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Observing the topological magnetoelectric effect in classical and quantum electrodynamics

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Abstract
Paraphrasing Jackson [1], "Whenever new states of matter are discovered, or a new energy window is opened, there is a need and interest to look for new physics". Phases of matter described by topological order, insofar new states of quantum matter [2], have thus attracted considerable attention. Not surprisingly, their study has opened a possibility for discovering new physics. Topological Insulators are among the most studied materials described by topological phases. On the one hand they seem promising for applications such as quantum computation or spintronics to name a few. On the other, they may shed some lights on axion physics, or on possible magnetic-monopole-like behaviour of certain materials, or on a novel kind of light-matter interaction [3]. In this talk I will present old [4] and new [5] results regarding the electromagnetic response of topological insulators in configurations that are highly sensitive to the boundary conditions. In all the cases commented, minute, yet observable *topological magnetoelectric (TME) effects* are predicted. Special attention will be paid to the case of systems comprised of a TI and a quantum dot (QD), both immersed in an external magnetic field. The quantum mechanical interaction is such that a novel topological entanglement between the states of the QD and those of the plasmons induced at the TI's surface is found. .

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