Scanning-Probe and Magneto-Optical Studies of Integer and Fractional Moiré Chern Insulators

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Moiré bilayers of van der Waals (vdW) materials are a perfect playground for studying the properties of Chern insulators. We present here a selection of remarkable results achieved with attocube systems technology in labs of attocube customers with emphasis on integer and fractional moiré Chern insulators (MCIs) in vdW materials.

Scanning magnetometry of an integer MCI $MoTe_2/WSe_2$ shows that its magnetization can be flipped with a very low current [1], which is appealing for utilization in energy-efficient magnetic memories. A magneto-optical study of the same heterostructure discovered a valley-coherent nature of the quantum anomalous Hall state in this material [2]. A scanning single electron transistor (SET) study [3] established the high field flavor phase diagram of the magic angle twisted bilayer graphene (MATBG), identified earlier as an integer MCI at high field [4]. Scanning magnetometry also reveals the mosaic of MCIs with different Chern numbers induced by local variations in the Berry curvature as a function of the filling factor [5]. Moreover, MATBG can also host fractional Chern insulating states (FCIS) even in low magnetic fields $B < 12$ T [6]. Finally, FCIS that survive in $B = 0$ have been identified magneto-optically in twisted bilayer $MoTe_2$ using trion sensing [7].

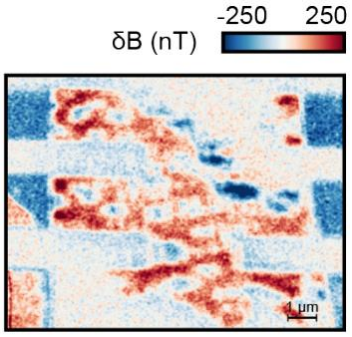

Fig.1. NanoSQUID scan of a Chern magnet with nonuniform magnetization [1]

References

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