Asymptotic symmetries of three dimensional black string

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Main goal:

Asymptotically flat toy models

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Asymptotics

Field theory: fields need to decay fast enough at infinity

How precisely it decays?
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Boundary conditions: the fall-offs of the field such that the charges are finite

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Asymptotic symmetries: preserving only the asymptotic structure of spacetime

Example: anti-de Sitter 3D with Brown-Henneaux boundary conditions
$\rightarrow$ Asympt. group of symm. $=$ conformal group in 2D

Method to identify potential **new holographic dualities**

2+1 dimensions

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3D: no degree of freedom, no gravitational waves

However, non trivial as there are black holes

→ Good framework for toymodels

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No asymptotically flat black hole in pure three-dimensional gravity

$\rightarrow$ way out: add higher curvature terms or matter fields

three dimensional black string

$$S = \frac{1}{16\pi G}\int d^3x\sqrt{-g}\left(R - 4\nabla_\mu\Phi\nabla^\mu\Phi - \frac{1}{12}H^2 e^{-8\Phi} - \frac{k_g}{8}F^2 e^{-4\Phi} + 4\,e^{4\Phi}\right)$$

Field content: $\Psi = (g, A, B, \Phi)$
with $F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu$, $\quad H_{\mu\nu\rho} = \partial_\mu B_{\nu\rho} - \frac{k_g}{4}A_\mu F_{\nu\rho} + (\nu\rho\mu) + (\rho\mu\nu)$

$$ds^2 = -\frac{(r-r_-)(r-r_+)}{f_0^2}du^2 + \frac{r}{f_0^2}\,du\,dr + r^2\left(\frac{\omega}{r}du + d\phi\right)^2 d\phi^2$$

$$\Phi = -\frac{1}{2}\log(r) + \frac{1}{2}\log(f_0)$$

$$A = \frac{2}{\sqrt{k_g}\,r}\sqrt{-\omega^2 f_0^2 + r_- r_+}\,du$$

$$B = \frac{\omega f_0^2}{r}\,du\wedge d\phi \qquad \text{with } f_0 \neq 0 \text{ and } \omega^2 f_0^2 < r_+ r_-$$

Asymptotically flat: $R \propto \frac{1}{r^2}$

Results:

- Consistent set of boundary conditions
- Computations of the charges
- Asymptotic group of symmetries: $u(1) + 3$ exact charges
- New familly of solutions
- Thermodynamics of the black string solution

Merci!