PRECISION FOURIER TRANSFORM SPECTROSCOPY WITH FEMTOSECOND FREQUENCY COMBS

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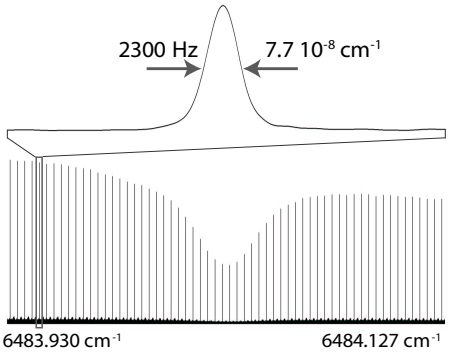
Fourier transform spectrometers play a crucial and intensive role in molecular spectroscopy. However, these instruments, most often based on Michelson interferometers, are presently unable to address some of the new challenges associated with fundamental experiments or optical diagnostic.

In recent years, femtosecond frequency combs, which are new laser sources exhibiting an optical spectrum made of very sharp and uniformly spaced lines, have revolutionized the field of frequency metrology. They lead also to the implementation of a new kind of Fourier interferometers, where two frequency combs with slightly different repetition rates beat with each other. These spectrometers may bring remarkable characteristics, amongst which extremely short measurement time.



We report on the implementation of an original and simple set-up for frequency comb Fourier transform spectroscopy, which reaches the unprecedented resolution of 1 kHz within 6 s recording time. Moving mirror of equivalent Michelson interferometers should cover 130 km path-difference excursion at 10 km.s^{-1} velocity. We also record simultaneously Doppler-limited dispersion and absorption spectra within a few tens of microseconds. The comb structure of the light source provides self-calibration of the wavenumber scale. Precision spectroscopy of the overtone spectrum of acetylene, in the 1.5 μm range, is reported as a first demonstration.