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Photovoltaic Hall Effect in Dirac systems – Application to Graphene TAKASHI OKA, University of Tokyo, Department of Physics, HIDEO AOKI, University of Tokyo, Department of Tokyo — We theoretically propose to irradiate electron systems with massless Dirac dispersion with circularly polarized light, for which we predict that the photo-irradiation can induce a dc Hall effect in the absence of static, uniform magnetic fields. The effect bears a geometric origin, traced back to the non-adiabatic phase (Aharonov-Anandan phase) which is acquired by the motion of k-points in the Brilliouin zone when they encircle the Dirac cones. The Kubo formula for linear responses is extended to the nonlinear effects via the Floquet formalism for strong ac fields, which is used to calculate the *photo-induced Berry curvature*. The irradiation induces a dynamical gap at the Dirac point which gives rise to a universal ac Wannier-Stark ladder in Dirac systems observable in the density of states. We further use the Keldysh + Floquet method to analyze finite graphene systems, which confirms the existence of photovoltaic dc Hall effect. The required strength of the circularly polarized light to observe these effects is estimated to be $O(10^7 eV/m)$, which is within an accessible range for present laser sources. (arXiv:0807.4767)

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