COHERENT SYNCHROTRON RADIATION FOR ROTATIONAL SPECTROSCOPY: APPLICATION TO THE ROTATIONAL SPECTRUM OF PROPYNAL IN THE 200-750 GHz RANGE

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In storage rings, short electron bunches can produce an intense THz radiation called Coherent Synchrotron Radiation (CSR). The flux of this emission between 250 and 750 GHz (in the mW range, up the 10000 times the regular synchrotron emission) is very advantageous for broad band absorption spectroscopy, using interferometric techniques. This source is, however, inherently difficult to stabilize, and intensity fluctuations lead to artifacts on the FT-based measurements, which strongly limit the use of CSR in particular for high-resolution measurements. At SOLEIL however, by screening different currents and bunch lengths, we defined stable CSR conditions for which the signal-to-noise ratio (S/N) allows for measurements at high resolution. Moreover, we developed an artifact correction system, based on a simultaneous detection of the input and the output signals of the interferometer, which allows to further improve the S/N. For this purpose, the optics and electronics of two bolometers were matched. The stable CSR combined with this ingenious technique allowed us to record for the first time high-resolution FT spectra in the sub-THz range, with a S/N of 100 in a few hours. This enables many applications such as broadband rotational spectra in the THz range, studies of molecules with low frequency torsional modes, absolute intensities determinations, or studies of unstable species. Results obtained on Propynal illustrate these possibilities and enabled to improve significantly the ground state spectroscopic constants.