IMPROVED FT SPECTROSCOPY WITH FREQUENCY COMB SOURCES

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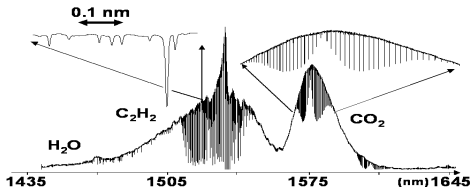

A femtosecond frequency comb may be advantageously used for broadband high resolution absorption spectroscopy. With a Fourier transform spectrometer, it is possible[a] to analyze within a single recording the large spectral domain of emission of the comb at a resolution only limited by the comb repetition rate. Demonstrated recording times are as short as 13 s for a 0.12 cm^{-1} resolution experiment. Due to the brightness of the comb source, signal-to-noise ratio reaches up to several thousands. A recording time up to 300 times longer is needed to get identical results with a classical tungsten lamp source instead of the laser. These qualities have been demonstrated with a Cr:YAG laser[a] and a supercontinuum source[b] in the 1.5 μm region and with a Cr:ZnSe laser[c] around 2.4 μm. When the comb is coupled to a multipass cell exhibiting 152 m path length, as shown on the Figure, the minimum absorption coefficient at 1s averaging reaches 5 10^{-9} $cm^{-1}.Hz^{-1/2}$ per spectral element. Our first-step experiments demonstrate that FTS is the most effective method to simultaneously provide from frequency combs, sensitivity, spectral extension, resolution with fast acquisition time.

For further sensitivity enhancement, we demonstrated[d] that the comb structure enables to implement a time domain approach based on the rf detection of an interferogram. The absorption and dispersion of the spectral features are measured simultaneously in the same high resolution recording exhibiting otherwise all the characteristics of a FTS experiment with a comb source. Examples will be provided with C_2H_2 spectra. An advantage of our method is that, unlike with high finesse cavities injected by combs, no trade-off has to be made between sensitivity and spectral extension.

[a] J. Mandon, G. Guelachvili, N. Picqué, F. Druon, P. Georges, Optics Letters 32, 1677, 2007.
[b] J. Mandon, E. Sorokin, I.T. Sorokina, G. Guelachvili, N. Picqué, Optics Letters 33, 285, 2008
[c] E. Sorokin, I.T. Sorokina, J. Mandon, G. Guelachvili, N. Picqué, Optics Express 15, 16540, 2007.
[d] J. Mandon, G. Guelachvili, N. Picqué, Efficient two-comb spectroscopy, submitted, 2008.