

**Attachment ACF to the**  
**Memorandum of Understanding (LIGO-M 050306 -00-M)**  
**between the**  
**National Astronomical Observatory of Japan TAMA Group ( NAOJ-TAMA )**  
**and the**  
**Laser Interferometer Gravitational Wave Observatory (LIGO)**  
**August 15, 2006**

This Attachment ACF to the Memorandum of Understanding LIGO-M 050306 -00-M defines the role of the **National Astronomical Observatory of Japan TAMA Group** as a Member of the LIGO Scientific Collaboration (LSC) and a member of the Advanced Detector Configurations Development Group (ADCDCG). The period of performance for the activities in this Attachment is from August 15, 2006 to August 15, 2007.

1. Advanced Detector Configurations Development Group - The Advanced Detector Configurations Development Group (ADCDCG) is the scientific collaboration for defining and developing entirely new advanced interferometers. It is expected that this development group will pursue research in dual recycling, resonant sideband extraction, Sagnac interferometers, systems with non-transmitting optics and other advanced configurations. MOU Attachments define the roles and responsibilities of groups in this development group.
2. During the period August 15, 2006 to August 15, 2007, the members of **NAOJ-TAMA** will participate in ADCDCG in the following areas:

#### a) Interferometer Configurations

V. Leonhardt, F. Kawazoe, K. Kokeyama, S. Sato, and S. Kawamura will continue an experiment to demonstrate the new signal extraction method in the 4-m suspended RSE interferometer at NAOJ. This signal extraction method, which would be a backup method for Advanced LIGO interferometer, uses two modulations: one phase modulation and one amplitude modulation. The phase modulation sidebands will transmit through the Michelson interferometer because of the Michelson asymmetry, while the amplitude modulation sidebands will be completely reflected back because of the Michelson asymmetry. This contrast of the behavior between the two sets of the sidebands makes it possible to extract most effectively the length signal of the signal extraction cavity.

During this period we will first add the amplitude modulation to the existing Mach-Zehnder interferometer. With this double-modulated light, we will try to lock the power recycled Michelson interferometer, then the tuned RSE without the arm cavities. After we lock the central part of the interferometer, we will try to lock the whole RSE interferometer.

N. Atsushi and S. Kawamura will continue to work on the new configuration for Advanced LIGO. During this period we will focus on the realistic comparison between the locked Fabry-Perot type RSE and the ordinary RSE in terms of sensitivity.

S. Kawamura will visit Caltech in summer of 2007 to work on the 40m prototype. He will focus on whatever is the most important issue at that time.

## b) Squeezed Light Generation

V. Leonhardt, S. Sakata, S. Sato, and S. Kawamura will start the experiment of the quantum non-demolition. Our first goal is to observe the radiation pressure noise in the Fabry-Perot Michelson interferometer. And then we will try to reduce it using the homodyne detection. We have already found that it is quite possible to observe the radiation pressure noise with the following specifications: mass of the mirror of 20 mg, fiber with diameter of 10 micron and length of 10 mm, and finesse of the cavity of 7000. We will build the whole set-up as well as making the super-small mirror attached to the super-thin fiber. We will then measure Q of the mirrors. We will measure the sensitivity curve and do noise hunting to improve the noise so that we can see the radiation pressure noise.

c) Other Contributions

Not Applicable

3. Resource Sharing: The LIGO Laboratory will contribute resources including allocation of appropriate scientific and engineering personnel, research facilities and funding in support of the effort in Item No. 2, as indicated below.
  - a) Research accommodations for **AOJ-TAMA** group members while on LIGO research assignment at any LIGO Laboratory site,
  - b) Access to LIGO data through established LSC channels in support of this work.
  - c) Not Applicable

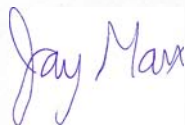
## 4. Coordination and Reporting -

**NAOJ-TAMA** will perform this research within the structures established by the LIGO Laboratory and the LSC where appropriate. In particular activities described in Item 2 will be carried out within the Advanced Detector Configurations Development Group of the LSC. Coordination will include keeping the Group leaders informed of activities and plans, reporting to the group at meetings and telecons, and through technical documents submitted to the LIGO Document Control Center.

In addition, an annual report will be submitted with the update to this Attachment, giving a summary status on research by topic as indicated in Item No. 2, including progress against the milestones if any, significant accomplishments such as new insights/discoveries or publications, issues of concern if any, and an indication of invested time. This Attachment will be updated at least annually with a plan of activities for the succeeding on-year period. These documents will be due one month before the close of the period of performance under this Attachment.

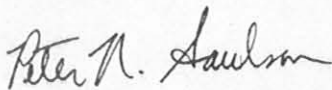
5. All computer code delivered to the LSC under this Attachment must be developed in consultation with the LSC Data Analysis Software Working Group (DASWG) and archived, documented and reviewed as determined by that group.

Approved:



Jay Marx

LIGO Laboratory Director



Peter Saulson

LSC Spokesperson



Seiji Kawamura

Principal Investigator(s)

**National Astronomical Observatory of Japan TAMA Group**