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Low-temperature optical spectroscopy of single-layer transition metal dichalcogenides GERD PLECHINGER, PHILIPP NAGLER, CHRISTIAN SCHÜLLER, TOBIAS KORN, Institut für Experimentelle und Angewandte Physik, Universität Regensburg, D-93040 Regensburg, Germany — In recent years, layered materials beyond graphene have attracted immense interest in the scientific community. Among those, particularly the semiconducting transition metal dichalcogenides (TMDCs) in their monolayer form are in the focus of the current research due to their intriguing optical properties and their potential application in valleytronic-based devices. The optical properties are governed by excitonic features, even at room temperature. The excitons in monolayer TMDCs have unusually large binding energies due to the two-dimensional carrier confinement and weak dielectric screening. Here, we investigate the photoluminescence spectra of monolayer TMDCs at low temperatures. We present clear evidence for the existence of biexcitons in monolayer WS_2, exhibiting a superlinear behavior in excitation-power-dependent measurements. Applying a gate-voltage in a FET-configuration, we can identify charge-neutral and negatively charged excitons (trions) in the optical spectrum of different TMDCs. The trion binding energies range in the order of 30 meV. The evolution of the excitonic peaks under the application of external magnetic fields give further insight into the internal structure of these materials.

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