

Holographic RG flow and Ricci flow

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Holographic RG flow

- Before AdS/CFT was born, Polyakov already proposed that the Liouville field, as an extra dimension, is related to the RG flow.
- This proposal is realized by AdS/CFT.
 - The additional radial coordinate of the bulk theory is dual to the energy scale of the boundary QFT, so the radial flow corresponds to the holographic RG flow.

Domain wall solution

- Bottom up approach: Einstein-Dilaton action

$$S = \int d^d x \int du \sqrt{\gamma} N \left(R^{(g)} - \frac{1}{2} g^{ab} \partial_a \phi \partial_b \phi + V \right) + 2 \int d^d x (\sqrt{\gamma} K)_{UV}^{IR}$$

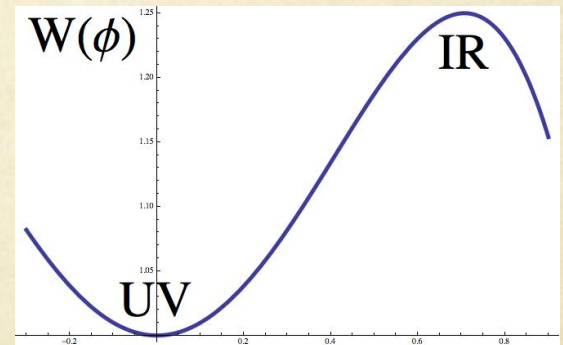
where $ds^2 = g_{ab} dx^a dx^b = N^2 du^2 + \gamma_{\mu\nu} (dx^\mu + N^\mu du)(dx^\nu + N^\nu du)$

- Domain wall solution (flat and homogeneous) $N = 1, N^\mu = 0$

$$\partial_u \gamma_{\mu\nu} = -\frac{1}{(d-1)} W \gamma_{\mu\nu}, \quad \partial_u \phi = \frac{d}{d\phi} W$$

where W is the fake superpotential satisfying

$$V = \frac{d}{4(d-1)} W^2 - \frac{1}{2} W'^2$$



Ricci flow

- Considering curvature, the holographic RG equation is

$$\partial_u \tilde{\gamma}_{\mu\nu} = f(\phi) R_{\mu\nu} + \mathcal{O}(\partial^4)$$

where $\tilde{\gamma}_{\mu\nu} = e^{\frac{1}{d-1} \int du W} \gamma_{\mu\nu}$ is the rescaled induced metric.

- Ricci flow $\partial_u g_{\mu\nu} = R_{\mu\nu}$

The 2d non-linear sigma model is the low energy effective field theory of string theory, where the Ricci flow is the 1-loop RG flow equation of target space metric (coupling constants of this 2d QFT).

Prospects

- Novel formulation of string theory from high dimension ($d > 2$) QFT arXiv:1301.6810, Kiritsis
(Strings are Wilson loops? Weyl anomaly matching?)
- AdS/Cosmology: Strongly coupled inflation
(AdS/dS? The inflaton potential is fine tuned by the RG flow?)

Thank you!