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Valley splitting and polarization by the Zeeman effect in monolayer MoSe2 YILEI LI, Columbia Univ, JONATHAN LUDWIG, National High Magnetic Field Lab, TONY LOW, ALEXEY CHERNIKOV, XU CUI, GHIDEWON AREFE, YOUNG DUCK KIM, AREND VAN DER ZANDE, ALBERT RIGOSI, HEATHER HILL, SUK HYUN KIM, JAMES HONE, Columbia Univ, ZHIQIANG LI, DMITRY SMIRNOV, National High Magnetic Field Lab, TONY HEINZ, Columbia Univ — We have measured circularly polarized photoluminescence in monolayer $MoSe_2$ under perpendicular magnetic fields up to 10 T. At low doping densities, the neutral and charged excitons shift linearly with field strength at a rate of $\mp$ 0.12 meV/T for emission arising, respectively, from the K and K' valleys. The opposite sign for emission from different valleys demonstrates lifting of the valley degeneracy. The magnitude of the Zeeman shift agrees with predicted magnetic moments for carriers in the conduction and valence bands. The relative intensity of neutral and charged exciton emission is modified by the magnetic field, reflecting the creation of field-induced valley polarization. At high doping levels, the Zeeman shift of the charged exciton increases to $\mp$ 0.18 meV/T. This enhancement is attributed to many-body effects on the binding energy of the charged excitons.

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