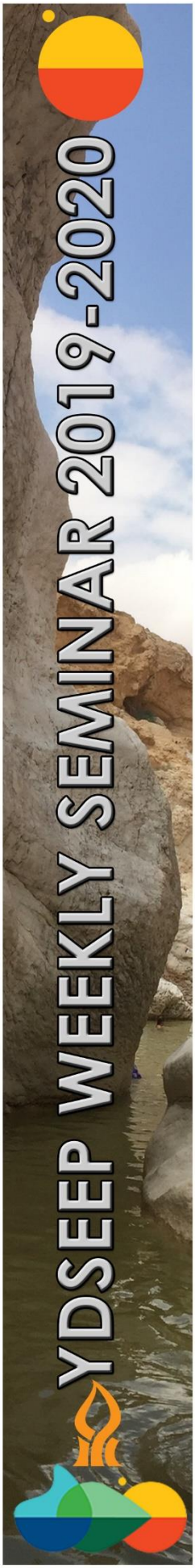

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The effect of magnetism on the optical properties of bulk and confined perovskite structures

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Abstract:
The perovskite materials are at the forefront of scientific and technological interest more than a decade, due to their intriguing physical properties and extraordinary performance in a few different opto-electronic applications. The lecture focuses on the influence of photo-induced magnetic fields on the optical properties of the nominally non-magnetic MAPbBr3 bulk and nanocrystal perovskites. Although the electronic band structure of MAPbBr3 is based on the inorganic network, the MA counter induce an inversion of symmetry breaking and consequence development of a Rashba effect [Isarov, 2017]. The last is associated with the creation of an exotic spin-orbit magnetic field which split both valence and conduction band in k-space into two valleys with opposing spin helicities, with the anomalous exciton fine-structure with a bright triplet state below a dark singlet state [Becker, 2018], and with the relatively long spin lifetime (~1nsec) and coherence time (~80 spec) [Akkerman 2018, Belykh 2019].

The lecture includes a description of magneto-photoluminescence experiments which monitored the degree of circular polarization (DECP) of bulk- or single nanocrystals, under the influence of an external magnetic field (B) and by mounting them onto a confocal microscope immersed in cryo-magnetic system. The plot DCP versus B exposed non-Zeeman behavior with a few interesting features: The quenching of polarization at external field close to zero, followed by a rebuilt of polarization via a non-linear trend. The quenching events are associated with creation of carrier-to-nuclear spin coupling creating an internal nuclear (Overhauser) magnetic field, with a significant influence on the carrier polarization and coherence. The non-linear behavior at B>>0 is related to the influence of a Rashba field. Furthermore, the results exposed three type of recombination processes, associated with neutral exciton, trapped exciton and charged exciton, depending on the excitation history (resonant/non-resonant excitation and fluence, direction of the excitation beam with respect to a unique crystallographic axis), each of which characterized by typical DCP(B) pattern. Overall, the photo-induced Rashba and nuclear internal fields have a paramount influence on the optical properties of halide perovskites.

Date & Location:

Tuesday, January 7, 2020, 11:00
Lecture room, Physics Building (ground floor)