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New frontiers in dual-comb spectroscopy

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A frequency comb is a broad spectrum of evenly spaced phase-coherent narrow laser lines. Initially invented for frequency metrology, such combs enable new approaches to interferometry. Exploiting time-domain interference between frequency combs of different repetition frequency has grown increasingly popular.

One of the most widespread applications has been dual-comb spectroscopy, which enables fast and accurate measurements over broad spectral bandwidths, of particular relevance to molecular sensing[1]. Accurate determination of all spectral line parameters[2] and broadband detection in light-starved conditions[3] become possible in regions of interest to sensing such as in the mid-infrared fingerprint region. Combined to nonlinear excitation of the samples[4], they open up new opportunities for precision spectroscopy and stringent comparisons with theories in atomic and molecular physics. Concurrently, progress towards chip-scale dual-comb spectrometers promises integrated devices[5] for real-time sensing in analytical chemistry and biomedicine.

Recently, dual-comb digital holography, another application of frequency-comb interferometry, has been demonstrated[6]. The combination of broad spectral bandwidth and high temporal coherence opens up novel optical diagnostics, such as precise dimensional metrology over large distances without interferometric phase ambiguity, or hyperspectral 3-dimensional imaging with molecule-selective imaging of an absorbing gas.

With selected examples, I will illustrate the rapidly advancing field of dual-comb spectroscopy.

[1] N. Picqué *et al.*, *Nature Photonics* **13**, 146 (2019).
[2] Z. Chen *et al.*, *PNAS* **116**, 3454 (2019).
[3] N. Picqué *et al.*, *PNAS* **117**, 26688 (2020)
[4] S.A. Meek *et al.*, *Optics Letters* **43**, 162 (2018).
[5] K. Van Gasse *et al.*, preprint at arXiv:2006.15113 (2020).
[6] E. Vicentini *et al.*, *Nature Photonics* **15**, 890 (2021)