Holographic conformal interfaces and their bulk dual

Based on 2202.11718 and WiP with T. Anous, M. Meineri and J. Sonner

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SwissMAP
The Mathematics of Physics
National Centre of Competence in Research

Pietro Pelliconi
CFTs and Integrable Models
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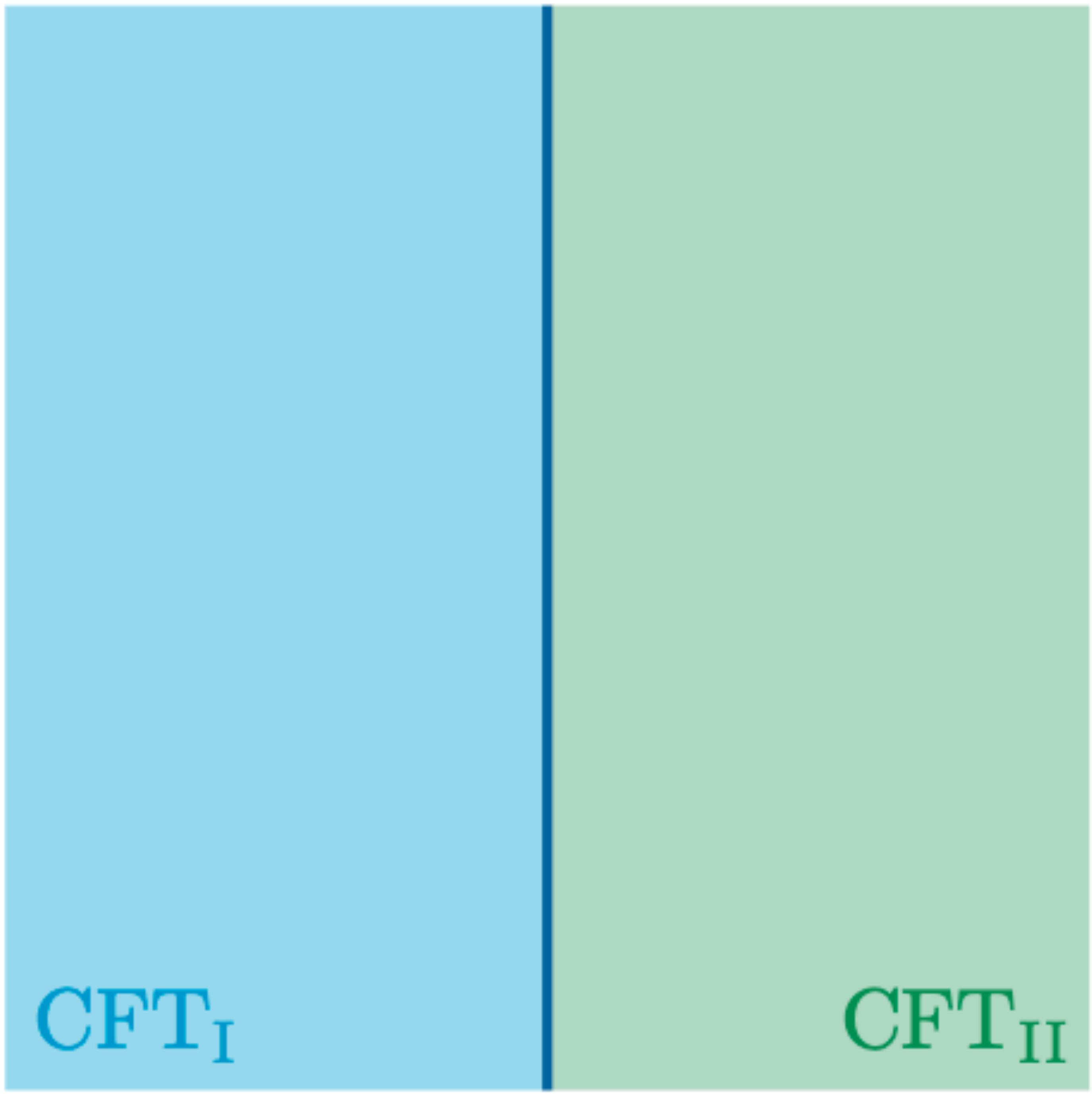
Holographic Interfaces

What is the bulk dual of a holographic Interface CFT?

Many possible answers:



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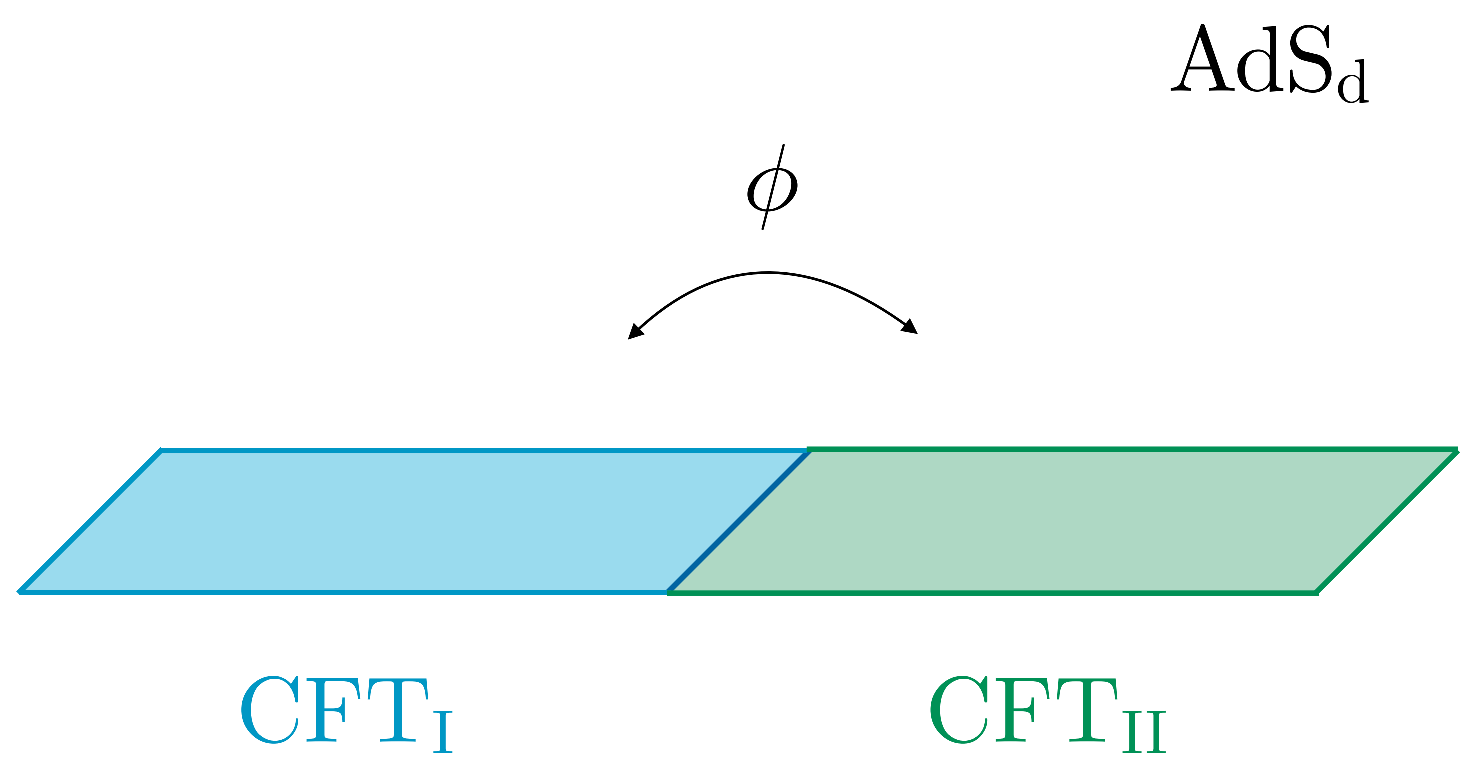
- Janus solutions

Top down construction, gravity + dilaton



[Bak, Gutperle, Hirano, 2003;
Clark, Freedman, Karch, Schnabl, 2004]

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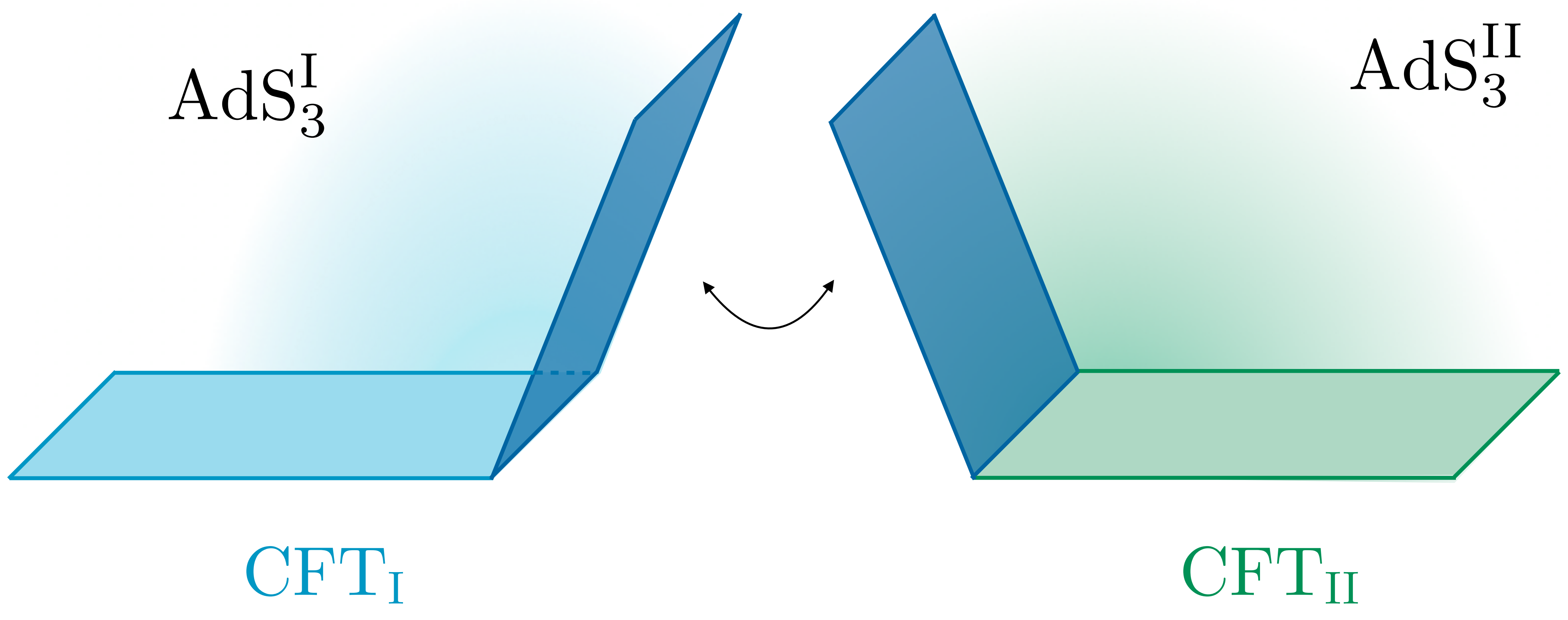
Bottom up constructions (connections with BH information paradox)



[Karch, Randall, 2001; Takayanagi, 2011; Fujita, Takayanagi, Tonni, 2011]

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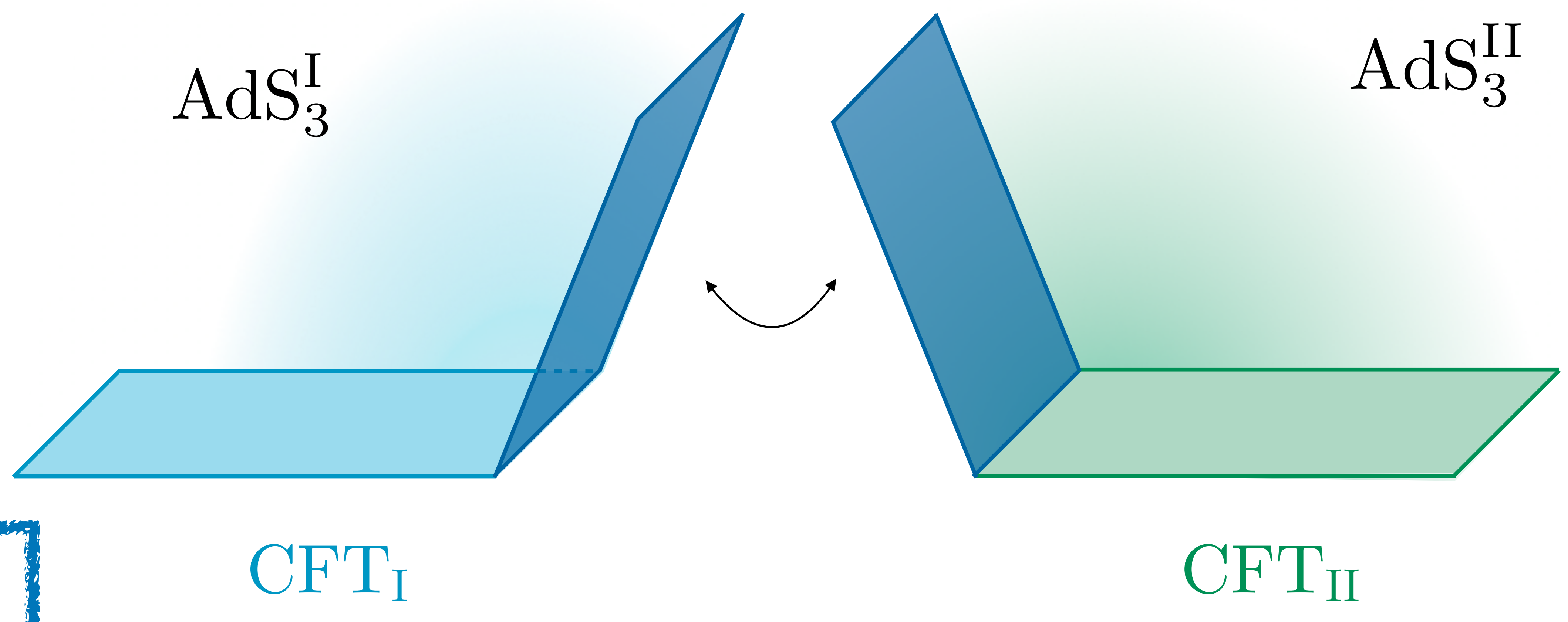
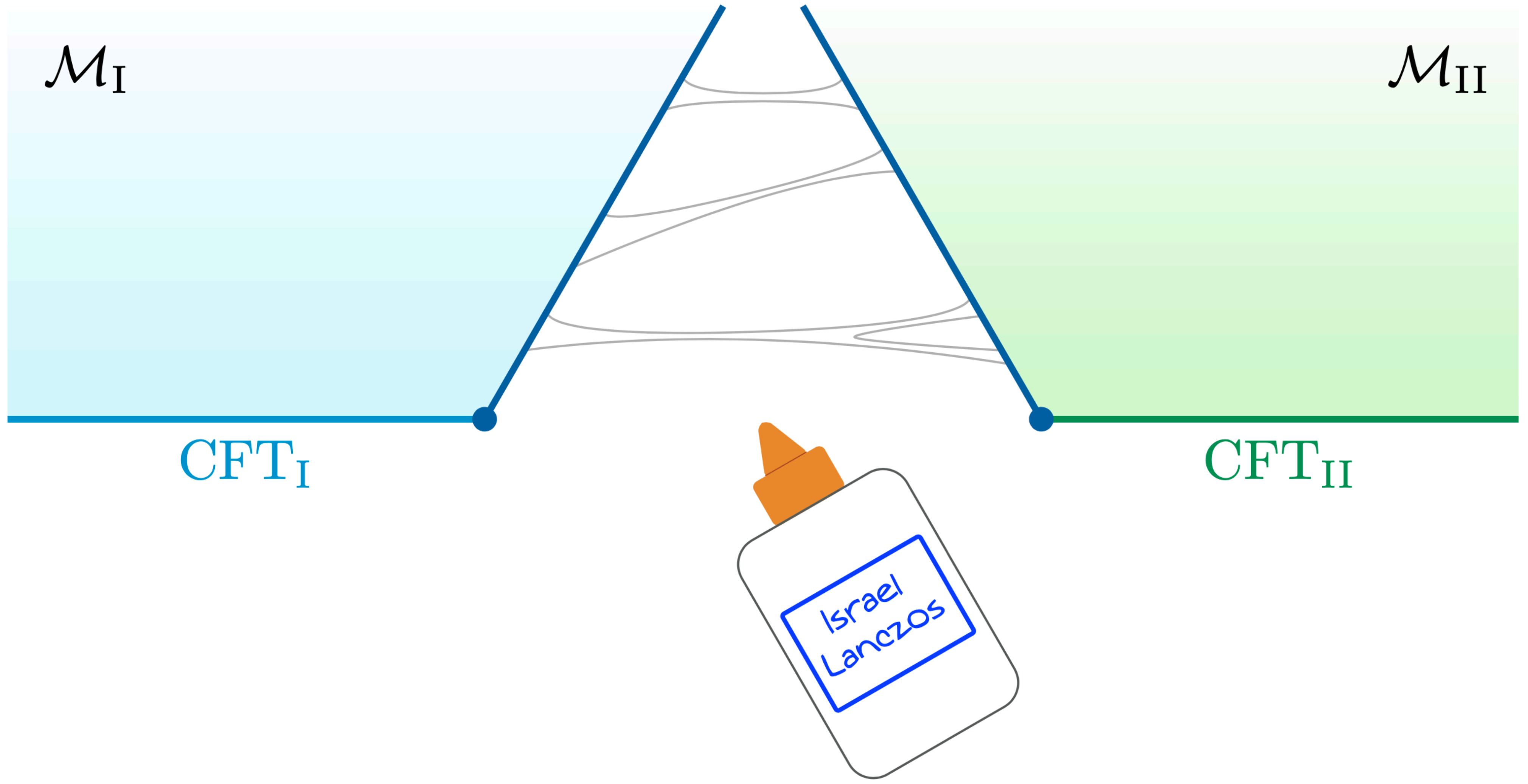


[Karch, Randall, 2001; Takayanagi, 2011; Fujita, Takayanagi, Tonni, 2011]

Brane Models

Low energy effective action

$$S_{\text{EH}} = -\frac{1}{16\pi G_{(3)}}\left[\int_{\mathcal{M}_\text{I}} \mathrm{d}^3x \left(R_\text{I} + \frac{2}{L_\text{I}^2}\right) + \int_{\mathcal{M}_\text{II}} \mathrm{d}^3x \left(R_\text{II} + \frac{2}{L_\text{II}^2}\right) + 2\int_{\mathcal{S}} \mathrm{d}^2y\,(K_\text{I} - K_\text{II} - T)\right]$$



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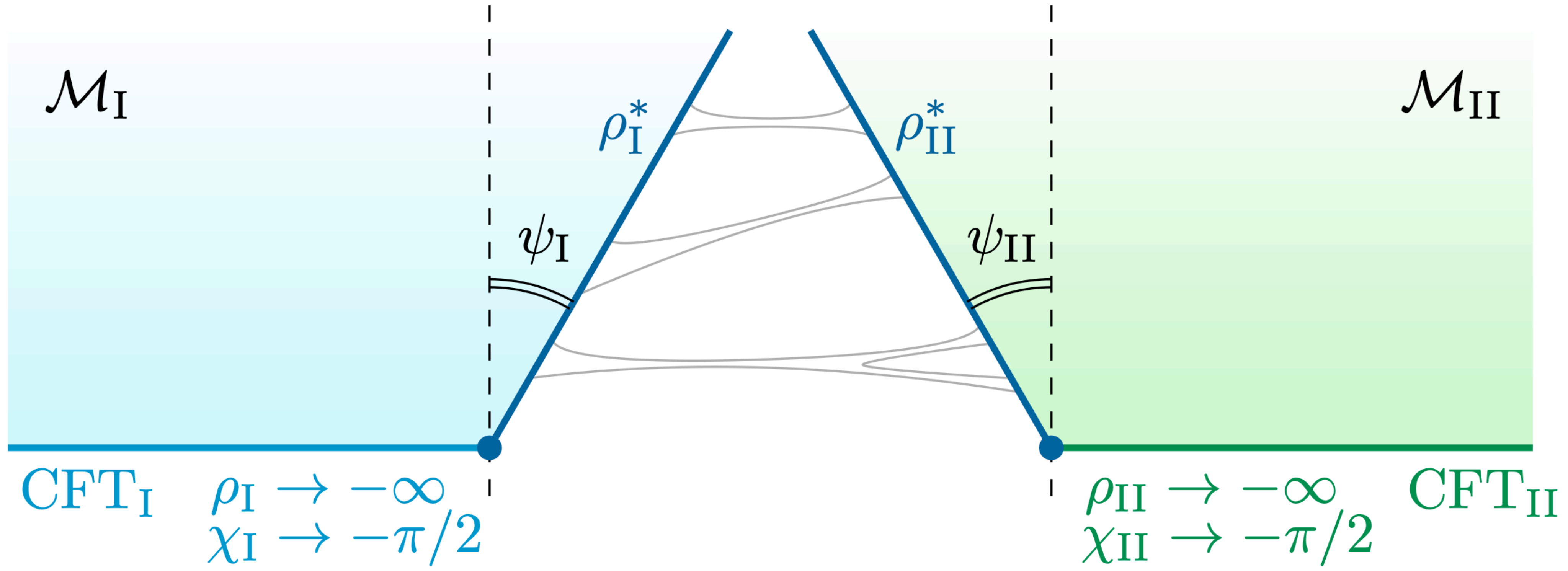
Solved by

$$\sin(\psi_{\mathrm{I,II}}) = \frac{L_{\mathrm{I,II}}}{2T}\left(T^2 + \frac{1}{L_{\mathrm{I,II}}^2} - \frac{1}{L_{\mathrm{II,I}}^2}\right)$$



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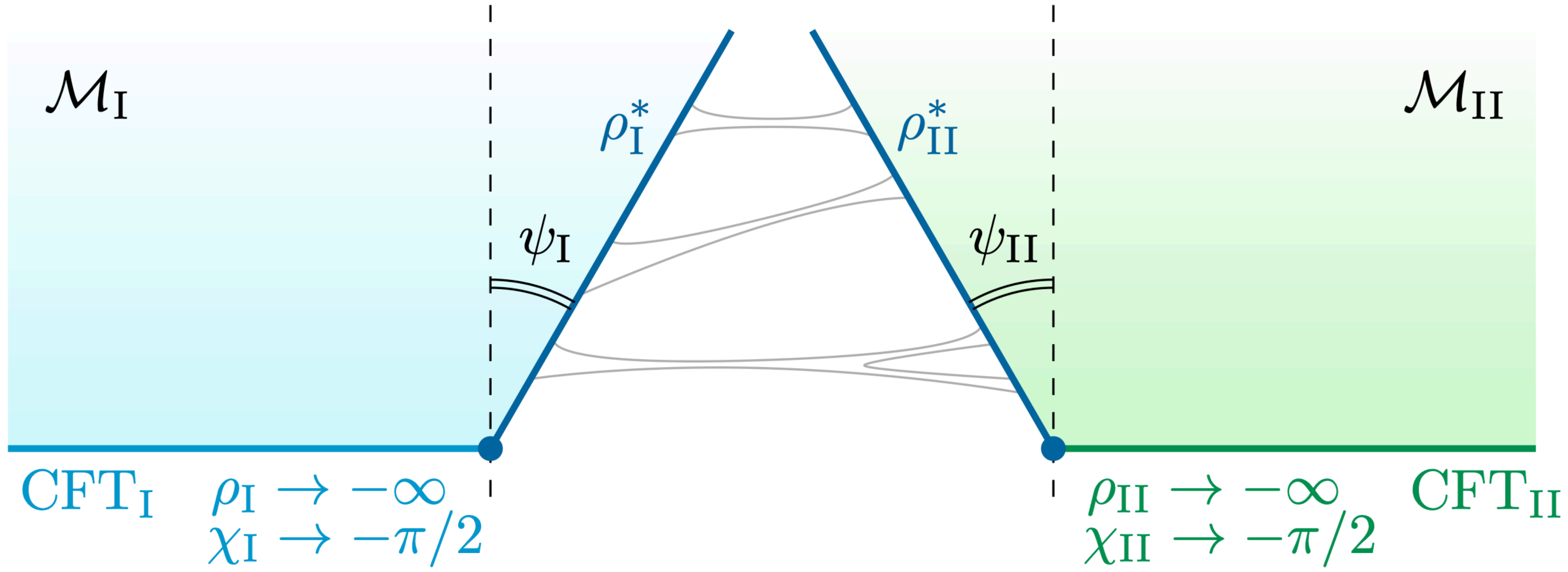

First identification:

- boundary entropy $g = \langle 0|B\rangle$

$$\log(g) = \frac{L_{\mathrm{I}}}{4G}\tanh^{-1}(\sin(\psi_{\mathrm{I}})) + \frac{L_{\mathrm{II}}}{4G}\tanh^{-1}(\sin(\psi_{\mathrm{II}}))$$

Correlation Functions and Geodesics

Geodesic approximation

$$\langle \mathcal{O}_1(\mathbf{x}_1)\mathcal{O}_2(\mathbf{x}_2)\rangle \approx \sum_{\mathcal{P}} e^{-md(\mathbf{x}_1,\mathbf{x}_2)}$$

Good approximation for operators with

$$1 \ll \Delta \ll c$$

or equivalently bulk fields with

$$\frac{1}{L} \ll m \ll \frac{1}{G_N}$$

The structure of geodesics is very rich

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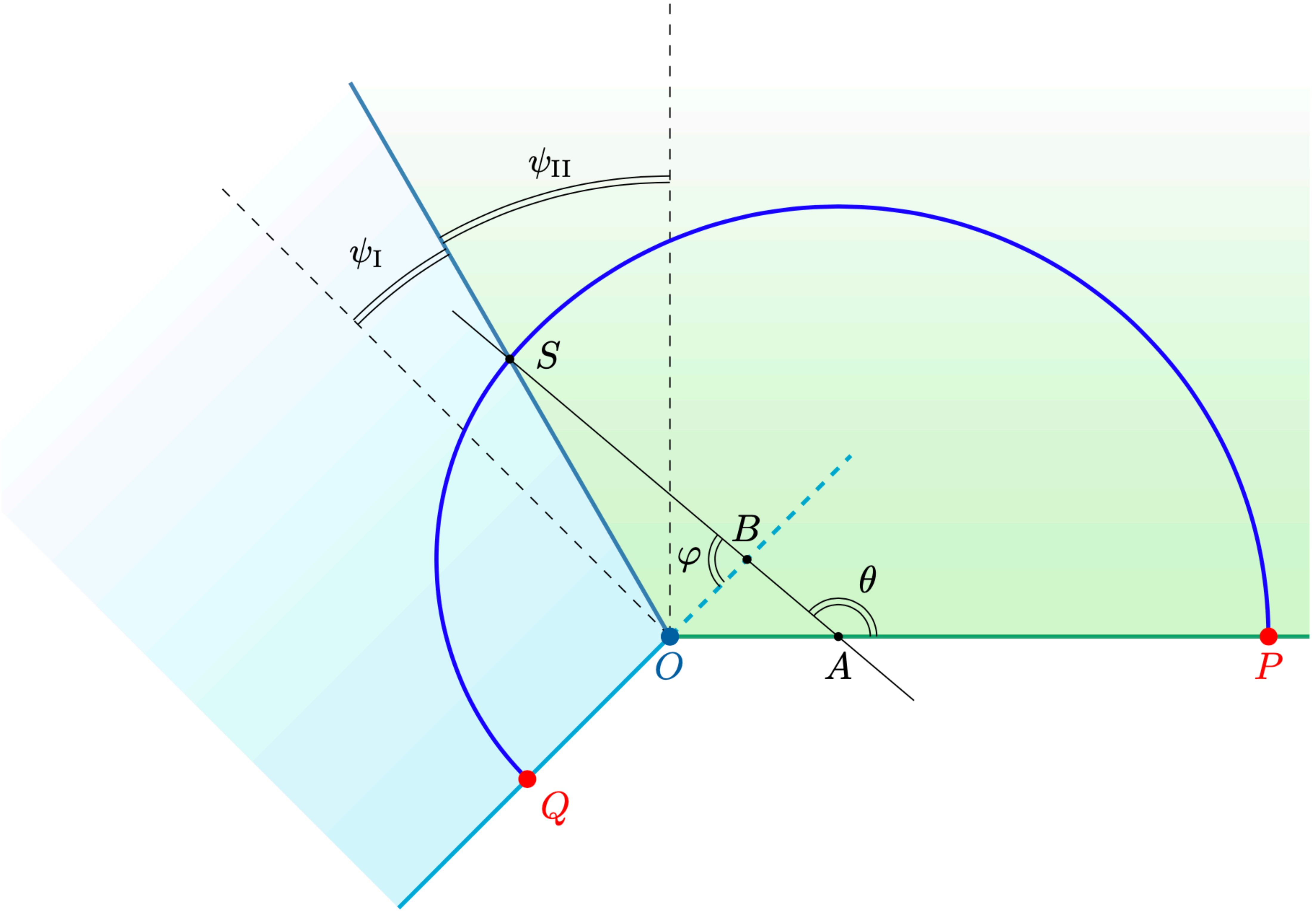
Geodesics are smooth through the brane

- Different sides of the interface



[Anous, Meineri, PP, Sonner, 2022]

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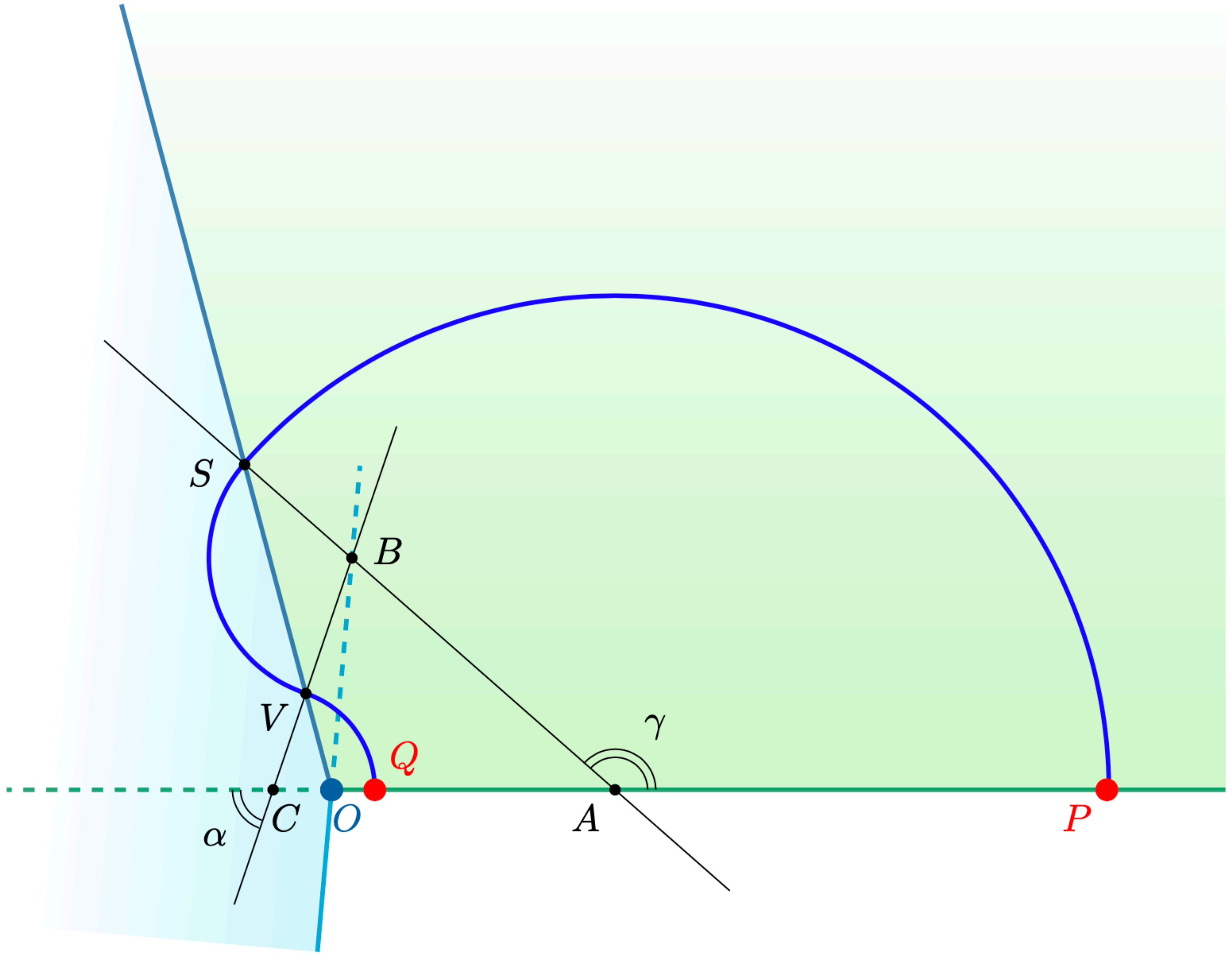
Geodesics are smooth through the brane.

- Different sides of the interface
- Same side



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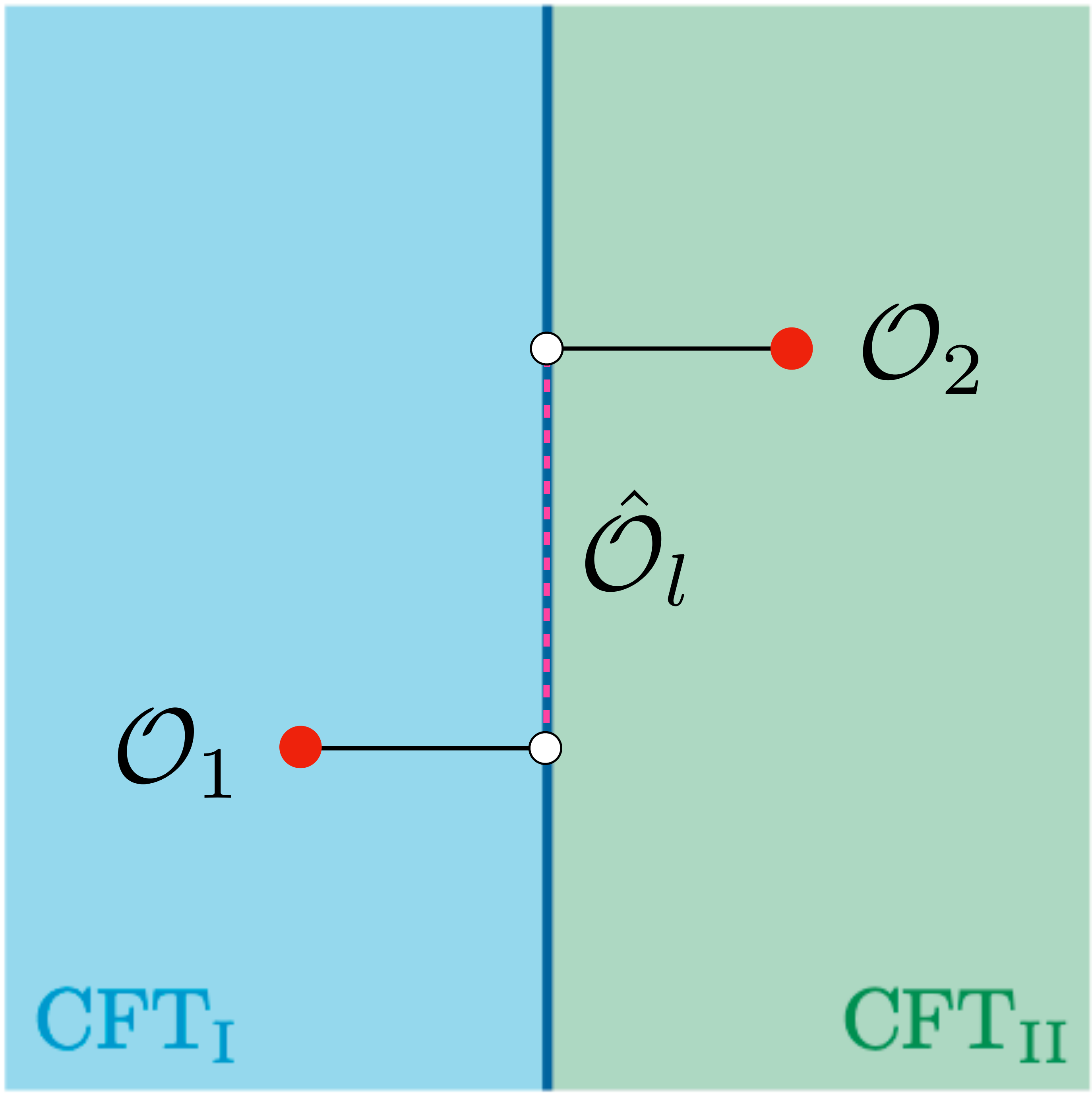
Interface Spectrum



Rewrite in terms of cross ratio

$$\xi = \frac{(x_1 - x_2)^2 + (y_1 - y_2)^2}{4 y_1 y_2}$$

Expand in (bdy) conformal blocks

$$\langle \mathcal{O}_1(\mathbf{x}_1) \mathcal{O}_2(\mathbf{x}_2) \rangle = \frac{1}{(2x_1)^{\Delta_1} (2x_2)^{\Delta_2}} \left[a_{\mathcal{O}_1} a_{\mathcal{O}_2} + \sum_l \mu_l^2 \, \xi^{-\hat{\Delta}_l} \, {}_2F_1\left(\hat{\Delta}_l, \hat{\Delta}_l; 2\hat{\Delta}_l; -\frac{1}{\xi} \right) \right]$$

Interface spectrum: $\hat{\Delta}_{1,n} = \Delta_1 + n \;\; , \;\; \hat{\Delta}_{2,n} = \Delta_2 + n \;\; , \;\; n \in \mathbb{N}$

Thanks

For more details see my poster!