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# Dual Frequency Injection locked Continuous Wave Ti: Sapphire Laser

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## Introduction:

A laser with high spectral purity and high output power is essential tool in non-linear optics, precession spectroscopy and meteorology. An injection locked laser satisfies these required features in which a high power slave laser controlled by one or more low power master lasers. Dual wavelength injection locked Ti.Sapphire laser in pulsed regime has reported[1].

Here, we demonstrate dual frequency injection locked continuous wave Ti.Sapphire laser with stable frequency and power. The advantage of this technique is that both the output beams are collinear and maintain spatial overlap when they are focused to the diffraction limited spot sizes. This kind of laser system has specific applications such as stimulated Raman scattering and differential absorption lidar.

## Experimental system:

The experimental system is shown in Fig.1 (a). The ring laser is constructed with four mirrors, the intra cavity elements are Ti: Sapphire crystal and a pair of glass plates. Two seed lasers with stable frequencies are injected into the Ti: sapphire ring laser. The glass plate pair allows the fine tuning of the cavity length to obtain simultaneous resonance of these two injected frequencies. One of the flat mirrors mounted on the PZT element to adjust and modulate cavity length. The signal from one of the photo detectors is given to PZT through a phase locked loop to maintain resonance. As a result stable dual frequency injection locking is obtained.

Some of the results are shown in Fig.1. The dual frequency injection locked output from Ti: sapphire laser has clear Gaussian profile with good beam quality ($M^2$ =1.1). All the laser power oscillates simultaneously in the two injected frequencies is shown in Fig.1 (b). The free run oscillations are suppressed by increasing the injection seed power as shown in fig.1(c). As a result 30 mW total injection seeds power is sufficient to obtain stable injection locking and >2.5 W output power at 10 W pump powers.

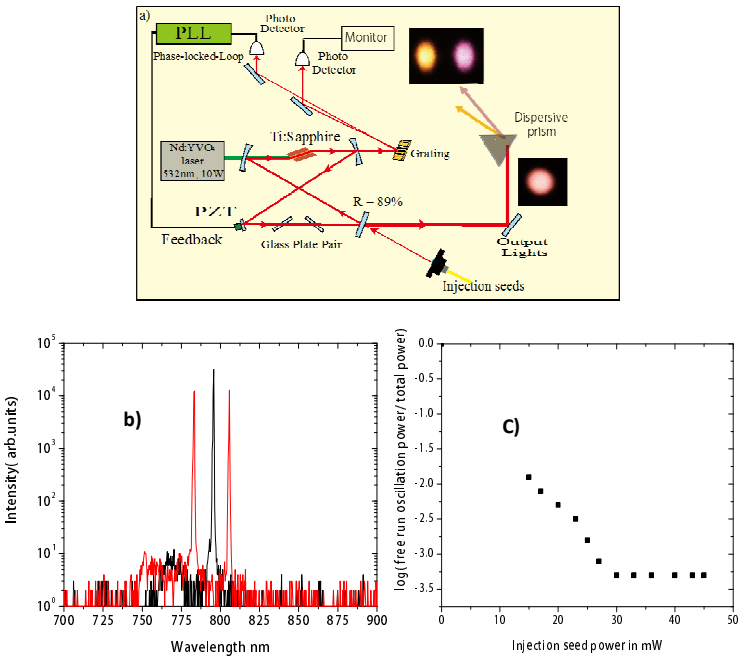


**Fig.1**. **(a)** Schematic diagram of a dual frequency injection locked continuous wave Ti.Sapphire laser **(b)** (red) dual frequency injection locked and free run (black) spectrums with Optical Multi-channel Analyzer **(c)** free run suppression as a function of injection seeds power in the case of dual frequency injection locking.

## Reference:

**1)** Masayuki Katsuragawa and Takashi Onose, Opt. Lett. 30, 2421- 2423 (2005).