1. Does string theory
describe the real world?

Need experiments.

Don't know

LHC cosmology

2. What is analog of equiv.
principle?

Dualities etc.

3. Application to pure mathematics

Mirror symmetry, Algebraic geometry/

Donaldson Langlands

4. Applications RHIC, CM

other physical problems

5. Applications to probrems

in GR singularities

at horizons.

Outline

1. BH microstate counting

   AdS_3 / CFT_2

2. Open problems & issues

3. Recent work

   on lower dim. gravity

BH - entropy

$$T_H = \frac{\hbar}{8\pi G M_{BH}}$$

$$\frac{dS_{BH}}{dM_{BH}} = \frac{1}{T_H}$$

$$S_{BH} = \frac{4\pi G M_{BH}^2}{\hbar} = \frac{A_{reg}}{4\hbar G}$$

The action from Type IIB s.t.

$$S = \frac{1}{16\pi G_{10}} \int d^{10}x \sqrt{-g} \left(R - \frac{1}{2} (\nabla\phi)^2 - \frac{1}{12} e^{-\phi} H^2 + \cdots \right)$$

$H = dB$; $G_{10} = 8\pi^6 g^2$

$\alpha' = 1$, $g_s = g e^{-\phi}$

$$ds^2 = \left(1 + \frac{g Q_5}{r^2}\right)^{-\frac{1}{4}} \left(-dt^2 + dx_5^2 + \underbrace{dx^i dx^i}\right)$$

$$+ \left(1 + \frac{g Q_5}{r^2}\right)^{\frac{3}{4}} \left(dr^2 + r^2 d\Omega_3^2\right)$$

$$e^{2\phi} = 1 + \frac{g Q_5}{r^2}$$

$$Q_5 = \frac{1}{4\pi^2 g} \int_{S^3} H$$

$g_{ij} dx^i dx^j$

K3 or T^4

$$dH = 0$$

$$d e^{-\phi} * H$$

$$\theta_1 = \frac{1}{4\pi^2 g} \int_{M^7} e^{-\phi} * H$$

$$\| $$

$$K3 \times S^3$$

$$T^4 \times S^3$$

$$ds_{10}^2 = \left(1+\frac{g\Theta_5}{r^2}\right)^{-\frac{1}{4}}\left(1+\frac{g\Theta_1}{r^2}\right)^{-\frac{3}{4}}$$

$$\times\left[-dt^2+dx_5^2+\left(1+\frac{g\Theta_1}{r^2}\right)g_{ij}\,dx^i dx^j\right]$$

$$+\left(1+\frac{g\Theta_5}{r^2}\right)^{\frac{3}{4}}\left(1+\frac{g\Theta_1}{r^2}\right)^{\frac{1}{4}}\left(dr^2+r^2 d\Omega_3^{\,2}\right)$$

$$e^{-2\phi} = \left(1+\frac{g\Theta_5}{r^2}\right)\Big/\left(1+\frac{g\Theta_1}{r^2}\right)$$

$\longrightarrow \dfrac{\Theta_5}{\Theta_1}$ attractor mechanism

$$ds_{10}^2 = \frac{r^2}{g\,\Theta_5^{1/4}\,\Theta_1^{3/4}}\left(-dt^2 + dx_5^2\right) + g\,\Theta_5^{\frac{3}{4}}\,\Theta_1^{\frac{1}{4}}\,\frac{dr^2}{r^2}$$

$$+\left(\frac{\Theta_1}{\Theta_5}\right)^{\frac{1}{4}} dx^i dx^j\, g_{ij} + g\,\Theta_4^{\frac{3}{4}}\,\Theta_1^{\frac{1}{4}}\, d\Omega_3^2$$

$dx^i dx^j\, g_{ij}$: $K3$ or T^4

$d\Omega_3^2$: S^3

$$g\,\Theta_5^{\frac{3}{4}}\,\Theta_1^{\frac{1}{4}}\left(-r^2 dt^2 + r^2 dx_5^2 + \frac{dr^2}{r^2}\right)$$

$$= g\,\Theta_5^{\frac{3}{4}}\,\Theta_1^{\frac{1}{4}}\left(\frac{-dt^2 + dx_5^2 + dy^2}{y^2}\right)$$

$$\Rightarrow \quad AdS_3 \times S^3 \times K3$$