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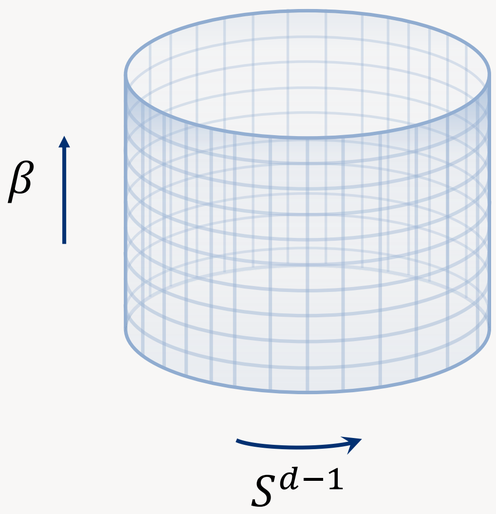
It from Anomalies

Defect anomaly determines the universal defect energy and entropy



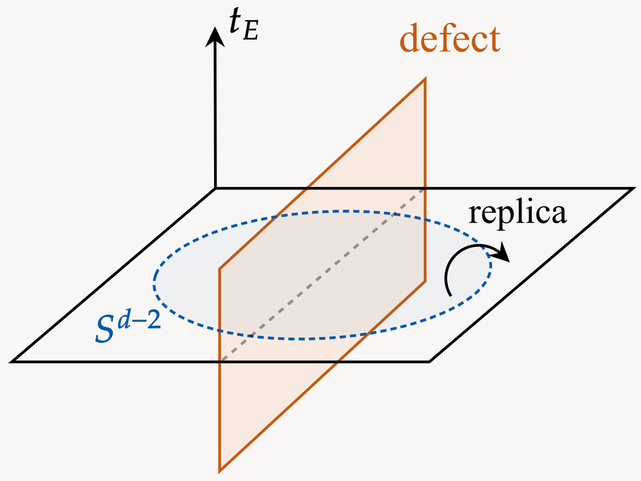
Defect Anomalies

$b,\ d_2, k_R, \ldots$

(Weyl/ 't Hooft)

Universality

(structural relation of observables)



Defect Energy

Defect contribution to the twisted ground state energy

$$\log Z[\beta \to \infty] \sim -\beta E$$

Defect Entropy

Defect contribution to the twisted Rényi entropy

$$S_n = \frac{1}{1-n} \log \frac{Z_n}{(Z_1)^n}$$

THREE-IN-ONE METHOD

Three independent approaches → Closed-form formula ← Non-perturbative derivation

① Localization

SUSY partition function on radial quantization $S^1 \times S^{d-1}$

② Anomaly Polynomial

Encoded symmetry structures & anomaly data

③ Holography

Brane construction AdS/CFT duality

ILLUSTRATIVE EXAMPLES

➢ ½-BPS surface defect in 6d (2,0) [1]

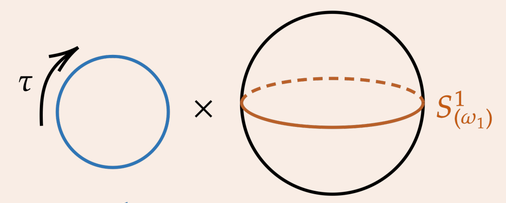
$$E = -\frac{1}{\omega_1}\left[\frac{d_2 - b}{6}\omega_2\omega_3 + \frac{2b - d_2}{24}\sigma_1\sigma_2\right]$$

$$S_n = \frac{2b - d_2}{6}\left[\frac{r_1 r_2}{2}\left(\frac{1}{n} - 1\right) + 1\right]$$

➢ Gukov-Witten defect in 4d N=4 [2]

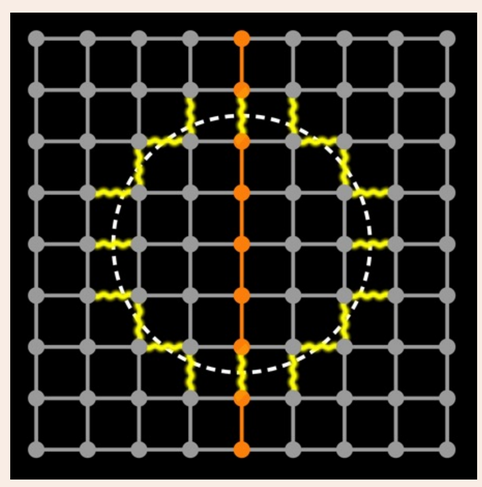
$$E = -k_R \frac{\Delta_2\Delta_3}{\omega_1} \qquad S_n = k_R\left[s_1 s_2\left(\frac{1}{n} - 1\right) + 1\right]$$

➢ Surface defect in 6d (1,0), etc... [2]



Surface defect in radial quantization geometry

Defect contributes to the entanglement structure (spherical entangling region)



[1] **Z.-X. Huang**, M.-K. Yuan and Y. Zhou, *From Weyl Anomaly to Universal Defect Casimir Energy and Rényi Entropy*, **Phys. Rev. Lett. 136 (2026) 201601**.

[2] **Z.-X. Huang**, M.-K. Yuan and Y. Zhou, *Defect Super-symmetric Casimir Energy and Rényi Entropy in 4d and 6d* (to appear).