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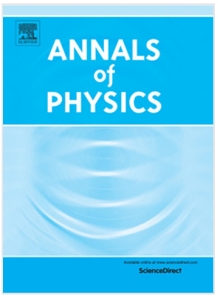

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Holographic Correspondence in Topological Superconductors

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Abstract

We analytically derive a compatible family of effective field theories that uniquely describe topological superconductors in 3D, their 2D boundary and their 1D defect lines. We start by deriving the topological field theory of a 3D topological superconductor in class DIII, which is consistent with its symmetries. Then we identify the effective theory of a 2D topological superconductor in class D living on the gapped boundary of the 3D system. By employing the holographic correspondence we derive the effective chiral conformal field theory that describes the gapless modes living on the defect lines or effective boundary of the class D topological superconductor. We demonstrate that the chiral central charge is given in terms of the 3D winding number of the bulk which by its turn is equal to the Chern number of its gapped boundary.

Keywords: Topological superconductors, Chern-Simons theory, Majorana fermions, Holography, Cartan geometry

1. Introduction

Topological phases of matter are characterised by topological invariants in the bulk and topological protected gapless edge states Fradkin (2013); Bernevig (2013). This bulk-edge correspondence in systems supporting fractional quantum Hall states can be nicely described by the $\mathrm{CS}_{2+1}/\mathrm{CFT}_{1+1}$ correspondence Witten (1989). There, the Chern-Simons (CS) theory that defines the properties of the bulk ground state is in correspondence to the conformal field theory (CFT) that characterises the edge modes. Many of