CHIRPED-PULSE FOURIER TRANSFORM MM-WAVE SPECTROSCOPY FROM 260-290 GHz

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A broadband chirped-pulse Fourier transform mm-wave spectrometer operating in the 260-290 GHz frequency range has been constructed. The spectrometer uses a dual channel arbitrary waveform generator to create both the chirped excitation pulse and local oscillator (LO) inputs to the mm-wave multiplier chains for excitation (x24) and detection in a sub-harmonic mixer. The excitation and LO pulses are derived from the same single frequency phase-locked microwave oscillator giving good phase stability to permit deep averages of the molecule free induction decay signals. The excitation chirp from 2 to 3.5 GHz is generated by a high-speed arbitrary waveform generator and provides direct access to the full bandwidth of the spectrometer. All frequency sources in the experiment are locked to a 10 MHz Rb-disciplined oscillator providing direct frequency calibration for molecular transitions in the Fourier transform frequency-domain spectrum. Benchmark measurements on methylamine, ethyl cyanide, acetonitrile, and acrylonitrile will be presented. The design advantages and disadvantages for full bandwidth and segmented measurements will be discussed with an emphasis on detection limits caused by the presence of spurious signals from either LO purity or intermodulation (IM) at the digitizer.