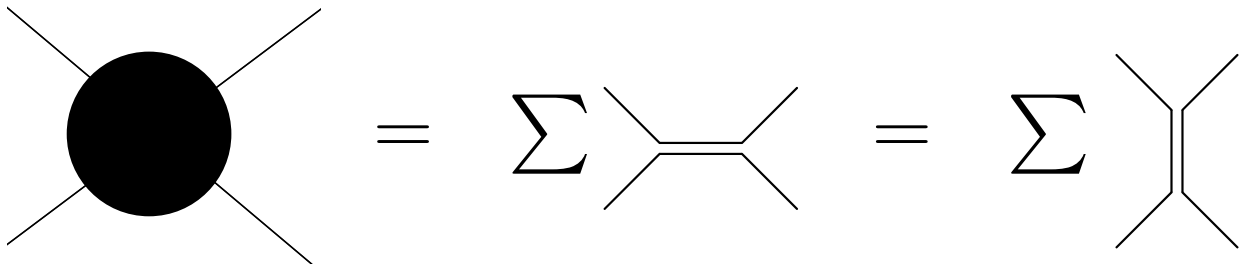
Crossing symmetry



- S-matrix (partial wave decomposition)
- Correlation function of composite operators.
  In a *conformal* field theory the OPE

$$\mathcal{O}_1(x)\mathcal{O}_2(y) = \sum_k \lambda_{12k}(x-y)\mathcal{O}_k(y)$$

  is a bona fide operator algebra.

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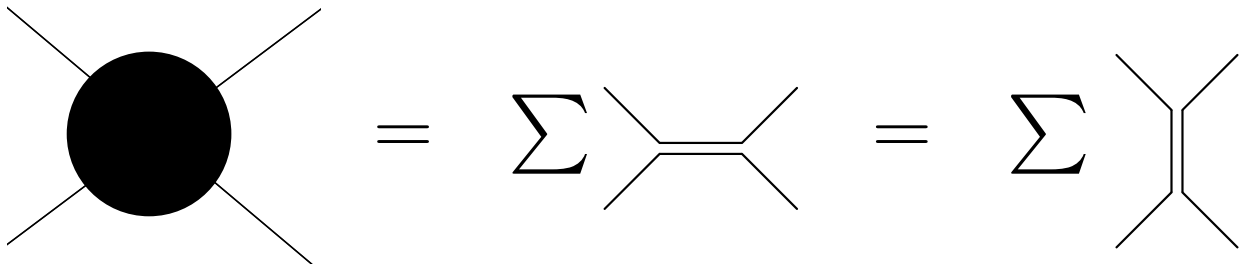

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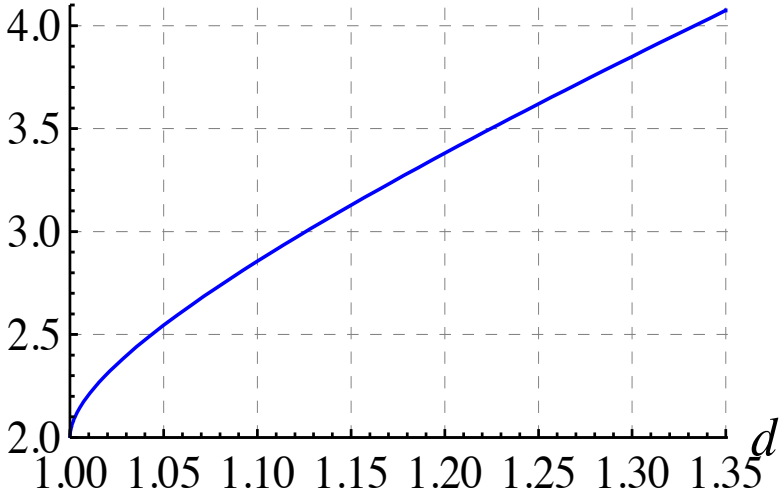
The conformal bootstrap

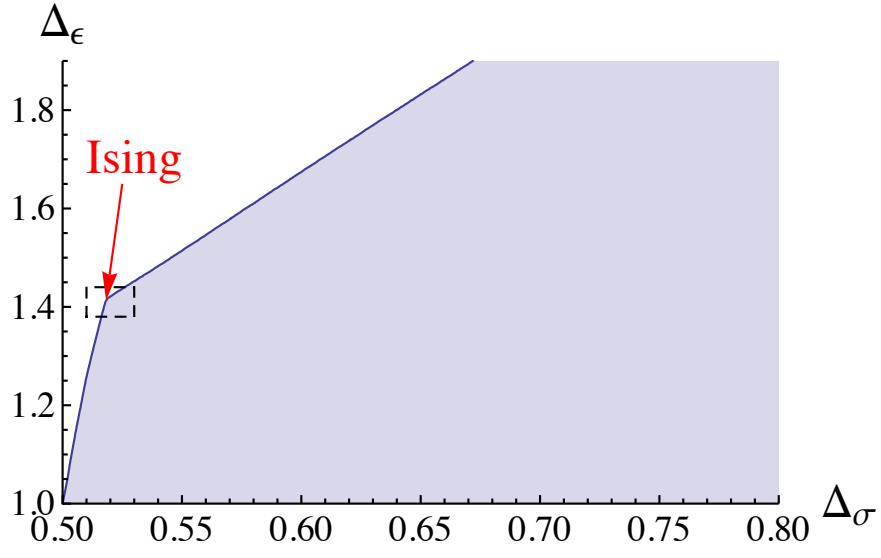
Idea: 'solve' the theory from crossing symmetry [Polyakov (1974)]

- Works often forn two dimensional CFTs (e.g. minimal models)
- Hard in higher-dimensional CFTs...
  but constraining works!

  [Rattazzi, Rychkov, Tonni, Vichi (2008), ...]

$$\mathcal{O}_d(x)\mathcal{O}_d(y) \sim \mathcal{O}_\Delta(x_2) + \dots$$





The conformal bootstrap

What can we say about the space of conformal field theories?

The conformal bootstrap

What can we say about the space of *super*conformal field theories?

The conformal bootstrap

What can we say about the space of $\mathcal{N}$-extended superconformal field theories?

The conformal bootstrap

What can we say about the space of $\mathcal{N} = 4$ superconformal field theories?

The $\mathcal{N} = 4$ superconformal bootstrap

$\mathcal{N} = 4$ super Yang-Mills is completely fixed by

- $G \in \{A_n, B_n, C_n, D_n, E_6, E_7, E_8, F_4, G_2\}$
- $\tau \in H/SL(2, \mathbb{Z})$

Very well-explored theory

- Lots of things protected by supersymmetry
- Large N: integrability / dual conformal symmetry (S-matrix)
- Also unprotected quantities
  e.g. four-loop Konishi anomalous dimension

What can the bootstrap say about $\mathcal{N} = 4$ superconformal theories?

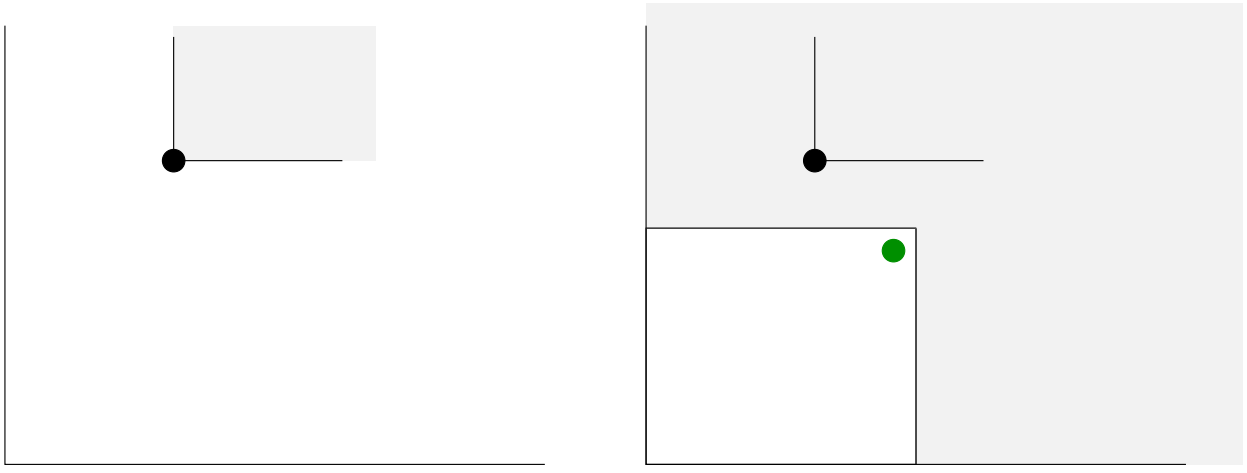
The $\mathcal{N} = 4$ superconformal bootstrap

Movie

Why the *u**?

Why the cube?

We are looking at *bounds*



$\rightarrow$ there is a special solution to crossing symmetry at the corner

We conjecture that it corresponds to strongly coupled $\mathcal{N} = 4$ SYM.

This leads e.g to

$$\Delta \lesssim 2.90$$

for the Konishi operator $\mathrm{Tr}\,(\Phi^I \Phi_I)$ in $SU(2)$ $\mathcal{N} = 4$ SYM at $g = 1$.

Outlook

- Find the rest of the conformal manifold $H/SL(2,\mathbb{Z})$
- What about $\mathcal{N}=2$ theories?
- A minibootstrap manifesto (to appear soon)
- Why the cube?

Collaborators:

Leonardo Rastelli

Christopher Beem

Pedro Liendo

Ashoke Sen

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