# GSS 2.0: Gauge theories, supergravity and string theory

## National coordinator

Anna Ceresole INFN section: Torino

## Nodes

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

# 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 main topics

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

# GSS: Genova Node

## The Genoa group 2021

- Carlo Becchi (Emeritus)
- Camillo Imbimbo, 100%
- Nicola Maggiore, 100%

## Financial requests 2021

- Missioni e partecipazioni a conferenze: 5 kE

# GSS: Genova Node

## The specific themes of the Genoa group

The Genova node has focused and developed an expertise on topological quantum field theories and string theories, boundary field theories, massive quantum gravity, their non-perturbative dynamics and application to supersymmetric theories.

# Quantum field theories with boundaries

- Quantum Field Theories with Boundaries (BQFT) displays in presence of boundaries interesting non-trivial algebraic structures which have important applications, mainly in the framework of condensed matter, to the study of Fractional Quantum Hall Effect (FQHE) and Topological Insulators (TI).
- N. Maggiore in collaboration with **Erica Bertolini** ("Laurea Magistrale student) has investigated BQFT's in both 3 and 4 dimensions, obtaining promising and interesting results also in the case of non-topological field theories, the simplest of which is Maxwell theory, which seems to display on the boundary a structure similar to that found for topological theories. The hope is that of being able to describe, with a unique theory, both the behaviours of the FQHE and of the TI.

# Supersymmetric Localization and Topological Gravity

- In Genova we developed an original approach to supersymmetric localization which is based on emergent topological structures sitting inside supergravity theory which had been identified in a series of works done in collaboration with **Dario Rosa** of the KIAS of Seoul.
- In a collaboration with **Valentina Pedemonte** (former student of Dept of Physics of Genova) a complete classification of the space of classical supersymmetric vacua of $N = 4$ $d = 2$ supergravity was presented, discovering new localizable backgrounds and obtaining new insights about the moduli dependence of the localizable models.

# Ongoing and future projects

- In collaboration with **F. Bonucci** (“Laurea Magistrale" student) we are applying our methods to the challenging 4-dimensional $N = 2$ supersymmetric gauge theories, with the goal of exploring and classifying the space of their supersymmetric vacua.
- In collaboration with **N. Risso**, (“Laurea Magistrale" student) we are attempting to elucidate the long standing and still not settled issue of supersymmetry quantum anomalies by putting those in relation with the topological multiplets sitting inside supergravity.

# Ongoing and future projects

- N. Maggiore, in collaboration with **G. Gambuti** (“Laurea Magistrale" student) , has addressed the problem of giving a graviton a mass, in the framework of Linearized Massive Gravity (LMG), with the goal of solving the problematic aspects of the standard Fierz-Pauli (FP) theory. The latter has the advantage of describing a graviton with 5 degrees of freedom (DOFs), together with the well known difficulty of not displaying a good massless limit and of showing the so called vDVZ discontinuity, which constitutes a strong discrepancy with the theory of General Relativity.
- The aim of this research is to solve both these flaws of the FP theory, by treating LMG as a gauge field theory, which should be given a gauge fixing term first, in order to have a well defined theory, and only after a mass term, which should be such that the graviton has five DOFs

# Publications 2018-20

- G. Gambuti and N. Maggiore, “A note on harmonic gauge(s) in massive gravity”, Phys.Lett.B 807 (2020).
- G. Gambuti and N. Maggiore, “From a theory of a symmetric tensor field to a new massive gravity”, Symmetry 12 (2020) 7, 1134.
- A. Blasi, N. Maggiore, “Topologically protected duality on the boundary of Maxwell-BF theory”, Symmetry 11 (2019) 921.
- N. Maggiore, “Conserved chiral currents on the boundary of 3D Maxwell theory”, J.Phys.A 52 (2019) 11, 115401.
- M. Bonici, N. Maggiore, “Constraints on interacting dynamical dark energy and a new test for $\Lambda$ CDM”, Eur.Phys.J.C 79 (2019) 8, 672.

# Publications 2018-20

- N. Maggiore, “Holographic reduction of Maxwell Chern-Simons theory”, Eur.Phys.J.Plus 133 (2018) 7, 281.
- N. Alchera, M. Bonici, R. Cardinale, A. Domi, N. Maggiore et al. ,“Analysis of the angular dependence of time delay in gravitational lensing”, Symmetry 10 (2018) 7, 246.
- N. Maggiore, “From Chern-Simons to Tomonaga-Luttinger”, Int.J.Mod.Phys.A 33 (2018) 02, 1850013.
- C. Imbimbo, D. Rosa, “The topological structure of supergravity: an application to supersymmetric localization,” JHEP 1805, 112 (2018).
- C. Imbimbo and V. Pedemonte, “The vacuum structure of $N = 4$ supergravity in 2 dimension”, forthcoming.