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Exciton Binding energies and effective masses in Organo-lead Tri-Halide Perovskites OLIVER PORTUGALL, ATSUHIKO MIYATA, ANATOL MITIOGLU, PAULINA PLOCHOCKA, LNCMI Toulouse, JACOB TSE-WEI WANG, SAMUEL STRANKS, HENRY SNAITH, ROBIN NICHOLAS, Oxford University, LNCMI TOULOUSE TEAM, OXFORD UNIVERSITY TEAM — Solid-state perovskite-based solar cells have made a dramatic impact on emerging PV research with efficiencies of over 17% already achieved. However, to date the basic electronic properties of the perovskites such as the electron and hole effective masses and the exciton binding energy are not well known. We have measured both for methyl ammonium lead tri-iodide using magneto absorption in very high magnetic fields up to 150T showing that the exciton binding energy at low temperatures is only 16 meV, a value three times smaller than previously thought and sufficiently small to completely transform the way in which the devices must operate. Landau level spectroscopy shows that the reduced effective mass of 0.104 me is also smaller than previously thought. In addition by using a fast pulse 150T magnet we measure the band structure change due to the structural phase transition that occurs in this system at around 160K. We also observe Landau levels in the high temperature phase as used for device production, which has a very similar effective mass and the analysis suggests an exciton binding energy which is even smaller than in the low temperature phase.

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