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Magnetic brightening of dark excitons in transitional metal dichalcogenides XIAO-XIAO ZHANG, Columbia University, ZHENGGUANG LU, National High Magnetic Field Laboratory, TING CAO, University of California, Berkeley, FAN ZHANG, JAMES HONE, Columbia University, STEVEN G. LOUIE, University of California, Berkeley, ZHIQIANG LI, DMITRY SMIRNOV, National High Magnetic Field Laboratory, TONY HEINZ, Stanford University —

Transitional metal dichalcogenides (TMDC) in the MX_2 (M = Mo, W, X = S, Se) family represent an excellent platform to study of excitonic effects. At monolayer thickness, these materials exhibit both direct band-gap character and enhanced excitonic interactions. Theoretical studies suggest that both the valence and conduction bands are split and exhibit spin polarized character at the K/K' valleys. The lowest energy band-edge excitons are predicted to have different spin configurations for different materials in this family. When the lowest lying exciton has parallel electron and hole spin, radiative decay is forbidden and the state is dark. Here we demonstrate that by applying an in-plane magnetic field we can perturb the exciton spin configuration and brighten this state, allowing it to undergo radiative decay. We identify such a brightened dark state by the emergence of a new emission peak lying below the absorption peak, with a strength growing with applied in-plane magnetic field. On the other hand, for monolayer $MoSe_2$, where no low-lying dark state is expected, we do not see the growth of a new emission feature under application of an in-plane magnetic field. Our experimental findings are in agreement with the calculated properties of dark excitons based on GW plus Bethe-Salpeter equation approach

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