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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  $AdS_4 \times CP^3 \times S^1 / Z_k$ , 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 supersymmetries, 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-branes; 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