Applied Newton-Cartan geometry workshop
Talk Schedule

Events for:
Monday, March 6th - Friday, March 10th

Monday, March 6th

9:30am **Coffee - SCGP Cafe**

10:30am **Peter Horvathy - SCGP 102**

Title: Unified Framework for Carroll and Galilei Symmetry

Abstract: Whereas the usual Wigner-Ino ?nu ? contraction c ? ? of the Poincar ?e group yields the Galilei group, another c ? 0 contraction yields the “Carroll group” of L ?evy-Leblond. Both boost-invariant theories are conveniently unified within the “Eisenhart-Duval” framework. The Chaplygin gas carries both types of symmetries simultaneously, which extend into a full Poincar ?e symmetry in one higher dimension as found before by Bazeia, Jackiw et al. Plane gravitational waves have a Carroll symmetry with broken rotations. The BMS group is the conformal extension the conformal Carroll group. Based on: • C. Duval, G. W. Gibbons, P. A. Horvathy and P. M. Zhang: “Carroll versus Newton and Galilei: two dual non-Einsteinian concepts of time,” Class. Quant. Grav. 31 (2014) 085016 [arXiv:1402.0657 [gr-qc]] • C. Duval, G. W. Gibbons, P. A. Horvathy, “Conformal Carroll groups and BMS symmetry,” Class. Quant. Grav. 31 (2014) 092001 [arXiv:1402.5894 [gr-qc]] • C. Duval, G. W. Gibbons and P. A. Horvathy, “Conformal Carroll groups,” J. Phys. A 47 (2014) 335204 [arXiv:1403.4213 [hep-th]]

12:00pm **Lunch - SCGP Cafe**

2:00pm **Andrey Gromov - SCGP 102**

Title: Geometry of Anisotropic Quantum Hall states

3:00pm **Tea - SCGP Cafe**

3:30pm **Jan Rosseel - SCGP 102**

Title: Non-Relativistic Supergravity

Tuesday, March 7th

9:30am **Niels Obers - SCGP 102**

Title: Non-Lorentzian geometry in gravity and string theory

10:30am **Coffee - SCGP Cafe**

11:00am **Kristan Jensen - SCGP 102**

Title: Schwinger-Keldysh effective field theory

Abstract: The subject of quantum field theory in mixed states of quantum matter is an old and rich one. The natural setting to discuss field theory in a mixed state is the Schwinger-Keldysh formalism. The subject of this talk is the set of peculiar symmetries that arise in Schwinger-Keldysh theories, and how they may be accounted for in effective field theory. In particular, when the mixed state is thermal, the effective description is constrained by two BRST-like supercharges which, at low energies, generate an algebra akin to minimal supersymmetric quantum mechanics. If time allows, I will also discuss a sort of Schwinger-Keldysh bootstrap for effective actions on more complicated closed-time-contours, which describe the out-of-time-ordered correlation functions that diagnose early-time chaotic growth in quantum systems.

12:00pm **Lunch - SCGP Cafe**

1:00pm **SCGP Weekly Talk: Eric Bergshoeff - SCGP 102**

Speaker: Eric Bergshoeff

Title: Applied Newton-Cartan Geometry

Abstract: I will give a non-specialist introduction into the non-relativistic version of Riemannian geometry, which is called Newton-Cartan geometry. The corresponding non-relativistic gravity theory, called Newton-Cartan gravity, has received a renewed attention due to unexpected applications as a new tool to examine the (non-perturbative) properties of non-relativistic quantum field theories. I will explain the basic construction of Newton-Cartan gravity plus some of its generalizations thereby putting an emphasis on how these different theories can be obtained by taking limits or reductions of General Relativity.

3:00pm **Tea - SCGP Cafe**

3:30pm **Daniel Grumiller - SCGP 102**

Title: Lifshitz Anisotropy from Boundary Conditions

Abstract: Gravitational theories with Lifshitz-type of scaling usually require some exotic aspect in the bulk: either a non-relativistic theory, a higher derivative theory, or some exotic matter content. In my talk I review the alternative possibility of inducing Lifshitz-scaling through boundary conditions and give several examples: higher spin theories, lower spin theories and pure Einstein gravity in three dimensions. For the last option I will then argue that the singular limit of Lifshitz exponent z=0 is relevant for near horizon physics and soft Heisenberg hair.

Wednesday, March 8th

9:30am **James Liu - SCGP 102**

Title: Rigid supersymmetric backgrounds of Newton-Cartan supergravity

Abstract: "Newton-Cartan geometry provides a useful framework for coupling non-relativistic field theories to curved backgrounds, and arises naturally in non-relativistic holography. In the relativistic case, the combination of rigid supersymmetry and localization has led to many successful tests of precision holography. This naturally leads to the question of whether similar results can be attained in the non-relativistic case. As a first step in this direction, I will present a study of rigid supersymmetric backgrounds of three-dimensional ""new minimal"" Newton-Cartan supergravity with and without torsion. Such backgrounds are either maximally supersymmetric or 1/2-BPS, and I will give examples of both types of background"

10:30am **Coffee - SCGP Cafe**

11:00am **Christian Duval - SCGP 102**

Title: On the Schrödinger-Newton equation and its conformal-Bargmann symmetries

Abstract: The Schrödinger-Newton (SN) equation [Diosi, Penrose] is recast geometrically in terms of Bargmann structures over (n+1)-dimensional Newton-Cartan (NC) spacetimes. Its maximal group of invariance, the SN group, is determined as the group of conformal Bargmann automorphisms preserving the coupled Schrödinger and NC gravitational field equations. The canonical unitary representations of the SN group are worked out, unveiling the dynamical exponent z=(n+2)/3.

12:00pm **Lunch - SCGP Cafe**

2:00pm **Cindy Keeler - SCGP 102**

Title: Spacetime Reconstruction in Non-Relativistic Holography

3:00pm **Tea - SCGP Cafe**

3:30pm **Matt Roberts - SCGP 102**

Title: Physical stress, mass and energy for non-relativistic matter

Thursday, March 9th

9:30am **Jelle Hartong - SCGP 102**

Title: A general theory of fluid dynamics with and without boost symmetries

Abstract: System that are characterized by a dynamical scaling exponent z>1 can have Galilean (non-relativistic) or Carrollian (ultra-relativistic) boost invariance, but generically have no boost symmetries at all. In this talk I will discuss how to describe such theories in the hydrodynamic limit. More explicitly, I will first discuss an ideal gas of particles with dispersion relation w ~ k^z for any z. I will then describe the general thermodynamic properties of systems with no boost symmetries by introducing velocity as a chemical potential whose conjugate variable is momentum. This can be used to give a description of perfect fluids with no presupposed knowledge of its boost symmetries if any. Finally, I will discuss first order corrections for Galilean and Carrollian invariant fluids and show that generic uncharged Lifshitz hydrodynamics is described by 11 transport coefficients at first order.

10:30am **Coffee - SCGP Cafe**

11:00am **Xavier Bekaert - SCGP 102**

Title: Connections in Newton-Cartan Geometry: Intrinsic and Ambient Approaches

12:00pm **Lunch - SCGP Cafe**

3:30pm **Tea - math Common room**

Friday, March 10th

9:30am **Dieter Van den Bleeken - SCGP 102**

Title: Torsional Newton-Cartan gravity from a 'pre-Newtonian' expansion of GR

Abstract: The post-Newtonian expansion provides a framework that perturbatively describes General Relativity through deviations from Newtonian gravity. This method can be made manifestly covariant and in that form the leading order is Newton-Cartan gravity, the covariant formulation of Newtonian gravity. In this talk I point out how the regime of general relativity well-approximated by this expansion can be extended by relaxing a certain simplifying assumption. This leads to an expansion that at the leading order is torsional Newton-Cartan gravity, and since the order at which the torsion appears is one higher than that of the standard Newtonian fields in a sense it provides a 'pre-Newtonian' expansion. We argue that this expansion captures certain strong gravity effects that are absent in the Newtonian regime.

10:30am **Coffee - SCGP Cafe**

11:00am **Arjun Bagchi - SCGP 102**

Title: The BMS Bootstrap

Abstract: I will speak about our recent efforts at the initiation a study of the bootstrap programme for field theories with BMS symmetry. Specifically, we look at two-dimensional field theories with BMS3 symmetry and, using highest weight representations, we construct the BMS bootstrap equation by formulating the notion of crossing symmetry in the four-point functions of these field theories. In the limit of large central charges, we find analytic expressions for the BMS blocks that are the basic ingredients for the solution of the bootstrap equation. This constitutes, to the best of our knowledge, the first example of the formulation and significant steps towards the solution of a bootstrap equation in a theory which is not a relativistic conformal field theory.

12:00pm **Lunch - SCGP Cafe**

3:00pm **Tea - SCGP Cafe**