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Exciton Rydberg series in mono- and few-layer WS2 ALEXEY CHERNIKOV, TIMOTHY C. BERKELBACH, HEATHER M. HILL, ALBERT RIGOSI, YILEI LI, ÖZGUR B. ASLAN, MARK S. HYBERTSEN, DAVID R. REICHMAN, TONY F. HEINZ, Columbia University — Considered a long-awaited semiconducting analogue to graphene, the family of atomically thin transition metal dichalcogenides (TMDs) attracted intense interest in the scientific community due to their remarkable physical properties resulting from the reduced dimensionality. A fundamental manifestation of the two-dimensional nature is a strong increase in the Coulomb interaction. The resulting formation of tightly bound excitons plays a crucial role for a majority of optical and transport phenomena. In our work, we investigate the excitons in atomically thin TMDs by optical micro-spectroscopy and apply a microscopic, *ab-initio* theoretical approach. We observe a full sequence of excited exciton states, i.e., the Rydberg series, in the monolayer WS_2, identifying tightly bound excitons with energies exceeding 0.3 eV - almost an order of magnitude higher than in the corresponding, three-dimensional crystal. We also find significant deviations of the excitonic properties from the conventional hydrogenic physics - a direct evidence of a non-uniform dielectric environment. Finally, an excellent quantitative agreement is obtained between the experimental findings and the developed theoretical approach.

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