

Non-Lorentzian Geometries and their Applications

Report of Contributions

Contribution ID: 10

Type: **Theme 2: Carroll session**

Null Open Strings and Boundary Conformal CFTs

Wednesday 30 April 2025 14:30 (30 minutes)

We study null open strings and establish, for the first time, that the worldsheet residual gauge symmetry algebra is the Boundary Carrollian Conformal Algebra (BCCA). We present the construction of open null strings and demonstrate that, under Dirichlet boundary conditions, Boundary Carrollian Conformal Algebra emerges as the algebra of constraints. Additionally, we show that the BCCA can be obtained by contracting a single copy of the Virasoro algebra, confirming that null open strings arise as the tensionless limit of tensile open strings. This discovery initiates a broader study of Carrollian Conformal Field Theory (CCFT) with boundaries, opening a range of new research possibilities, given the growing importance of Carrollian symmetries.

Author: Dr PANDIT, Priyadarshini (Indian Institute of Technology Kanpur)

Co-authors: Prof. BAGCHI, Arjun (Indian Institute of Technology Kanpur); GRUMILLER, Daniel (Institute for Theoretical Physics, TU Wien); CHAKRABORTY, Pronoy (Indian Institute of Technology Ropar); CHAKRABORTTY, Shankhadeep; FREDENHAGEN, Stefan (University of Vienna)

Presenter: Dr PANDIT, Priyadarshini (Indian Institute of Technology Kanpur)

Session Classification: Carroll: Contributed Talk (Chair: ...)

Contribution ID: 16

Type: **Theme 1: Non-relativistic session**

M(atrix)-Theory from Nonrelativistic Sigma Models

Tuesday 29 April 2025 14:30 (30 minutes)

I will talk about two classes of nonrelativistic sigma models and their roles in M-theory and matrix theory. I will start with the quantum critical supermembrane and its quantization, which is described by a renormalizable three-dimensional sigma model at a $z=2$ Lifshitz point. This model provides a natural candidate high-energy completion of the supermembrane in M-theory, where the latter is described by a nonrenormalizable sigma model that is relativistic. A more standard approach to the quantization of supermembranes is via matrix theory. I will show that the fundamental string associated with matrix theory is described by a two-dimensional Carrollian sigma model. I will illustrate how these two approaches to M-theory are related to each other.

Author: Dr YAN, Ziqi (Nordita)

Presenter: Dr YAN, Ziqi (Nordita)

Session Classification: Non-relativistic: Contributed Talk (Chair: ...)

Contribution ID: 18

Type: **Theme 3: mathematics of NL geometries**

Semi-infinite cohomology of the BMS algebra and carrollian strings

I will report on work in progress (which ought to be finished by the time of the workshop) using conformal field theoretical techniques to calculate the semi-infinite cohomology of the BMS algebra with values in some representations coming from the quantisation of carrollian strings. This will be based on papers with Girish Vishwa and, separately, Emil Have and Niels Obers.

Author: Prof. FIGUEROA-O'FARRILL, José (The University of Edinburgh)

Presenter: Prof. FIGUEROA-O'FARRILL, José (The University of Edinburgh)

Session Classification: Mathematics of NL geometries: Plenary Talk (Chair: ...)

Contribution ID: 19

Type: **Theme 2: Carroll session**

A Conformal Approach to Carroll Gravity

Wednesday 30 April 2025 15:30 (30 minutes)

In this talk, I will outline how to take the first step in the conformal program for constructing general matter couplings to Carroll gravity. In particular, I will show how a (non-conformal version of) electric/magnetic Carroll gravity arises from gauge-fixing a theory of a single massless electric/magnetic scalar coupled to conformal Carroll gravity with isotropic dilatations. Special attention will be paid to the way intrinsic torsion tensors occur in the full Carroll transformation rules. These results form a convenient starting point for constructing general matter couplings to Carroll gravity. Towards the end of the talk, I will argue that, surprisingly, the relation between dynamical matter and gravity, that forms the basis of the conformal program, does not work in the usual fashion in the Galilei case.

Authors: BERGSHOEFF, Eric; RODRIGUEZ, Evelyn; ROSSEEL, Jan (Ruder Boskovic Institute); FIERRO, Octavio; CONCHA, Patrick

Presenter: ROSSEEL, Jan (Ruder Boskovic Institute)

Session Classification: Carroll: Contributed Talk (Chair: ...)

Contribution ID: 21

Type: **Theme 2: Carroll session**

Flat Space Holography from the Flat/Carrollian Limit of AdS/CFT

Wednesday 30 April 2025 14:00 (30 minutes)

Carrollian holography proposes that gravity in four-dimensional (4d) asymptotically flat spacetime is dual to a 3d Carrollian CFT living at null infinity. In this talk, I will review this framework and explain how massless amplitudes in flat space can be re-expressed as Carrollian CFT correlators at the boundary, referred to as Carrollian amplitudes. I will show that these correlators naturally emerge from the Carrollian limit of holographic CFT correlators computed via AdS Witten diagrams, establishing a correspondence between the flat limit in the bulk and the Carrollian limit at the boundary. As a concrete application, I will implement the flat/Carrollian limit of the duality between 11d supergravity on $AdS_4 \times S_7$ and 3d $\mathcal{N} = 8$ ABJM theory, extracting supergravity amplitudes in flat space.

Based on arXiv:2406.19343 and work in preparation with A. Y. Srikant and A. Lipstein.

Author: RUZZICONI, Romain (University of Oxford)

Presenter: RUZZICONI, Romain (University of Oxford)

Session Classification: Carroll: Contributed Talk (Chair: ...)

Contribution ID: 25

Type: **Theme 2: Carroll session**

From a covariant Maxwell-like theory to fractons: a new approach

Wednesday 30 April 2025 16:00 (30 minutes)

The concept of fracton quasiparticle has recently emerged in many areas of physics, from mathematical physics to condensed matter and quantum information, unified by the general feature of restricted mobility.

In this talk I will show that the fracton phenomenology of Pretko's original papers [1604.05329,1606.08857] can be reproduced from first principles of QFT through a symmetry-based approach. A strong relation with Linearized Gravity naturally emerges, interesting boundary effects can be observed, and a generalized "self-duality" can be implemented. These results open the doors to the study of a new class of covariant gauge field theories.

Author: Dr BERTOLINI, Erica (Dublin Institute for Advanced Studies)

Presenter: Dr BERTOLINI, Erica (Dublin Institute for Advanced Studies)

Session Classification: Carroll: Contributed Talk (Chair: ...)

Contribution ID: 26

Type: **Theme 1: Non-relativistic session**

Symmetries, holography and integrability in NR string theory in SNC $\text{AdS}_5 \times S^5$

Tuesday 29 April 2025 14:00 (30 minutes)

Integrability and holography have played a huge role in understanding string theory in $\text{AdS}_5 \times S^5$, so it is worth studying if they survive in the non-relativistic string theory. In this talk, I will show that the Maldacena's construction of the $\text{AdS}_5/\text{CFT}_4$ correspondence survives the limit process, giving us a duality between NR string theory in SNC $\text{AdS}_5 \times S^5$ and Galilean Electrodynamics with additional scalar fields. I will also discuss the symmetries of both theories and the non-diagonalisable integrability of the string theory.

Author: NIETO GARCÍA, Juan Miguel (Universität Hamburg)

Presenter: NIETO GARCÍA, Juan Miguel (Universität Hamburg)

Session Classification: Non-relativistic: Contributed Talk (Chair: ...)

Contribution ID: 27

Type: **Theme 1: Non-relativistic session**

The Surprising Structure of Non-Relativistic 11-dimensional Supergravity OR TTbar deformations as non-Lorentzian limits in reverse

Tuesday 29 April 2025 15:30 (30 minutes)

I can give one of two talks.

In one, I can discuss the surprising structure of non-relativistic 11-dimensional supergravity, based on <https://arxiv.org/abs/2407.21648>

In the other, I can explain a surprising link between decoupling limits leading to non-Lorentzian corners of string theory and the TTbar deformation. The latter in its original incarnation is a deformation of 2d field theories with many remarkable properties. It turns out that the non-relativistic string limit can be viewed in reverse as a TTbar deformation, which takes a theory of free bosons to the Nambu-Goto action. This observation can be exploited to derive new field theory deformations - in higher dimensions - using other non-Lorentzian limits. For instance, these provide deformations which take Maxwell theory to the DBI action. This talk would be based on <https://arxiv.org/abs/2002.12413> and <https://arxiv.org/abs/2410.03591>

Author: BLAIR, Chris

Presenter: BLAIR, Chris

Session Classification: Non-relativistic: Contributed Talk (Chair: ...)

Contribution ID: 31

Type: **Theme 1: Non-relativistic session**

Towards a covariant approach to post-Newtonian gravity

Tuesday 29 April 2025 16:00 (30 minutes)

In this talk, I will show how we used the covariant $1/c$ -expansion to construct a framework for post-Newtonian gravity that is valid in any gauge with a Newtonian regime. This is not true for every gauge as Newtonian gravity itself is a gauge fixed version of Newton-Cartan gravity. Thus, we fix the leading order gauge choice but keep full gauge freedom at all subleading orders in this framework. Due to the limited region of validity of the PN expansion, we have to construct a similarly covariant (for all post-Newtonian gauges) framework for the multipolar post-Minkowskian expansion outside the compact matter source. This is then glued together with the PN expansion through matched asymptotic expansion methods. This framework stands in contrast to the standard Blanchet-Damour approach which relies entirely on the harmonic gauge. I will show how this new framework allows us to make general statements about the structure of the equations at any order and write down the full field equations to 2.5PN order, valid for any PN gauge. I will then go on to showcase the framework in what we refer to as transverse gauge and explain why this could be an interesting alternative to the standard harmonic gauge. Particularly, I will highlight how this gauge reduces the number of relativistic wave equations (exchanging them for the simpler Poisson equation) that one has to solve for in MPM expansion as well as significantly simplifying half-PN orders in the metric as compared to harmonic gauge.

Author: MUSAEUS, Jørgen Sandøe (University of Edinburgh)

Presenter: MUSAEUS, Jørgen Sandøe (University of Edinburgh)

Session Classification: Non-relativistic: Contributed Talk (Chair: ...)