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2d Heterojunctions From Non-Local Manipulation of the Interactions: Single and Two-Particle Properties C. STEINKE, D. MOURAD, M. ROESNER, M. LORKE, G. CZYCHOLL, F. JAHNKE, C. GIES, T. O. WEHLING, Institute for Theoretical Physics, University of Bremen, Germany — Semiconductors play a major role in modern optoelectronics. Especially heterojunctions are central building blocks of various applications, which commonly rely on interfaces of different materials. Here, we propose a novel scheme to induce heterojunctions within a single *homogeneous* layer of a two dimensional (2d) material based on Coulomb-interaction effects. Therefore we make use of the fact that in 2d semiconductors the Coulomb interaction can modify band gaps on an eV scale and can be drastically manipulated by external screening. This allows to spatially control the band gap by structured dielectric surroundings. We provide a proof of principle by combining a real-space tight-binding description with a many-body formalism for a model system emulating transitionmetal dichalcogenides. We find sizable spatial band-gap modulations yielding type-II heterojunctions as needed for solar cells or quantum dots and present detailed insights into their excitation-induced two-particle properties. Utilizing the Bethe-Salpeter equation we show that Rydberg-like higher excitonic states can be strongly tuned by the dielectric surroundings. This effect may be used for efficient trapping of these excitonic states upon tailoring of the environment.

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