Non-integer high-harmonic generation in a topological insulator

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Topologically non-trivial matter has been predicted to support a new quality of high-harmonic generation (HHG) [1–4]. Here, we present our results on HHG in the topological insulator bismuth telluride [5]. As shown in Fig. 1a, the frequency of the driving field sharply discriminates between HHG from the bulk and the topological surface, where long scattering times and the quasi-relativistic dispersion enable unusually efficient HHG. Intriguingly, all observed orders, generated in the surface state, can be continuously shifted to arbitrary non-integer multiples of the driving frequency by varying the carrier-envelope phase (CEP) of the driving field (see Fig. 1b). The anomalous Berry curvature warranted by the non-trivial topology enforces meandering ballistic trajectories of the Dirac fermions, which were calculated in Fig 1c, causing a hallmark high-harmonic polarization pattern (see Fig. 1d). Our study provides a new platform to explore topology and relativistic strong-field quantum physics and sparks hope for non-dissipative topological electronics at infrared frequencies.

Figure 1: (a) HHG from Bi2Te3 for different driving frequencies, (b) Critical carrier-envelope phase dependence of the surface-generated harmonics allowing for non-integer HHG, (c) Real-space trajectory of Dirac fermions, (d) Hallmark high-harmonic polarization pattern due to Berry curvature

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