Recent Developments of the Lauricella String Scattering Amplitudes and their Exact SL(K+3,C) Symmetry

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Abstract: In this review we propose a new perspective to demonstrate Gross conjecture on high energy symmetry of string theory. We review the construction of the exact string scattering amplitudes (SSA) of three tachyons and one arbitrary string state, or the Lauricella SSA (LSSA), in the 26D open bosonic string theory. These LSSA form an infinite dimensional representation of the SL(K+3,C) group. Moreover, we show that the SL(K+3,C) group can be used to solve all the LSSA and express them in terms of one amplitude. As an application in the hard scattering limit, the LSSA can be used to directly prove Gross conjecture which was previously corrected and proved by the method of decoupling of zero norm states (ZNS). Finally, the exact LSSA can be used to rederive the recurrence relations of SSA in the Regge scattering limit with associated SL(5,C) symmetry and the extended recurrence relations (including the mass and spin dependent string BCJ relations) in the nonrelativistic scattering limit with associated SL(4,C) symmetry discovered recently.