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Electrically and optically detected spin echo of hopping carriers in organic semiconductors[1] VAGHARSH MKHITARYAN, VIATCHESLAV DOBROVITSKI, Ames Laboratory, Iowa State University, Ames, Iowa 50011 — We develop a theory for electrically and optically detected primary (2-pulse) and stimulated (3-pulse) spin echo produced by the polaron pairs coupled to the nuclear spins in organic semiconductors. The theory employs fully quantum description of the nuclear and polaron spins, and explains how the structure of the echo signal (electron spin echo envelope modulation, ESEEM) depends on the statistics and rate of the polaron hopping. For the primary spin echo the envelope modulation is strong for slow hopping; both modulation amplitude and dephasing time T_2 decrease with increasing hopping rate. As the hopping rate increases further, T_2 starts to increase again due to motional narrowing, while the primary echo signal becomes exponential without modulation. The stimulated spin echo signal also shows strong envelope modulation for slow polaron hopping. For faster hopping the stimulated echo (unlike the primary echo) shows a modulation which does not disappear for fast hopping, and has the frequency of the nuclear Larmor precession. Besides describing the recent spin echo measurements in π-conjugated polymers [1], our work provides a way to directly determine the polaron hopping dynamics from the spin echo experiments. [1] H. Malissa et al, Science 345, 1487 (2014).

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