

LSC Six-Month Progress Report

LIGO-M000268-00-M

Organization Australian Consortium for Interferometric Gravitational Astronomy (ACIGA)

Report Date August 15, 2000

Attachment B - Isolation/Suspension/Thermal Noise

Participation

ANU: Tilt Locking readout and intensity stabilisation

Frequency stability of Tilt locking has been tested by measuring the Allen deviation between two lasers locked to the same cavity using different tilt modes. The radiation pressure noise suppression technique, known as squashing, in which the readout cavity is inserted into the feedback loop has been experimentally demonstrated.

ANU: Cavity mounting

Flexure mount for cavity mirror has been designed

AU: vibration pre isolator and vacuum system

Vibration pre isolator and vacuum vessel refurbishments now complete.

AU: Reference cavity

PDH stabilisation electronics for cavity servo completed. Cavity assembled. Laser stabilisation in progress.

UWA: Isolator and optical bench design

Isolator design complete. First article under construction.

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Attachment C - Lasers/Optics

Participation Jesper Munch - 100%, Peter Veitch - 100%, Murray Hamilton - 100%, Martin Ostermeyer - 100%, Damien Mudge - 100%

(a) Characterization of HPL1 (100W pump power)

- (1) Initial operation of stable/unstable standing wave laser with strip graded-reflectivity-mirror (GRM) outcoupler has been successfully completed. Good near- and far-field beam quality was observed. The lasing efficiency was compromised by a crack in the Nd:YAG gain medium.
- (2) Single frequency operation of the stable/unstable standing wave laser, by injection of approximately 300mW from an NPRO, has been demonstrated. Gain competition and spatial hole burning in the standing wave configuration limited the duration of the single frequency operation and thus we could not demonstrate coherence between the output of the high power laser and the power from the NPRO laser. These problems were not significant in the injection-locking of our 5W ring laser, and are not expected to be significant for the high power ring laser.

Thus, essentially all of the important design verification experiments have been successfully completed: the control of the thermal lensing in the unstable direction, lasing using a stable/unstable resonator and GRM outcoupler, and the suppression of all but one mode by the injection of a single frequency beam into the stable/unstable resonator.

(b) Fabrication of HPL2 (520W pump power)

The cracked laser crystal used for HPL1 prematurely curtailed the design verification experiments. Thus we assembled a 200W-pumped standing-wave laser, which used a new gain medium and some of the new pump diodes. We have recently determined that the new gain medium, and another which was to have been used for the 520W-pumped laser, has been cut with an incorrect crystal orientation, producing unacceptably high thermally induced birefringence, and thus cannot be used in a high power laser.

In relation to the original research plan:

- (1,2) All of the temperature control and drive electronics for the new diode lasers (26 x 20W fibre-coupled diodes from Siemens) have been constructed, installed and tested. All diodes have been mounted on their temperature control systems and most have been temperature tuned.
- (3) A 3D version of the thermo-mechanical ANSYS model, which predicts the stresses within the gain medium, has been completed. We are now using it to investigate the effect of pumping and cooling profiles, and the shape of the gain medium on the compressive and shear stresses within the gain medium.
- (4) An improved laser head for the high power laser has been constructed and debugged using the 200W-pumped laser discussed above.

(c) Fabrication of the ARI laser

The components for this laser have been acquired but it has not yet been assembled.

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Attachment D - Advanced Detector Configurations

Participation

Control system for Resonant sideband Extraction with power recycling

We have completed our bench top experiment demonstrating a control scheme for RSE which allows continuous tuning of the signal mirror. Results including frequency response curves under various tuning conditions will be reported at the August LSC meeting. Consideration of applicability to a long baseline interferometer is underway.