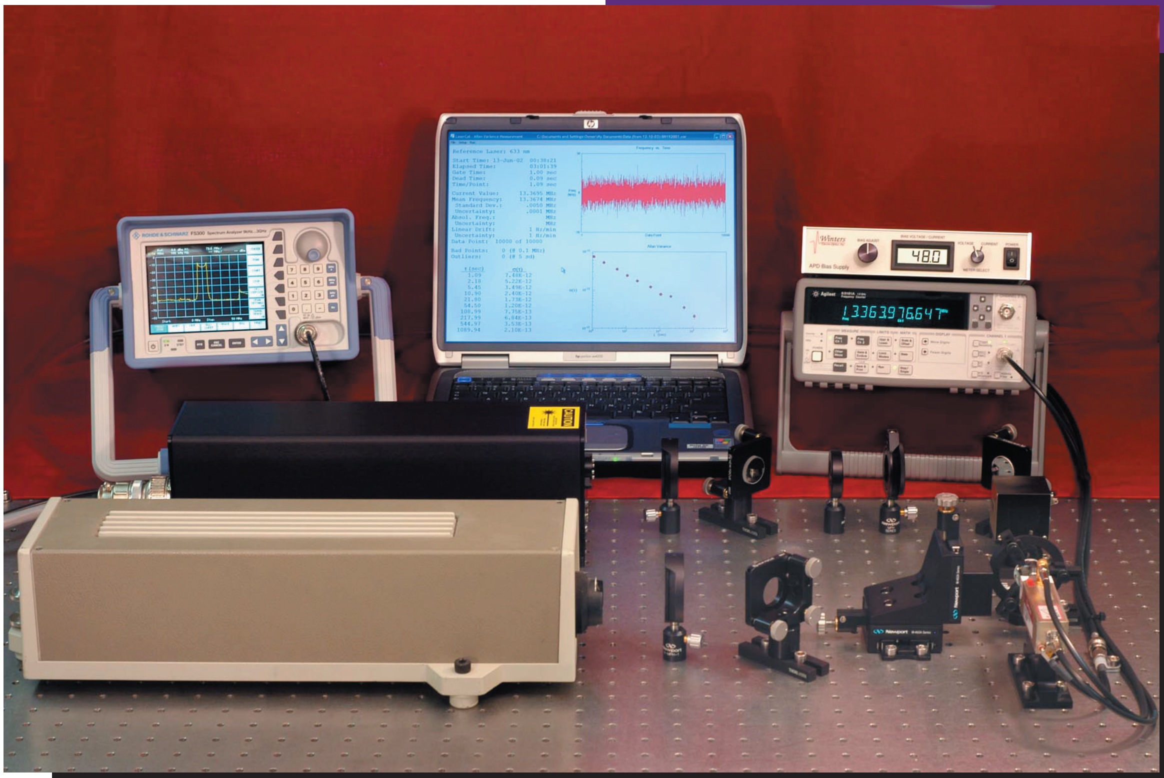
Winters

Electro-Optics, Inc.

Laser Heterodyne System



The Laser Heterodyne System is a complete, easy-to-use system for calibrating and characterizing laser frequency standards. The system allows for characterization of both short- and long-term laser behavior using the highly accurate and sensitive optical heterodyne technique. The setup can be easily re-configured to meet the requirements of special applications, or expanded to accommodate multiple lasers.

Basic System Components

- 0.6 m x 0.9 m optical breadboard
- (2) broadband HR mirrors and (1) broadband beam combiner with kinematic mirror mounts
- Focusing lens with 3-axis translation stage
- Linear polarizer, $\lambda/4$ and $\lambda/2$ waveplates with rotary mounts, and adjustable aperture
- Acousto-optic modulator for optical isolation
- 1 GHz photodetector with lo-noise high-gain amplifier, power supplies, lo-pass filters, and rf power splitter
- Agilent 53181A frequency counter with IEEE-488 interface and 1.5 GHz option
- Notebook computer with IEEE-488 interface and Windows XP operating system
- *LaserCal* data acquisition and analysis software

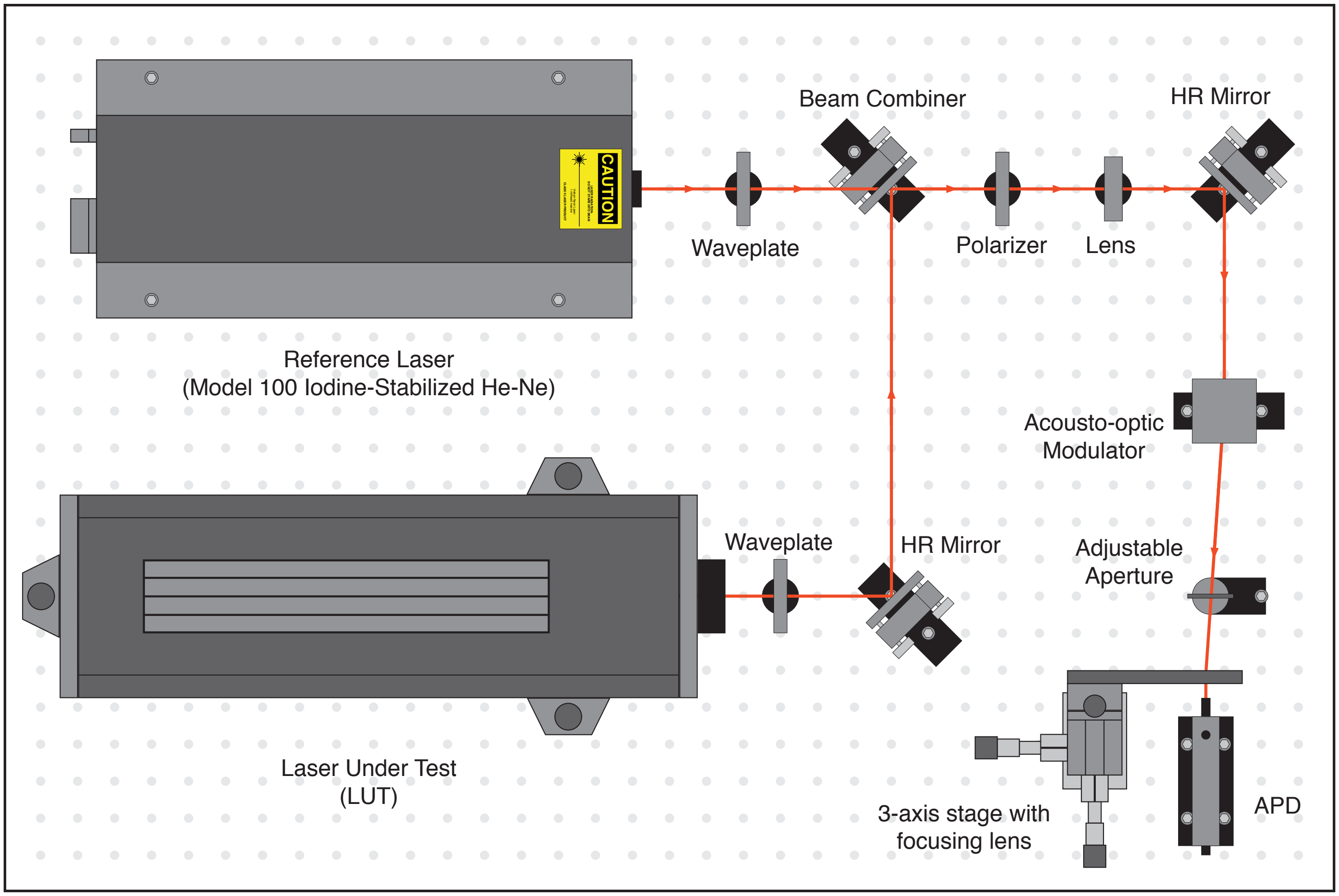
The Laser Heterodyne System is used to calibrate and characterize primary (e. g. iodine-stabilized) and secondary (e. g. 2-mode polarization-stabilized or Zeeman-stabilized) laser frequency standards. It includes all the optics and electronics required to generate and measure an optical heterodyne signal produced by the "beating" of two frequency-stabilized lasers. While primarily designed for use with 633 nm He-Ne lasers, it can also be used to compare frequency-stabilized lasers in other parts of the visible spectrum.

The Laser Heterodyne System includes beam steering and beam combining optics to physically overlap the output beams of a reference laser and a laser-under-test (LUT). A focusing lens steers the overlapped beams onto a high-bandwidth, high-gain avalanche photodetector (APD), which generates an electrical signal representing the frequency difference of the two lasers. Waveplates, a polarizer, and electrical filters can be used in various combinations to isolate individual modes of two-mode lasers. An acousto-optic modulator provides isolation from optical feedback, ensuring stable operation of the reference laser and the LUT.

Frequency measurements are made with an Agilent 53181A frequency counter linked to a notebook computer via an IEEE-488 interface. *LaserCal* data acquisition and analysis software records frequency data and calculates Allan Variances and matrix frequency differences. Results can be output to Windows-compatible printers or saved to disc. Data files are written in a simple format for easy exportation to other applications for further manipulation and analysis, if desired.

A basic heterodyne system is built on a 0.6 m x 0.9 m optical breadboard and accommodates a reference laser and one LUT. The system is highly modular and can be easily modified to meet special requirements, and it can be expanded to accommodate multiple LUTs with the addition of a few standard components.

Layout of the basic heterodyne system showing the optics, optical mounts, acousto-optic modulator, and avalanche photodetector (APD). System components not shown include the notebook computer, frequency counter, IEEE-488 interface, power supplies, rf filters, and rf power splitter. (Reference laser, laser under test, and spectrum analyzer are not included in the basic system.)



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