Aspects of the Gauge/Gravity Duality

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Gauge/Gravity Duality

- A technique to describe a system in a strongly coupled regime in terms of another system in a weakly coupled regime
- It was discovered in string theory by Maldacena em 1997
- It relates a superstring propagating in an anti-De Sitter spacetime in 10 dimensions to a supersymmetric gauge theory in flat spacetime in 4 dimensions
- Since then several other instances of the duality were found
- In general it proposes that quantum field theories and string theories are intimately related and are different descriptions of the same physical system
- The duality represents an enormous advance in our understanding of quantum gravity, string theory and other areas of physics
- It is one of most active areas of research in theoretical physics
- It has been used to analyse certain aspects of condensed matter physics, relativistic plasmas, early universe cosmology, scattering amplitudes in quantum field theory, integrability in gauge theory and string theory, higher spin theories, supergravity theories and superstring theories

Thematic Project: Gauge/Gravity Duality

- USP: Diego Trancanelli and Victor Rivelles
- USP Postdoc: Edoardo Vescovi

- IFT/UNESP: Horatiu Nastase, Andrei Mikhaylov and Nathan Berkovits
- IFT/UNESP Postdocs: Chrysostomos Kalousios, Georgio Itsios, Francisco Javier Rojas and Thiago Fleury

Main Research Lines

- Aspects of the pure spinor formalism
  It represents an alternative formulation of superstrings
  Relation to twistor formulation of field theory
  Integrability properties
- Probing string theory via localization
  Localization is a powerful tool to compute Wilson loops in gauge theory
  Understand better the dual string configurations
- Integrability in string theory and gauge theory
  String theory is formulated as a string sigma model on a super-coset space
  Spectrum of anomalous dimensions operators have a description in terms of generalized spin chains
  Proof of the correspondence?
  Integrable deformations of strings
- Higher spin theories and string theory
  Duality between a higher spin theory of gravity and vector models

- Scattering amplitudes in AdS/CFT
  Computing scattering amplitudes in the gauge theory using string theory
- Holographic renormalization
  On-shell boundary actions in AdS are divergent
  They affect the computation of correlation functions in the field theory side
- Black holes and relativistic plasmas
  Describe a strongly coupled fluid, a quark-gluon plasma, produced by heavy ion collision at RHIC
- AdS/CMT
  Quantum critical systems at finite temperature and ABJM theory
- String theory cosmology
  Holographic gauge theory description of cosmological backgrounds