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Topology and Correlations in Monolayer WTe_2

Topology and correlations are two fundamental aspects that determine the electronic ground states of condensed matter systems. Both aspects individually have led to striking observations such as the quantum spin Hall insulating state and superconductivity, respectively. The combination of them can result in exotic phenomena including topological superconductivity and non-abelian anyons. In this talk I will discuss our study on monolayer tungsten ditelluride (WTe_2), where we find that both topology and correlations are important in understanding its ground state properties. I will first talk about quantum transport measurements for identifying the undoped monolayer WTe_2 as a two-dimensional topological insulator [1]. The observation of the quantum spin Hall effect surviving up to 100 Kelvin will be discussed. I will then talk about the observation of superconductivity below 1 Kelvin when the same monolayer is electrostatically doped through dielectric gating [2]. These observations demonstrate that the ground state of the monolayer is remarkably gate-tunable between the two extremes of electronic transport in materials (insulator and superconductor). The results establish monolayer WTe_2 as a novel, tunable material platform for studying rich electronic phenomena driven by topology and correlations, potentially allowing for the creation and detection of non-abelian quantum particles.

References

[1] Sanfeng Wu, Valla Fatemi, Quinn Gibson, Kenji Watanabe, Takashi Taniguchi, Robert Cava, and Pablo Jarillo-Herrero, Science 359 (6371) (2018),76-79
[2] Valla Fatemi, Sanfeng Wu, Yuan Cao, L. Bretheau, Q. Gibson, K. Watanabe, T. Taniguchi, R. Cava, and Pablo Jarillo-Herrero, Science 362 (2018), 926–929