# GSS 2.0: Gauge theories, supergravity and string theory

- The project involves 8 INFN divisions with solid interconnections and well established synergies.

## National coordinator

Anna Ceresole INFN section: Torino

## Nodes

- Milano Bicocca
- Milano
- Padova
- Torino
- Pisa
- Lecce
- Genova

# The over-arching theme

- The research project of GSS 2.0 is devoted to the investigation of some challenging problems in Supersymmetric Quantum Field Theories for the unified description of Gravity and Gauge interactions.
- The geometry of spacetime, the intricate web of string and quantum field theories dualities, supersymmetry, supergravity and higher spin dynamics are the tools and the themes that are used and developed in this collaboration in order to explore quantum gravity and gauge theories at strong coupling.

## The main topics

- String Theory, M-Theory, Supergravity.
- Perturbative and non-perturbative properties of Gauge Theories.
- Topological field and string theories.
- Black Hole physics.
- Supersymmetry in Cosmology and Particle Physics.

# GSS: Genova Node

## The Genoa group

- Giuseppe Bandelloni (Retired since November 2016)
- Carlo Becchi (Emeritus)
- Camillo Imbimbo
- Valentina Pedemonte (Student, Laurea Magistrale)

## The specific theme of the Genoa group

Within this context, Genova node has focused and developed an expertise on topological quantum field theories, topological string theories, higher-spin field theories, their non-perturbative dynamics and application to supersymmetric theories.

# Higher-spin field theories

- Higher-spin field theories are generalizations of Einstein gravity whose gauge symmetries are tensorial extension of the usual reparametrization algebra.
- This topic has been studied by **G. Bandelloni** which has investigated both the algebraic structures of such gravitational theories with extended metric tensors and their quantum anomalies.

# Topological Field Theories and Supersymmetric Theories

- Topological field theories and topological string theories have been studied in the past by **C.M.Becchi** and C. Imbimbo.
- Topological (field and string) theories are close "cousins" of supersymmetric theories, characterized by a special "topological" supersymmetry — the so-called BRST symmetry.
- The BRST symmetry of topological theories is intimately related to the "physical" supersymmetry of the corresponding supersymmetric theories.

# Localization for supersymmetric theories

- A phenomenon which has studied intensely in recent years is the one of localization which occurs for supersymmetric gauge theories on curved space-times and with non-trivial gauge backgrounds.
- By “localization” one refers to the circumstance for which the semi-classical approximation to quantum field theory in such non-trivial backgrounds turns out to be, in certain cases, exact.

# Localization and topological gravity

- In Genova we developed an original approach to localization which is based on the relationship between topological theories and supersymmetric ones.
- In a collaboration involving **Dario Rosa** of the Korean Institute for Advanced Studies of Seoul, we applied this strategy to various supersymmetric theories, discovering new localizable backgrounds and obtaining new insights about the moduli dependence of the localizable models.

# The topological sector of supergravity

- More recently, always in collaboration with Dario Rosa, of KIAS, we have been able to identify a universal topological sector sitting inside *any* supergravity theory.
- We have used this, in an ongoing collaboration with **Valentina Pedemonte**, student of the Laurea Magistrale of the Department of Physics of Genova, to describe, for the first time, the complete space of classical supersymmetric vacua of $N = 4$ $d = 2$ supergravity.

# Ongoing and future projects

- In the future we plan to extend our analysis to the more challenging and interesting case of $N = 2$ $d = 4$ supersymmetric gauge theories.
- We also think that our description of the classical space of vacua of supergravity might lead to a new approach to investigate the non-perturbative quantum dynamics of supergravity itself.

# Publications 2016-18

- C. Imbimbo, S.-J. Rey, D. Rosa, “New Supersymmetric Localizations from Topological Gravity J. Bae’,’ JHEP **1603** (2016) 169.
- C. Imbimbo, “B-Strings on non-Kahlerian manifolds”, Nucl. Phys. B **912**, 249 (2016).
- C. Imbimbo and D. Rosa, “The topological structure of supergravity: an application to supersymmetric localization,” JHEP **1805**, 112 (2018).