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Berry phase dependent quantum trajectories of electron-hole pairs in semiconductors under intense terahertz fields[1] FAN YANG, RENBAO LIU, Department of Physics, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong, China — Quantum evolution of particles under strong fields can be approximated by the quantum trajectories that satisfy the stationary phase condition in the Dirac-Feynmann path integrals. The quantum trajectories are the key concept to understand strong-field optics phenomena, such as high-order harmonic generation (HHG), above-threshold ionization (ATI), and high-order terahertz siedeband generation (HSG) [1]. The HSG in semiconductors may have a wealth of physics due to the possible nontrivial "vacuum" states of band materials. We find that in a spin-orbit-coupled semiconductor, the cyclic quantum trajectories of an electron-hole pair under a strong terahertz field accumulates nontrivial Berry phases. We study the monolayer MoS_2 as a model system and find that the Berry phases are given by the Faraday rotation angles of the pulse emission from the material under short-pulse excitation. This result demonstrates an interesting Berry phase dependent effect in the extremely nonlinear optics of semiconductors.

[1] B. Zaks, R. B. Liu, and M. S. Sherwin, Nature **483**, 580 (2012).

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