Cosmology and Particles, June 12-14

Wednesday, 12 June 2019 - Friday, 14 June 2019

UBB Chillan

Book of Abstracts

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Amplitudes from first principles

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n 2004 it has been shown that scattering amplitudes can be expressed by glueing together simple three-point on-shell amplitudes. These so-called BCFW-recursion relations can for instance be used to proof the explicit form of the n-gluon scattering amplitude as conjectured by Parke and Taylor. Moreover, the basic building blocks, the three-point on-shell amplitudes, are, apart from a coupling constant, fixed by Poincaré invariance. However, the BCFW-recursion relations are limited to tree diagrams. We would like to show how, by a combination of the Feynman-tree theorem with BCFW recursion relations, general scattering amplitudes can be fixed from first principles, that is, Poincare invariance, unitarity and gauge invariance.

Thursday morn. / **5**

Skyrme model at finite density and Skyrme crystals: analytic results

In this talk I will show how one can deduce exact analytic results in the Skyrme model on flat space-times using a quite remarkable mapping from the Einstein-Skyrme system. In particular, the explicit form of the critical Isospin chemical potential for one Skyrmion will be derived. Moreover, I will also describe analytically how Skryme crystals appear at finite Baryon density. Due to the relations of the Skyrme model with the low energy limit of QCD, these results are not just of academic interest.

Thursday morn. / **6**

A chiral model using unconventional SUSY and its possible applications

Author: Alvarez Pedro[1]

[1] *Universidad de Antofagasta*

Using unconventional SUSY, we construct a model that allow us to obtain a theory that is chiral and contains dynamical gravity, therefore resembling the structure of the Standard Model and General Relativity. We review the main features of Zanelli's unconventional SUSY that allow us to couple matter fields in a gauge invariant way. We will discuss the difficulties, advantages and future tasks of using unconventional SUSY in constructing more realistic models.

Thursday morn. / **7**

Two dimensional chiral anomaly in Very Special Relativity

Authors: Alex Soto Villarroel[None]; Alfaro Jorge[1]

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We discuss the Schwinger model in the formalism of Very Special Relativity. Although there is not mass from spontaneous symmetry breaking, there is a mass term coming from the SIM(2) invariant terms and the axial current stills conserved in this case. It is shown that the current when the fermion is coupled to an external electromagnetic field is modified due to the non local operator present in the theory. Finally, a new term in the chiral anomaly is present in the computation.

Wednesday aft. / **8**

One-loop divergences in 7D Einstein and 6D Conformal Gravities

Authors: Danilo Diaz[None]; Rodrigo Aros[None]; Fabrizzio Bugini[None]

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The aim of this work is to unveil a striking equivalence between the one-loop divergences in 7D Einstein and 6D conformal gravities.
The particular combination of 6D pointwise Weyl invariants of the 6D conformal gravity corresponds to those of Branson's Q-curvature and can be written solely in terms of the Ricci tensor and its covariant derivatives.
The quadratic metric fluctuations of this action, 6D Weyl graviton, are endowed with a sixth-order kinetic operator that happens to factorize on a 6D Einstein background into product of three shifted Lichnerowicz Laplacians. We exploit this feature to use standard heat kernel techniques and work out in one go the UV logarithmic divergences of the theory that contains in this case the four Weyl anomaly coefficients.
In a seemingly unrelated computation, we determine the one-loop IR logarithmic divergences of 7D Einstein gravity in a particular 7D Poincaré-Einstein background that is asymptotically hyperbolic and has the above 6D Einstein manifold at its conformal infinity or boundary.
We show the full equivalence of both computations, as an outgrowth of the IR/UV connection in AdS/CFT correspondence, and in this way the time-honoured one-loop calculations in Einstein and higher-derivative gravities take an interesting new turn.
If time permits, we elaborate on one-loop Witten diagrams in AdS which should encode equivalent information.

Friday morn. / **9**

Five-loop massive tadpoles

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Feynman integrals (FIs) play a central role in quantum field theory (QFT). They comprise the coefficients of weak-coupling expansions within theoretical particle physics, allowing for high-precision comparisons of theory with collider experiments with the ultimate goal of discovering new elementary particles.

Given this strong phenomenological motivation, FIs form interesting objects to study, since they can be argued to encompass the numbers that occur in nature. From the mathematical side, FIs have been (and continue to be) a rich source of inspiration in fields such as e.g. special functions, graph theory, or number theory, and many different methods have been developed to get a grip on numerical as well as analytical evaluations.

In this talk, I will briefly review recent progress achieved in precise evaluations of so-called massive tadpoles, which form an important sub-class of FIs that is universal in the sense that it allows for a complete characterization of renormalization constants within QFT. Furthermore, I will formulate a number of well-defined open problems in these evaluations. Applications of results to the renormalization of a specific four-dimensional QFT will also be sketched.

Wednesday aft. / **10**

Bayesian Comparison of Cosmological Models

Wednesday aft. / **11**

Emergent Universe by Tunneling in a Jordan-Brans-Dicke Theory

In this work we study an alternative scheme for an Emergent Universe scenario in the context of a Jordan-Brans-Dicke theory, where the universe is initially in a truly static state supported by a scalar field located in a false vacuum. The model presents a classically stable past eternal static state which is broken when, by quantum tunneling, the scalar field decays into a state of true vacuum and the universe begins to evolve following the extended open inflationary scheme.

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Cosmological constant problem: deflation during inflation

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Including magnetic effects in QCD Finite Energy Sum Rules

Wednesday aft. / **14**

Renormalization in a higher-order Lorentz symmetry breaking model

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Quantization of Higher Derivative Maxwell Chern Simons Theory

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Electromagnetic fields induced by an electric charge near a Weyl semimetal

Weyl semimetals (WSMs) are a new class of topological materials that exhibit a bulk Hall effect and a chiral magnetic effect. The topological contribution of these unusual electromagnetic responses can be characterized
by an axion term $\theta\mathbf{E}\cdot\mathbf{B}$ with space and time dependent axion angle $\theta(r,t)$. In this presentation I will show the electromagnetic fields produced by an electric charge near a topological WSM in the equilibrium state, at zero electric chemical potential, and with broken time-reversal symmetry. As in ordinary metals and dielectrics, outside the WSM the **E** field is mainly determined by the optical properties of the material. On the contrary, the **B** field is of topological origin due to the magnetoelectric effect of topological phases, a distinctive behaviour that is an experimentally observable signature of the anomalous Hall effect in the bulk of the WSM. Two experimental setups for testing our predictions of the induced magnetic field will be discussed.

Friday morn. / **18**

TBA

Friday morn. / **20**

Thermo-magnetic Corrections to π-π Scattering Lengths in the frame of the Linear Sigma Model

We discuss how magnetic fields and temperature affect the behavior of π-π scattering lengths in the linear sigma model. These are interesting parameters in the context of the physics of relativistic heavy ion collisions. We extend previous results were only magnetic effects were taking into account. Although the effects are comparatively small, it is interesting to remark that magnetic field and temperature display opposite effects over the scattering lengths.

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TBA

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Odderon slope in non-perturbative QCD

In this talk we will present first numerical calculation of the Odderon intercept and slope obtained with IR-regulator approach.

Friday morn. / **27**

Extending the momentum space topology from fermions to bosons

Author: Igor Justo[1]

Co-authors: Fabrizio Canfora [2]; David Dudal [3]; Alex Giacomini [1]; Pablo Pais [4]; Luigi Rosa [5]

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Momentum space topology (MST) has been used since a long time in the study of condensed matter physics and nowadays it has become the main theoretical tool for the description and classification of topological insulators. This is because within MST it is possible to construct a topological invariant quantity in terms of two-point Greens function,
$\mathcal{N}_3 = N\mathrm{Tr}\int_\Sigma K\, GdG^{-1}\wedge GdG^{-1}\wedge GdG^{-1}$,$sothatasysteminagivenconfigurationlabeledby$\cal N}

Inspired by the power of MST in the classification of the vacuum of quantum field theories, a new topological object, $\{\calN\}\{3\}$ belongs to an specific topological phase. At the same time, MST does also appear as an invaluable tool in the classification of the ground state of relativistic quantum fermionic field theories, which happens to be topologically equivalent to some topological materials, that is, they belong to the same universality class. For example, the Standard Model (SM) below the Electroweak scale belongs to the same universality class as the superfluid 3-He, as well as 3-dimensional topological insulators obeying time-reversal symmetry.

Inspired by the power of MST in the classification of the vacuum of quantum field theories, a new topological object, $\{\calN\}\{\Gamma\}$, is proposed, so that not only fermionic systems can be topologically classified, but also bosinic ones. This object is defined on the complex plane and it turns out to depend on the analytical expression of the mass function of the (fermionic and/or bosonic) propagator and on the contour Γ.$Toillustrate, thecaseoflatticequarkpropagator, aswellasthefinitetemperatur

Wednesday aft. / 28

Analytical solution to nonsinglet DGLAP}]{Analytical solution to DGLAP integro-differential equation with running gauge coupling

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We propose an algorithm to solve DGLAP integro-differential equation analytically in higher orders of the running gauge coupling α with splitting functions given at a fixed order in α. Complex analysis is significantly used in the construction of the algorithm, we found a simpler way to calculate the involved integrals over contours in the complex planes than by any of the well-known methods.