Observation of tightly bound charged excitons in monolayer MoS$_2$

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Here we report results of studies of the optical absorption and photoluminescence of a monolayer MoS$_2$ field-effect transistor (FET) at 10 K. In the limit of very low doping, the optical properties are dominated by an excitonic feature at $\sim$ 1.9 eV. As the doping density is increased, a new resonance emerges on the low-energy side of the exciton. This feature has been identified as a trion, the bound state of an exciton and an additional electron (or hole). The absorbance and photoluminescence of both the trion and exciton can be tuned by electrostatic doping. A large trion binding energy, exceeding room temperature, is inferred. Our observation can be understood in terms of the dynamical many-body response of a 2D electron gas to the optically created hole and reflects the unusually strong many-body interactions in this 2D system.


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