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High field magneto-spectroscopy of excitons in monolayer WSe_2
ZHENGGUANG LU, National High Magnetic Field Laboratory and Florida State University, XIAOXIAO ZHANG, Columbia University, JONATHAN LUDWIG, National High Magnetic Field Laboratory and Florida State University, FAN ZHANG, Columbia University, KOMALAVALLI THIRUNAVUKKUARASU, National High Magnetic Field Laboratory, SEONGPHILL MOON, National High Magnetic Field Laboratory and Florida State University, JAMES HONE, Columbia University, TONY HEINZ, Stanford University, DMITRY SMIRNOV, National High Magnetic Field Laboratory — We have performed circularly polarized photoluminescence (PL) experiments on monolayer WSe_2 in magnetic fields up to 31T and at temperatures between 2K and 45K, focusing on the emission from the neutral (X^0) and negatively charged (X^-) excitons. A parallel magnetic field does not affect the exciton energy. At 45K, a perpendicular magnetic field (Faraday geometry) induces linear shift of about 0.12 meV/T$\approx 2\mu$B for both X^0 and X^- peaks indicating lifting of the valley degeneracy. The magnitude of this valley Zeeman shift agrees with the valence band edge lifting due to atomic orbital contribution. The change of the X^- PL intensity with the magnetic field suggests that the intravalley configuration is the lower energy state of the trion in WSe_2. At lower temperatures, the X^0 exhibits the same shift with the magnetic field as at 45K, while the X^- shows a more pronounced and non-linear shift with respect to magnetic field.

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