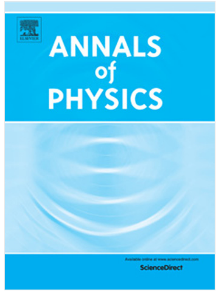
Accepted Manuscript



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PII: S0003-4916(17)30238-5
DOI: http://dx.doi.org/10.1016/j.aop.2017.08.018
Reference: YAPHY 67470

To appear in: *Annals of Physics*

Received date : 24 February 2017
Accepted date : 22 August 2017

Please cite this article as: G. Palumbo, Geometric model of topological insulators from the maxwell algebra, *Annals of Physics* (2017), http://dx.doi.org/10.1016/j.aop.2017.08.018

Geometric Model of Topological Insulators from the Maxwell Algebra

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Abstract

We propose a novel geometric model of time-reversal-invariant topological insulators in three dimensions in presence of an external electromagnetic field. Their gapped boundary supports relativistic quantum Hall states and is described by a Chern-Simons theory, where the gauge connection takes values in the Maxwell algebra. This represents a non-central extension of the Poincaré algebra and takes into account both the Lorentz and magnetic-translation symmetries of the surface states. In this way, we derive a relativistic version of the Wen-Zee term and we show that the non-minimal coupling between the background geometry and the electromagnetic field in the model is in agreement with the main properties of the relativistic quantum Hall states in the flat space.

Keywords: Topological insulators, Chern-Simons theory, Quantum Hall effect, Maxwell algebra

1. I. Introduction

It is well know that there exists a deep relation between topological phases of matter and gauge theories. In fact, at ground state, topological matter can be described by suitable topological quantum field theories (1; 2; 3; 4), which can be classified in terms of their topological invariants and underlying gauge groups. For instance, the interacting edge states of topological phases can be derived from suitable gauge theories (5). Another further example is the Berry phase, which plays a crucial role in several topological systems and represents a geometric phase related to a gauge connection (Berry connection) in the momentum space (6). The Abelian Berry phase is given in terms