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Observation of tightly bound charged excitons in monolayer MoS_2 KELIANG HE, Case Western Reserve University, KIN FAI MAK, Columbia University, CHANGGU LEE, Sumgkyunkwan University, Suwon, Korea, JIM HONE, TONY HEINZ, Columbia University, JIE SHAN, Case Western Reserve University —
Recent advances in the development of atomically thin layers of materials have opened up many new research opportunities. In particular, the transition metal-dichalcogenide molybdenum disulfide (MoS_2) has been shown to cross over from a dark indirect semiconductor to a highly luminescent direct gap material in the limit of monolayer thickness.[1] 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.

[1]Mak et al. *Phys. Rev. Lett.* **105**, 136805 (2010); Splendiani et al. *Nano Letters* **10**, 1271-1275, (2010).

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