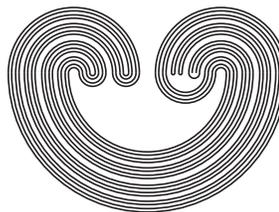


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## FIELD THEORIES, STABLE HOMOTOPY THEORY, AND KHOVANOV HOMOLOGY

by

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## FIELD THEORIES, STABLE HOMOTOPY THEORY, AND KHOVANOV HOMOLOGY

PO HU, DANIEL KRIZ, AND IGOR KRIZ

**ABSTRACT.** In this paper, we discuss two topics: First, we show how to convert 1+1-topological quantum field theories valued in symmetric bimonoidal categories into stable homotopical data, using a machinery by A. D. Elmendorf and M. A. Mandell. Then we discuss, in this framework, two recent results (independent of each other) on refinements of Khovanov homology: our refinement into a module over the connective  $k$ -theory spectrum and a stronger result by Robert Lipshitz and Sucharit Sarkar refining Khovanov homology into a stable homotopy type.

### 1. INTRODUCTION

The present paper has a somewhat peculiar history. Essentially, all the work took place in Fall 2011 and Winter 2012. It was a conglomerate of several mathematical projects. We put the outcome on the arXiv, but no author had strong feelings about publication. Recently, however, interest in these topics was rekindled (see for example [19]). We, therefore, decided to revise the manuscript, and publish it in the present volume.

As for the ingredients of the project, Po Hu and Igor Kriz were long interested in topological modular functors, i.e., 1 + 1-topological quantum field theories (TQFTs) valued in finite-dimensional  $\mathbb{C}$ -vector spaces, and developing a “realization” construction which would convert such a structure into a 1 + 1-topological quantum field theory valued in  $k$ -modules,

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*Key words and phrases.* categorification, Khovanov homology, knot theory, stable homotopy, quantum field theory.

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