High density THz frequency comb produced by coherent synchrotron radiation

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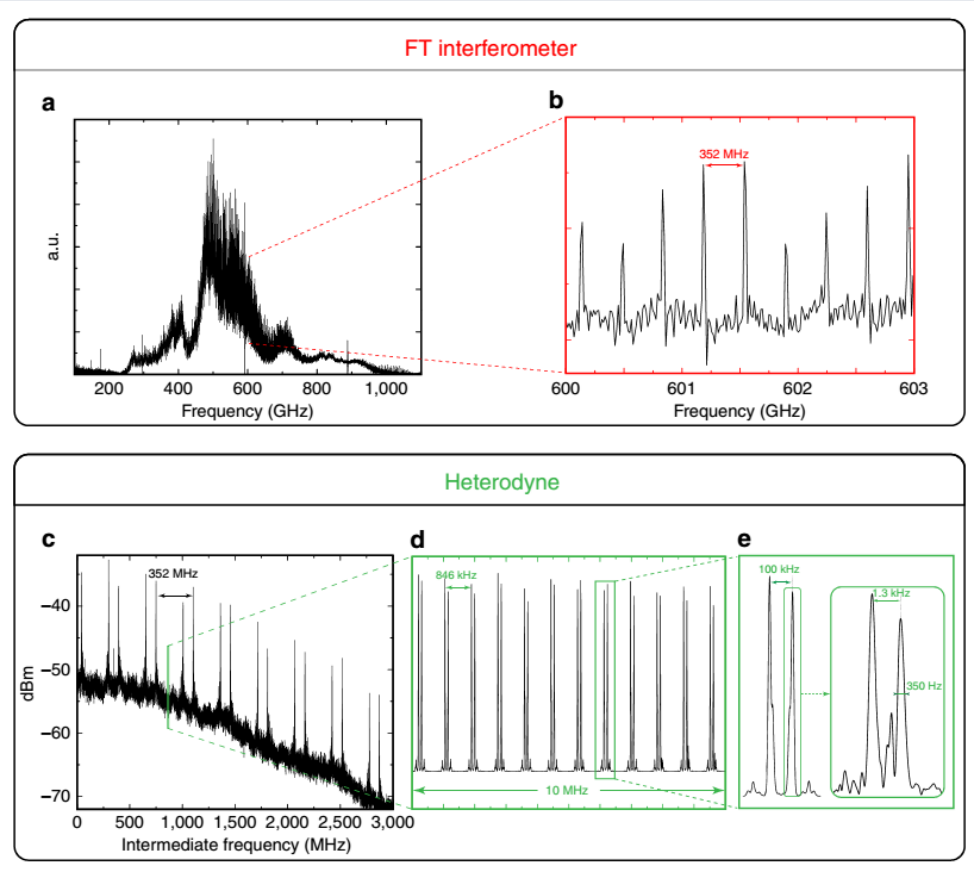
Frequency combs have enabled significant progress in frequency metrology and high-resolution spectroscopy extending the achievable resolution while increasing the signal-to-noise ratio. In its coherent mode, synchrotron radiation (CSR) was accepted to provide an intense terahertz continuum covering a wide spectral range from about 0.1 to 1 THz. Using a dedicated heterodyne receiver, we reveal the purely discrete nature of this emission. A phase relationship between the light pulses leads to a powerful frequency comb spanning over one decade in frequency. The comb has a mode spacing of 846 kHz, a linewidth lower than 200 Hz, and no frequency offset.



The figure above shows the CSR extracted by the AILES beamline of SOLEIL and analyzed by 1) a 30 MHz ultimate resolution Fourier Transform interferometer (top panel), and 2) by our new ultra-high resolution heterodyne receiver in a small spectral region around 200 GHz (lower panel). Recently, we used the same heterodyne receiver to generalize this obsrevtaion to all CSR operation modes at SOLEIL (single bunch, 8 bunches and low alpha). These 3 operation modes emit intense THz frequency combs with different spectral caracterics (in terms of bandwidth, linewidth of each comb, frequency offset) and will be used to perform ultra-high resolution molecular spectroscopy in the THz domain.

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