Five Dimentional Supersymmetric Black Hole (F.S.B.H) in String Theory

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Strings and D-branes (basic facts)...

Strings

- Bosonic Strings $\rightsquigarrow$ Open Closed
- Superstrings
  - Open
  - Closed
    - Type IIA $\rightsquigarrow$ Massless States A_μ, $A_{\mu\nu\rho}$
    - Type IIB $\rightsquigarrow$ Massless States A, $A_{\mu\nu}$, $A_{\mu\nu\rho\sigma}$

D-branes

- hypersurfaces on which the endpoints of open strings slide...
- they can carry charge!
- compactifying one **dim** seems like point charge

$$Q = \frac{V_p}{(l_s)^p}$$

for observers in remaining **uncompacts**

Complex System - F.S.B.H

- **Complex System**
  For a system with fermionic and bosonic degrees f , b

$$\frac{S}{k} = lnP(N, b, f) \simeq 2\pi\sqrt{\frac{N}{6}(b + \frac{f}{2})}$$

  where N the number eigenvalue...

- **F.S.B.H(Classical case)**[1]
  - Characteristics
    - Charges $\rightsquigarrow$ Q_1 Q_5 N
    - Entropy **and** Temperature
  - We care mostly for extremal limit... (no interactions) where

$$S = 2\pi\sqrt{Q_1 Q_5 N}$$

[1] Maldacena, J. M. (1998a). Black holes and D-branes. Nucl. Phys. Proc. Suppl.,61A, 111. E-print hep-th/9705078.

Microscopic Description

We use IIB string theory...[2] (**dim** D=10)

- **Quantum Charges ($M^5 \times T^5$)**
  - $Q_1 \rightsquigarrow$ D1-branes wrapped Q_1 times around x^5
  - $Q_5 \rightsquigarrow$ D5-branes wrapped Q_5 around five circles
  - $N \rightsquigarrow$ momentum on x^5 coordinate where $p^5 = \frac{N}{R}$
- **Entropy**

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- **Entropy**
  - Possible states: $(1,1)(1,5)(5,1)(5,5)$
  - On calculations contribute only $(1,5)$ $(5,1)$
  - Near $Q_1 Q_5$ the system $(1,5)$ or $(5,1)$ - $Q_1 Q_5$ wires
  - The degeneracy $b = 4Q_1Q_5$ and $I = 4Q_1Q_5$

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Some cases left!

Susy Argument

Q_1 D-branes each wrapped one time around a **dim** equals to a D-brane wrapped Q_1 times around the same **dim**

- **Entropy**
  - Q_1 rotations $\longmapsto$ returning to the starting point
  - On (1,5) or (5,1)$\longmapsto$ $Q_1 Q_5$ rotations to have the begging state
  - The quantized momentum is

$$p^5 = \frac{NQ_1Q_5}{Q_1Q_5R}$$

Participating $N' = NQ_1Q_5$ and $b = f = 4$ the result is

$$\frac{S_{str}}{k} = \ln P(NQ_1Q_5; 4, 4) \simeq 2\pi\sqrt{NQ_1Q_5}$$