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Cycling, Twisting, and Sewing in the Group Theoretic Approach to Strings

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Abstract. The general theory for cycling transformations in the group theoretic approach to strings is presented. It leads to a simple physical interpretation of the method which is discussed. We also demonstrate that twisting and sewing, i.e. factorization are an inevitable consequence of the method. We show that there exists a particularly simple choice of cycling transformations that leads to very great simplifications in the results for excited string scattering.

1. Introduction

In spite of its spectacular developments, string theory remains ill-understood in many respects. The existence of several approaches, each with its own starting point and advantages is a sure sign that we have not yet reached the deepest level of understanding. Of these approaches, light-cone [1] and covariant string field theory [2] is the most complete and ambitious, since at least the latter can address in principle non-perturbative effects; although formally elegant, it lacks practical efficiency even to recover simple perturbation theory results which had been derived 15 years ago by most primitive methods. The Polyakov approach stresses the two-dimensional world-sheet conformal field theory features of the string. It has led to deeper understanding of the critical dimension and of the rôle of the Faddeev-Popov ghosts of two-dimensional reparametrization invariance, but remains clumsy when one asks questions about excited state scattering and does not include non-perturbative effects.

Two more approaches have been developed more recently; one, based on Grassmanians [3] emphasizes elegant mathematical structures connected with Riemann surfaces. The other one, which we have developed in preceding publications [4–7], makes extensive use of the specific features of string scattering. Basically the geometrical fact underlying the original idea of duality, that strings interact by joining and splitting, from which overlap conditions can be derived, and the realization that the multistring vertices transform simply under the two-

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