Microstates of supersymmetric BHs in AdS5

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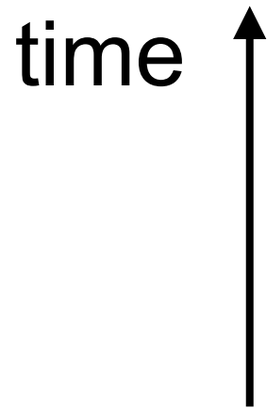
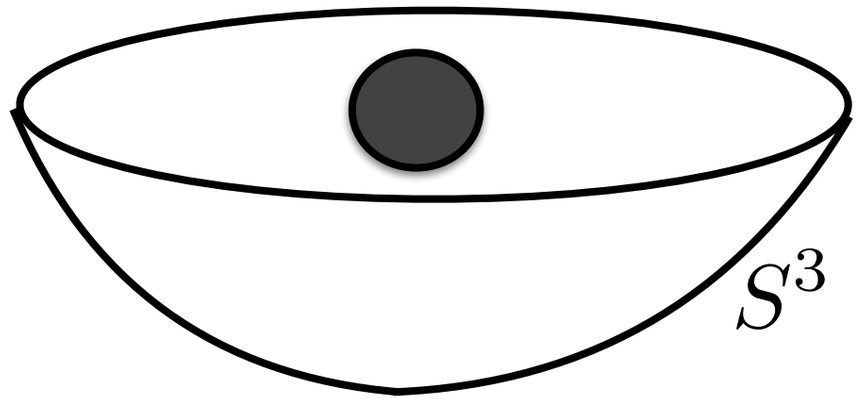
Does the most general index in $\mathcal{N}=4$ SYM capture the susy BH entropy in $\mathrm{AdS}_5\times \mathrm{S}^5$?





$\mathcal{N}=4$ $U(N)$ SYM

$\mathrm{AdS}_5\times S^5$

$\frac{1}{16}$-BPS states

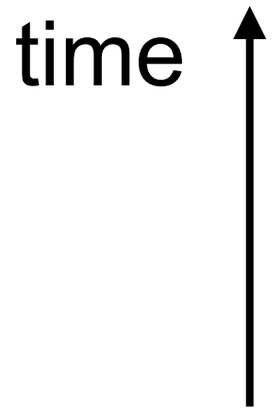
$\frac{1}{16}$-BPS BH

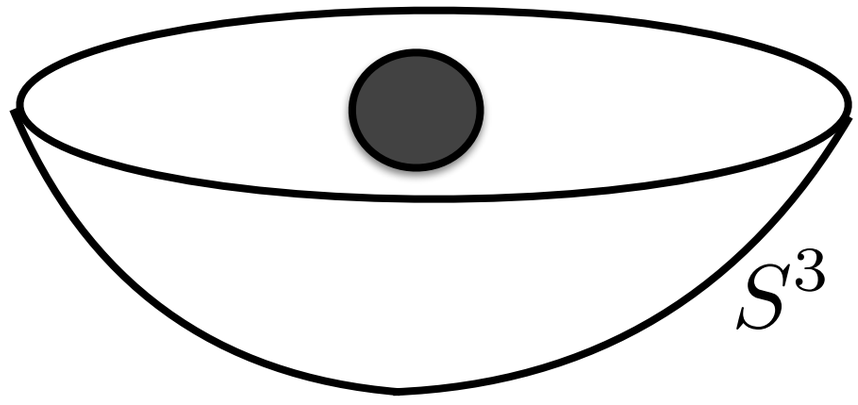
$\mathcal{I}_N(\tau) = \mathrm{Tr}(-1)^F e^{2\pi \mathrm{i}\tau_i q_i}$ $\log \mathcal{I}_N \stackrel{?}{=} O(N^2)$	$S_{\mathrm{BH}} = \frac{A_H}{4G_N} = O(N^2)$

[Sundborg '99; Aharony, Marsano, Minwalla, Papadodimas, van Raamsdonk '03; Kinney, Maldacena, Minwalla, Raju '05]

[Gutowski, Reall '04; Chong, Cvetic, Lu, Pope '05; Kunduri, Lucietti, Reall '06]

Does the most general index in $\mathcal{N}=1$ SCFT4 capture the susy BH entropy in dual AdS5 ?





$\mathcal{N}=1$ SCFT

$\frac{1}{4}$-BPS states

$\mathrm{AdS}_5 \times M_5$

$\frac{1}{4}$-BPS BH

$\mathcal{I}_N(\tau) = \mathrm{Tr}(-1)^F e^{2\pi \mathrm{i}\tau q}$ $\log \mathcal{I}_N \stackrel{?}{=} O(N^2)$	$S_{\mathrm{BH}} = \dfrac{A_H}{4G_N} = O(N^2)$

The goal of these lectures is to explain this question and the answer (Yes).

Plan of lectures

- Why exactly do we expect (in AdS/CFT) that the superconformal index (SCI) captures BH entropy?
- What exactly is the SCI? How to calculate it? (Review)
- How to extract BH growth from the large-charge asymptotics of the SCI?
- How to see the BH in the large-N limit of SCFT? Are there other phases?
- What can we say about the gauge theory operators that make up the BH?

Plan of Lecture 1 (gravity)

- How to treat BH thermodynamics within AdS/CFT?
  - Gibbons-Hawking Euclidean quantum gravity.
  - Hawking-Page transition/Deconfinement.

- How to define BH thermodynamics for susy BH?
  - Variational principle for susy BH “thermo”dynamics.
  - Express susy BH entropy as AdS partition function.