Giant gravitons in Twisted Holography

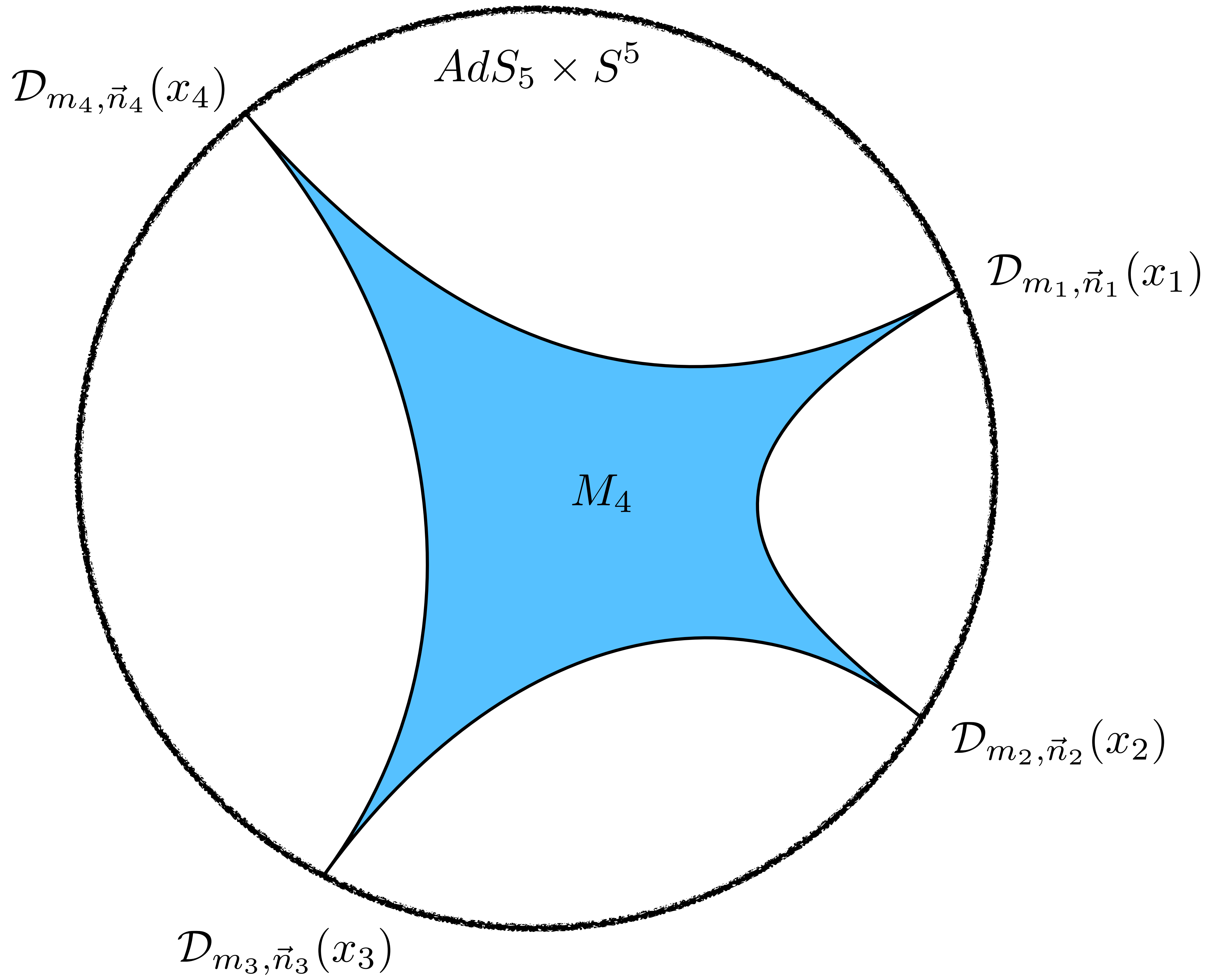
In collaboration with Kasia Budzic

Determinant operators

$$\mathcal{D}_{m,\vec{n}}(x) = \det\left[m\,1_{N\times N} + \vec{n}\cdot\vec{\Phi}(x)\right] \qquad m\in\mathbb{C} \qquad \vec{n}\in\mathbb{C}^6 \qquad \vec{n}^2=0$$

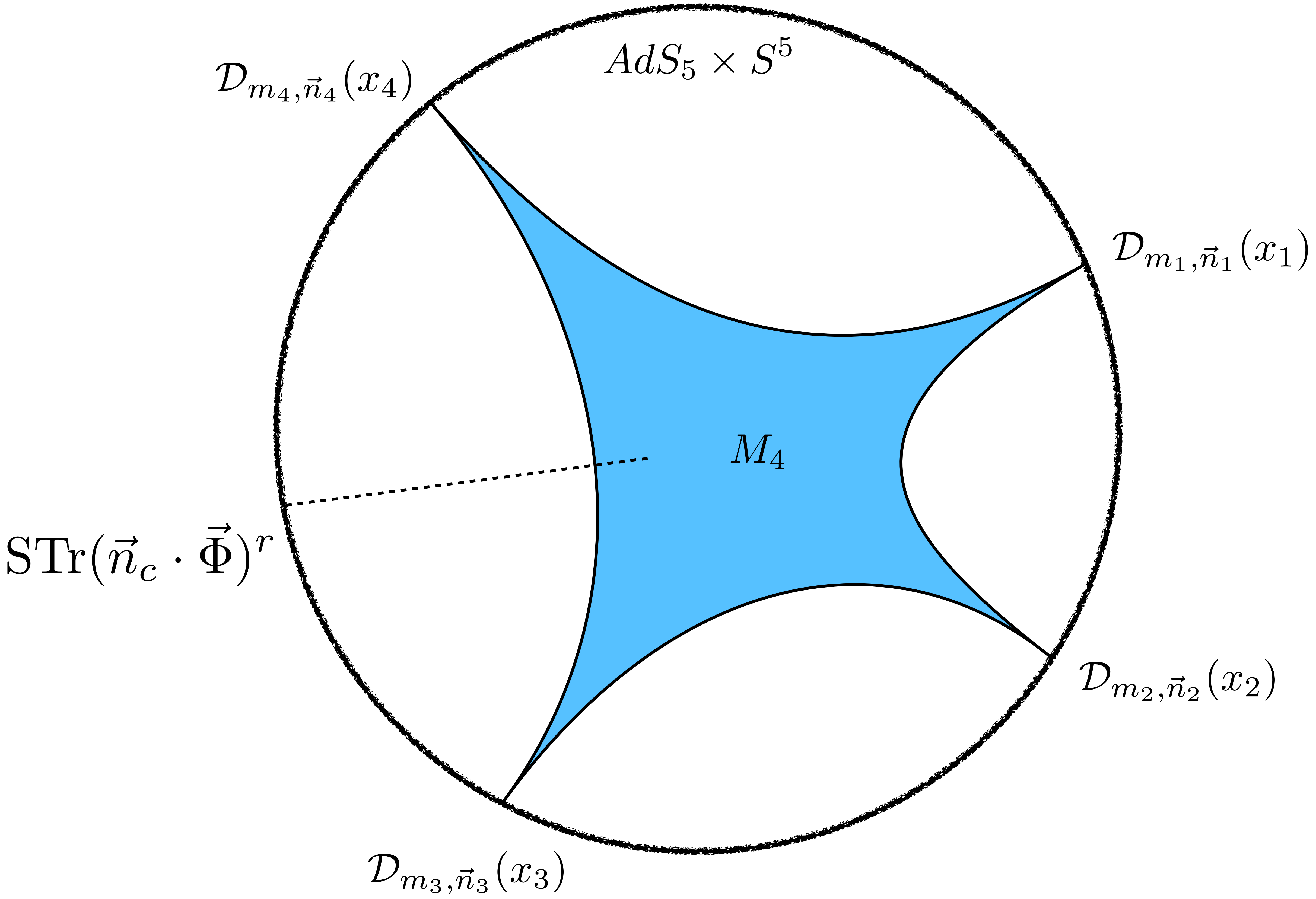
- Dual to the insertion of a ``giant graviton” D3 brane at the boundary
  - Wraps asymptotically $\mathbb{R}^+\times S^3 \subset AdS_5\times S^5$
  - n determines orientation, m determines size
- Target: multi-determinant correlators at large N

D-brane saddles



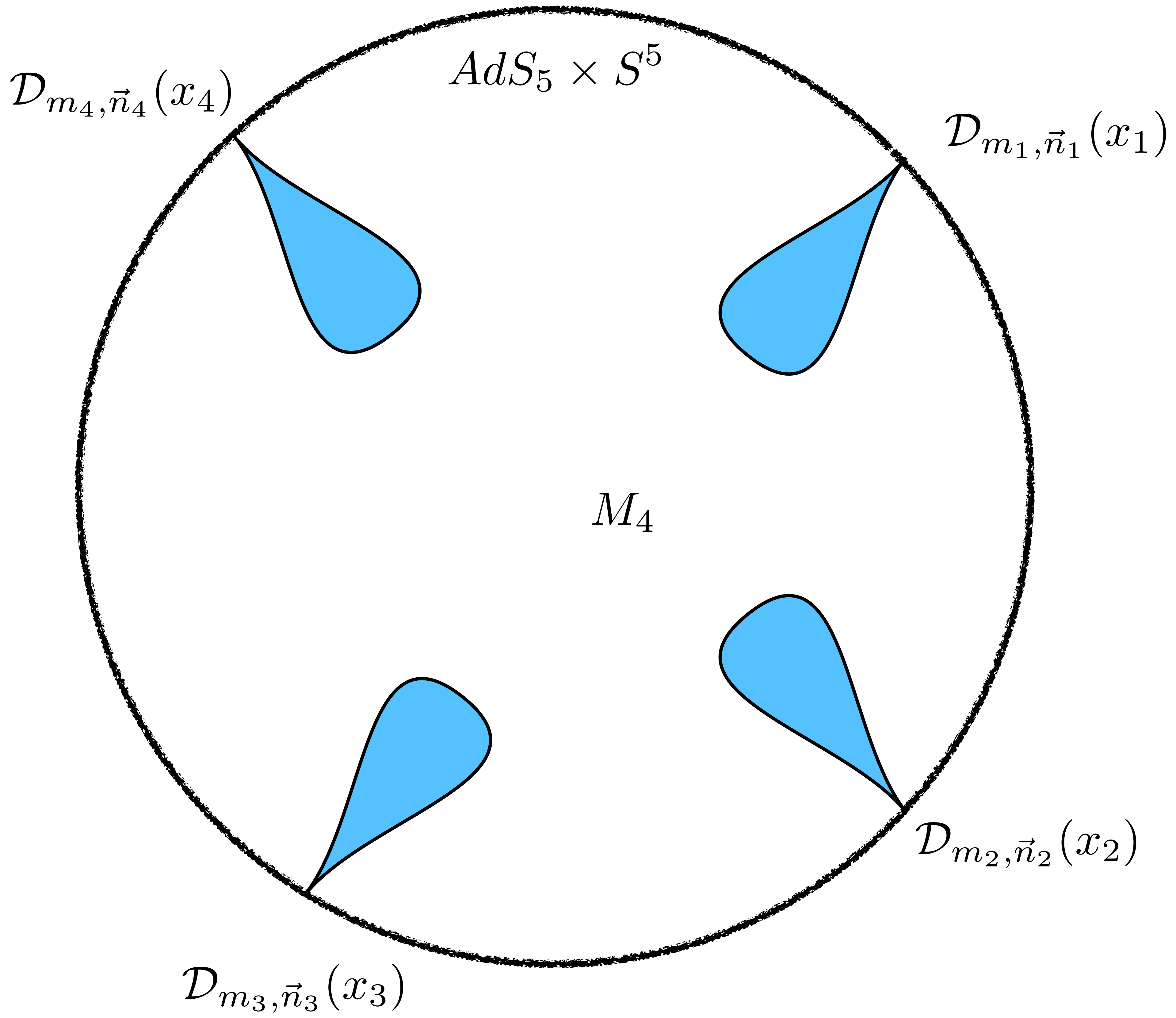
$e^{-NS^{cl}_{M_4}}$ (IIB open + closed)

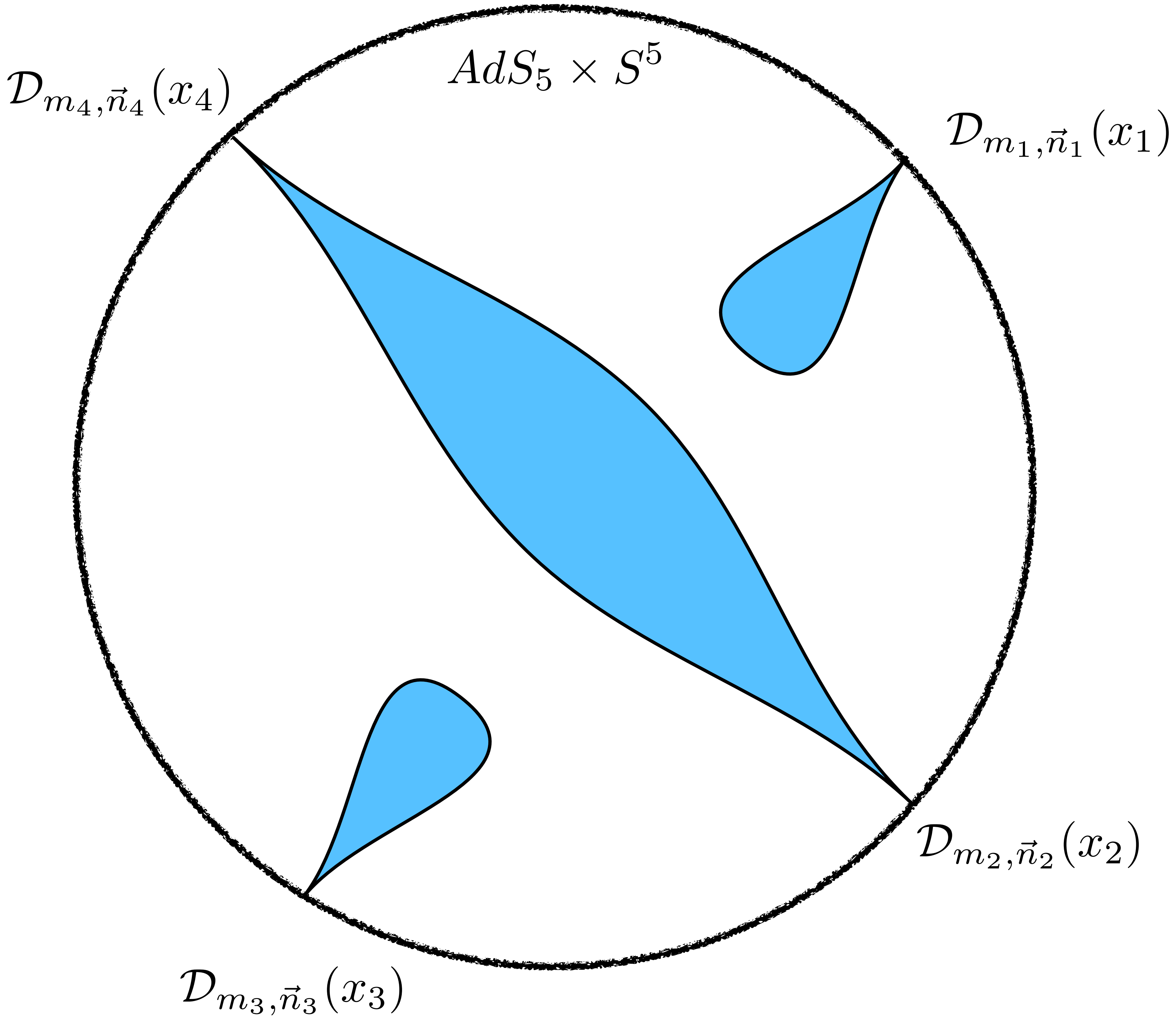
D-brane saddles



$e^{-NS^{cl}_{M_4}}$ (IIB open + closed)

Multiple saddles





Classical actions add up for disconnected branes

Chiral algebra subsector

C. Beem, M. Lemos, P. Liendo, W. Peelaers, L. Rastelli, B. C. van Rees

$$X(z) = \Phi_{++}(\mathrm{Re}\, z, \mathrm{Im}\, z, 0, 0) + \bar{z}\Phi_{-+}(\mathrm{Re}\, z, \mathrm{Im}\, z, 0, 0)$$
$$Y(z) = \Phi_{+-}(\mathrm{Re}\, z, \mathrm{Im}\, z, 0, 0) + \bar{z}\Phi_{--}(\mathrm{Re}\, z, \mathrm{Im}\, z, 0, 0)$$

- Free 2d chiral algebra correlation functions

$$\det\left[m\, 1_{N\times N} + X(z) + vY(z)\right]$$

- Twisted holography: dual reduces to B-model on SL(2,C)
- D3 branes => B-branes on holomorphic curve
    - Detailed dictionary not worked out!

Chiral algebra saddles

- Borrow free saddle analysis from Jiang, Komatsu, Vescovi
    - Fermionize $\det\left[m 1_{N\times N} + X(z) + vY(z)\right] = \int d\bar{\psi} d\psi \, e^{m\bar{\psi}\psi + \bar{\psi}(X(z)+vY(z))\psi}$
    - integrate away 4d scalars, Hubbard Stratonovich
- Saddle equations for auxiliary matrix ρ of size k, admit factorized saddles
    - $[\zeta,\rho] + [\mu,\rho^{-1}] = 0 \qquad \rho_{aa} = m_a \qquad \zeta = \mathrm{diag}(z_a) \qquad \mu = \mathrm{diag}(v_a) \qquad (\rho^{-1})_{aa} = \frac{\partial S}{\partial m_a}$

A spectral curve

- Build commuting matrices

$$
\begin{aligned}
B(a) &= a\mu - \rho \\
C(a) &= a\zeta + \rho^{-1} \\
D(a) &= a\zeta\mu + \rho^{-1}\mu - \zeta\rho \\
aD(a) - B(a)C(a) &= 1
\end{aligned}
$$

- Simultaneous eigenvalues (a,b,c,d) with ad-bc=1
  - Spectral curve in SL(2,C)

Spectral curve as a dual brane

- Passes multiple tests
  - Correct asymptotic shape at large a
  - Single trace insertion = B-model bulk-boundary propagator
  - Action of global symmetry algebra
  - One-loop check

To be done

- Is every curve a spectral curve? Checked only genus 0
- Subleading 1/N corrections
- Spectral curve => four-dimensional D3 brane shape
- Near-chiral algebra expansion?