

# A Construction of the $c < 1$ Modular Invariant Partition Functions<sup>★</sup>

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**Abstract.** Decomposition theorems for certain representations of Kac-Moody algebras which are needed for the construction of modular invariant unitary conformal models are proved. It is shown that all  $c < 1$  modular invariant models can then be recovered from gauged free fermionic models, including the exceptional cases.

## 1. Introduction

In a recent paper [6], new two-dimensional conformal models were constructed by tensoring the  $c < 1$  discrete unitary series of Friedan, Qiu, and Shenker [4] with itself. In this way, one can reach models with central charges larger than one, which are of interest in string theory as well as in two-dimensional statistical mechanics. The building blocks of these new models are the representations of the Virasoro algebra (Vir) with central charge less than one, and they were explicitly constructed in [6] using a technique introduced by Goddard, Kent, and Olive [2] (see also [5]). The construction starts with  $N$  free fermions, and a suitable subgroup of the orthogonal group  $O(N) \times O(N)$  is gauged to reduce the central charge. It was argued in [6] that, if one starts with a standard set of modular invariant free fermion models, the complete set of minimal modular invariant models discovered by Cappelli, Itzykson, Zuber, and Gepner [8, 9] can be recovered. There were, however, two technical points left incomplete in [6]. A theorem which gave the decomposition of the level one highest weight representations of the affine  $O(4N)$  algebra was left unproved. Also, the exceptional solutions of CIZ remained beyond

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\* This work was supported in part by the Director, Office of Energy Research, Office of High Energy and Nuclear Physics, Division of High Energy Physics of the U.S. Department of Energy under Contract DE-AC03-76SF00098 and in part by the National Science Foundation under grant PHY85-15857

★★ Supported by the Swiss National Science Foundation

★★★ Supported in part by the American-Israeli Binational Science Foundation and the Israeli Academy of Sciences