Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Topological aspects of nonlinear optical responses TAKAHIRO MORIMOTO, University of California, Berkeley, NAOTO NAGAOSA, RIKEN CEMS, University of Tokyo — There are a variety of nonlinear optical effects including higher harmonic generations, photovoltaic effects, and nonlinear Kerr rotations. A recent remarkable progress in the photovoltaic effect is the high efficiency solar cell action in perovskite oxides without inversion symmetry. The crystal structure lacking inversion replaces the role of artificial structures such as p-n junctions in conventional solar cells. One of the proposed mechanisms for this phenomenon is the shift-current which is supported by a band structure lacking inversion and is related to the Berry connection of Bloch wavefunctions. Motivated by these, we explore topological aspects of the nonlinear optical responses. To this end, we employ the Keldysh method combined with the Floquet formalism, where effective band structures can be defined under an electric field periodic in time. This enables us to describe the shift-current, nonlinear Kerr rotation, photovoltaic effect, and the photo-induced change in the order parameters in a unified fashion. We connect these nonlinear optical responses to topological quantities involving the Berry connection and Berry curvature. It is found that vector fields defined with the Berry connections in the space of momentum and/or parameters govern the nonlinear responses.

Takahiro Morimoto
University of California, Berkeley

Date submitted: 06 Nov 2015 Electronic form version 1.4