

**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  
November 12, 2002**

This amendment to the Attachment No. 5 to the Memorandum of Understanding LIGO-M970009-00-M describes continuing cooperative research in the area of seismic attenuation technology (SAS), to be undertaken by the TAMA Project and the Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory. The period of performance for the activities in this Attachment No. 5 is from April 1, 2003 to March 31, 2005. This period may be modified by agreement to a revision of this Attachment.

1. The TAMA SAS implementation effort will be under the direction of Kimio Tsubono and Ryutaro Takahashi. The corresponding SAS development activity in the LIGO Laboratory will be under the direction of Riccardo De Salvo. Tsubono and Takahashi, and De Salvo will be responsible for the coordination of the TAMA SAS effort on the part of their respective research teams.
2. 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/or in technical progress reports keyed to critical program milestones.
3. Following successful activities, as described in the basic Attachment No. 5 (LIGO-M020416-00-M), SAS seismic attenuation towers (TAMA SAS), will be integrated into the TAMA 300 interferometer. SAS installation is an on-going program. SAS use in TAMA is projected to continue beyond to term of this agreement. The tasks planned for the period April 1, 2003 through March 31, 2005 are as follows:
  - a) TAMA SAS design finalization: This effort will be contributed by the LIGO Laboratory and carried out under the supervision of Riccardo DeSalvo in collaboration with, and following the specifications of Kimio Tsubono and Ryutaro Takahashi.

- b) TAMA SAS hardware production: This effort will be contributed by TAMA, and will be supervised by Kimio Tsubono and Ryutaro Takahashi. The day-to-day production supervision at the production company (Galli & Morelli in Lucca) will be contributed in situ by Alessandro Bertolini (University of Pisa), one of the collaborators in the LIGO SAS group and, remotely from Pasadena, by Riccardo DeSalvo.
- c) TAMA SAS assembly and implementation: This effort will take place at the National Astronomical Observatory of Japan (NAOJ) under the direction of Kimio Tsubono and Ryutaro Takahashi. The LIGO SAS team, and in particular Akiteru Takamori, who developed and tested the TAMA SAS prototypes, will assist and provide their accumulated know how and expertise.

#### 4. TAMA Science

TAMA SAS prototype will be installed in the TAMA 300m interferometer.

R. DeSalvo, Virginio Sannibale, Szabolcs Marka, and Alessandro Bertolini will be full time TAMA collaborators through March 31, 2005.

#### 5. 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.

#### 6. Resource Sharing

LIGO Laboratory will:

Provide accommodations for TAMA investigators while on research assignment at Caltech, and as indicated in Item No. 3 above.

Pay for travel expenses to be incurred by the TAMA investigators while at Caltech participating in ongoing SAS research and development activity.

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

Supply any additional 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. 3 above.

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

Approved:

Barry Barish  
Barry Barish  
LIGO Laboratory Director  
14-Nov-02  
Date

Riccardo De Salvo  
Riccardo De Salvo  
LIGO Scientist  
14-Nov. 2002  
Date

Alessandro Bertolini  
Alessandro Bertolini  
LIGO SAS Group  
18-Nov. 2002  
Date

Yoshihide Kozai  
Yoshihide Kozai  
TAMA Principal Investigator  
Aug. 14, 2003  
Date

Kimio Tsubono  
Kimio Tsubono  
TAMA R&D Group Leader  
Aug. 13, 2003  
Date

Ryutarō Takahashi  
Ryutarō Takahashi  
TAMA Scientist  
11-Aug. 2003  
Date