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Instanton solutions in a model of AdS_4/CFT_3 correspondence

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Abstract

From the wrapping of the (anti)membranes of 11-dimensional supergravity over $AdS_4 \times CP^3 \ltimes S^1 / Z_k$, on the internal directions along with an ansatz for its 4-form flux, by solving the original equations and identities, we arrive at scalar differential equations in the Euclidean AdS_4 space; note that the associated bulk solutions and setups break all supersymmeties, parity and scale invariance; the resulting (pseudo) scalar potential, which is Higgs-like with two nearly homogeneous vacua, provides the first-order phase transition and tunneling from the false- to true- vacuum. Here, concentrating on the three (pseudo) scalar modes m^2=-2, 4, 10 , which are, in turn, realizable in Wick-rotated and skew-whiffed M2-branes backgrounds, we employ approximate methods and, particularly, Adomian decomposition method to solve the nonlinear second-order partial differential equations, valid in the probe approximation, with the Dirichlet boundary condition or the initial data from a basic exact solution, to get solutions in series expansions near the boundary in different orders of perturbation. Next, making use of the AdS_4/CFT_3 correspondence rules, after swapping the three fundamental representations of $SO(8)(\rightarrow SU(4)\times U(1))$ for gravitino, we build the dual singlet $\Delta_+ = 2,4,5$ operators from the (scalar, fermion and gauge) fields in a 3-dimensional Chern-Simons-matter $SU(N)$ gauge field theory living on the resultant anti-M2-brnaes; after that, by deforming the corresponding boundary actions with the operators, we get $SO(4)$ invariant solutions with nonzero finite actions, which ,in turn, are small instantons sitting at the origin of a 3-sphere at infinity, causing instability and mediating false vacuum decay. In other words, the boundary potentials unbounded from below are duals for the collapse of the bulk (thin-wall) vacuum bubbles and big crunch singularities.

Keywords: AdS_4/CFT_3 correspondence, (pseudo) scalar equations, adomian decomposition method, dual operators, instanton solutions

For full article, refer to the Persian section