Attachment ACF to the
Memorandum of Understanding LIGO-M050306-00
between the National Astronomical Observatory of Japan TAMA (NAOJ-TAMA)
and the Laser Interferometer Gravitational Wave Observatory (LIGO)
For The Period
August 15, 2008 - August 14, 2009

This Attachment ACF to the Memorandum of Understanding LIGO-M050306-00 defines the role of the National Astronomical Observatory of Japan TAMA (NAOJ-TAMA) as a Member of the LIGO Scientific Collaboration (LSC), and a member of the Advanced Detector Configurations Development Group (ADCDG). The period of performance for the activities described in this Attachment is from August 15, 2008 - August 14, 2009.

1. Collaboration

The Advanced Detector Configurations Development Group (ADCDG) 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 Attachment ACF defines the role and responsibilities of workgroups participating in this development group.

2. Participation

During the period August 15, 2008 - August 14, 2009, the members of NAOJ-TAMA will participate in the ADCDG in the following areas:

a. Interferometer Configurations

   (1) Juggling interferometer
   We plan to apply for a budget for this research. If approved by the ministry of education, we can start the research in April, 2009. The juggling interferometer is a Michelson interferometer with the two masses and the beamsplitter floating continually. We hope that this interferometer can improve the low-frequency (down to 0.1Hz) sensitivity drastically since it is free from the seismic noise and suspension thermal noise. We will present the idea in the September L-V meeting.

   (2) 40m prototype at Caltech
S. Kawamura will visit Caltech in summer of 2008 to work on the 40m.

b. Squeezed Light Generation

(1) Observation of radiation pressure noise
S. Sakata, A. Nishizawa, E. Nishida, and S. Kawamura will reduce the noise level down to $10^{-17}$ m/rHz at 100Hz. Then we will replace the 23 mg low-quality mirror by the 23 mg high-quality mirror, which will give a finesse of 8000. We will try to improve the sensitivity to observe the radiation pressure noise.

c. Other Contributions

(1) Displacement noise free interferometer
S. Sato, K. Kokeyama, A. Nishizawa, and S. Kawamura will use the 3D bi-directional Mach Zehnder interferometer to demonstrate the basic features of the DFI interferometer, using an EOM as a simulator of the gravitational wave signals and the mirror motion.

(2) Resonant speed meter
T. Morioka, A. Nishizawa and S. Kawamura will do a table-top experiment to verify the principle of the resonant speed meter. We will set up a resonant speed meter, and demonstrate the enhancement of gravitational wave signals and cancellation of the mirror motion using EOMs.

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 NAOJ-TAMA group members while on LIGO research assignment at any LIGO Laboratory site.

   Not Applicable

b. Access to LIGO data through established LSC channels in support of this work.

   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. This includes 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 one-year period. These documents will be due one month before the close of the period of performance under this Attachment.

5. Computer Code

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.

Jay Marx  
LIGO Laboratory Director

Seiji Kawamura  
Principal Investigator(s)  
NAOJ-TAMA

David Reitze  
LSC Spokesperson
Attachment Z to the
Memorandum of Understanding LIGO-M050306-00
between the National Astronomical Observatory of Japan TAMA (NAOJ-TAMA)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO)
For The Period
August 15, 2008 - August 14, 2009

This Attachment Z to the Memorandum of Understanding LIGO-M050306-00 lists the members of National Astronomical Observatory of Japan TAMA (NAOJ-TAMA) participating in LIGO Scientific Collaboration (LSC) development group activities in support of the initial LIGO interferometers. The period of performance for these activities is from August 15, 2008 - August 14, 2009.

Faculty:

The Faculty category includes all “faculty rank” LSC members. This includes professorial appointments, research faculty appointments, teaching faculty appointments, lecturer and reader appointments, and similar appointments, and visiting appointments in all these categories.

Name: Arai, Koji
Phone: Voice: 81 422 34 3662
       Fax: 81 422 34 3793
Email: @LIGO.Org: koji.arai@LIGO.Org
       Forwarding: koji.arai@nao.ac.jp

Name: Fujimoto, Masa-Katsu
Phone: Voice: 81 422 34 3622
       Fax: 81 422 34 3793
Email: @LIGO.Org: masa-katsu.fujimoto@LIGO.Org
       Forwarding: fujimoto.masa-katsu@nao.ac.jp
Technical Staff:

The Technical Staff category includes all non-PI LSC members with scientist, engineer, computer systems administrator or programmer, technician, and similar appointments, and visiting appointments in all these categories.

Postdoctoral Scholars:
Name: Sakata, Shihori  
Phone:  
Voice: 81 422 34 3664  
Fax: 81 422 34 3793  
Email:  
@LIGO.Org: shihori.sakata@LIGO.Org  
Forwarding: shihori.sakata@nao.ac.jp

Postal Address:  
2-1-1 Otsuka  
City: Bunkyo-ku  
State: Tokyo  
Postal Code: 112-8610  
Country: JPN

Graduate Students:

Name: Kokeyama, Keiko  
Phone:  
Voice: 81 422 34 3662  
Fax: 81 422 34 3793  
Email:  
@LIGO.Org: keiko.kokeyama@LIGO.Org  
Forwarding: keiko.kokeyama@nao.ac.jp

Postal Address:  
2-1-1 Otsuka  
City: Bunkyo-ku  
State: Tokyo  
Postal Code: 112-8610  
Country: JPN

Name: Morioka, Tomoko  
Phone:  
Voice: 81 422 34 3769  
Fax: 81 422 34 3793  
Email:  
@LIGO.Org: tomoko.morioka@LIGO.Org  
Forwarding: tomoko.morioka@nao.ac.jp

Postal Address:  
National Astronomical Observatory of Japan  
2-21-1 Osawa  
City: Mitaka  
State: Tokyo  
Postal Code: 181-8588  
Country: JPN

Name: Nishida, Erina  
Phone:  
Voice: 81 422 34 3626  
Fax: 81 422 34 3793  
Email:  
@LIGO.Org: erina.nishida@LIGO.Org  
Forwarding: nishida.erina@nao.ac.jp

Postal Address:  
National Astronomical Observatory of Japan  
2-21-1 Osawa  
City: Mitaka  
State: Tokyo  
Postal Code: 181-8588  
Country: JPN

Name: Nishizawa, Atsushi  
Phone:  
Voice: 81 422 34 3662  
Fax: 81 422 34 3793  
Email:  
@LIGO.Org: atsushi.nishizawa@LIGO.Org  
Forwarding: atsushi.nishizawa@nao.ac.jp

Postal Address:  
Oosawa  
2-21-1  
City: Mitaka  
State: Tokyo  
Postal Code: 181-8588  
Country: JPN

Undergraduate Students:
Administrative Staff:

The Administrative Staff category allows the listing of administrative aides and other staff members who perform essential support services in or for LSC member groups, but are not involved in the LIGO Scientific Collaborations engineering or scientific work. Personnel who are involved in the LSC's scientific or engineering work, including computer system administration and programming, should be listed under other categories. Personnel listed as Administrative Staff may be designated as a point of contact or proxy, but do not appear as authors on LSC publications, do not count toward a group's council delegate allocation, may not serve as council delegates, and do not increase a group's shift obligation.

FTE Commitment:

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Category</th>
<th>Member</th>
<th>Research</th>
<th>LIGO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arai, Koji</td>
<td>faculty</td>
<td>100%</td>
<td>100%</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>Fujimoto, Masa-Katsu</td>
<td>faculty</td>
<td>100%</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>Kawamura, Seiji</td>
<td>faculty</td>
<td>100%</td>
<td>90%</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>Kokeyama, Keiko</td>
<td>graduate</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>5</td>
<td>Morioka, Tomoko</td>
<td>graduate</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>6</td>
<td>Nishida, Erina</td>
<td>graduate</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>7</td>
<td>Nishizawa, Atsushi</td>
<td>graduate</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>8</td>
<td>Sakata, Shihori</td>
<td>postdoc</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>9</td>
<td>Sato, Shuichi</td>
<td>faculty</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>10</td>
<td>Tatsumi, Daisuke</td>
<td>faculty</td>
<td>100%</td>
<td>100%</td>
<td>10%</td>
</tr>
<tr>
<td>11</td>
<td>Ueda, Akitoshi</td>
<td>faculty</td>
<td>100%</td>
<td>100%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Total FTE: 3.90

Roles:

Principal Investigators: Kawamura, Seiji

Membership Point-Of-Contact: Kawamura, Seiji

Group PIO/Press Coordinator: Kawamura, Seiji

Proxies:

Author Eligible

| Kawamura, Seiji |
| Sato, Shuichi |
| Sakata, Shihori |
| Kokeyama, Keiko |
| Nishizawa, Atsushi |

Council Delegates

| Kawamura, Seiji |
Approvals:

Jay Marx
LIGO Laboratory Director

Seiji Kawamura
Principal Investigator(s)
NAOJ-TAMA

David Reitze
LSC Spokesperson