

AdS Solutions of IIB Supergravity

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Due to the celebrated duality relation between string theory in anti-de-Sitter (AdS) backgrounds and conformal field theory, it is nowadays of great interest to find new AdS solutions to string/M-theory and study their field theory duals. Several different avenues have been taken to accomplish this goal, but what has proved to be very fruitful recently is to study the consequence of the supersymmetry on the local form of the spacetime geometry.

In this work we study IIB vacua with a AdS_3 factor and establish how supersymmetry restricts the local form of the metric and field fluxes. To simplify the analysis we consider pure D3-brane configurations, i.e. the nontrivial fields of IIB supergravity are only Ramond-Ramond 5-forms and metric.

We introduce a scalar field A and a two-form field strength F as follows.

$$ds^2 = e^{2A}(AdS_3) + g_{ab}dx^a dx^b, \quad F^{(5)} = (1 + *)Vol_{AdS_3} \wedge F.$$

The dilatino variation vanishes trivially and we only need to consider the gravitino variation equation, and introducing a specific basis for the gamma matrices which respect the dimensional decomposition we obtain a system of Killing spinor equations in 7 dimensions.

$$\nabla_a \eta - \frac{e^{-3A}}{4} \not{F} \gamma_a \eta = 0, \quad \left(\not{\partial} A + \frac{e^{-3A}}{2} \not{F} - iae^{-A} \right) \eta = 0,$$

where η is a Dirac spinor in seven dimensions defined by x^a . One can construct differential forms of various ranks defined on the 7 dimensional space as spinor bilinears of η , and derive the algebraic and differential relations from the Killing spinor equations to restrict the form of the metric. We find that the 7 dimensional metric has to be written as warped Hopf-fibration of Kahler 3-fold g_{ij} ,

$$ds^2 = e^{2A}(d\psi + B)^2 + e^{-2A} g_{ij} dx^i dx^j$$

where dB gives the Ricci-form of the Kahler 3-fold base manifold and A, F are given as follows,

$$\begin{aligned} F &= \bar{F} + K \wedge e^{2A} dA, \\ e^{4A} dB &= -4\bar{F} - 2J, \\ \text{Tr}(dB \cdot J) &= 4, \end{aligned}$$

It is possible to reproduce known solutions of IIB supergravity with 3 or higher dimensional AdS factors and obtain several new solutions.