

Breaking of Time-Reversal Symmetry in Graphene *via* Nonlinear Optical Spectroscopy

Nele Tornow¹, Konrad Krieghoff¹, Omid Ghaebi¹, Giancarlo Soavi^{1,2}

¹Institute of Solid State Physics, Friedrich Schiller University Jena, Jena, Germany. ²Abbe Center of Photonics, Friedrich Schiller University Jena, Jena, Germany

Abstract

Monolayer graphene provides the ideal platform to study the interplay between space inversion symmetry, time-reversal symmetry, and topology. In this work, we use nonlinear optical spectroscopy to investigate time-reversal symmetry breaking while preserving space inversion symmetry. We excite a high quality monolayer graphene with an elliptically polarized light pulse, which gives rise to new non-zero components of the nonlinear susceptibility tensor. Experimentally, we observe a rotation in the polarization of the emitted third-harmonic signal of the graphene. Our results demonstrate a novel approach to explore time-reversal and topology in centro-symmetric materials.