

High spectral purity lasers stabilized on mini Fabry-Perot fiber resonators

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Compact low phase noise lasers are key devices in many applications such as precision measurements, clock interrogation and optical frequency synthesis. Various types of optical resonators may be used to frequency stabilize semiconductor lasers and get narrow linewidth and reduced frequency or phase noise. However, resonators featuring simultaneously high Q factor, compact size and an easy control of their coupling factor to the optical system are difficult to find. These last years, we have developed a resonator technology based on the deposition of high quality mirrors on both ends of a piece of optical fiber. The size of these Fabry-Perot resonators goes from 1 cm to 7 cm and their free spectral range is between 10 GHz and 1.5 GHz. The Q factor is in the range of 10^8 , but can exceed largely 10^9 depending on the fiber type and size.

In this communication, we present the stabilization of two different semiconductor lasers ($\lambda = 1550$ nm) on 2 cm length FP resonators embedded in a zirconium ferule. The first laser is a DFB laser without isolator and a full optical stabilization approach is chosen for this laser. The second laser is an external cavity laser (RIOTM) which is stabilized on the resonator using an electronic feedback loop (Pound Drever Hall). Lasers frequency noise is measured using a delay line frequency discriminator, with 2 km delay and isolated from mechanical vibrations. The free running laser performance is compared to the stabilized laser performance in Figure 1 and 2. PDH leads to a high performance close to the carrier meanwhile the large bandwidth of the optical locking technique provides better performance far from the carrier.

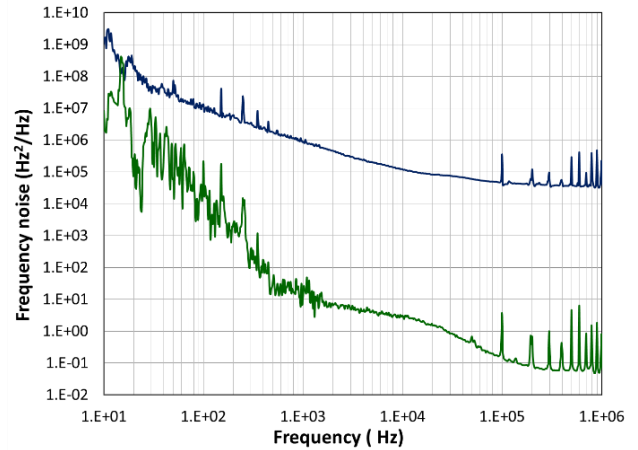


Fig. 1: DFB laser free running (blue) and stabilized (green) through optical self-injection on a $Q = 5 \cdot 10^7$ SMF fiber FP resonator

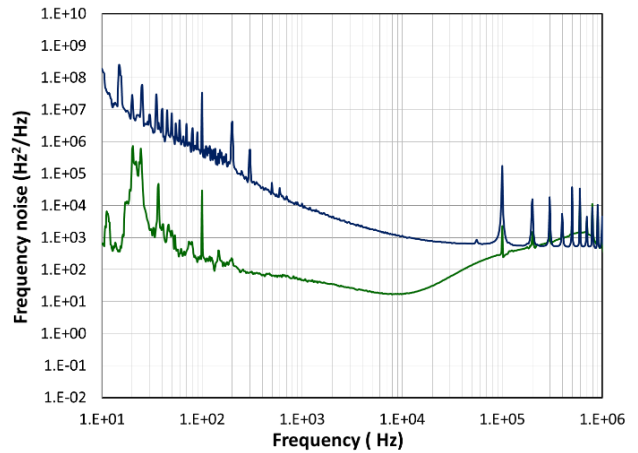


Fig. 2: RIO laser free running (blue) and stabilized (green) using a PDH loop on a $Q = 10^8$ SMF fiber FP resonator