

# Using light as a topological switch

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Light-matter interaction is at the center of intriguing phenomena and has led to many practical applications like, for instance, Raman spectroscopy. But beyond characterization, several studies have gone deeper into actually using light to modify the electrical properties of a material. This can be done, for example, by using light to switch off the conduction in graphene [1,2] (or other materials [3]), thereby allowing to tune the material's response by optical means, or even inducing tunable topological states in materials that would otherwise lack them [1,2,4,5,6,7,8] (i.e. a *Floquet topological insulator* [4]). The latter would expand the playground of topological insulators to a broader set of materials. Recent studies have reported the experimental observation of laser-induced bandgaps at the surface of a topological insulator [3], and the observation of a light-induced Hall response [9], thereby adding much interest to this area

In this talk I will provide a brief overview of our works in this field with a focus on the generation of Floquet chiral edge states in graphene [6,10-11] and other systems/materials [8,12]. I will also comment on their Hall response [13] and laser-induced one-way transport of charge and valley [14].

- [1] T. Oka and H. Aoki, Phys. Rev. B **79**, 081406 (2009); F. J. López-Rodríguez, G.G. Naumis, Phys. Rev. B **78**, 201406 (R) (2008).
- [2] H. L. Calvo, H. M. Pastawski, S. Roche, and L. E. F. Foa Torres, Appl. Phys. Lett. **98**, 232103 (2011).
- [3] Y. H. Wang, H. Steinberg, P. Jarillo-Herrero, and N. Gedik, Science **342**, 453 (2013).
- [4] N. H. Lindner, G. Refael, and V. Galitski, Nat. Phys. **7**, 490 (2011).
- [5] T. Kitagawa, T. Oka, A. Brataas, L. Fu, and E. Demler, Phys. Rev. B **84**, 235108 (2011).
- [6] P. M. Perez-Piskunow, G. Usaj, C. A. Balseiro, and L. E. F. Foa Torres, Phys. Rev. B **89**, 121401(R) (2014).
- [7] E. Suárez Morell and L. E. F. Foa Torres Phys. Rev. B **86**, 125449 (2012).
- [8] H. L. Calvo, L. E. F. Foa Torres, P. M. Perez-Piskunow, C. A. Balseiro and G. Usaj, Phys. Rev. B **91**, 241404(R) (2015).
- [9] J.W. McIver, B. Schulte, F.-U. Stein, T. Matsuyama, G. Jotzu, G. Meier, A. Cavalleri, arxiv: 1811.03522.
- [10] G. Usaj, P. M. Perez-Piskunow, L. E. F. Foa Torres, and C. A. Balseiro Phys. Rev. B **90**, 115423 (2014); P. M. Perez-Piskunow, L. E. F. Foa Torres and G. Usaj, Phys. Rev. A **91**, 043625 (2015).
- [11] D. A. Lovey, G. Usaj, L. E. F. Foa Torres, C. A. Balseiro, Phys. Rev. B **93**, 245434 (2016).
- [12] V. Dal Lago, M. Atala and L. E. F. Foa Torres, Phys. Rev. A **92**, 023624 (2015).
- [13] L. E. F. Foa Torres, P. M. Perez-Piskunow, C. A. Balseiro, and G. Usaj, Phys. Rev. Lett. **113**, 266801 (2014).
- [14] V. Dal Lago, E. Suárez Morell, L. E. F. Foa Torres, Phys. Rev. B **96**, 235309 (2017).