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Fibers and combs: weaving a portable frequency reference in the near-IR[1]

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Ten years after the advent of femtosecond optical frequency combs, they are now used for many applications. Here, we use near infrared combs to characterize and develop portable frequency references based on gas-filled hollow optical fibers. We explore the accuracy and stability of saturated absorption features in acetylene gas confined inside both 10 micron core diameter photonic bandgap fibers and ∼60 micron core diameter kagome-structured photonic crystal fibers. A cw fiber laser referenced to these features has resulted in stabilities of $\sim 10^{-11}$ in 1 s, competitive with iodine-stabilized HeNe lasers. Most of these studies have been performed using a femtosecond fiber laser that relies on a carbon nanotube saturable absorber. However, we have also explored Cr:forsterite femtosecond lasers with intracavity prisms, which reveal dramatic narrowing of the carrier-envelope offset beat when a knife edge is inserted in the cavity. Such observations and subsequent noise dynamics studies will lead to a better understanding of noise in these solid state combs, making Cr:forsterite laser combs more competitive for spectroscopy and other applications.

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