A narrow-linewidth frequency-tunable cw laser from 700 nm to 1000 nm

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Spectroscopists have been long-dreaming of frequency synthesizers in the optical domain (or optical frequency synthesizers), which can generate optical light with high precision and high spectral purity at any moment and at any wavelength over a wide range.

In this presentation, a narrow-linewidth frequency-tunable cw laser from 700 nm to near 1000 nm will be introduced, which is based on a narrow-linewidth laser[1] at 1064 nm and a femtosecond (fs) laser frequency comb. Using the techniques of collinear self-referencing[2] and cross-phase modulation[3], a Ti:Sapphire femtosecond laser frequency comb with a repetition rate of 800 MHz is phase-locked to a cavity-stabilized laser at 1064 nm with a linewidth of 0.6 Hz[1]. By comparing against three independent cavity-stabilized lasers at 1064 nm , 578 nm and 532 nm respectively, the absolute linewidths of the optical frequency comb teeth have been measured at 0.6~1.2 Hz over an octave spectrum[4]. A frequency tunable Ti:Sapphire laser with power of >1 W from 700 nm to near 1000 nm is phase-locked to the optical frequency comb with a relative linewidth of 1 mHz (in-loop).

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[2] Y. Y. Jiang, *et al*., "A collinear self-referencing set-up for control of the carrier-envelope offset frequency in Ti : sapphire femtosecond laser frequency combs", Metrologia, vol. 42, p. 304-307, 2005.

[3] D. J. Jones, *et al*., "Frequency comb generation using femtosecond pulses and cross-phase modulation in optical fiber at arbitrary center frequencies", Opt. Lett., vol. 25, p. 308-310, 2000.

[4] S. Fang, *et al*.,"Optical frequency comb with an absolute linewidth of 0.6 Hz-1.2 Hz over an octave spectrum", Appl. Phys. Lett. Vol. 102, 231118 (2013).