Supergravity, Generalized Geometry and Ricci Flow

Events for:
Monday, April 17th - Friday, April 21st

Monday, April 17th

9:00am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: Magdalena Larfors - SCGP 102**

Speaker: Magdalena Larfors

Title: Stringy perspectives on manifolds with G2 structure

Abstract: Seven-dimensional, real, Riemannian manifolds with G2 structure have interesting geometric properties. In this talk, I will discuss some of these aspects, and how they relate to supersymmetric solutions of string and M theory.

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

Title: Coffee Break

11:00am **Workshop: Lorenzo Foscolo - SCGP 102**

Speaker: Lorenzo Foscolo

Title: Complete non-compact G2 manifolds

Abstract: In collaboration with Haskins and Nordström, I have recently given new constructions of infinitely many complete non-compact manifolds with G2 holonomy and AC (asymptotically conical) or ALC (asymptotically locally conical) asymptotic geometry. These constructions were partially motivated by the physical duality between M Theory and Type IIA String Theory and geometric transitions such as the M Theory flop. In this talk I will recall these constructions and discuss the properties of known examples that I understand to be most relevant to physical applications. These include the topology of the manifolds and their ends, the description of their L2 integrable harmonic forms, the existence of different AC G2-manifolds asymptotic to the same G2 cone, and similarities/differences between ALC and AC asymptotics. The examples I will discuss have been obtained in collaboration with Haskins and Nordström and with Acharya-Najjar-Svanes.

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

Title: Lunch

2:30pm **Workshop: Fridrich Valach - SCGP 102**

Speaker: Fridrich Valach

Title: On exceptional algebroids (of all ranks)

Abstract: I will discuss the recent progress in the search for a class of algebroids that describes generalised and exceptional geometry for exceptional groups of all ranks. I will explain why this is important and how it relates to the study of dualities and consistent truncations.

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

Tuesday, April 18th

9:00am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: David Tennyson - SCGP 102**

Speaker: David Tennyson

Title: Supersymmetric flux backgrounds and generalised K-stability

Abstract: I will introduce a new geometric object called the Exceptional Complex Structure (ECS). This is an extension of the notion of complex structure to include all of the degrees of freedom of string backgrounds, much like the Generalised Complex Structure of Hitchin and Gualtieri was an extension that naturally included the B-field. In the first half of the talk I will define the ECS and provide some classification results, showing that they provide a unified framework to describe many supersymmetric geometries in various dimensions including complex structures, G_2, and their flux deformed counterparts. In the second half of my talk, I will discuss an intriguing observation that one may be able to use the ECS to extend the notions of K-stability to any supersymmetric background, possibly providing new tools to define and study G2 stability.

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

Title: Coffee Break

11:00am **Workshop: Raul Gonzalez-Molina - SCGP 102**

Speaker: Raul Gonzalez-Molina

Title: Futaki invariants and harmonic metrics for the Hull-Strominger system

Abstract: The Hull-Strominger system has been proposed by Yau as a tool for the geometrization of conifold transitions to address Reid's fantasy on the moduli of Calabi-Yau threefolds. Accordingly, a conjecture for the existence of solutions was put forward. In this talk, we will recast the system in generalized-geometric terms and explain its relation with a Hermite-Einstein type condition for Courant algebroids, and we produce a new family of holomorphic invariants which obstruct the system beyond the existence of balanced metrics and stabilility of the bundles as a consequence. Interestingly, the conditions under which this holds tie in with natural equations in supergravity and generalized geometry. We then move on to explore a conjectural picture of stability conditions for Courant algebroids and a notion of harmonic metrics in relation to the Hull-Strominger system with the aim of producing obstructions reminiscent of GIT.

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

Title: Lunch

1:15pm **SCGP Weekly Talk & Workshop Speaker: Jeffrey D. Streets - SCGP 102**

Speaker: Jeffrey D. Streets

Title: All roads lead to generalized geometry

Abstract: I will discuss the historical emergence of the fundamental concepts of `generalized geometry,' with overlapping threads initiating from such diverse fields as dynamics, Poisson geometry, complex geometry, algebraic geometry, special holonomy, supersymmetry, mirror symmetry, and string theory. To finish I will discuss the potential role of generalized geometry in answering some classical questions in complex geometry.

2:30pm **Workshop: Sebastien Picard - SCGP 102**

Speaker: Sebastien Picard

Title: Non-Kahler heterotic geometry

Abstract: We will survey various constructions of non-Kahler solutions to the heterotic system. The system generalizes Calabi-Yau metrics to non-Kahler complex threefolds with trivial canonical bundle. Solutions broadly fall into three categories: Lie groups with symmetry, torus fibrations, and perturbations of Kahler solutions. We will also discuss connections to Yau's conjecture on non-Kahler conifold transitions.

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

Wednesday, April 19th

9:00am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: Ryushi Goto - SCGP 102**

Speaker: Ryushi Goto

Title: Generalized Kahler structures and generalized Sasakian structures

Abstract: I will discuss some topics on Generalized Kahler structures relating with the stability theorem of generalized Kahler structures and the moment map picture of the scalar curvature, including some applications. If time permits, I will discuss generalized contact structures and generalized Sasakian structures.

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

Title: Coffee Break

11:00am **Workshop: Yury Ustinovskiy - SCGP 102**

Speaker: Yury Ustinovskiy

Title: Generalized K\"ahler constant scalar curvature problem

Abstract: In this talk we consider the space of symplectic generalized K\"ahler (GK) structures on a given holomorphic Poisson manifold (M,J,π). Fixing the cohomology class of the underlying symplectic form $[F]$ we denote this space by $GK_{[F]}(M,J,\pi)$. Recently Goto and Boulanger arrived at the moment map framework for the action of the group of hamiltonian diffeomorphisms $Ham(F)$ on the space of generalized almost K\"ahler structures, and used it to define the notion of the GK scalar curvature. Following the classical K\"ahler setup, we formulate the (generalized K\"ahler) Calabi Problem of finding a constant GK scalar curvature (cscGK) in $GK_{[F]}(M,J,\pi)$. We use the GIT interpretation of the moment map to develop the GK analogues of the notions of extremal metrics, Futaki invariant, Mabuchi energy and Mabuchi metric familiar from the K\"ahler setting. This allows us to recast Calabi-Lichnerowicz-Matsushima obstruction for the cscGK metrics in terms of the automorphism group of (J,\pi) and prove conditional uniqueness of cscGK metrics in $GK_{[F]}(M,J,\pi)$. In the special case when (M,J,π) is a \emph{toric} Poisson manifold, we prove an existence result for the cscGK problem, constructing new examples of the cscGK metrics on P^2. (Based on a joint work with V.Apostolov and J.Streets)

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

Title: Lunch

2:30pm **Workshop: Kuan-Hui Lee - SCGP 102**

Speaker: Kuan-Hui Lee

Title: Linear stability and integrability of generalized Ricci solitons

Abstract: The generalized Ricci solitons are basic objects when we study the stationary points of the generalized Ricci flow. In this lecture, we would like to study the local behavior of the generalized Ricci solitons. First, we compute the second variation of the generalized Einstein-Hilbert functional and deduce that any Bismut flat, compact manifold is linearly stable. Secondly, we study the kernel of the second variation, in other words, they are called infinitesimal deformation. We show some properties of the infinitesimal deformation. In the last part, we focus on the 3-dimensional case and prove that not all infinitesimal deformations are integrable in a 3-dimensional case.

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

Thursday, April 20th

9:00am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: Vicente Cortes - SCGP 102**

Speaker: Vicente Cortes

Title: Generalized K\"ahler structures on odd exact Courant algebroids

Abstract: Odd exact Courant algebroids form the simplest class of transitive Courant algebroids beyond the class of twisted generalized tangent bundles. Although their rank as vector bundles is odd, the notion of a generalized complex structure has been extended to that setting. I will define generalized Hermitian and generalized K\"ahler structures on odd exact Courant algebroids (allowing, both, definite and indefinite generalized metrics). Then I will describe these structures in terms of classical tensor fields on the base of the Courant algebroid. This is reminiscent of the bi-Hermitian viewpoint on generalized K\"ahler structures on exact Courant algebroids. Finally, I will discuss some classification results for left-invariant generalized K\"ahler structures on odd exact Courant algebroids over Lie groups of low dimensions. This talk is based on joint work with Liana David, see arXiv:2206.10456.

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

Title: Coffee Break

11:00am **Workshop: Yucong Jiang - SCGP 102**

Speaker: Yucong Jiang

Title: Double structures in generalized Kähler geometry

Abstract: A generalized Kähler structure can be equivalently defined in terms of holomorphic Manin triples also known as Lie bialgebroids. From this point of view, we will explain why symplectic double groupoids are useful in the study of generalized Kähler geometry.

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

Title: Lunch

2:30pm **Workshop: Luis Alvarez-Consul - SCGP 102**

Speaker: Luis Alvarez-Consul

Title: Embedding superconformal vertex algebras from Killing spinors and (0,2) mirror symmetry

Abstract: I will construct embeddings of the N=2 superconformal vertex algebra under appropriate conditions inspired by the Killing spinor equations in supergravity. Firstly, when these equations are formulated on a quadratic Lie algebra, they become purely algebraic conditions that induce an embedding in the corresponding superaffine vertex algebra. Secondly, when they are formulated on a suitable class of Courant algebroids, they induce an embedding in the vertex algebra of global sections of the corresponding chiral de Rham complex. As an application, I will present an example of (0,2) mirror symmetry given by pairs of homogeneous Hopf surfaces equipped with a Bismut-flat pluriclosed metric. Joint work with Andoni De Arriba De La Hera and Mario Garcia-Fernandez (arxiv:2012.01851, to appear in IMRN, and further work in progress).

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

Friday, April 21st

9:00am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: Xin Fu - SCGP 102**

Speaker: Xin Fu

Title: Generalized Kahler Calabi-Yau problem

Abstract: We formulate an extension of the Calabi conjecture to the setting of generalized Kahler geometry. We will discuss a new transgression formula for the Bismut Ricci curvature in this setting and use that to show solutions of the generalized Calabi-Yau equation on compact manifolds are classically Kähler, Calabi-Yau, and furthermore unique in their generalized Kähler class. We will also discuss how the generalized Kähler-Ricci flow is naturally adapted to the existence of solutions to the generalized Calabi-Yau equation. In particular, we will show the global existence and convergence of GKRF assuming that there is a generalized Calabi-Yau structure. The talk is based on joint work with Vesti Apostolov, Jeffrey Streets and Yury Ustinovskiy.

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

Title: Coffee Break

11:00am **Workshop: Tristan Collins - SCGP 102**

Speaker: Tristan Collins

Title: Spinor flows with flux

Abstract: I will introduce a coupled system of nonlinear heat flows whose critical points are spinors which are parallel with respect to a certain connection with flux. These critical equations are motivated by the equations of motion in supergravity. I will describe the basic properties of these flows, including short time existence and smoothing estimates. This is joint work with D.H. Phong.

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

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3:30pm **Workshop: Tea Time - SCGP Cafe**

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