Mapping the space of QFTs through Scattering Amplitudes

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Academic Path













Universidad de Guanajuato

BSc
2008-2013

PERIMETER INSTITUTE

MSc & PhD
2013-2018

ENS
ÉCOLE NORMALE SUPÉRIEURE

Postdoc
2019-2022

CERN

Fellow
2022-2025

UvA

Fellow
2025-2026

Instituto de Ciencias Nucleares UNAM

Researcher
2026

What is the space of consistent QFTs?

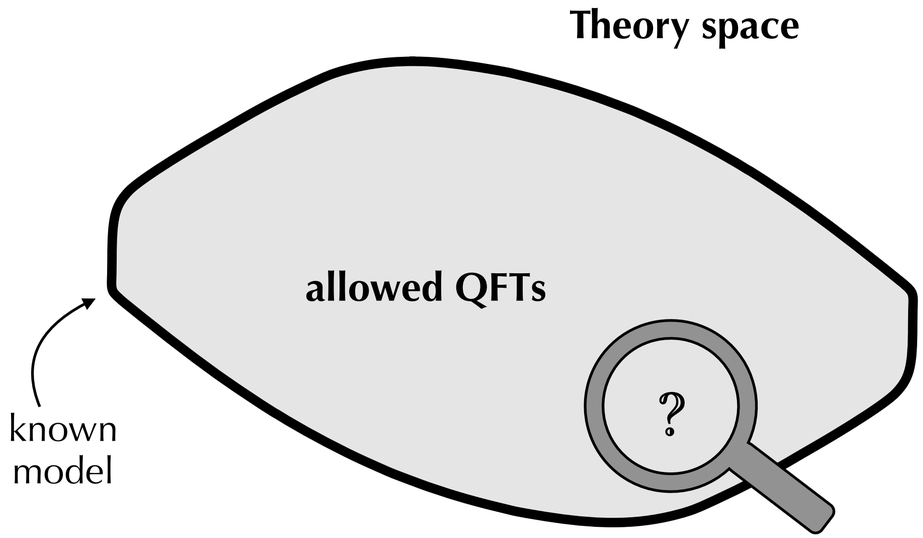
The Dream: A complete map of QFTs

- Develop non-perturbative tools

  → strongly coupled theories

- Investigate allowed theories

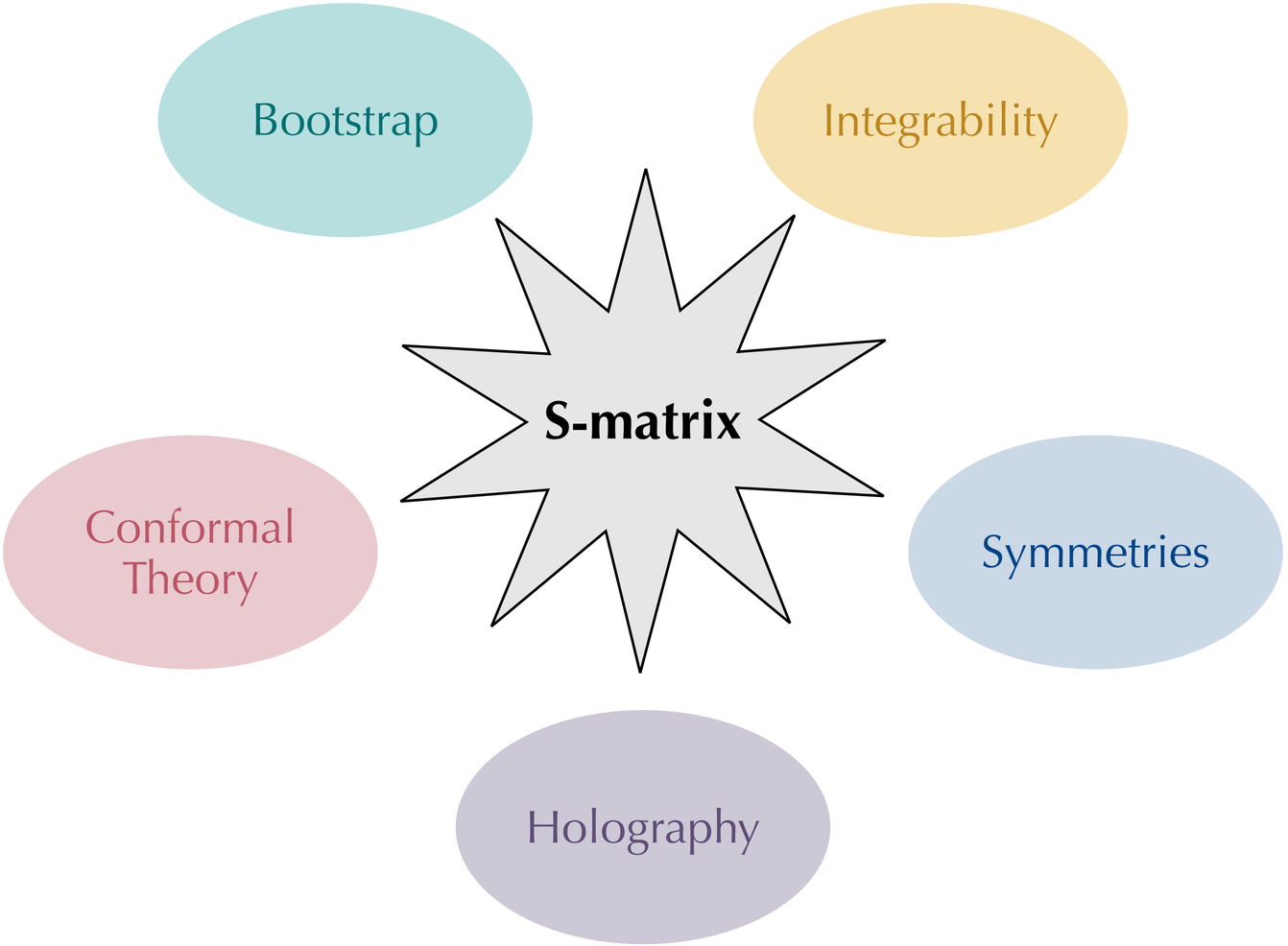
  → what are the unknown models?



- What are the correct consistency conditions to impose?

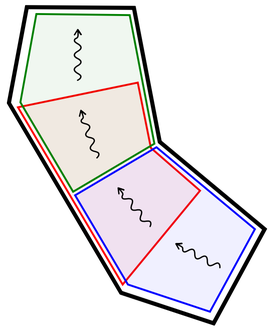
  → generic QFT or criteria to distinguish theories

Approaches

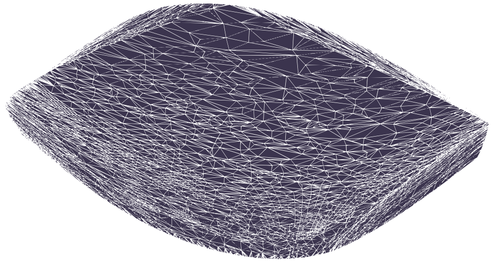

Bootstrap
Integrability
S-matrix
Conformal Theory
Symmetries
Holography

My Research

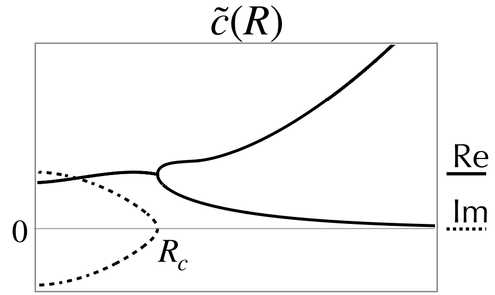
$\mathcal{N} = 4$ SYM



S-matrix & Form Factor Bootstrap

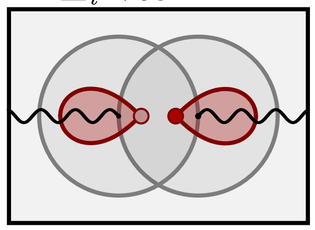


Integrable deformations

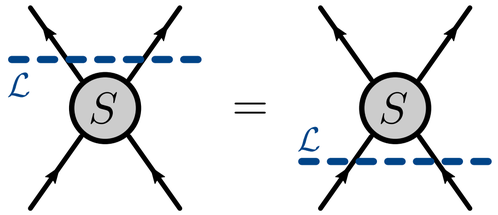


Flat space limit of AdS

$$\lim_{\Delta_i \to \infty} \mathcal{G}(z)$$

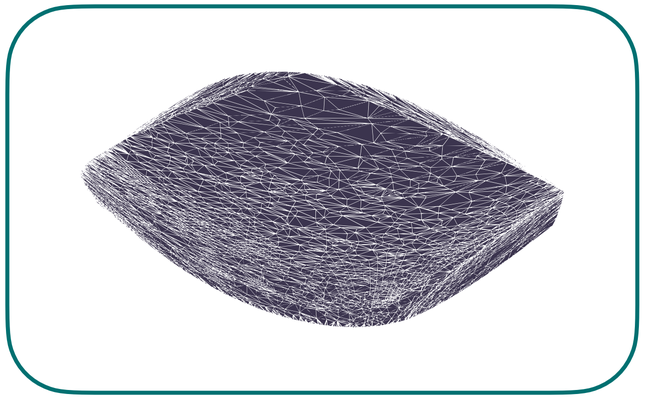


Generalized syms. & modified crossing



My Research

S-matrix & Form Factor Bootstrap

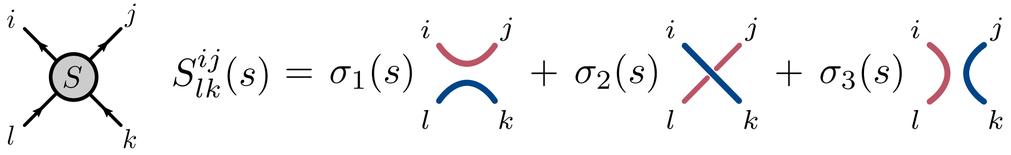


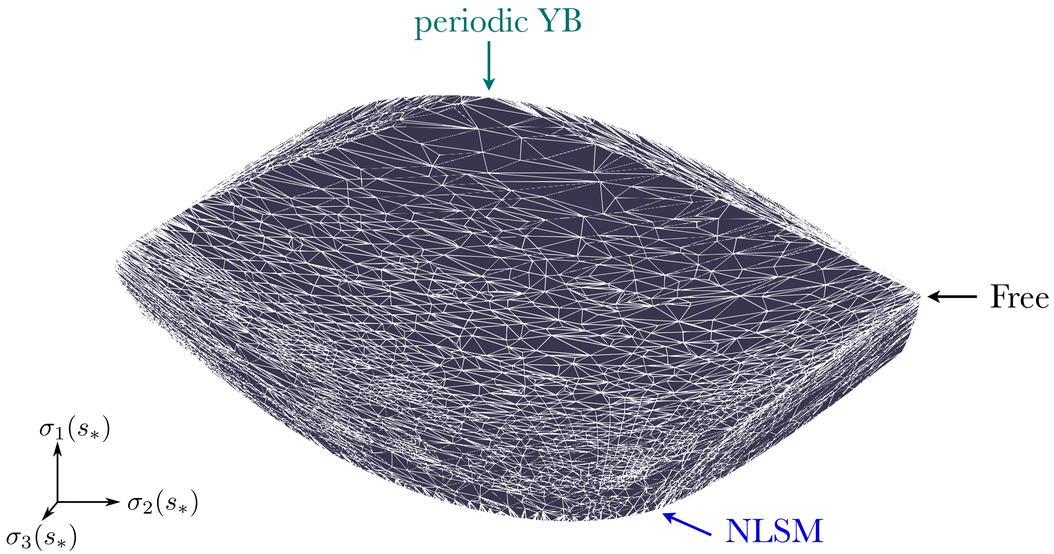
S-matrix Bootstrap

What is the space of consistent amplitudes?

Establish bounds on parameters imposing consistency conditions: **Analyticity**, **Crossing**, **Unitarity**

Simple set-up with very rich structure:
2d, massive, O(N) symmetry, no bound states

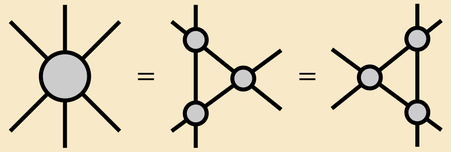




2d O(N) monolith
[LC, He, Kruczenski, Vieira '19]

- Dual approach: rigorous bounds
- Known models at vertices

Connection to **integrable** models



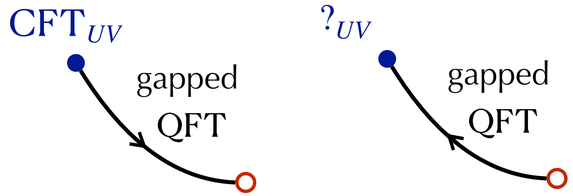
Exact non-perturbative S-matrices!

- Other consistent S-matrices: models unknown

Generic features: many resonances, emergent periodicity

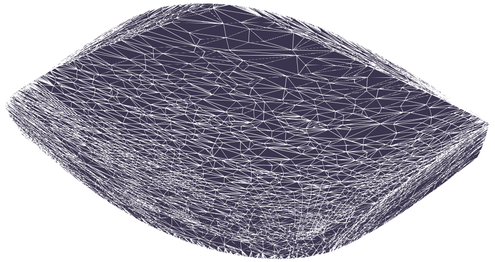
- Hints (FF Bootstrap + Integrability) many "consistent" amplitudes lead to unconventional UV behaviour

[LC, Negro, Schaposnik Massolo '21; LC, Correia, Georgoudis, Vuignier '23]



My Research

S-matrix & Form Factor Bootstrap

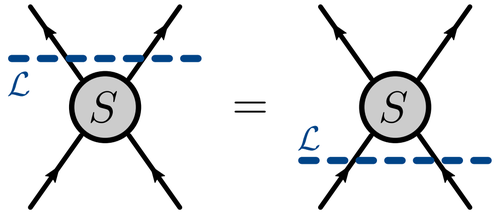


Integrable deformations

$\mathcal{N} = 4$ SYM

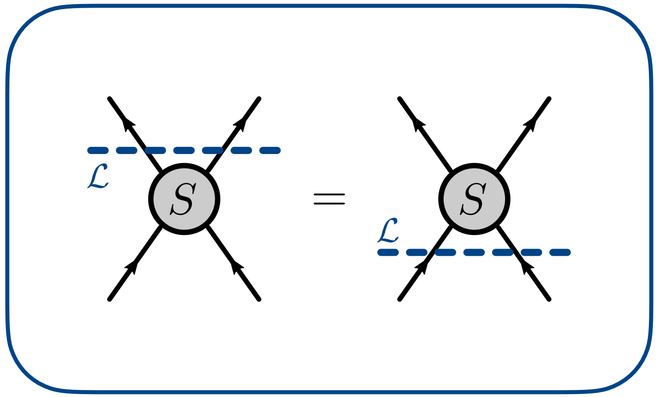
Flat space limit of AdS

Generalized syms. & modified crossing



My Research

Generalized syms. & modified crossing

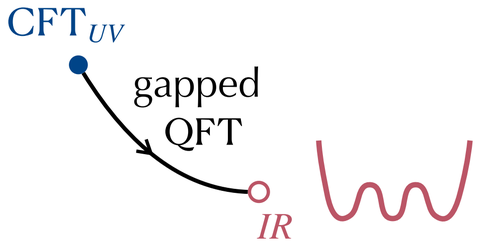


Generalized symmetries and modified crossing

Implications of generalized symmetries for scattering amplitudes

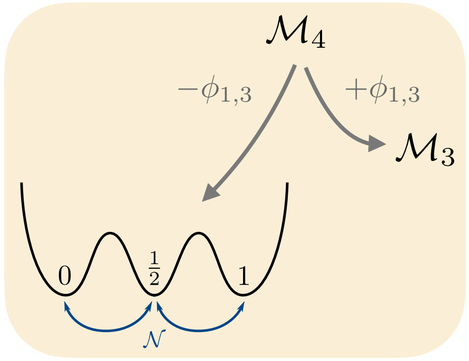
- (global) Symmetries in QFT ↔ Topological operators. *Groups → non-invertible, higher form syms.*

∃ symmetries and anomalies → strong constraints on IR



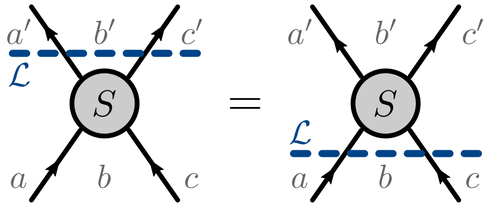
- Implications for amplitudes: **Crossing symmetry of S-matrix gets modified!**

Example: integrable deformation of Tricritical Ising 2d, scattering of kinks interpolating between vacua

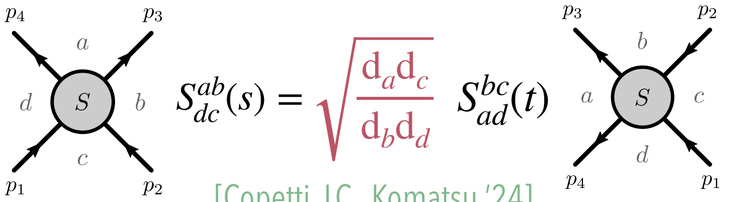


- unitarity + crossing + integrability [Zamolodchikov '89] → ~~non-invertible syms~~

- unitarity + non-invertible syms + integrability



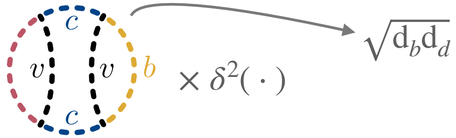
→ **Modified crossing**



[Copetti, LC, Komatsu '24]

symmetry data (d_a: *quantum dimensions*)

→ In general: normalization of $|\text{in}\rangle$ and $|\text{out}\rangle$ states, taking into account topological degrees of freedom.

$\langle \text{in}|\text{in}\rangle_s =$ 

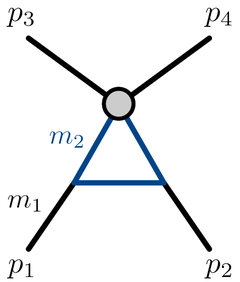
$\times\, \delta^2(\,\cdot\,)$ $\sqrt{d_b d_d}$

Ongoing projects

S-matrix and Form Factor Bootstrap

Beyond 2→2 lightest particles: Anomalous thresholds

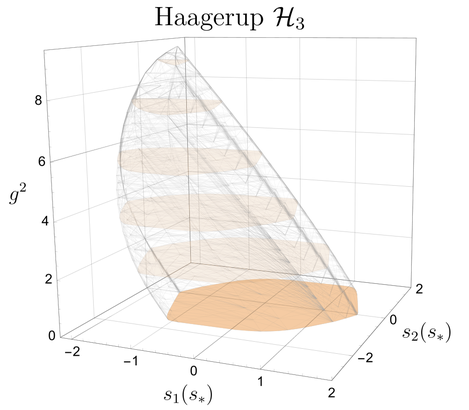
[LC, Rodrigues]



Generalized syms. and modified crossing

Bootstrap other categories: Haagerup and conditions for integrability

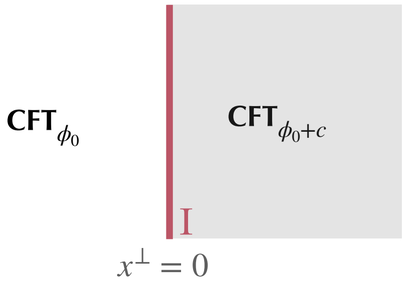
[LC]



Holography

Absence global syms. in quantum gravity: No shift symmetries in QG from CFT

[Calderon Infante, LC, Komatsu, Valenzuela]



Future

Gauge and Gravity

Soft dynamics

Generalized syms. and Bootstrap

Extension to higher d



Thank you!