

ESEEM and HYSCORE spectroscopy: Unlocking the secrets of spin-nuclear interaction

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Electron Spin Echo Envelope Modulation (ESEEM) and Hyperfine Sublevel Correlation (HYSCORE) spectroscopies are advanced (Electron Paramagnetic Resonance) EPR techniques designed to probe spin-nuclear interactions in paramagnetic systems. ESEEM relies on the modulation of electron spin echo signals caused by hyperfine interactions between electron spins and nearby nuclear spins. By applying a sequence of microwave pulses, the resulting oscillations in echo intensity reveal complex nuclear interactions, enhancing sensitivity and enabling the study of weak spin systems. HYSCORE, using a three-pulse sequence, generates a 2D correlation spectrum that provides detailed insights into hyperfine couplings between electron and nuclear spins, offering high resolution for systems with multiple interacting nuclei. Together, ESEEM and HYSCORE offer valuable tools for investigating the local environments of paramagnetic centers, providing crucial structural and dynamic information for a wide range of scientific applications. Here, we will discuss these techniques and their application to study various materials at Vilnius University.

[1] Dikanov, S. A., & Tsvetkov, Y. Electron Spin Echo Envelope Modulation (ESEEM) Spectroscopy (1992).

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