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Scaling Properties of Exciton Binding Energies in Two-Dimensional Insulating Films[1] HAIPING LAN, PING CUI, Univ. of Sci. and Tech. of China, ZHENYU ZHANG, Univ. of Sci. and Tech. of China, Harvard University — Using the GW and Bethe-Salpter Equation (BSE) methods with inclusion of many-electron effects, we carry out a systematic study of the quasiparticle energy and optical absorption spectra of various two-dimensional (2D) thin-film insulators, including boron nitride, graphane, fluorographene, fluorosilicene, etc. All the calculated band gaps of these systems are increased by the GW corrections, and their optical responses are dominated by the strongly bound excitons, which can be attributed to the enhanced Coulomb attraction in 2D. Most strikingly, we find a well-defined linear scaling dependence between the exciton binding energy and band gap, and this scaling relationship is in stark contrast with the established ones in 3D and 1D insulating systems. The likely underlying physical mechanism for the linear scaling relationship will also be discussed.

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