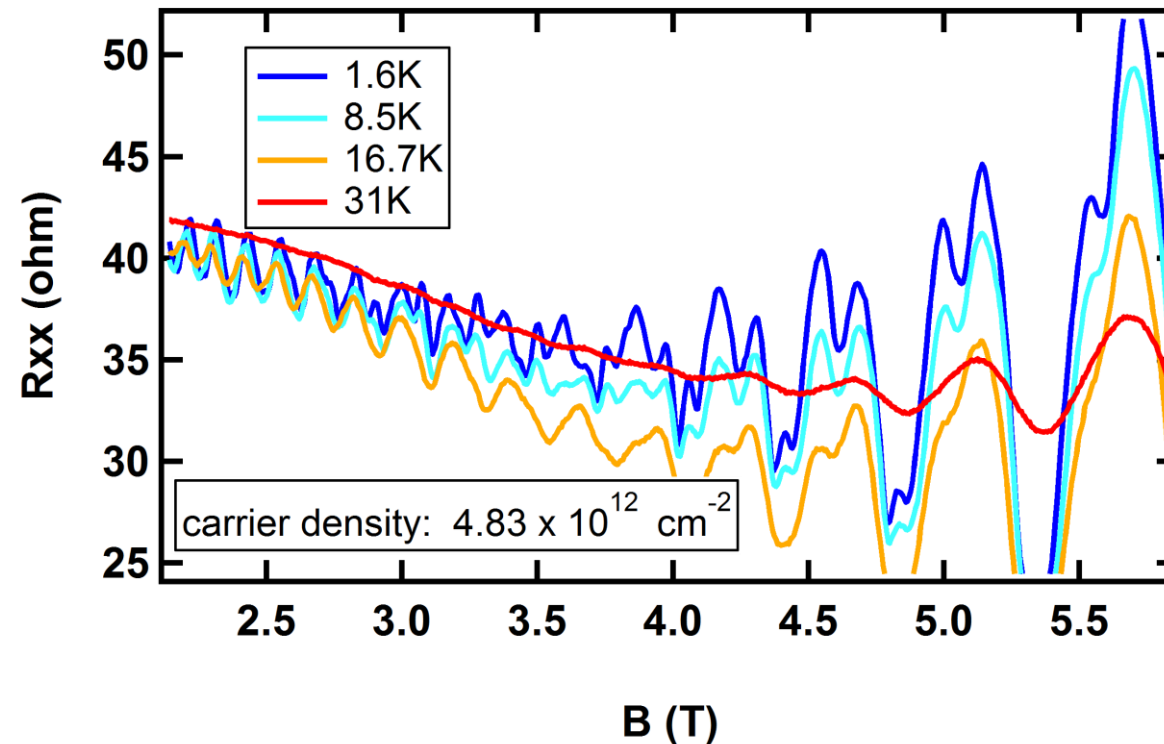


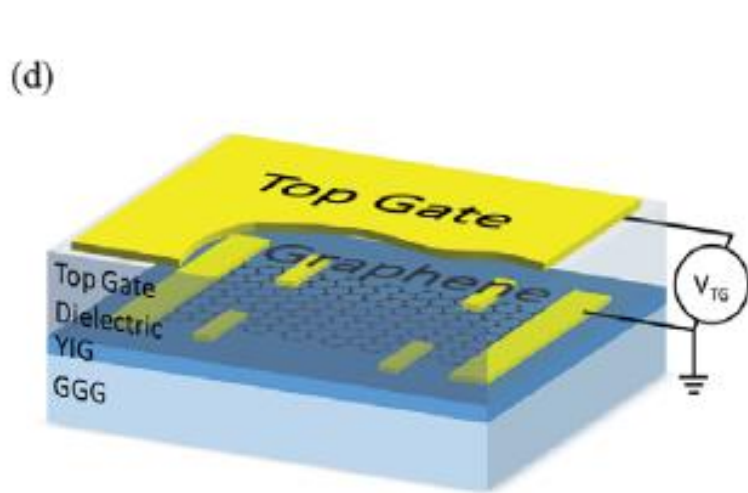
# Magnetotransport in Graphene/Ferromagnetic Insulator Heterostructures

Aaron Sharpe, Wenmin Yang, Menyoung Lee, Takashi Taniguchi, Kenji Watanabe, Robert Cava, Jason Petta, David Goldhaber-Gordon



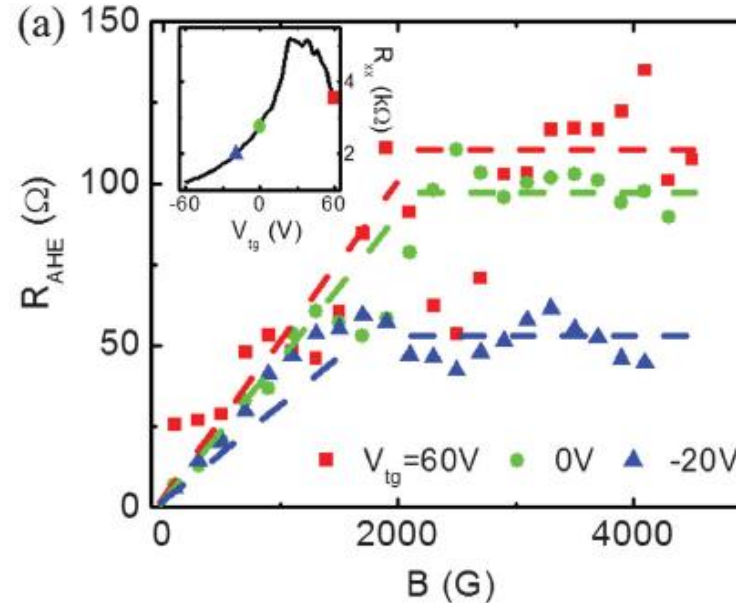
# Heterostructures of Graphene and other 2D materials

## Anomalous Hall on YIG

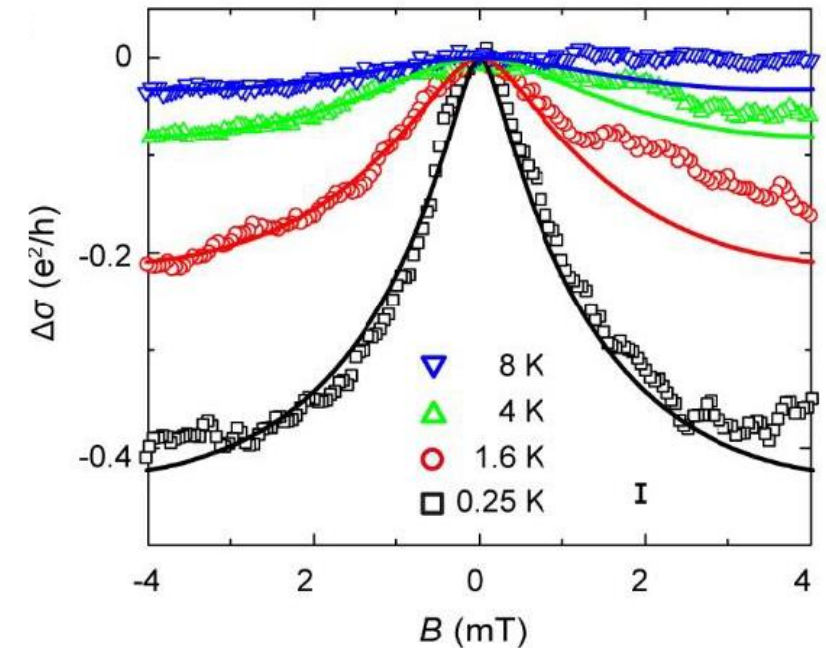


$$\mu = 10,000 \text{ cm}^2/(\text{Vs})$$

Zhiyong Wang et al, Phys. Rev. Lett. 2015



## Enhanced spin-orbit on WS2



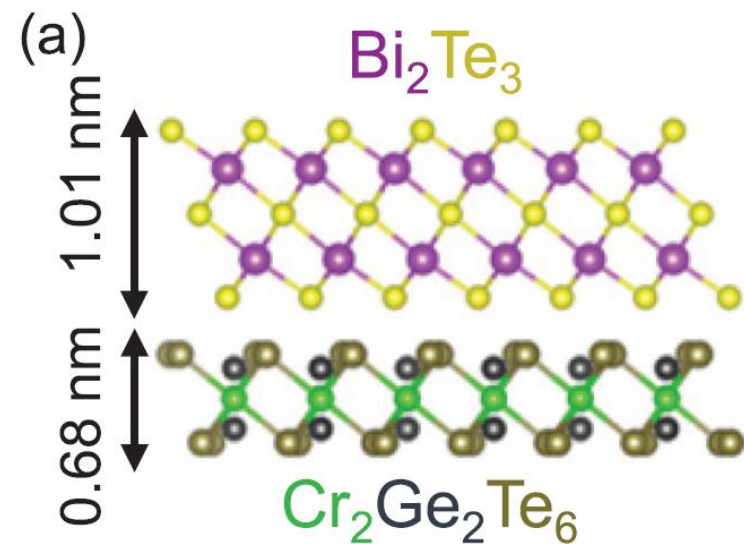
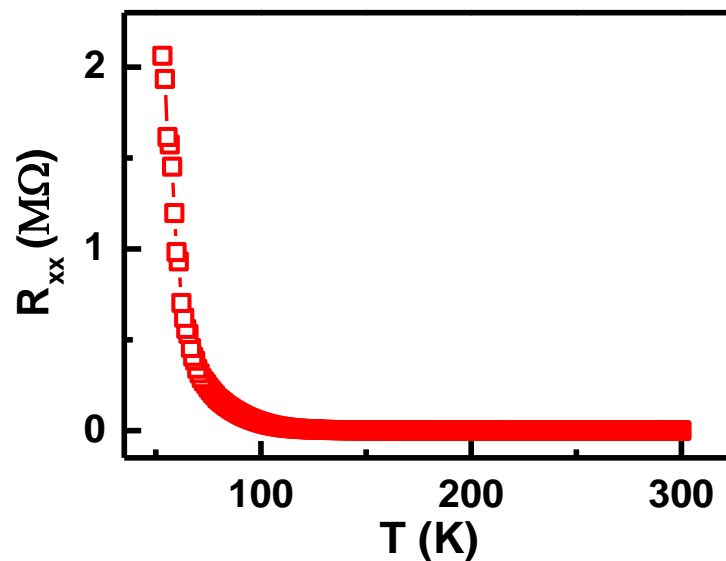
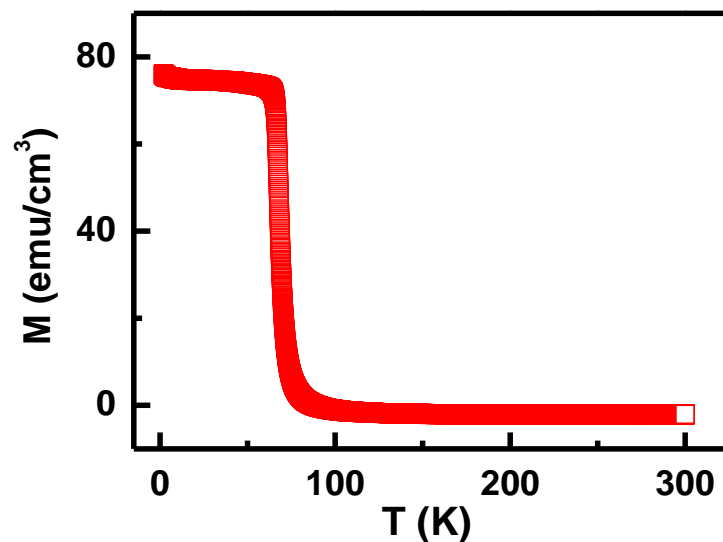
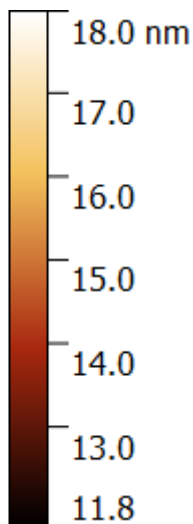
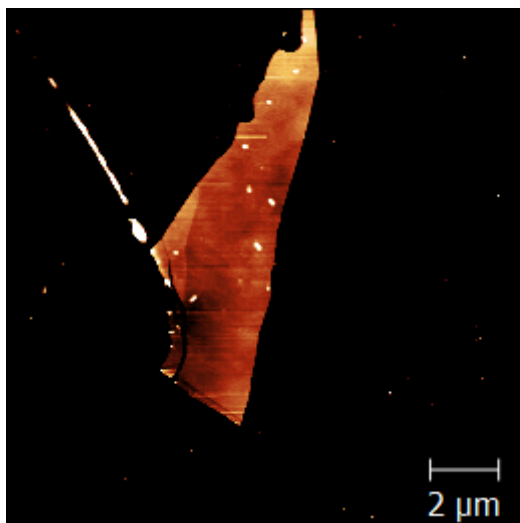
$$\mu \sim 60,000 \text{ cm}^2/(\text{Vs})$$

Zhe Wang et al, Nat. Commun. 2015

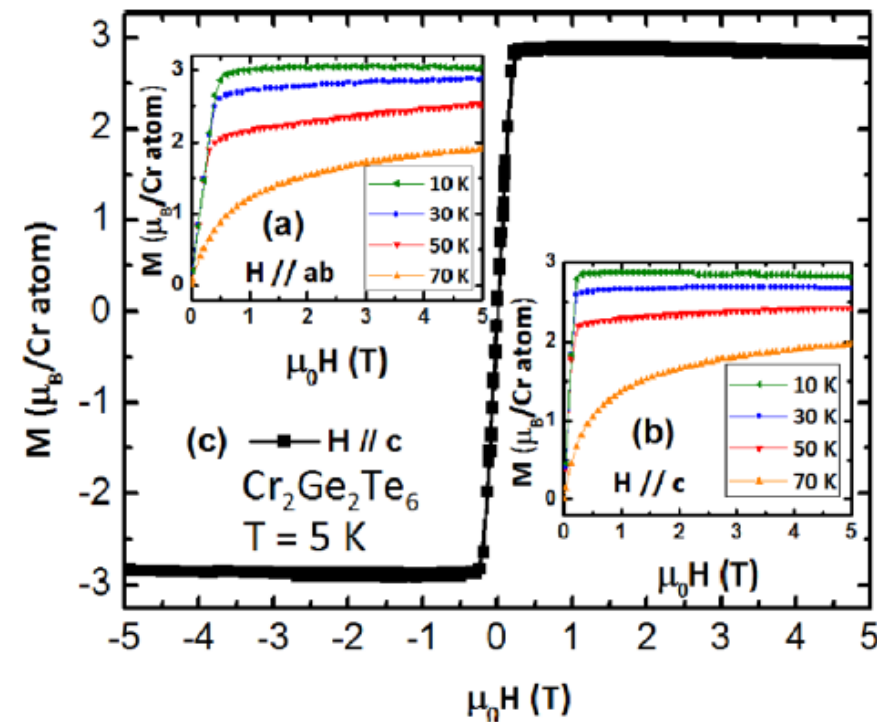
# Desired Properties for Proximity Effect Induced Ferromagnetism

- Insulating
- Magnetically anisotropic with out of plan polarization
- Has a Van Der Waals gap
  - Mechanically cleave easily with clean/flat basal plane

# Cr<sub>2</sub>Ge<sub>2</sub>Te<sub>6</sub> (CGT)

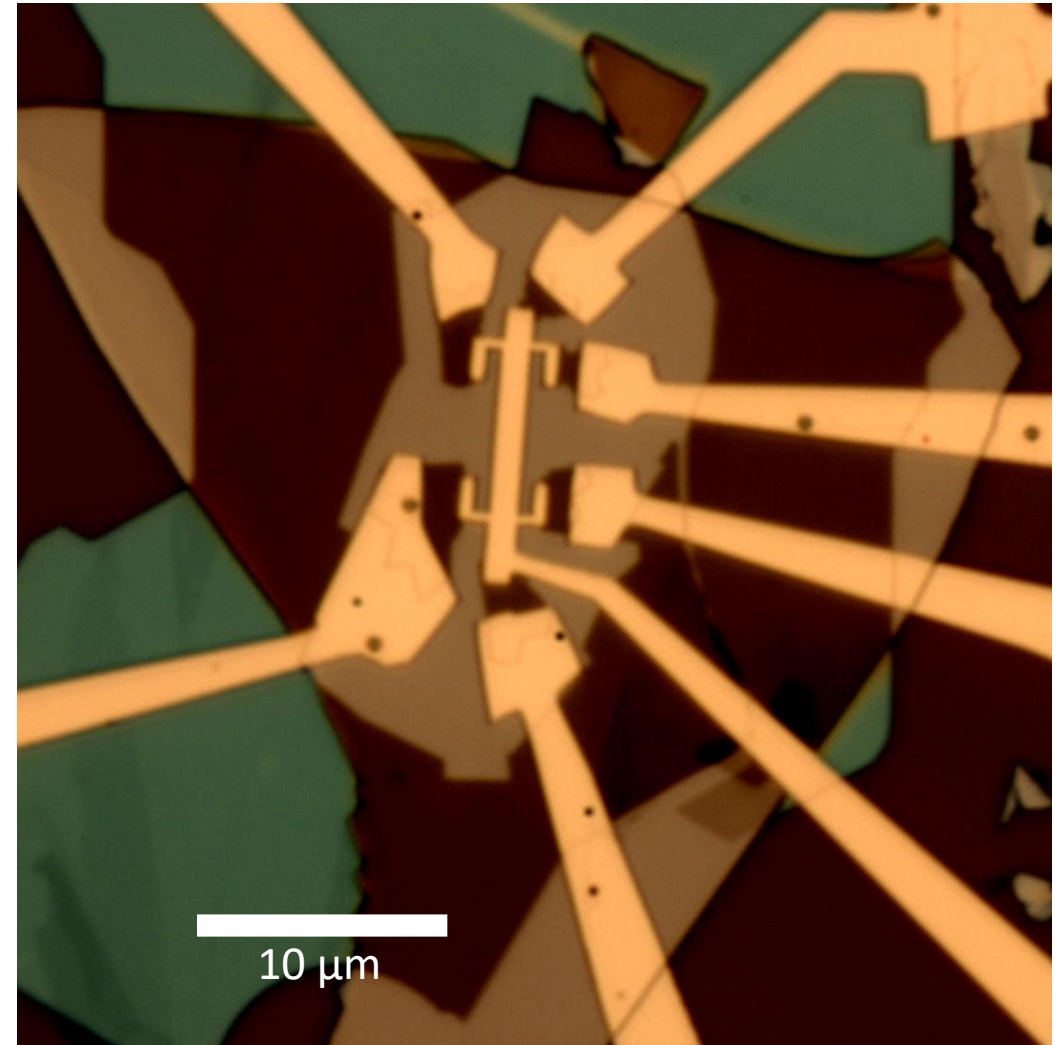
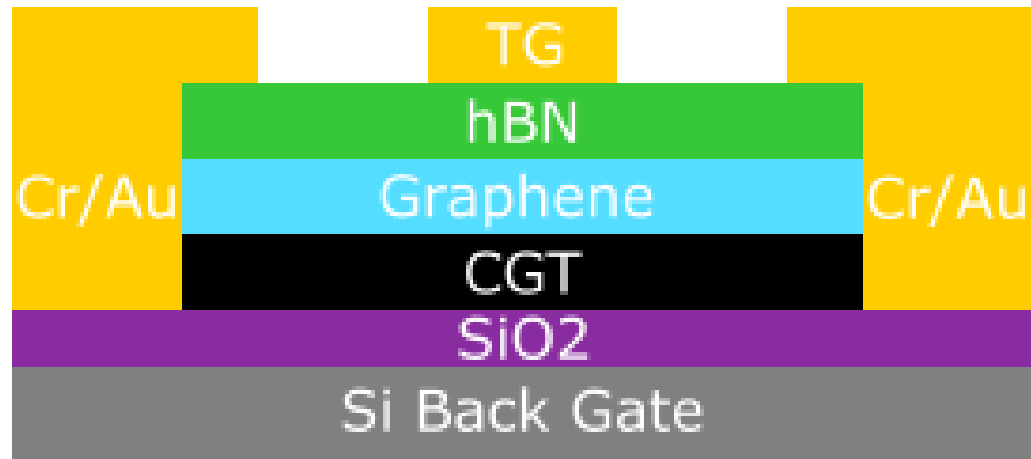


Alegria et al, Appl. Phys. Lett. 2014

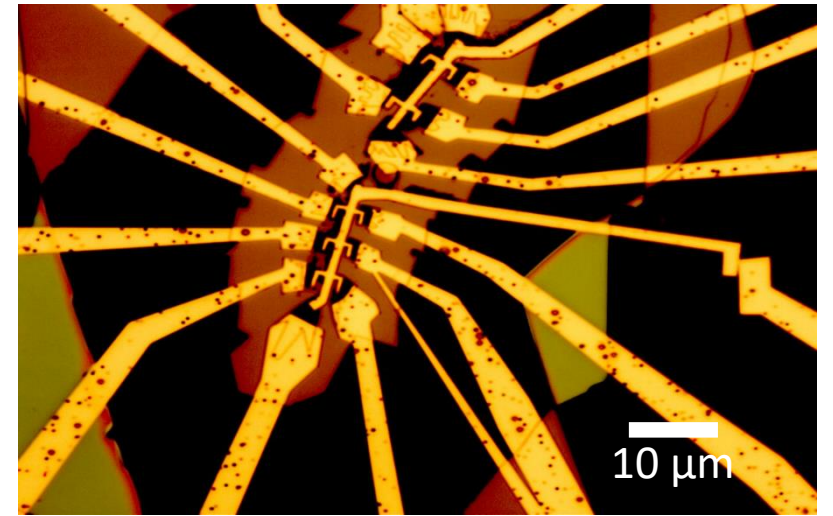
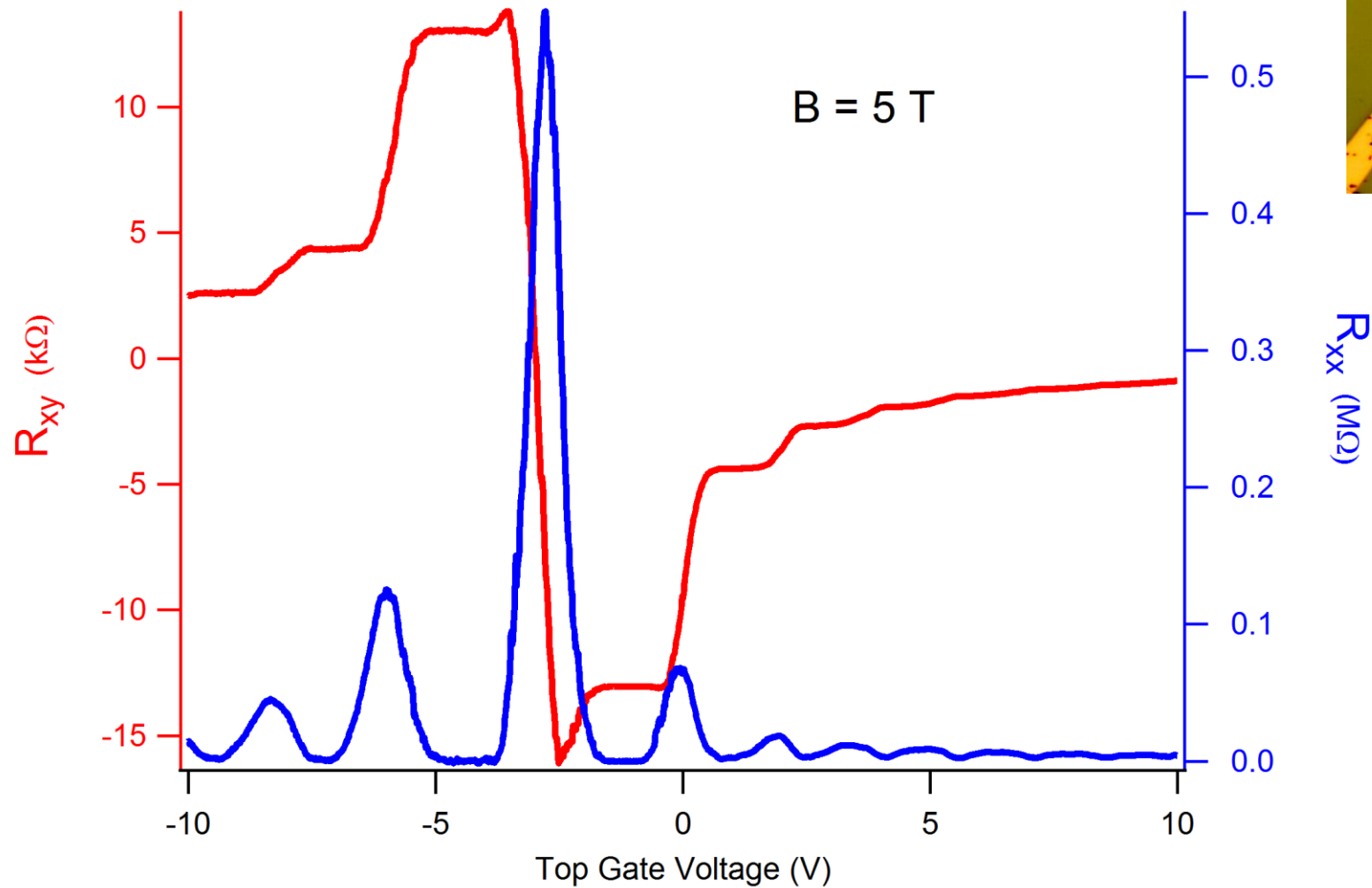


Huiwen et al, App. Phys. 2013

# Building Heterostructures

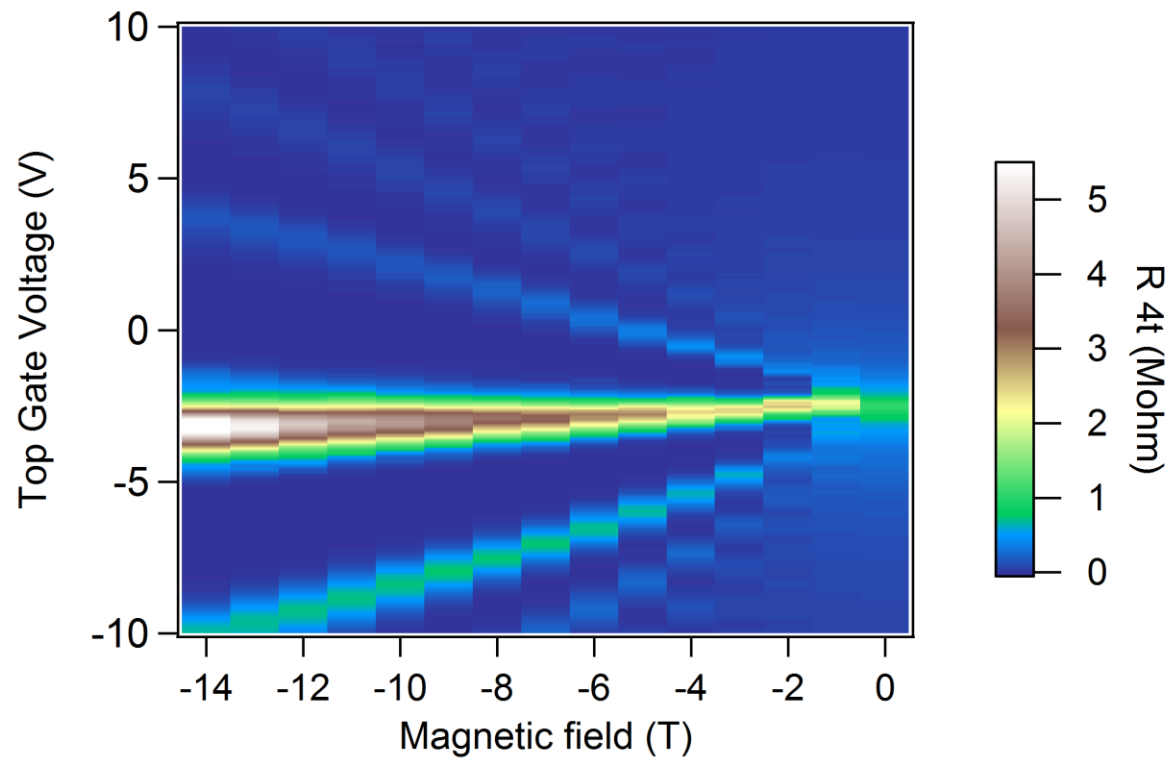


# Robust Quantum Hall

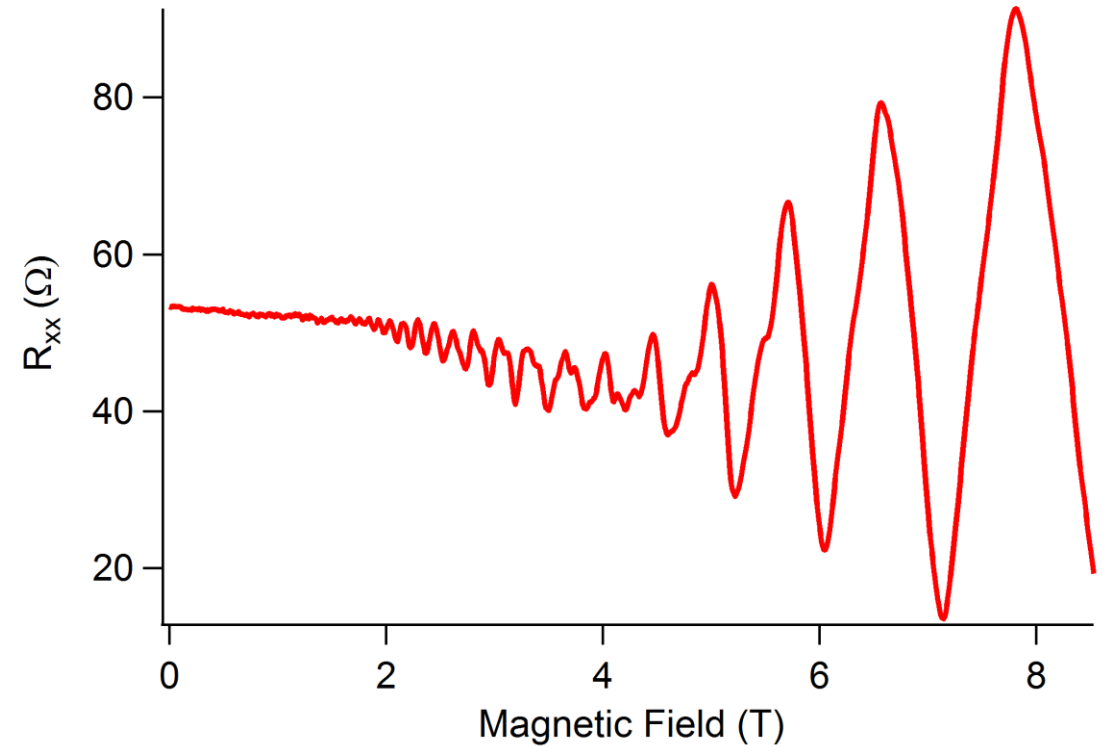
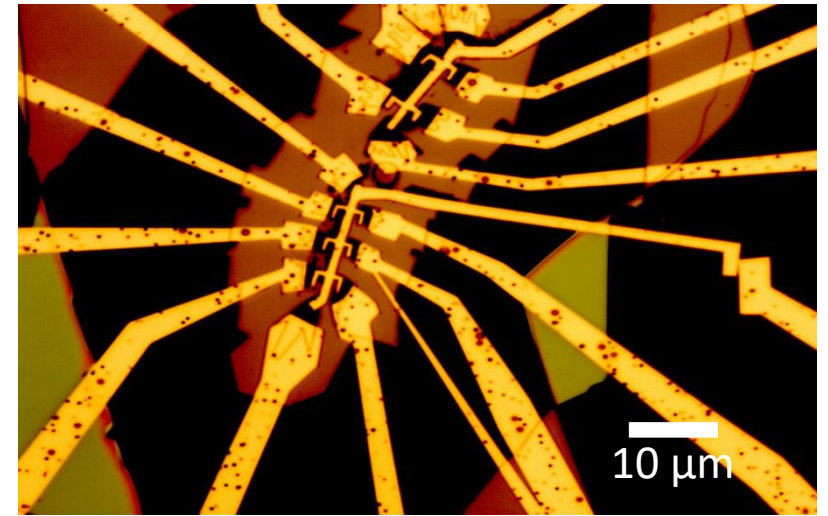




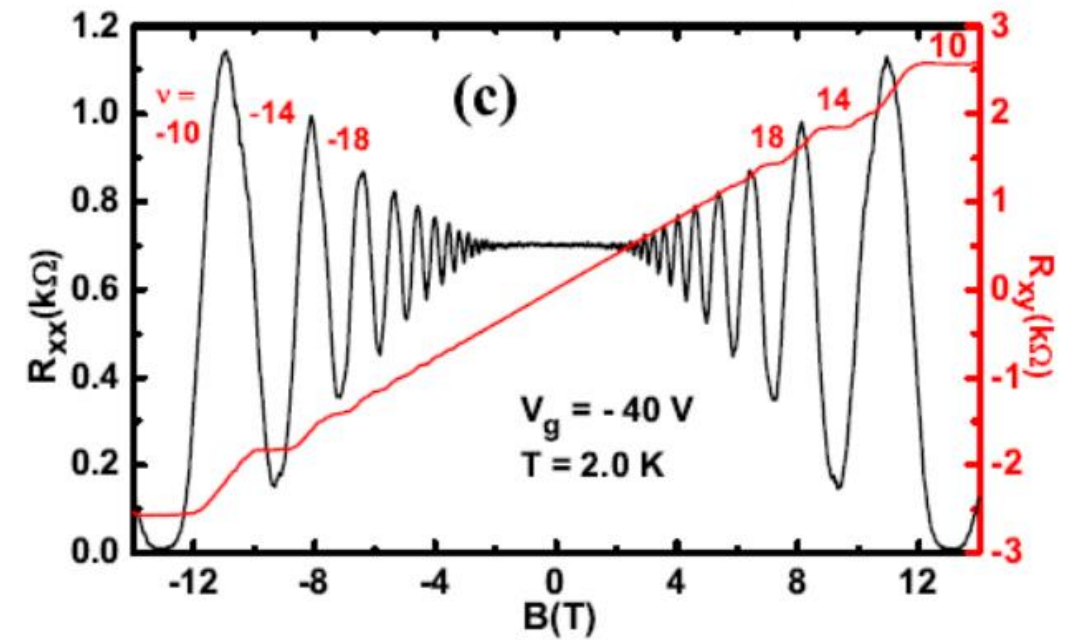
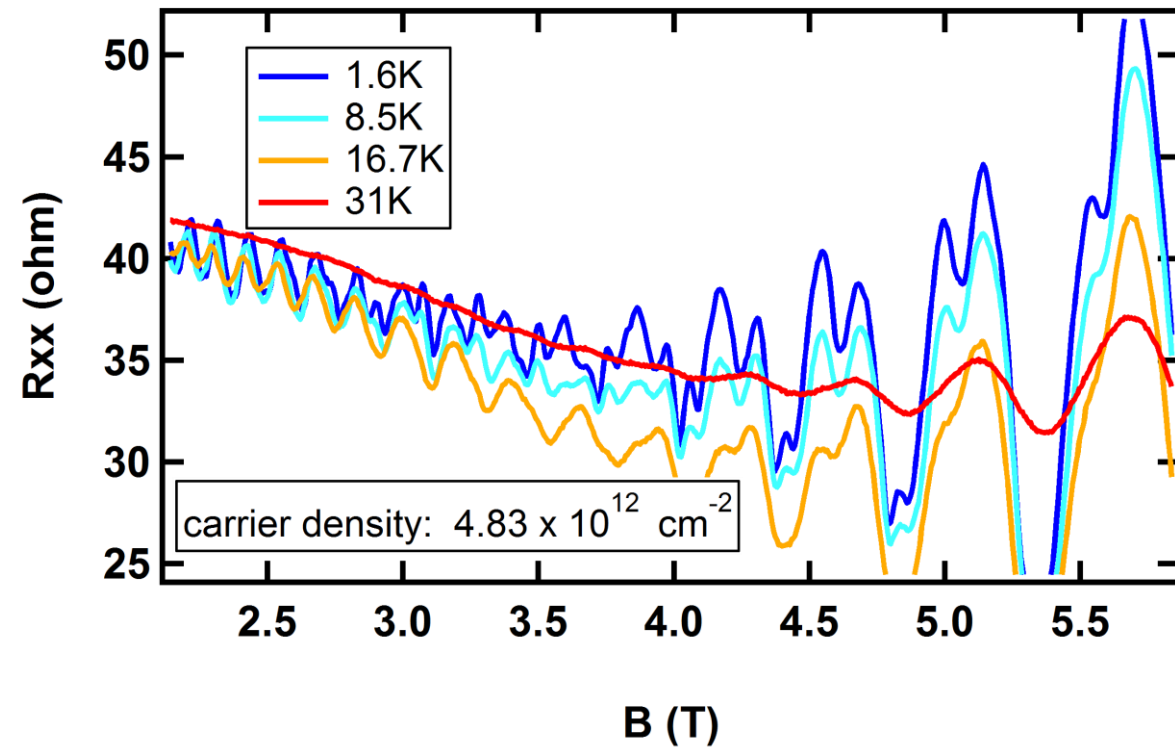
# Potential Spin Splitting



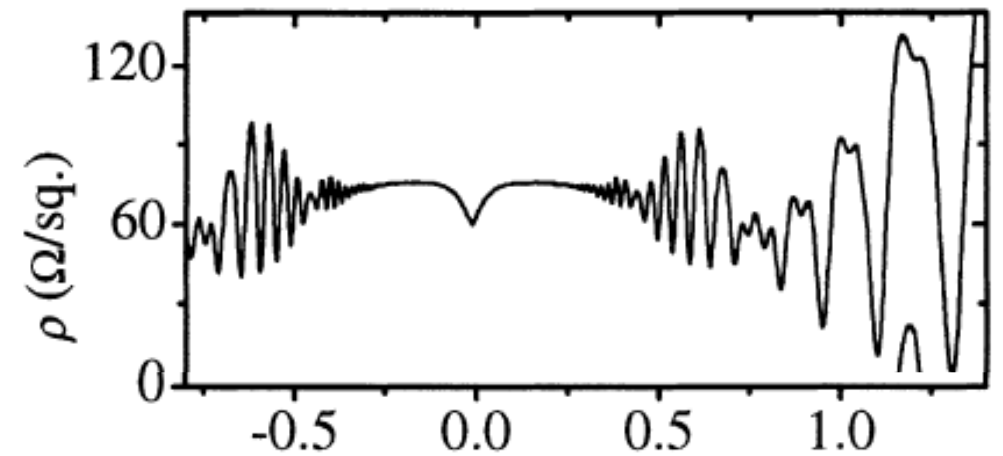
$$\mu = 40,000 \text{ cm}^2/(\text{Vs})$$



# Potential Spin Splitting



Tan et al, Phys. Rev. B 2011



Papadakis et al, Physica E 2001



# Acknowledgments

- The entire Goldhaber-Gordon group
- Loren Alegria for helping start this collaboration

