The Good, The Bad & The Ugly

The primary reason for using a single-mode CW laser is to exploit the narrow spectral linewidths of these systems. The accurate determination of these linewidths, however, poses a significant experimental challenge requiring very special equipment.

Your choices for laser linewidth determination are:

The Good

- **Beat note generation:** This method requires two separate single-frequency lasers, and the calculated linewidth will be an average of the two.
- **Self homodyning**: requires only one laser, and a mile-long optical fiber.
- Check against a "**Super Cavity**"

The Bad

Linewidth measurement of an ultra-narrow-line laser poses a significant experiment challenge.

Measure fluctuation in the error signal from the laser's own built-in reference cavity. All manufacturers of frequency-stabilized CW lasers – ring lasers, external-cavity diode lasers – use the results of this method to specify the linewidth. The problem, however, is that so-called "internal" linewidths measured using the laser's error signal always give a narrower value than the actual "spectral" linewidth.

The Ugly

Comparison with the **known linewidths of atoms &/or molecules**. Intensity absorption/saturation effects make these measurements notoriously difficult and misleading.

This is the reason that we developed the ***EagleEye***, a high-finesse confocal "super cavity". The EagleEye cavity is made up of two spherical mirrors that are mounted into an INVAR steel housing, where one of the mirrors is attached to a piezoelectric actuator, allowing a slight variation of the spacing between the mirrors.

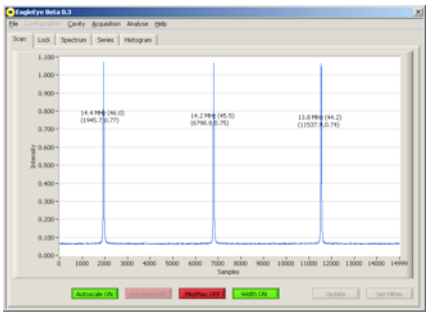
We apply a voltage to the piezoelectric actor using a digital signal processor (DSP) with three modes of operation: "scan", "lock" and "measure".

In **scan mode** operation, a triangular-shaped voltage waveform is applied to the piezoelectric element, and the unit acts as a standard optical spectrum analyzer. The resolution in this mode is about one MHz.

In **lock mode**, the DSP applies a PID algorithm to control the length of the "super cavity" in such a way that the half-maximum position of transmission peak coincides with the laser frequency.

Linewidth **measurement mode**: The PID control is disengaged, the cavity length is held constant and a photodiode is used to monitor the fluctuations of the transmitted intensity. Assuming that all of the intensity fluctuations result from laser frequency fluctuations, a corresponding linewidth is calculated.

This proprietary high-resolution measurement procedure is also called **"Lock, Let Loose, Look"**. It can provide you with straightforward and accurate determinations of laser linewidths down to 20 kHz.



The ***EagleEye*** is made in Germany by *Sirah GmbH*.

For more information contact:

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