Impact of the electric field in high Chern number Quantum Anomalous Hall states

Yuriko Baba[1,2]
Mario Amado[3], Enrique Díez[3], Francisco Domínguez-Adame[1], Rafael A. Molina[2]

[1]*GISC, Universidad Complutense de Madrid*
[2]*IEM, Consejo Superior de Investigaciones Científicas*
[3]*USAL-NANOLAB, Universidad de Salamanca*
yuribaba@ucm.es

Topological magnetic insulators have been discovered as a new platform for observing Quantum Anomalous Hall states with high Chern number C. In three-dimensional structures of stacking layers of magnetically doped and undoped topological insulators, the number of chiral edge channels can be controlled by the width and number of layers. More specifically, samples of Cr-doped $Bi_2(Se,Te)_3$ have been recently measured by Zhao *et al.* [1] in transport experiments showing this feature up to C = 5.

In this work, we explore the possibilities of tuning the chiral channels of the aforementioned materials in the presence of electric fields in multilayered structures [2]. The external field tunes the Chern number and changes the number of topological channels dinamically. The tunability has a remarkable impact on the transport properties of pristine and disordered samples.

References

[1] Zhao, Y. F. *et al.*, Nature, **588** (2020) 419
[2] Wang, Y.X. and Li, F., Physical Review B, **104** (2021) 035202

Figures

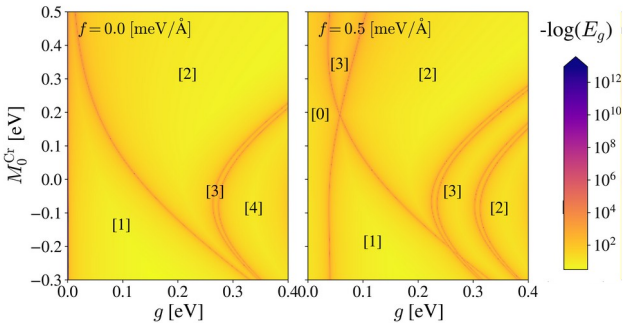

Figure 1: Phase map of the gap E_g as a function of the inverted mass in the Cr-doped layers M_0^{Cr} and the Zeeman splitting g for zero electric field and f = 0.5 meV/A. The Chern number is indicated in square brackets.

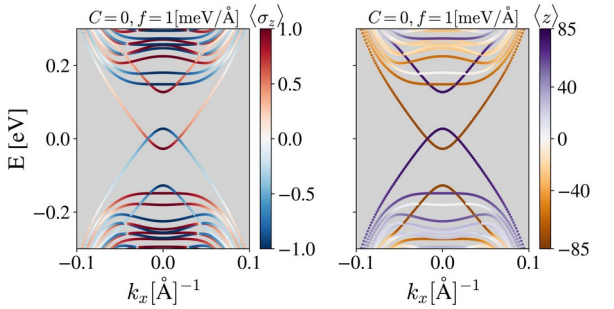

Figure 2: Collapse of the bands and modification of the Chern number due to the Stark effect in a multilayer sample with C=1 at zero electric field and C=0 with f = 1 meV/A. The colors represent the expected value of spin σ_z and z in the left and right pannel, respectively.