Generation of a nested frequency comb

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Simple etalons inserted in a laser cavity are used to tune the wavelength of a laser. Inserting that element inside a mode-locked laser leads to a frequency comb with counter-intuitive features. Instead of a decaying sequence of pulses, the etalon produces a symmetric bunch of pulses, at a repetition rate in the GHz range, that can be fine tuned with the laser cavity length. The wavelength of the laser — as in the cw case — can be tuned with the angle of the etalon. However, the high and low frequency components of the repetition rate are both modified with the angle of incidence. Insertion of the Fabry-Perot results in a much larger modification of the laser cavity round-trip time than would be expected from the modification in optical path. Finally, the repetition rate of the laser has a much stronger dependence on the pump pulse power after insertion of the Fabry-Perot. The application of this research is in repetition rate spectroscopy (tuning the repetition rate of a laser to hit a vibrational resonance). There are applications in metrology, communications and astronomy where very high, tunable, repetition rates are desirable.

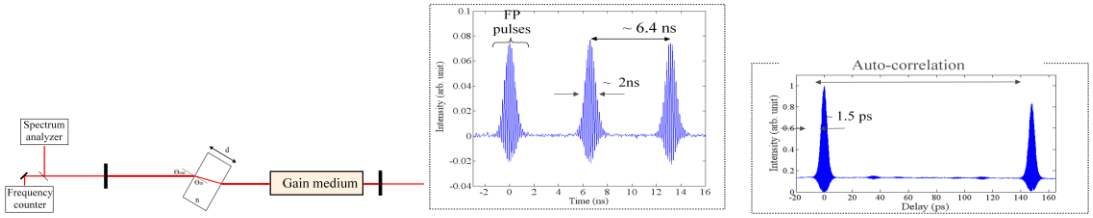

Fig1. Left)A simple setup of generating nested frequency comb. Right) The multiple reflections of the Fabry Perot are amplified in the laser cavity, resulting in a nested structure presented in time.

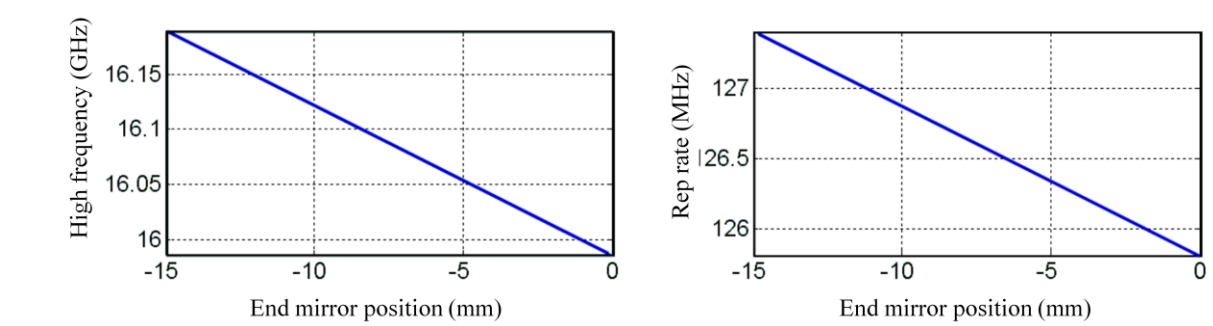

Fig2. Coupling of high frequency and low frequency in the nested cavity.Left)Change of high frequency with cavity length Right) Change of low frequency with cavity length.