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Coherent spin dynamics of charge carriers and excitons in lead halide perovskite nanocrystals

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Nanocrystals (NCs) based on lead halide perovskites have become an attractive object of study in the last decade due to their potential application in photovoltaics, electronics and optoelectronics. The physical properties of these materials differ significantly from those of conventional III-V and II-VI semiconductors and remain insufficiently studied. In the present work, the coherent spin dynamics of charge carriers and excitons in $CsPbI_3$ and $CsPbBr_3$ perovskite NCs of different sizes from 4 to 16 nm is investigated by the time-resolved pump-probe Faraday rotation or ellipticity techniques. In the external magnetic field, we observe coherent Larmor spin precession of electrons and holes. Larmor frequency of the spin precession is determined by g-factor, which is strongly dependent on charge carriers' quantum confinement in NCs. In zero and small magnetic fields spin beats induced by the hyperfine coupling of the hole spin with fluctuations of the nuclear spin are observed. At the small time delays between pump and probe pulses we also observe very fast oscillations (with frequencies of order of 1 meV) of the Faraday ellipticity and rotation signals, which correspond to the quantum beats between different states of the bright exciton fine structure.