Integrated f_{CEO} Phase Noise of 280 mrad RMS in a SESAM-based Frequency Comb Supporting a Fractional Frequency Instability of $1.3x10^{-17}$ at 1 s

Vescent presents our latest generation SESAM mode-locked Er:fiber frequency combs exhibiting a dramatically reduced phase noise in the carrier-envelope offset frequency (f_{ceo}) without sacrificing on environmental ruggedness and industry-leading compactness associated with our previous generation SESAM-based frequency combs. Figure 1A shows the free-running f_{ceo} beatnote, exhibiting a signal-to-noise ratio (SNR) of >50 dB (RBW = 30 kHz) and a Lorentzian linewidth of 15 kHz. Figure 1B shows a zoomed-in RF spectrum of the f_{ceo} beatnote after tightly phase locking to an RF reference. A coherent carrier can be seen with an SNR of 43 dB (RBW = 3 kHz). The corresponding phase noise of the stabilized f_{ceo} signal is shown in Figure 1C, revealing an RMS integrated phase noise of **280 mrad RMS** (integrated between 10 Hz and 1 MHz). This level of performance is similar to some of the lowest noise fiber lasers available. The fractional frequency instability of the signal can be expressed as the Modified Allan deviation (MDEV) which is calculated from a series of frequency measurements and is shown in Figure 1D. The fractional frequency instability contribution of f_{ceo} is $1.3x10^{-17}$ at 1 s, which represents the lowest fractional frequency instability that can be supported by Vescent's newly released frequency combs.

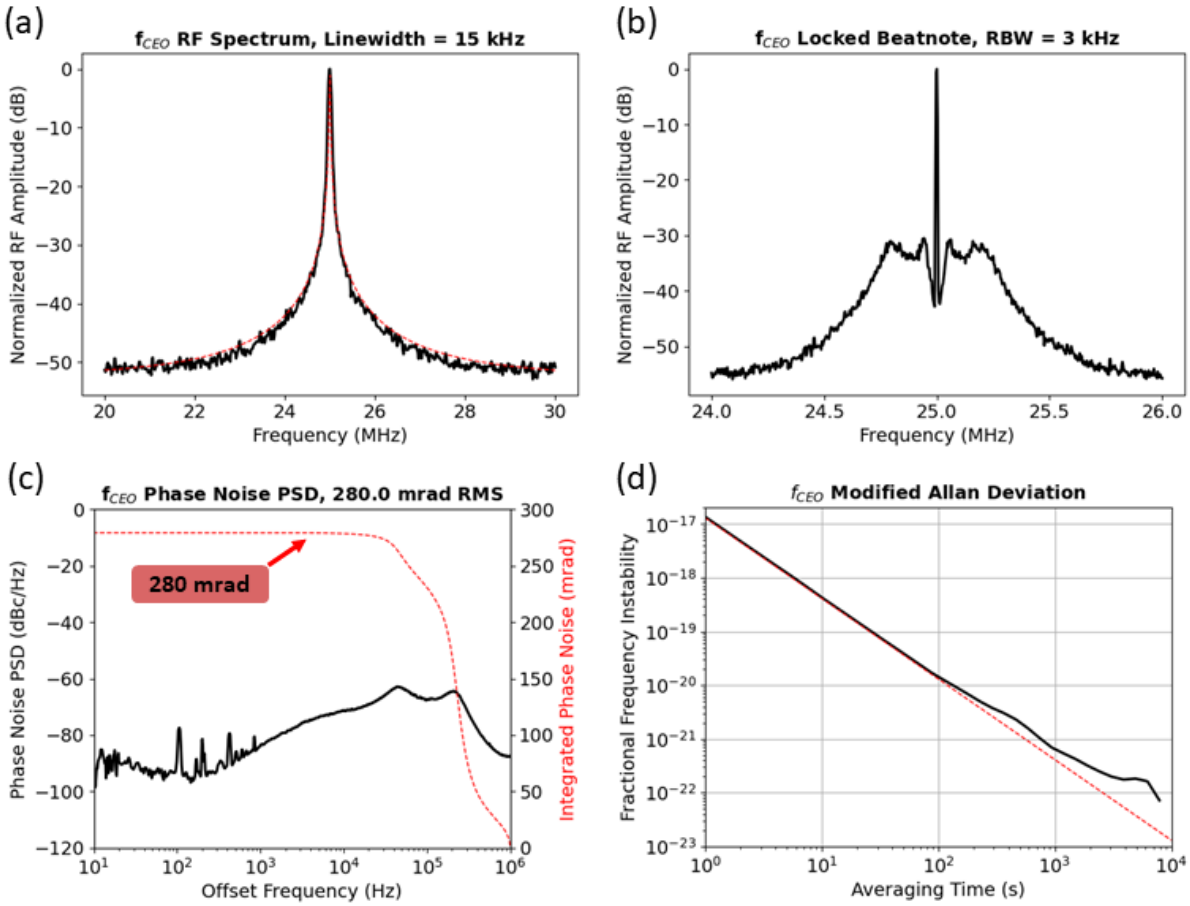

Figure 1: (a) Stabilized f_{ceo} beat signal and Lorentzian fit showing a linewidth of 15 kHz and >50 dB SNR. (b) Zoom into the f_{ceo} signal revealing a coherent carrier of 43 dB SNR. (c) Residual phase noise of the f_{ceo} signal when stabilized to an RF reference oscillator. The integration of the phase noise leads to an RMS phase error of 280 mrad. (d) Fractional frequency instability of f_{ceo} expressed as the modified Allan deviation (MDEV), demonstrating that the frequency comb supports a fractional frequency instability of $1.3x10^{-17}$ at 1 s and averages down as $\tau^{-3/2}$ in the MDEV, as expected for white phase noise dominated signals. The data was taken with a dead time-free λ-type frequency counter.