The role of string theory?

Coupling N-species to Einstein creates a new fundamental scale:

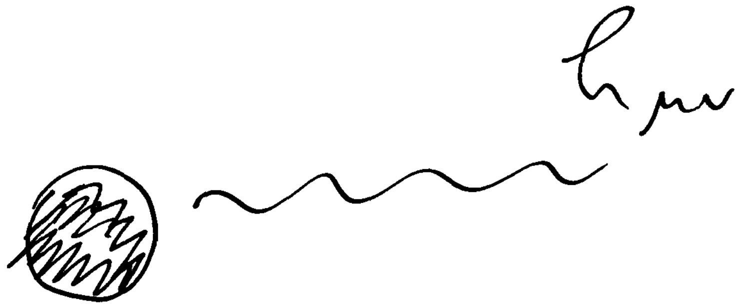
$$L_N \equiv \sqrt{N}\, L_P$$

or in D-dimensions

$$L_N \equiv N^{\frac{1}{D-2}}\, L_D$$

This can be seen in many different ways.

Evaporation of $D=10$ Black holes.



$$\frac{1}{T}\frac{dT}{dt} = T\left(\frac{T}{M_{10}}\right)^{8}$$

For N-species

$$\frac{1}{T}\frac{dT}{dt} = N\,T\left(\frac{T}{M_{10}}\right)^{8}$$

Semi-classicality condition

$$\frac{1}{T^2}\frac{dT}{dt} \ll 1$$

Condition

$$\frac{1}{T^2}\frac{dT}{dt} \ll 1$$

Breaks down at

$$T = T_N \equiv L_N^{-1} = \frac{M_{10}}{N^{\frac{1}{8}}} \; !$$

Identifying $T_N = M_S$

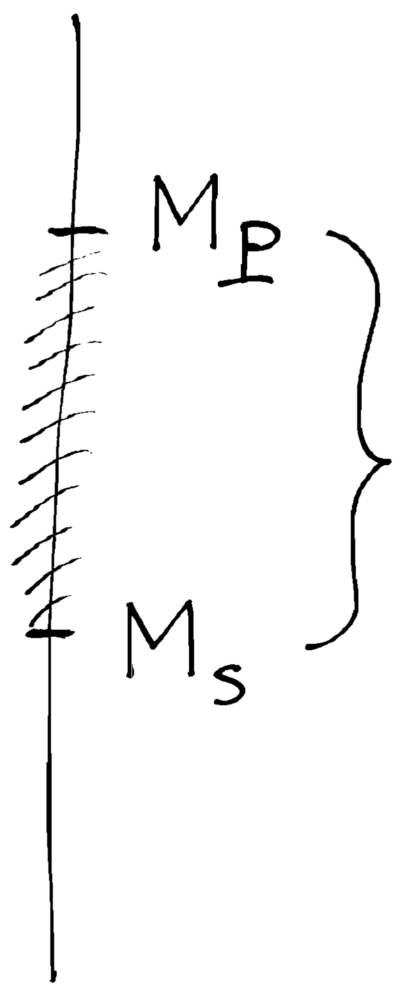
we get

$$\frac{1}{g_s^2} = N \; !$$

String theory is a theory

of $\frac{1}{g_s^2} = N$ species.

We think that the role of string theory is to couple gravity to the species that do not fill the gravity super(multiplets).



window with $\frac{1}{g_s^2} = N$.

We have argued that there must be quantum degrees of freedom around M_p.

These are ~~...~~ the lowest mass Black holes.

Then there must be certain quantization rule that even large black holes obey. We suggest that this is

$$A = n L_p^{D-2}$$

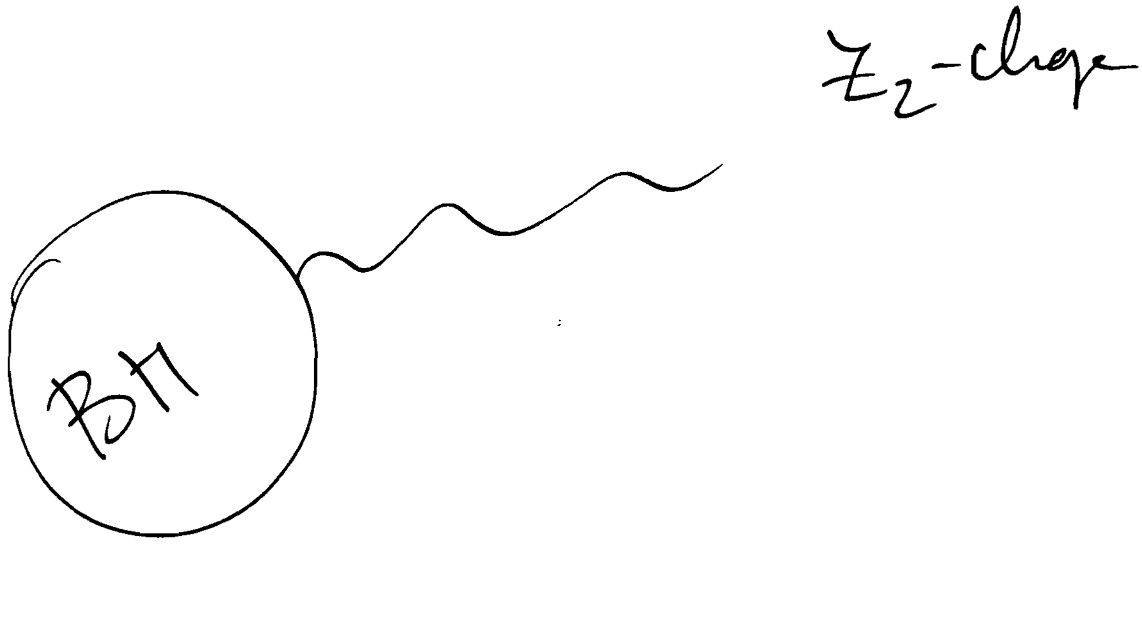
Bekenstein, Mukhanov

Let us show this based on holographic bound and Black hole no-hair.

Information in Black hole

$$N_{MAX} = A_D L_P^{D-2}$$

Emission of a Z_2-charge from Black hole.



According to Hawking an arbitrarily soft quantum can be emitted.

But if $\Delta M_{BH} \ll T$, the holographic bound will be violated ?

Because Z_2 carries at least 1 info-bit.

So

$$A_D = n \, L_P^{D-2}$$

Black hole mass is also quantized

$$M_n = M_D \, n^{\frac{1+d}{2+d}}$$

Emission process.

$$\mathcal{E}_n = M_n - M_{n-1} = M_D \left(n^{\frac{1+d}{2+d}} - (n-1)^{\frac{1+d}{2+d}} \right)$$

$n \gg 1$

$$\mathcal{E}_n \simeq \frac{1+d}{2+d} R_g^{-1}$$

$$n_{TOTAL} \simeq (M_{BH} L_D)^{\frac{2+d}{1+d}}$$

Decay width

$$\tilde{\Gamma}_n = \alpha \left(L_D \varepsilon_n \right)^{2+d} \varepsilon_n =$$

$$= \alpha M_D \left(n^{\frac{1+d}{2+d}} - (n-1)^{\frac{1+d}{2+d}} \right)^{3+d}$$

Total rate

$$\Gamma_n = \tilde{\Gamma}_n \left(\frac{R_g^{2+d}}{L_D^{2+d}} \right) = n \tilde{\Gamma}_n$$

$$\Gamma_n \simeq \alpha \varepsilon_n$$

for $n \gg 1$

For large $n \gg 1$,

this reproduces.

$$T_h \sim \alpha^{-1} n^{\frac{3+d}{2+d}} L_D \sim$$

$$\sim \alpha^{-1} R_g^{3+d} M_D^{2+d}.$$

Implication for LHC

Black holes?

Implication for
Cosmological singularities?

Hubble volume is quantized:

$$\delta H^{-2} = n L_p^2$$

Implications for moduli
stabilization:

Compactification volume
is quantized:

$$V_d = n L_{4+d}^{d+2}$$