DEPARTMENT OF PHYSICS & ASTRONOMY

CONDENSED MATTER SEMINAR

Uyen Huyhn

Department Physics & Astronomy

University of Utah

Studies of the Exciton Fine Structure in Bulk Metal Halide Perovskite Single Crystals by Photoinduced Transient Quantum Beatings

The lowest exciton 'fine structure' (EFS), where the four spin sublevels are split into a dark singlet and bright triplets, has attracted substantial interest in the metal halide perovskites, since it determines the exciton brightness and also demonstrates the strength of the exchange interaction. At the present time, however the EFS in the perovskites, especially the dark and bright exciton order are a matter of controversy. The reason for that might be the lack of suitable experimental techniques for measuring the anticipated miniature EFS splitting.

Here we have used picosecond time-resolved quantum beatings (QB) in the circularly polarized photoinduced reflection to investigate the EFS in $(CH_3NH_3)PbI_3$ and $CsPbBr_3$ single crystals in the orthorhombic phase at liquid Helium temperature 4K. From the QB frequencies at zero magnetic field (B=0), we determined the very long spin dephasing time $\tau_2 \sim 5.6$ nanoseconds and the triplet EFS splitting $\sim 2\mu eV$. We found that the EFS depends on the crystal orientation with respect to the incident light, which indicates that it is necessary to add to the exciton Hamiltonian a long-range exchange coupling term that describes the exciton-photon interaction. At B>20mT the QB correspond to the Larmor precession frequencies of decoupled electrons and holes, from which we obtained the anisotropic g values; for instance: $g_{e\perp}$=2.42 and $g_{e//}$=2.60 for the electron; whereas for the hole $|g_{h\perp}|$=0.67 and $|g_{h//}|$=0.39 in $(CH_3NH_3)PbI_3$.

Tuesday, September 24, 2019

JFB 334

4:00 pm

Refreshments will be served in JFB 334 at 3:45 pm