

## String Correlation Functions of Spin-1/2 Heisenberg XXZ Chain

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Recent developments of the exact calculation of the correlation functions for spin-1/2 Heisenberg XXZ chain have brought us lots of new features of the model especially at the ground state. Among them, we have found that a certain kind of string correlation functions  $\mathcal{O}(n, \theta)$  can be evaluated exactly in the thermodynamic limit. These string correlation functions were originally introduced by den Nijs-Rommelse ( $\theta = \pi$ ) and Oshikawa ( $\theta = \text{general}$ ) as possible order parameters to characterize the Haldane state of integer spin Heisenberg XXX chains. The same string correlation functions was considered by Hida as well as Lou *et al* for spin-1/2 systems. In particular Hida has reported the asymptotic form of  $\mathcal{O}(n, \pi)$  is given by  $\sim n^{-1/4}$  by use of the bosonization method, which is remarkably slower than the usual spin-spin correlation functions. More recently the asymptotic formula was generalized to  $\mathcal{O}(n, \theta) \sim n^{-\theta^2/4\pi^2}$  by Lou *et al*. In this work, we have generalized these asymptotic formulas to general XXZ chain with the anisotropy parameter  $\Delta$  in the critical region. We have also found the exact correlation amplitude, which allows us to compare with the newly obtained exact results for  $\Delta = 1, 1/2$  and numerical data for other  $\Delta$ . In the special case  $\Delta = 0$ , we have applied the Fisher-Hartwig conjectures for Toeplitz determinant to obtain both exact short range values and asymptotic formulas.