Attachment Number 1 to the Memorandum of Understanding (LIGO-M950060-A-M) between the GALILEO Program at Stanford University and the Laser Interferometer Gravitational Wave Observatory (LIGO) Project

September 1, 1996

This Attachment to the Memorandum of Understanding LIGO-L950042-A-M describes a cooperative research effort between the Stanford Advanced Gravitational-Wave Laser Interferometer Program(Galileo) and the Laser Interferometer Gravitational-Wave Observatory(LIGO) Project to develop an optical system to spatially filter the output of the diode-laser-pumped ND:YAG laser being developed for LIGO by Lightwave Electronics Inc. The period of performance for the activities in this Attachment is from September 1, 1996 to August 31, 1997. This period may be modified by agreement to a revision of this Attachment.

1. The goal of this work is to produce a prototype system to spatially filter the output of the LIGO diode-laser-pumped Nd:YAG laser in which the optical transmission will be greater than 95% for the TEM00 mode and less than 0.1% for all higher modes TEMpq where $(p+q < 4)$ at an input power of less than 13 watts.

2. This task will be led by Noboru Uehara under the supervision of Professor Robert L. Byer. The technical representative from Stanford is Eric Gustafson. The technical representative for LIGO is Rick Savage, under the supervision of Stan Whitcomb.

3. Work Plan- The tasks to be carried out and the groups responsible for them are as follows:

   a. Develop performance goals for spatial mode filtering and for temporal amplitude noise filtering. (Joint)

   b. Build a table-top ring interferometer and the control electronics necessary for the measurements of the system's spatial filtering performance. (GALILEO)

   c. Measure the mode filtering performance of the ring cavity first with a low power (P<300 mW NPRO) and then with the highest power single frequency source available to the GALILEO group during the program.(GALILEO, LIGO)

   d. Using tunable sidebands, study the power handling capacity of the interferometer by probing changes in the mirrors' radius of curvature as a function of the carrier power coupled into the interferometer.(GALILEO)

e. Measure the amplitude noise filtering performance of the system at the highest photodiode current practical. (GALILEO, LIGO)

f. Begin the development of a thermal model which incorporates the absorption of the laser light in the mirror coatings and substrates.(GALILEO)

g. Collaborate to develop controls consistent with the overall LIGO laser frequency control system. (Joint)

4. Technical, Schedule and Cost Reporting - The status of the work will be reviewed in a biweekly teleconference involving all interested parties from GALILEO and LIGO. The emphasis of these meetings will be on technical and schedule issues. Cost status will be reviewed monthly.

5. Cost - Each group will be responsible for the salaries and travel expenses of its staff participating in this effort. The main experimental work will take place at GALILEO; existing capitalequipment and routine lab supplies will be provided by GALILEO. LIGO will provide special purpose lab equipment and materials with a total value of $44,000 to support these experiments.

6. Intellectual Property Rights - The rights to intellectual property developed under this Attachment will be subject to the National Science Foundation Grant Policy as indicated in Section 750, Intangible Property.

Approved:

Barry Barish
Barry Barish
LIGO Principal Investigator

Sept 24, 1996.
Date

Robert L. Byer
Robert L. Byer
GALILEO Principle Investigator

Sept 25, 1996
Date