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Semiclassical dynamics of Bloch electrons to second order in electromagnetic fields YANG GAO, SHENGYUAN YANG, QIAN NIU, University of Texas at Austin — Berry curvature appears in the semi-classical theory of Bloch electrons already to first order in electromagnetic fields, resulting in profound modification of the carrier velocity and phase space density of states. Here we derive the equations of motion for the physical position and crystal momentum to second order in the fields. The dynamics still has a Hamiltonian structure, albeit with non-canonical Poisson brackets between the physical variables. We are able to expand both the carrier energy and the Poisson brackets to second order in the fields with terms of clear physical meaning. To demonstrate the utility of our theory, we obtain with much ease the electromagnetic response and orbital magnetic susceptibility.

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