
Barry Barish
LIGO Laboratory Director
Aug 1, 2000
Date

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TAMA Principal Investigator
Aug 23, 2000
Date

Riccardo De Salvo
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LIGO Staff
Aug. 3, 2000
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