Quantum Oscillations in Magnetized Graphene on an Antiferromagnet

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Introduction

Spintronic devices, which utilize the electron spin for information storage and logic operations, have long been envisioned as a solution to Joule heating in conventional electronic devices. As has been reported experimentally, an exchange coupling can be induced by an adjacent magnetic insulator (EuS)[1], enabling efficient control of local spin generation and spin modulation in 2D graphene devices. Like ferromagnets and ferrimagnets, antiferromagnets (AFMs) are magnetically ordered but possess a net zero magnetization, eliminating fringing fields and allowing the information stored in an antiferromagnet device to remain insensitive to external magnetic perturbations. This stability makes antiferromagnet-induced proximity effects extremely promising, with theoretical calculations suggesting that coupling graphene to an antiferromagnetic $BiFeO_3$ may yield a ~70meV exchange splitting of the spin-polarized π bands near the Dirac point [2].

Experimental

We studied the exchange splitting in graphene/AFM heterostructure dependence on the field cooling with the help from Eun Sang Choi on both SCM-2 (1.5K-300K, 18T) and Cell 9 (1.4K-300K, 31T).

Results and Discussion

We identify that the quantum transport behavior of the system may be modulated through field treatment. The exact modulation of the graphene spectrum is expected to be extremely sensitive to the atomic and magnetic details of the interface, making it an ideal platform for both exploring quantum interface physics and developing new spin current functionalities. In principle, certain interface arrangements and orientations may possess rich physics that might result in a finite Berry curvature, a Chern insulator or even a Z2 invariant [3].

Conclusions

In principle, certain interface arrangements and orientations may possess rich physics that might result in a finite Berry curvature, a Chern insulator or even a Z2 invariant. More future work can be carried out by coupling graphene to insulating AFMs with a variety of crystal symmetries and orientations.

Acknowledgements

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References

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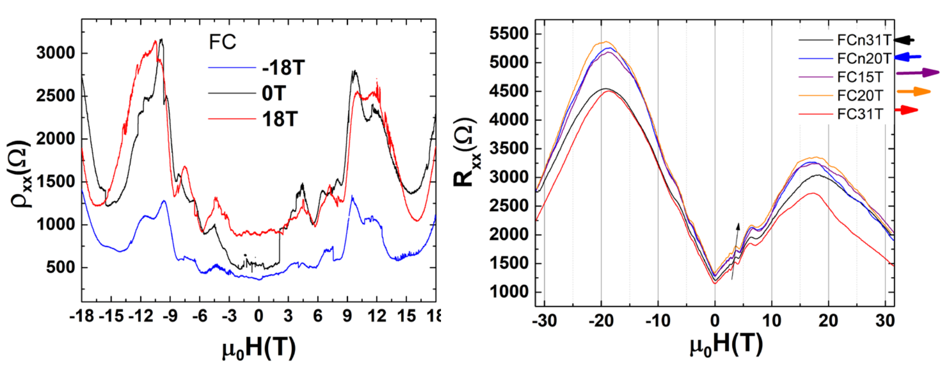

Fig. 1 Quantum oscillations in graphene/AFM shifted by field cooling. Left is carried out in SCM-2(1.5K-300K, 18T). Right is carried out in Cell 9(1.4K-300K, 31T).