High Output Maximum Efficiency Resonator (HOMER) Laser for NASA’s Global Ecosystem Dynamics Investigation (GEDI) Lidar Mission

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The HOMER cavity is a positive branch unstable resonator (PBUR), employing a Graded Reflectivity Mirror (GRM) with a Gaussian reflectivity profile. This produces high beam quality (TEM00) and produces high pulse energies typical of master oscillator/power amplifier (MOPA) designs, but with higher efficiency. Less optics, less volume/mass, excellent pointing.

**Parameter**
- **HOMER Output**
  - Energy: 17 - 9 mJ
  - Pulse Width: 10 +/- 1 ns
  - Rep Rate: 250 - 100 Hz
  - LDA Duty Cycle: ~2%
  - LDA Current: 50 A
  - LDA Derating: 50%
  - TRL 6 Mass: 5 kg
  - Total QS Shots HOMER Design: 15+ Billion
  - Optical Efficiency: 17%
  - Elect Efficiency: > 7%

**Environmental Testing:**

**Vibration Testing:**
- The General Environmental Verification Standard (GEVS) Qualification Vibration Specification was applied. The purpose of this test was to qualify the HOMER design through TRL 6 vibration testing. Since no launch vehicle was selected at that time, the HOMER was designed for a 0 C to 40 C survival temperature range. Therefore, using GEVS component qualification standards, HOMER was temperature cycled from -10 C for 4 hours and then to 50 C for 4 hours at total of 8 times. HOMER’s performance was checked at regular intervals to assure proper laser output quality.

**TVAC Testing:**
- HOMER was designed for a 0 C to 40 C survival temperature range. Therefore, using GEVS component qualification standards, HOMER was temperature cycled from 0 C to -10 C for 4 hours and then to 50 C for 4 hours at total of 8 times. HOMER’s performance was checked at regular intervals to assure proper laser output quality.

**Final HOMER Design:**

Incorporating all opto-mechanical lessons learned from HOMER-2, LOLA, MLA, CALIPSO, GLAS, & ESA’s ALADIN.

Now that HOMER is the GEDI laser, it is being mechanically upgraded; incorporating a beam expander, improved optical bench, and a flight-like laser electronics box. The ETU and flight laser systems will be built in-house and will go through environmental testing.

**Lab Results:**

**Optical Layout of the HOMER-2 Lifetest:**

- A 1064nm fiber coupled laser diode is reflected off reference cubes mounted on the enclosure and the base plate. These determine any movement of the laser cavity vs. the outside environment.

**Final HOMER Design:**

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**Optical Bench Pointing, Mass and Modularity Requirements were met with Aluminum. Materials trade study with Aluminum and Beryllium complete. Analysis shows mechanical and thermal requirements met with margin.**