

20 years of a holographic formula

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Introduction

We give a historical overview of a holographic formula that relates one-loop functional determinants of a bulk field with alternate boundary conditions in an asymptotic AdS background (Poincaré-Einstein with and Einstein metric on its conformal infinity) and the fluctuation determinants of the dual conformal fields on the conformal boundary (conformally Einstein).

The formula originated twenty years ago via a rather circuitous route involving the one-loop contribution to the partition function in the bulk by a scalar field with mass in the Breitenlohner-Freedman window [1] and the corresponding RG-flow on the conformal boundary triggered by a double-trace deformation [2]. Initially it arose as an $O(1)$ prediction for the (type-A) Weyl anomaly and revealed a remarkable interplay with Conformal Geometry and Spectral Theory, uncovering central constructs such as Q-curvature, GJMS operators and Polyakov formulas [3,4,5].

We revisit several instances of the formula and close with a newest extension to massive higher-spin bulk fields and GJMS-like operators on the boundary that reads

$$\frac{\det_{-,TT} \left\{ \hat{\Delta}_L^{(s)} + s(n+s-2) - \frac{n^2}{4} + k^2 \right\}}{\det_{+,TT} \left\{ \hat{\Delta}_L^{(s)} + s(n+s-2) - \frac{n^2}{4} + k^2 \right\}} = \det_{TT} P_{2k}^{(s)} \cdot \dots \cdot \det P_{2k}^{(0)}$$

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References

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