



## SPP Colloquium

**Date:** 17 June 2021  
**Time:** 5:00 PM – 7:00 PM  
**Location:** Online Zoom Meeting



### GUEST SPEAKER:

**Dr. James McIver**

Max Planck Institute for the Structure and Dynamics of Matter, Hamburg

### TITLE:

**"Ultrafast optoelectronic probes of 2D materials"**

### ABSTRACT:

Optoelectronic probes offer new opportunities for investigating quantum phenomena in 2D materials on ultrafast timescales and at terahertz frequencies. In this talk, I will report on our observation of a light-induced anomalous Hall effect in monolayer graphene driven by an intense femtosecond pulse of circularly polarized light [1]. We probed electrical transport using an ultrafast device architecture based on photoconductive switches. The dependence of the anomalous Hall effect on a gate potential used to tune the equilibrium Fermi level revealed multiple features that reflect a Floquet-engineered topological band structure [2], similar to the band structure originally proposed by Haldane [3]. This included an approximately 60 meV wide conductance plateau centered at the Dirac point, where a gap of equal magnitude was predicted to open. We found that when the Fermi level was tuned within this plateau, the estimated anomalous Hall conductance saturated around  $1.8 \pm 0.4 e^2/h$ .

As an extended outlook, I will share our progress on using ultrafast optoelectronic circuits to perform near-field terahertz spectroscopy on graphene heterostructures, which could be used to investigate a wide range of topological and strongly correlated phenomena in 2D materials that often fall on the terahertz energy scale.

## **PROFILE OF DR JAMES MCIVER:**

**Dr. James McIver** received his PhD in 2014 from Harvard University, where he investigated the nonlinear optical and optoelectronic properties of topological insulators. He then came to MPSD on a Humboldt postdoctoral fellowship, during which time he developed ultrafast circuitry to probe the topological transport properties of photon-dressed states in graphene. He now leads the Ultrafast Quantum Transport group in the Condensed Matter Dynamics Department at MPSD.

[1] J.W. McIver et al. Nature Physics 16, 38 (2020)

[2] T. Oka & H. Aoki. Phys. Rev. B 79, 081406 (2009)

[3] F.D.M. Haldane, Phys. Rev. Lett. 61, 2015 (1988)