NEW TECHNIQUES IN CHIRPED-PULSE FOURIER TRANSFORM MICROWAVE SPECTROSCOPY ILLUSTRATED BY MEASUREMENTS OF THE ROTATIONAL SPECTRUM OF 1,2,2,2-TETRAFLUOROETHYL DIFLUOROMETHYL ETHER (AN INHALATION AGENT FOR GENERAL ANESTHESIA KNOWN AS SUPRANE)

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We have used 1,2,2,2-tetrafluoroethyl difluoromethyl ether (Suprane®) as a benchmark molecule to test new capabilities in chirped-pulse Fourier transform microwave (CP-FTMW) spectrometers. We have extended our initial spectrometer design operating in the 7 - 18 GHz frequency range to two lower frequency bands: 800 MHz - 2200 MHz and 2 - 8 GHz. Both of these low frequency spectrometer designs perform direct digital FTMW measurements and offer compact designs that contain no components requiring mechanical adjustment. Comparisons between measured and calculated spectra show that the CP-FTMW spectrometer has equal sensitivity in all three frequency ranges. The frequency agility of high-speed arbitrary waveform generators (AWGs) is used to perform broadband microwave double-resonance measurements using selective excitation of a single rotational transition. In this measurement the AWG generates both the broadband polarizing pulse and the shaped, single-frequency double-resonance pulse. Finally, two strategies are explored to reduce the measurement time and sample consumption in CP-FTMW experiments. A multiple pulsed-jet source is used to increase the number of molecules in the active region of the spectrometer. This approach decreases both the measurement time and sample consumption by exploiting the coherent N-emitter effect of the rotational free induction decay. We also demonstrate the ability to acquire at least 10 broadband spectra on each sample pulse with equal sensitivity. Combined, we demonstrate the ability to reduce the measurement time by a factor of 90 and sample consumption by a factor of 30 for CP-FTMW spectroscopy.