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Interband Cascade Laser Frequency Comb generation and high- speed detection

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We present a new monolithic frequency comb sensing platform based on ICLs. We demonstrate self-starting frequency comb operation of ICLs based on the inherent gain non- linearity. In contrast to QCLs, the gain in ICLs is provided by an interband transition rather than an intersubband transition. Despite the fact that the laser transition lifetime differs by more than two orders of magnitude compared to QCLs, ICLs can respond to beatings between laser modes (Fig. 1a). We investigate the laser dynamics of the ICL frequency comb using a linear autocorrelation technique (Fig. 1b). Our experiments reveal that ICL frequency combs are characterized by a strong suppression of amplitude modulation. We further show that ICL combs can be locked to an external RF oscillator while maintaining full intermodal phase coherence. Finally, we highlight the unique detection functionality naturally provided by the ICL material, which can be used to directly integrate sensitive multi-heterodyne detectors.

[1] B. Schwarz, J. Hillbrand, M. Beiser, A. M. Andrews, G. Strasser, H. Detz, A. Schade, R. Weih, and S. Höfling, Optica 6, 890-895 (2019)
[2] A. Hugi, G. Villares, S. Blaser, H. C. Liu, and J. Faist, Nature 492(7428), 229 (2012)

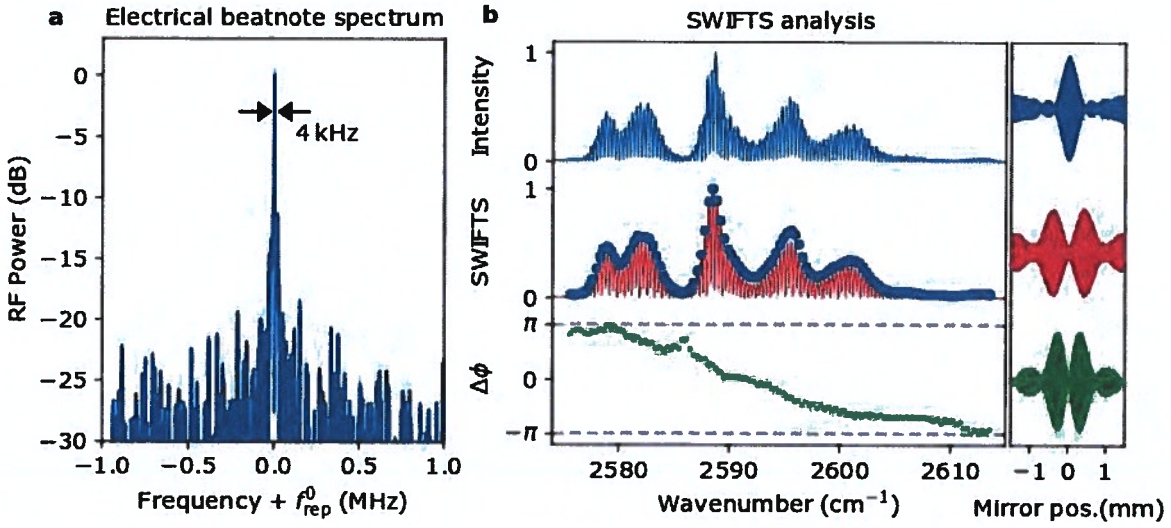

Fig. 1: a) Beatnote of the frequency comb modes at the cavity roundtrip frequency. b) Analysis of the frequency comb using SWIFTS. blue: intensity spectrum. red: coherence spectrum. green: intermodal phase differences.

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