Semiclassical dynamics of Bloch electrons to second order in electromagnetic fields

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We derive the field correction to the Berry curvature of Bloch electrons, which can be traced back to a gauge-invariant positional shift due to interband mixing induced by electromagnetic fields. Together with a second order correction to the band energy, the resulting semiclassical dynamics is accurate to second order in the fields in the same form as before. As applications, we discuss orbital magnetoelectric polarizability and orbital magnetic susceptibility, and predict nonlinear anomalous Hall effects. The semiclassical theory can also be quantized to yield Landau levels which are accurate to second order in the fields.

Reference: **arXiv:1402.2538 [pdf, other],** and PRL in press.