

Some aspects of BPS solutions in ABJM theory and their gravity duals

Department of Physics, Kyoto University Shinji Shimasaki

E-mail: shinji@gauge.scphys.kyoto-u.ac.jp

We investigate BPS configurations in ABJM theory [1] on $R \times S^2$ [2]. We find general BPS solutions for diagonal configurations. Interestingly, the BPS solutions we find have nonzero angular momentum on S^2 as well as non-trivial flux, not only “magnetic flux” but also “electric flux”, turned on. We then show that carrying out the Higgsing procedure of [3] around a 1/2-BPS solution of ABJM theory on $R \times S^2$ leads to $\mathcal{N} = 8$ super Yang-Mills theory (SYM) on $R \times S^2$. Higgsing around the 1/2-BPS solution where the scalar field vev is proportional to the identity gives rise to $\mathcal{N} = 8$ SYM on $R \times S^2$ expanded around the trivial vacuum while higgsing around 1/2-BPS solutions which are diagonal but not proportional to the identity leads to the SYM expanded around a non-trivial vacuum. If we Higgs around a 1/4-BPS configuration, then we end up getting the SYM expanded around a 1/2-BPS solution. In fact, higgsing around various solutions of ABJM theory should reproduce the SYM expanded around its various solutions.

Since the ABJM on $R \times S^2$ is dual to M-theory on global AdS_4 , it is worth asking what the duals of the BPS solutions, we find in this paper, are. In [4], Nishioka and Takayanagi solve the BPS equations explicitly in the bulk and construct a class of dual giant graviton solutions in M-theory on $AdS_4 \times S^7/Z_k$. In particular, they find a spinning dual giant graviton configuration. The spinning dual giant graviton is a M2-brane expanding into AdS_4 with a torus shape and rotates along the fiber coordinate of the S^7 (S^7 being the fibration of S^1 over CP^3) as well as spins along the azimuthal direction of $S^2 \subset AdS_4$. These solutions should be dual to the class of our solutions with nonzero angular momentum and R-charge in ABJM theory corresponding to the nonzero spin and the angular momentum, respectively, in the bulk.

In a forthcoming paper [5], we will classify the space of solutions on the bulk side, which includes the spinning dual giant solution, in terms of intersections of holomorphic surfaces with the target space, and then compare and match with a similar classification on the space of the boundary solutions we presented.

References

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