SENSITIVITY LIMITS OF DEEP AVERAGE BROADBAND MICROWAVE AND MM-WAVE SPECTRA

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High-speed digitizers have enabled the field of broadband molecular rotational spectroscopy at microwave-to-THz frequencies. Improvements in data throughput from these digitizers makes it feasible to perform deep averages (often more than 1 million time-domain averages of the free induction decay) to increase the measurement sensitivity. The use of broadband signal detection introduces new issues that are key for determining the practical sensitivity limits of these spectrometers. The practical limit on spectrometer sensitivity is often set by the number of spurious signals that are generated by the molecular signals themselves. For example, in cases where the molecular signals are down converted prior to digitization, the spectral purity of the local oscillator is crucial with spurious frequencies introducing spectral images. It is also possible to generate new local oscillator frequencies within the broadband mixers typically used in the broadband down conversion. A second issue it the potential for a vast number of intermodulation (IM) spurious signals resulting from the beating of two strong molecular transitions. This beat frequency can subsequently modulate all other molecular signals adding sidebands to all transitions at the beat frequency of the transition pair. This talk will summarize our experience with the spurious signal levels coming from these effects and the strategies we have adopted to minimize spurious signals in spectra where high sensitivity is necessary.