Development of High Frequency Rapid Scan EPR spectroscopy: Current State and Perspectives

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From its discovery, electron paramagnetic resonance (EPR) is a constantly developing technique following technological advances in generating and detecting microwaves, creating strong magnetic fields, and fast digitalization, among others. In the talk, I will discuss developments in the field of high-frequency EPR (HFEPR) with a special focus on experiments in the frequency domain compared to the traditional field domain EPR. I will report on the recent development of a high-frequency rapid scan electron spin resonance (FRASCAN) spectrometer at the Brno University of Technology. The basic principle of frequency rapid scan will be explained and compared to conventional methods. I will present significant progress in the experimental determination of Zeeman diagrams (frequency vs. field EPR maps) and discuss the advantages of HFEPR for investigating high-spin systems, particularly single-molecular magnets (SMMs). Besides, we dedicate a section to discuss the advances in the studies of the cyclotron resonance in thin-films and modern solid-state materials like graphene (graphite). Furthermore, the importance of HFEPR for dynamic nuclear polarisation (DNP) is discussed. At last, I will demonstrate the possibility of accessing very short relaxation times (ns) by implementing rapid frequency scans, emphasizing the power of frequency domain EPR. This technique allowed to perform, for the first time, multi-frequency relaxation studies in a single spectrometer at frequencies above 100 GHz.