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Emergent Electromagnetic Induction in Weyl Semimetals HIROAKI ISHIZUKA, Univ of Tokyo, TOMOYA HAYATA, Chuo University, MASAHITO UEDA, NAOTO NAGAOSA, Univ of Tokyo, RIKEN CEMS — Theoretical studies on the Weyl semimetals predicts various interesting nonlinear responses to the external electromagnetic field, such as chiral magneto-electric effect and photovoltaic effects. In many of these theories, the quantum anomaly of Weyl Hamiltonian or the spin-momentum locking take key roles. In this work, we propose a new mechanism for the photovoltaic effect in the Weyl semimetals. We show that the adiabatic Berry phase also contribute to the photovoltaic currents in Weyl semimetals. This phenomenon can be understood as an emergent electromagnetic induction in the momentum space. When a Weyl semimetal being irradiated by the light, which we treat as a slowly varying field in time, it shifts the position of the nodes, leading to a cyclic motion of the Weyl node in the momentum space, i.e., the light induces the cyclic magnetic charge current. In analogy to the electric current in the solenoids that induces magnetic field, the cyclic motion of magnetic monopoles results in dc electric field in the momentum space; the momentum space electric field brings about electric current. In a generalized Weyl Hamiltonian with k^2 terms, the charge current is induced by incident circularly polarized lights. In Weyl semimetals with broken inversion symmetry, this phenomenon potentially results in the photocurrent of magnitude that is experimentally observable.

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