DIELECTRIC ENVIRONMENT AND RYDBERG EXCITONS IN ATOMICALLY THIN SEMICONDUCTORS

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The dielectric environment contributes to electrostatic interaction in atomically thin (2D) semiconductors, rendering their excitons environmentally sensitive. With a general electron-hole interaction potential obtained by revisiting the electrostatics problem of a 2D semiconductor and its immediate surroundings, we establish a systematic relationship between 2D Rydberg exciton binding energies and radii and the environment's dielectric constants. Our results reproduce the observed dependence of 2D Rydberg exciton energies on the azimuthal quantum number with their arranged details and show reasonable agreement with experimental measurements. The model clarifies fundamental Rydberg exciton physics in 2D semiconductors and can be used for dielectric control of Rydberg exciton characteristics through dielectric engineering.