

ACIGA

Six-Month Progress Report

February 15, 1999

PROGRESS

1. Medium power laser

Measurements of the frequency and intensity noise of the prototype injection-locked 5 W laser have been completed. Both the frequency noise and the RIN satisfy LIGO-I specifications. The output is shot-noise-limited above 5 MHz for 6 mA of detected photocurrent, without the need for a post mode-cleaner. This easily satisfies the LIGO-I specification as the power spectral density above 24.5 MHz is within 2dB of that for 10 mA of photocurrent. We have also demonstrated in excess of 10 dB of intensity noise (additional) suppression at 100 Hz, by feedback to the pump diode of the 5 W laser. The loop gain of the suppression servo was limited by the electrical characteristics of the diode driver. Details of this laser development can be found in the PhD thesis recently submitted by David Ottaway, and in IEEE JQE **34**, 2006 (1998).

2. High power laser

The assembly of the laser head for the proof-of-principle tests of the stable-resonator (horizontal) plane of the high-power laser has been completed and testing has begun. A multi-mode output power of 28 W was produced for 104 W of pump power when using a standing-wave cavity with two flat mirrors. The output has not changed significantly during 3 months of operation. Diffraction-limited output can be produced by increasing the separation between the mirrors and the gain medium.

The gain medium for the proof-of-principle tests of the unstable resonator has been ordered. The mirrors for these tests will be ordered soon.

PLANS

1. Medium power laser

- (a) Construct a 5 W laser for ACIGA's Advanced Research Interferometer.
- (b) Investigate scaling of the 5 W design to 20 W.

2. High power laser

- (a) Measure the small signal gain of present configuration.
- (b) Determine the magnitude of the thermal lenses in the horizontal and vertical planes.
- (c) Assemble the laser for proof-of-principle tests of the unstable resonator.

- (d) Actively control the thermal lens in the vertical (unstable) plane.
- (e) Demonstrate a free-running stable/unstable resonator 25 W laser.
- (f) Begin fabrication of a higher power stable/unstable resonator laser.