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On the Stabilization of SiN Kerr Solitons

to be used as calibration source for astronomical spectrographs

Astronomical spectrographs require precise calibration, when used for the detection of earth-like planets [1]. Optical frequency combs build from fiber lasers are an excellent tool to achieve such high precision. In order for the fiber laser spectrum to be resolvable by an astronomical spectrograph the pulse train has to be filtered up to repetitions rates in the tens of Gigahertz [2]. The intrinsically high repetition rates of microresonator-based frequency combs make them an attractive platform to be used for astronomical calibration as previously demonstrated [3,4]. Here we report on a stabilization scheme of a SiN-microresonator (designed and fabricated by EPFL, LPQM [5]) as shown in Figure 1. The stabilization scheme combines active and passive stabilization techniques to achieve absolute frequency stability and long-term operation. The absolute frequency stability in the region between 1 to 2 um is determined to be at most a few Kilohertz (averaged over one second) by measuring the frequency stability of the Kerr soliton against a fiber laser comb, see Figure 1. The discussion will focus on the stabilization techniques, it's current limitations and learnings towards a potential self-referenced system.

References

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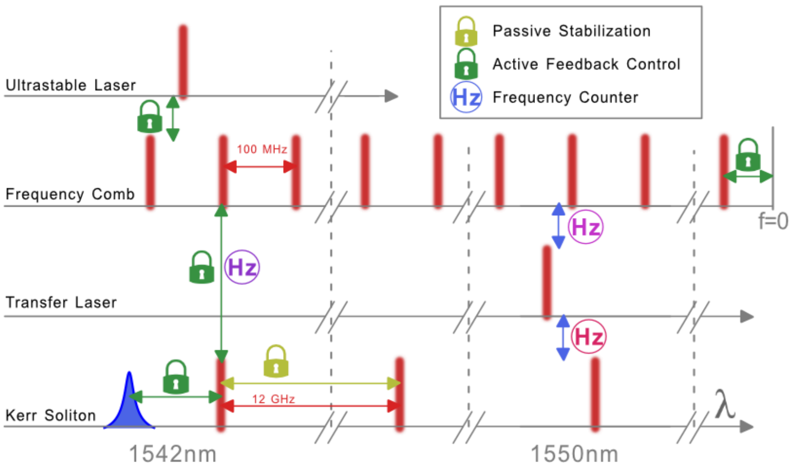

Figure 1: Schematic representation of stabilization scheme of a dissipative Kerr Soliton generated in a SiN-microresonator. The pump laser is phase locked to a fully stabilized optical fiber laser frequency comb. The fiber laser comb is locked on to an ultra-stable laser system. The microresonator pump-resonance is PDH-locked to the pump laser. Further, an injection lock is used to passively stabilize the resonator repetition-rate. The frequency stability of the Kerr soliton is characterized with respect to the fiber laser comb using a transfer laser scheme.