GGI Theory Lectures by Young Researchers

Report of Contributions

https://agenda.infn.it/e/26226

Contribution ID: **1** Type: **not specified**

Geometric Approach to Supergravity - Lecture 1

Thursday, 25 March 2021 11:00 (2 hours)

The construction of supergravity theories from the technical point of view is a non-trivial task. In particular, complications arise from the fact that fermionic representations are involved. It is therefore particularly useful to find an efficient method to deal with the technical labor in formulating supergravity theories. In these lectures, we will explore the geometric (aka rheonomic) approach to supergravity theories in superspace, which allows a complete geometrical interpretation of supersymmetry.

Primary author: RAVERA, Lucrezia (Politecnico di Torino (DISAT))

Presenter: RAVERA, Lucrezia (Politecnico di Torino (DISAT))

Contribution ID: **3** Type: **not specified**

Geometric Approach to Supergravity - Lecture 2

Friday, 26 March 2021 11:00 (2 hours)

The construction of supergravity theories from the technical point of view is a non-trivial task. In particular, complications arise from the fact that fermionic representations are involved. It is therefore particularly useful to find an efficient method to deal with the technical labor in formulating supergravity theories. In these lectures, we will explore the geometric (aka rheonomic) approach to supergravity theories in superspace, which allows a complete geometrical interpretation of supersymmetry.

Primary author: RAVERA, Lucrezia (Politecnico di Torino (DISAT))

Presenter: RAVERA, Lucrezia (Politecnico di Torino (DISAT))

Contribution ID: **4** Type: **not specified**

Cosmology and Geometry at the boundary - Lecture 1

Monday, 12 April 2021 11:00 (2 hours)

Cosmological observables, such as temperature fluctuations in the CMB and density fluctuations in the distribution of galaxies, can be traced back at the end of inflation where they are encoded in quantum correlations, and the wavefunction of the universe which generates them, at a space-like boundary of a quasi-dS space-time. These lectures will focus on a novel approach to construct the wavefunction of the universe from boundary data only and extract from them physical informations. We will learn about its analytic structure, the interpretation of the singuality coefficients as physical processes, including scattering processes in flat-space, as well as a first-principle formulation in terms of combinatorial-geometrical objects which, together to provide new computational tools, provide a window on the basic rules behind cosmological processes.

Primary author: BENINCASA, Paolo (Niels Bohr International Academy, IFT Madrid)

Presenter: BENINCASA, Paolo (Niels Bohr International Academy, IFT Madrid)

Contribution ID: **5** Type: **not specified**

Cosmology and Geometry at the boundary - Lecture 2

Tuesday, 13 April 2021 11:00 (2 hours)

Cosmological observables, such as temperature fluctuations in the CMB and density fluctuations in the distribution of galaxies, can be traced back at the end of inflation where they are encoded in quantum correlations, and the wavefunction of the universe which generates them, at a space-like boundary of a quasi-dS space-time. These lectures will focus on a novel approach to construct the wavefunction of the universe from boundary data only and extract from them physical informations. We will learn about its analytic structure, the interpretation of the singuality coefficients as physical processes, including scattering processes in flat-space, as well as a first-principle formulation in terms of combinatorial-geometrical objects which, together to provide new computational tools, provide a window on the basic rules behind cosmological processes.

Primary author: BENINCASA, Paolo (Niels Bohr International Academy, IFT Madrid)

Presenter: BENINCASA, Paolo (Niels Bohr International Academy, IFT Madrid)

Contribution ID: **6** Type: **not specified**

Aspects of Generalized Global Symmetries and Anomalies - Lecture 1

Tuesday, 11 May 2021 16:00 (2 hours)

I will review some recent results on the dynamics of quantum field theories based on a renewed understanding of global symmetries and their anomalies.

Primary author: TIZZANO, Luigi (Simons Center for Geometry and Physics, SUNY, Stony Brook, NY)

Presenter: TIZZANO, Luigi (Simons Center for Geometry and Physics, SUNY, Stony Brook, NY)

Contribution ID: **7** Type: **not specified**

Aspects of Generalized Global Symmetries and Anomalies - Lecture 2

Thursday, 13 May 2021 16:00 (2 hours)

I will review some recent results on the dynamics of quantum field theories based on a renewed understanding of global symmetries and their anomalies.

Primary author: TIZZANO, Luigi (Simons Center for Geometry and Physics, SUNY, Stony Brook, NY)

Presenter: TIZZANO, Luigi (Simons Center for Geometry and Physics, SUNY, Stony Brook, NY)

Contribution ID: **8** Type: **not specified**

Defects in conformal field theory and holography - Lecture 1

Thursday, 27 May 2021 11:00 (2 hours)

The general study of defects has relations with the physics of almost every field theory. Defects can be introduced into a conformal field theory as means to make contact with the real world, reducing the total amount of symmetry. The broken conformal symmetries relax some of the constraints put on the correlation functions and defects can be used as probes to study the dynamics of a theory. In the first part of these lectures, I will give some hints on the bootstrap program for defect conformal field theories. Furthermore, I will focus on a particular defect version of N=4 Super Yang-Mills which has a holographic realization in terms of a D3-probe-D5 brane system. In this setup, I will present some particular results for local and non-local observables achieved with different techniques.

Primary author: BONANSEA, Sara (Niels Bohr Institute, Copenhagen University)

Presenter: BONANSEA, Sara (Niels Bohr Institute, Copenhagen University)

Contribution ID: **9** Type: **not specified**

Defects in conformal field theory and holography - Lecture 2

Friday, 28 May 2021 11:00 (2 hours)

The general study of defects has relations with the physics of almost every field theory. Defects can be introduced into a conformal field theory as means to make contact with the real world, reducing the total amount of symmetry. The broken conformal symmetries relax some of the constraints put on the correlation functions and defects can be used as probes to study the dynamics of a theory. In the first part of these lectures, I will give some hints on the bootstrap program for defect conformal field theories. Furthermore, I will focus on a particular defect version of N=4 Super Yang-Mills which has a holographic realization in terms of a D3-probe-D5 brane system. In this setup, I will present some particular results for local and non-local observables achieved with different techniques.

Primary author: BONANSEA, Sara (Niels Bohr Institute, Copenhagen University)

Presenter: BONANSEA, Sara (Niels Bohr Institute, Copenhagen University)

Contribution ID: **10** Type: **not specified**

Primordial gravitational waves and interferometers - Lecture 1

Thursday, 17 June 2021 11:00 (2 hours)

Gravitational Waves (GWs) represent a unique tool to explore the physics and the microphysics of the universe. After the GW direct detections by the LIGO/Virgo collaboration, the next target of modern cosmology is the detection of Stochastic Gravitational Wave Backgrounds (SGWB), both of cosmological and astrophysical origin. In this lectures, I will present early universe scenarios that can be probed with future GW detectors; in particular I will show how the LISA and Einstein Telescope (ET) interferometers, in addition to the detection and characterization of GWs of astrophysical origin, will give compelling information about the cosmological background of GWs. I will discuss the main tools and observables to deal with GW physics at interferometers.

Primary author: RICCIARDONE, Angelo (Padua U., INFN)

Presenter: RICCIARDONE, Angelo (Padua U., INFN)

Contribution ID: **11** Type: **not specified**

Primordial gravitational waves and interferometers - Lecture 2

Friday, 18 June 2021 11:00 (2 hours)

Gravitational Waves (GWs) represent a unique tool to explore the physics and the microphysics of the universe. After the GW direct detections by the LIGO/Virgo collaboration, the next target of modern cosmology is the detection of Stochastic Gravitational Wave Backgrounds (SGWB), both of cosmological and astrophysical origin. In this lectures, I will present early universe scenarios that can be probed with future GW detectors; in particular I will show how the LISA and Einstein Telescope (ET) interferometers, in addition to the detection and characterization of GWs of astrophysical origin, will give compelling information about the cosmological background of GWs. I will discuss the main tools and observables to deal with GW physics at interferometers.

Primary author: RICCIARDONE, Angelo (Padua U., INFN)

Presenter: RICCIARDONE, Angelo (Padua U., INFN)

Contribution ID: **12** Type: **not specified**

Lattice QCD: a primer of methods and results - Lecture 1

Monday, 28 June 2021 11:00 (2 hours)

The lattice regularization of Quantum Field Theories is a first-principles approach that allows to explore their non-perturbative regime via computer simulations. Over the years, it has provided valuable inputs to experimental studies and has contributed to the understanding of some of the deepest features of strongly-interacting field theories. The constant improvement of algorithms and computational power makes the lattice regularization an essential tool in the hands of the theoretical physicists of the future. In these lectures, the theoretical foundations of this approach will be reviewed, and some of the main results and currently open problems will be discussed

Primary author: VADACCHINO, Davide (Trinity College, Dublin)

Presenter: VADACCHINO, Davide (Trinity College, Dublin)

Contribution ID: **13** Type: **not specified**

Lattice QCD: a primer of methods and results - Lecture 2

Tuesday, 29 June 2021 11:00 (2 hours)

The lattice regularization of Quantum Field Theories is a first-principles approach that allows to explore their non-perturbative regime via computer simulations. Over the years, it has provided valuable inputs to experimental studies and has contributed to the understanding of some of the deepest features of strongly-interacting field theories. The constant improvement of algorithms and computational power makes the lattice regularization an essential tool in the hands of the theoretical physicists of the future. In these lectures, the theoretical foundations of this approach will be reviewed, and some of the main results and currently open problems will be discussed

Primary author: VADACCHINO, Davide (Trinity College, Dublin)

Presenter: VADACCHINO, Davide (Trinity College, Dublin)

Contribution ID: **14** Type: **not specified**

Large scale structure - Lecture 1

Thursday, 9 December 2021 11:00 (2 hours)

Primary author: BERTACCA, Daniele (Dipartimento di Fisica e Astronomia ”Galileo Galilei” Universita’ degli Studi di Padova)

Presenter: BERTACCA, Daniele (Dipartimento di Fisica e Astronomia ”Galileo Galilei” Universita’ degli Studi di Padova)

Contribution ID: **15** Type: **not specified**

Large scale structure - Lecture 2

Friday, 10 December 2021 11:00 (2 hours)

Primary author: BERTACCA, Daniele (Dipartimento di Fisica e Astronomia ”Galileo Galilei” Universita’ degli Studi di Padova)

Presenter: BERTACCA, Daniele (Dipartimento di Fisica e Astronomia ”Galileo Galilei” Universita’ degli Studi di Padova)

Contribution ID: **16** Type: **not specified**

The holographic approach to non-perturbative QCD and baryon physics - Lecture 1

Monday, 13 September 2021 10:00 (2 hours)

The Gauge/Gravity duality introduced a new tool for investigating QFTs in non perturbative regimes: the most phenomenologically relevant example of these theories is QCD at low energy (at the scale of nuclear physics), whose spectrum of bound states ranges from glueballs, to mesons, to complicated atomic nuclei. In these lectures we will review the Gauge/Gravity duality and discuss its extension to (almost) QCD, illustrating the top-down model of Witten-Sakai-Sugimoto: we will show the emergence of baryons from the model, and how to use it to compute observables that can prove themselves challenging via other techniques.

Primary author: BARTOLINI, Lorenzo (Henan University)

Presenter: BARTOLINI, Lorenzo (Henan University)

Contribution ID: **17** Type: **not specified**

The holographic approach to non-perturbative QCD and baryon physics - Lecture 2

Tuesday, 14 September 2021 10:00 (2 hours)

The Gauge/Gravity duality introduced a new tool for investigating QFTs in non perturbative regimes: the most phenomenologically relevant example of these theories is QCD at low energy (at the scale of nuclear physics), whose spectrum of bound states ranges from glueballs, to mesons, to complicated atomic nuclei. In these lectures we will review the Gauge/Gravity duality and discuss its extension to (almost) QCD, illustrating the top-down model of Witten-Sakai-Sugimoto: we will show the emergence of baryons from the model, and how to use it to compute observables that can prove themselves challenging via other techniques.

Primary author: BARTOLINI, Lorenzo (Henan University)

Presenter: BARTOLINI, Lorenzo (Henan University)

Contribution ID: **18** Type: **not specified**

Localization of supersymmetric gauge theories in three dimensions - Lecture 1

Thursday, 29 April 2021 11:00 (2 hours)

Supersymmetric Quantum Field Theories provide an exciting arena for exploring physics in the strong coupling regime. Supersymmetric localization has turned out to be a formidable tool for making progress in this direction. The goal of these lectures is to provide a concrete example of supersymmetric localization in the context of three-dimensional gauge theories. I will first review the basic idea of localization in the finite-dimensional case. I will then show an application of this idea to supersymmetric Chern-Simons matter theories. In particular, I will explain how matrix models capture the partition function of these theories.

Primary author: GUERRINI, Luigi (Università di Parma, INFN)

Presenter: GUERRINI, Luigi (Università di Parma, INFN)

Contribution ID: **19** Type: **not specified**

Localization of supersymmetric gauge theories in three dimensions - Lecture 2

Friday, 30 April 2021 11:00 (2 hours)

Supersymmetric Quantum Field Theories provide an exciting arena for exploring physics in the strong coupling regime. Supersymmetric localization has turned out to be a formidable tool for making progress in this direction. The goal of these lectures is to provide a concrete example of supersymmetric localization in the context of three-dimensional gauge theories. I will first review the basic idea of localization in the finite-dimensional case. I will then show an application of this idea to supersymmetric Chern-Simons matter theories. In particular, I will explain how matrix models capture the partition function of these theories.

Primary author: GUERRINI, Luigi (Università di Parma, INFN)

Presenter: GUERRINI, Luigi (Università di Parma, INFN)

Contribution ID: **22** Type: **not specified**

TBA - Lecture 1

Thursday, 28 October 2021 11:00 (2 hours)

TBA

Contribution ID: **24** Type: **not specified**

TBA - Lecture 1

Thursday, 25 November 2021 09:00 (2 hours)

TBA

Contribution ID: **27** Type: **not specified**

TBA - Lecture 2

Friday, 29 October 2021 11:00 (2 hours)

TBA

Contribution ID: **28** Type: **not specified**

TBA - Lecture 2

Friday, 26 November 2021 11:00 (2 hours)

TBA

Contribution ID: **31** Type: **not specified**

Higher-derivative quantum field theories, unitarity and quantum gravity - Lecture 1

Thursday, 14 October 2021 10:00 (2 hours)

These lectures aim to clarify several aspects of higher-derivative quantum field theories, their issues and how to circumvent them. A special attention will be given to quantum gravity. After reviewing general definitions we discuss the role of higher derivatives in both effective field theories and fundamental ones. Focusing on the latter, we explore the class of theories suitable for quantum gravity, discuss their features and the issues with unitarity. Finally, we show how to reconcile renormalizability and unitarity by means of purely virtual quanta.

Presenter: PIVA, Marco (NICPB Tallinn)

Contribution ID: **32** Type: **not specified**

Higher-derivative quantum field theories, unitarity and quantum gravity - Lecture 2

Friday, 15 October 2021 10:00 (2 hours)

These lectures aim to clarify several aspects of higher-derivative quantum field theories, their issues and how to circumvent them. A special attention will be given to quantum gravity. After reviewing general definitions we discuss the role of higher derivatives in both effective field theories and fundamental ones. Focusing on the latter, we explore the class of theories suitable for quantum gravity, discuss their features and the issues with unitarity. Finally, we show how to reconcile renormalizability and unitarity by means of purely virtual quanta.

Presenter: PIVA, Marco (NICPB Tallinn)