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Nonlinear optical responses to circularly polarized lights of the surface state of a topological insulator TETSURO MISAWA, TAKEHITO YOKOYAMA, SHUICHI MURAKAMI, Tokyo Institute of Technology — Recent photoelectron spectroscopy experiments have revealed the presence of the Dirac cone on the surface of the topological insulator and its spin-splitting due to the spin-orbit interaction. In general, on spin-orbit coupled systems, electric fields induce spin polarizations as linear and nonlinear responses. Here we investigate the inverse Faraday effect on the surface of the topological insulator. The inverse Faraday effect is a non-linear optical effect where a circularly polarized light induces a dc spin polarization. We employ the Keldysh Green's function method to calculate the induced spin polarization and discuss its frequency dependence. In particular, in the low frequency limit, our analytical result gives the spin polarization proportional to the frequency and the square of the lifetime. As for the finite frequency regime, we employ numerical methods to discuss the resonance due to interband transitions. We also discuss the photogalvanic effect, where an illumination of a circular polarized light generates the dc charge current. Lastly, we evaluate those quantities with realistic parameters.

[1] T. Misawa, T. Yokoyama, S. Murakami, Phys. Rev. B84, 165407 (2011).

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[ ] Prefer Poster Session

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