SEEING IS BELIEVING: AN 11 GHZ MOLECULAR BEAM ROTATIONAL SPECTRUM (7.5 - 18.5 GHZ) WITH 100 KHZ RESOLUTION IN 15 μs MEASUREMENT TIME

BRIAN C. DIAN, KEVIN O. DOUGLASS, GORDON G. BROWN, SCOTT GEYER, BROOKS H. PATE,
Department of Chemistry, University of Virginia, McCormick Rd., P.O. Box 400319, Charlottesville, VA 22904.

Over the past year we have developed a radically new method for performing rotational spectroscopy that uses Chirped Pulse Fourier Transform Microwave (CP-FTMW) techniques. This technique utilizes the advantages of fast passage for optimal excitation.[a] Advances in test and measurement equipment driven by serial bus computer technology have made this technique possible. A $1\mu s$ 11 GHz bandwidth chirped pulse is derived from an arbitrary waveform generator with up conversion to the microwave region followed by bandwidth increase using active frequency multipliers (net x8). The linear sweep is phase coherent and is swept at a rate of 10^7 GHz per second. After amplifying the pulse with a 250 Watt TWT the molecules are polarized over the full 11 GHz. The rotational FID is detected using a 20 Gs per second (or 40 Gs per second) digital oscilloscope (200,000 or 400,000 points in 10 us). The spectrometer uses double ridge waveguide horns for excitation and detection of frequencies in the range of 7.5 to 18.5 GHz. The spectrometer design does not use microwave cavities or synthesizers. In the talk we will discuss the design requirements of the technique, signal to noise performance, and aspects of sample introduction. Spectra will be presented that cover 7.5 to 18.5 GHz of bandwidth for a single gas pulse, 100 averages (10 seconds), and 10000 averages (40 minutes). Here we emphasize the ability to see 11 GHz of a rotational spectrum in a single shot.

[a] J. C. McGurk, T. G. Schmalz and W. H. Flygare *J. Chem. Phys.* **60**, 4181-4186 1974.