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Algebraic Structures and Eigenstates for Integrable Collective Field Theories*, **

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Abstract. Conditions for the construction of polynomial eigen-operators for the Hamiltonian of collective string field theories are explored. Such eigen-operators arise for only one monomial potential $v(x)=\mu x^2$ in the collective field theory. They form a w_∞-algebra isomorphic to the algebra of vertex operators in $2d$ gravity. Polynomial potentials of orders only strictly larger or smaller than 2 have no non-zero-energy polynomial eigen-operators. This analysis leads us to consider a particular potential $v(x)=\mu x^2+g/x^2$. A Lie algebra of polynomial eigen-operators is then constructed for this potential. It is a symmetric 2-index Lie algebra, also represented as a subalgebra of $U(sl(2))$.

1. Introduction

Matrix models, i.e. quantum mechanics models with a $N\times N$ matrix as dynamical variable, were originally introduced as an approach to non-perturbative aspects of gauge theories [large-N limit of $su(N)$] [BIPZ, Co]. It was recently realized that they could be viewed as a natural regularization of string theory (in space-dimension $\leqq 2$) and thereby allowed a non-perturbative approach to it. This approach turned out to be extremely fruitful and has recently seen a lot of activity [BK, DS, GM, GMi, GKN].

The collective field method [JS, DJe] was applied to 1-dimensional matrix models as a natural description of the dynamics of the singlet sector (eigenvalues of the matrix). The resulting field theory was then extensively studied [P, G, K]. Perturbative computations were achieved [DJR 1, 2] and found in agreement with results from other approaches [Mo, DK]. On the other hand, it was shown that the

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