Abstract

We study various two-point functions in certain defect versions of $\mathcal{N} = 4$ super Yang Mills theory. These defect theories are obtained by insertion of a D7 probe-brane, with either $AdS_4 \times S^2 \times S^2$ or $AdS_4 \times S^4$ geometry, into the standard D3 brane configuration of AdS / CFT. The $\mathcal{N} = 4$ SYM theories, arising from the decoupling limit of these brane configurations, have non-zero vacuum expectation values (*vevs*) for the scalar fields ϕ_i. These non-zero vevs breaks super symmetry completely and conformal symmetry partially, thus presenting us with an interesting opertunity to make non-trivial tests of the AdS / CFT duality.
We focus first on two-point functions with $SO(3) \times SO(3)$ symmetric vevs, between chiral primary operators of the forms $\mathrm{tr}\, Z^L$, $\mathrm{tr}\, \bar{Z}^L$, $\mathrm{tr}\, X^L$, where $X = \phi_1 + i\phi_4$, $Y = \phi_2 + i\phi_5$ and $Z = \phi_3 + i\phi_6$. By use of pertubative methods, we were able to reduce the connected tree-level contributions to these two-point functions, down to expressions involving complicated infinite sums. These infinite sums unfortunately seem unevaluable in general. However, for specific values of L and parameters associated to the stabilization of the brane configurations, we were able to evaluate the sums explicitly.
We also study two-point functions, first with $SO(3) \times SO(3)$ symmetric vevs, between short scalar operators $\mathcal{O}_{W_1W_2} = \mathrm{tr}[W_1W_2]$ with scalars $W_1, W_2 = X, Y, Z, \bar{X}, \bar{Y}, \bar{Z}$, and Bethe state operators $\mathcal{O}_L = \Psi_M^{i_1 \cdots i_L}\, \mathrm{tr}[V_{i_1} \cdots V_{i_l}]$, with $V_i = X, Z$ and Ψ_M being a Bethe wavefunction with M excitations. By use of integrability techniques, we find that certain choices of W_1, W_2 allows for the tree-level contribution to these two-point functions to be expressed in terms of the tree-level value of $\langle \mathcal{O}_L \rangle$. The computations of these various types of two-point functions provide the first step towards a very non-trival check of the AdS / CFT duality. We hope that future work will enable us to complete this endeavor, by studying the corresponding objects on the gravity side of the duality.

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