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Optical signatures of valley-spin coupling in graphene-like materials: silicene and germanene[1] E.J. NICOL, C.J. TABERT, University of Guelph, L. STILLE, University of Toronto — With the success of graphene and the development of the field of two-dimensional crystals, other graphene-like materials are now of interest, such as, monolayers of silicon (silicene) and germanium (germanene). The interplay of spin orbit coupling, due to the buckled structure of these materials, and a perpendicular electric field is predicted to give rise to a rich variety of phases via an electrically tunable band gap [1,2]. These span a topological or quantum spin Hall insulator, a valley-spin-polarized metal and a band insulator [2]. We have calculated the dynamical conductivity [3] and show that it should reveal signatures of these different phases which would allow for their identification along with the determination of parameters such as the spin orbit energy gap. Furthermore, the effect of spin-valley coupling can be seen in the response to circularly polarized light as a function of frequency. Using right- and left-handed circular polarization it is possible to select a particular combination of spin and valley index. The frequency for this effect can be varied by tuning the band gap.

[1] N.D. Drummond, V. Zolyomi, V.I. Fal'ko, PRB 85, 075423 (2012).
[2] M. Ezawa, New J. Phys. 14, 033003 (2012).
[3] L. Stille, C.J. Tabert, E.J. Nicol, PRB 86, 195405 (2012).

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