Floquet theory of laser induced topological phase transitions

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The effect of strong laser on the topology of many-electron systems is becoming a hot topic [1,2,3]. Recently, a theoretical proposal was made in two dimensional Dirac systems where an application of circularly polarized light was shown to turn the system into a quantum Hall state with a non-trivial photo-induced Chern number [1,2]. One can see this as a dynamical realization of the Haldane model of a quantum Hall state without Landau levels [4]. This proposal applies to a broad class of multi-band systems including graphene, graphite and surface states of topological insulators as well as cold atoms in optical lattices with synthetic gauge fields. The hot issue now is to find a way to realize a "quantized" topological state. Another interesting application of circularly polarized light is the magnetization process in quantum spin systems[5]. We can quantum coherently control the magnetization by optimizing the pulse shape and using chirping techniques. We apply this idea to the Heisenberg model and demonstrate that the magnetization curve, which is usually studied in high magnetic field facilities, can be realized solely by laser. In these examples of light induced phenomena, the necessary strength of laser is below or within reach of the current state of the art laser techniques.

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References

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