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Aspects of Fractional Superstrings

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Abstract: We investigate some issues relating to recently proposed fractional superstring theories with $D_{\text{critical}} < 10$. Using the factorization approach of Gepner and Qiu, we systematically rederive the partition functions of the $K = 4$, 8, and 16 theories and examine their spacetime supersymmetry. Generalized GSO projection operators for the $K = 4$ model are found. Uniqueness of the twist field, $\phi_{K/4}^{K/4}$, as source of spacetime fermions is demonstrated.

Section 1: Introduction

In the last few years, several generalizations of standard (supersymmetric) string theory have been proposed [20, 28, 25, 22]. One of them [16, 7, 10, 6, 9, 14, 15, 13] uses the (fractional spin) parafermions introduced from the perspective of 2-D conformal field theory (CFT) by Zamolodchikov and Fateev [31] in 1985 and further developed by Gepner and Qiu [18].[3] In a series of papers, possible new string theories with local parafermionic world sheet currents (of fractional conformal spin) giving critical dimensions $D = 6$, 4, 3, and 2 have been proposed [16, 7, 10, 6, 9].

At the heart of these new "fractional superstrings" are $\mathbb{Z}_K$ parafermion conformal field theories (PCFT's) with central charge $c = 2(K-1)/(K+2)$. (Equivalently, these are $SU(2)_K/U(1)$ conformal field theories.) The (integer) level-K PCFT

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[3] This is not to be confused with the original definition of "parafermions." The term "parafermion" was introduced by H.S. Green in 1953 [19]. Green's parafermions are defined as spin-1/2 particles that do not obey standard anticommutation rules, but instead follow more general trilinear relations [5, 27, 12, 3, 21].