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Expansion of Two-Dimensional Spectroscopy into the Microwave: Implementation and Applications

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Over the past several decades the developments of pulsed, two-dimensional, spectroscopic techniques have covered a broad range of the electromagnetic spectrum, essentially spanning the radio frequency to the UV. However, a notable gap has been present in the microwave/millimeter wave region of the spectrum owing, in large part, to the lack of suitable pulsed broadband excitation and detection equipment in this part of the EM spectrum. In the past five years, fast digital electronics (40 Gs/s; 12 GHz bandwidth) have allowed the development for ultra-broadband spectroscopic techniques to be developed in the 8-18 GHz region of the EM spectrum. We will discuss our current efforts to develop an ultra-broadband two-dimensional spectroscopy, direct analogs of 2D-NMR techniques, in the 8-18 GHz region. Unique spectroscopic applications of the technique, such as the spectroscopic determination of chirality, will be discussed.