Random matrix statistics of a BCFT ensemble

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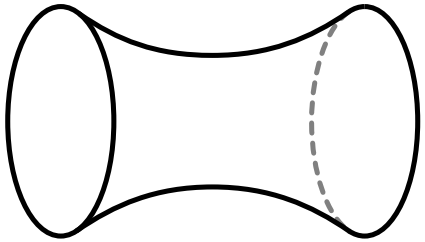
Based on work with Daniel Jafferis, Liza Rozenberg, Deb Sarkar (2512.05045)

Torus wormhole in 3d gravity

- Cotler-Jensen wormhole:

$$\langle \rho(E_1, s_1)\rho(E_2, s_2)\rangle_{g=0} = \quad \times S^1 \tag{1}$$



- Each torus boundary is the trace over the closed-string Hilbert space.
- Full description: [Jafferis, Rozenberg, Wong 24][Boruch, Ubaldo, Haehl, Perlmutter, Rozali 25]

$$\langle \rho(E_1, s_1)\rho(E_2, s_2)\cdots\rho(E_n, s_n)\rangle_g \stackrel{?}{=} Z_{\text{grav}}(\Sigma_{g,n} \times S^1) \tag{2}$$

  Hard to prove in general.
- Similar in fermionic gravity [Boruch, Tabor, Turiaci 26]

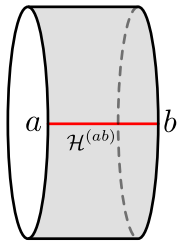
Spectrum of the open sector

- A simpler case:

$$\langle \varrho(E_1) \cdots \varrho(E_n) \rangle_g^{\text{open}} = Z_{\text{grav}}(\Sigma_{g,n} \times I) \tag{3}$$

- Each boundary is a BCFT trace over the open-string Hilbert space:

$$Z^{(ab)}(\tau) = \text{Tr}_{\mathcal{H}^{(ab)}} \left(\mathrm{e}^{-2\pi \,\text{Im}(\tau) H^{(ab)}} \right) \quad = \tag{4}$$



- Main result: for $\Sigma_{0,2}$, explicit path integral; for $\chi = 2 - 2g - n < 0$, compute using VTQFT followed by gauging large diffeos.
- The interpretation: *the random statistics of the BCFT spectra as defined via 3d gravity is precisely described by RMT to all orders in the genus expansion and for all points*