Australia-Brazil Conference on

String Geometries and Dualities

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Abstracts

Speaker: Marco Aldi

Title: Generalized CRF-structures and pure spinors

Abstract: Vaisman's theory of generalized CRF-structures, provides a useful extension of generalized complex structures in which non-trivial kernels are allowed. In this talk we emphasize a pure spinor approach (developed in collaboration with D. Grandini) to generalized CRF-structures. After presenting recent results on deformations and cohomology of generalized CRF-structures, we discuss some applications to quantum sigma-models.

Speaker: Tom Baird

Title: The moduli space of Higgs bundles over a real curve and the real Abel-Jacobi map

Abstract: The moduli space $\mathcal{M}_C$ of Higgs bundles over a complex curve X admits a hyperkähler metric: a Riemannian metric which is Kähler with respect to three different complex structures I, J, K, satisfying the quaternionic relations. If X admits an anti-holomorphic involution, then there is an induced involution on $\mathcal{M}_C$ which is anti-holomorphic with respect to I and J, and holomorphic with respect to K. The fixed point set of this involution, $\mathcal{M}_R$, is therefore a real Lagrangian submanifold with respect to I and J, and complex symplectic with respect to K, making it a so called (A, A, B)-brane. In this talk, I will explain how to compute the $\mathbb{Z}_2$ Betti numbers of $\mathcal{M}_R$ using Morse theory. A key role in this calculation is played by the Abel-Jacobi map from symmetric products of X to the Jacobian of X.

Speaker: Nathan Berkovitz

Title: Twistors and the superstring

Abstract: Although four-dimensional twistors have played an important role recently in understanding maximally supersymmetric four-dimensional Yang-Mills theory, the role of twistors in ten-dimensional superstring theory is just beginning to be explored. In higher dimensions, twistors are closely related to pure spinors, and the ten-dimensional version of pure spinors has been useful for covariant quantization of the superstring. The relations between twistors and pure spinors and superstring theory will be discussed in this talk.

Speaker: Alejandro Cabrera

Title: On the Mathai-Quillen formalism in topological field theories and the geometry of the target space

Abstract: In this talk, I will first review the Mathai-Quillen (MQ) formalism using a super-geometric set-up suitable for studying TFTs in the Batalin-Vilkovisky formalism. Then, I will elaborate on the following claim: TFTs built up (via so-called AKSZ construction) from a target space which is an 'odd tangent lift' of a symplectic supermanifold admit a MQ description. Finally, I will present a (surprisingly long and exhaustive) list of known examples and possible new ones. This is joint work with F. Bonechi.

Speaker: Gil Cavalcanti

Title: Stable generalized complex structures

Abstract: Stable generalized complex structures are a class of structures that are not too far from being symplectic and are characterised by displaying generic behaviour. Examples of manifolds possessing these structures abound, including several manifolds that do not have complex or symplectic structures. We will introduce the notion of complex divisor on a real manifold M and show it induces a corresponding Lie algebroid over M. Stable structures induce such a complex divisor on the underlying manifold and we will show that these structures are in fact equivalent to symplectic structures on the corresponding Lie algebroid. This allows us to use symplectic techniques to study stable structures. We prove, for example, that the deformation space is unobstructed, give a normal form for the structure in a neighbourhood of the singular locus and study the relationship between these structures and maps that are similar to Lefschetz fibrations. This is joint work with Marco Gualtieri and Ralph Klaasse.

Speaker: Andrew Clarke

Title: Instantons on the Bryant-Salamon Manifolds

Abstract: We give a construction of G_2 and $Spin(7)$ instantons on exceptional holonomy manifolds constructed by Bryant and Salamon, by using an ansatz of spherical symmetry coming from the manifolds being the total spaces of rank-4 vector bundles. In the G_2 case, we show that, in the asymptotically conical model, the connections are asymptotic to Hermitian Yang-Mills connections on the nearly Kähler $S^3 \times S^3$.

Speaker: Viviana del Barco

Title: T-duality on nilmanifolds

Abstract: We study T-duality in the family of nilmanifolds; these are compact manifolds carrying a natural torus bundle structure. Given a nilmanifold E with a left-invariant closed 3-form, we can explicitely construct a T-dual $E^\vee$ and the dual form, where $E^\vee$ is again a nilmanifold.

Invariant generalized complex structures on T-dual nilmanifolds are in one to one correspondece. We present clear examples of mirror symmetry in this context. We will discuss further applications. The topics treated here are part of an ongoing research, joint with Leonardo Soriani Alves and Lino Grama.

Speaker: Lázaro Rodríguez Díaz

Title: G_2 geometry and gauge theory over links of hypersurface singularities

Abstract: Links of hypersurface singularities have been studied for many years, they are ubiquitous and provide fertile ground for several exotic constructions ranging from geometry to topology. We show the links K of certain isolated hypersurface singularities in $\mathbb{C}^5$ carry a natural co-closed G_2-structure φ induced by the contact Calabi-Yau structure of K. We are able to distinguish these pairs (K, φ) by the $\mathbb{Z}_{48}$-valued ν invariant recently introduced by Crowley and Nordström. By the end we briefly sketch how these spaces are suitable to develop a natural Yang-Mills theory in which compatible G_2-instantons on holomorphic Sasakian bundles over K are exactly the transversely Hermitian Yang-Mills connections. Joint work with Calvo-Andrade and Sá-Earp.

Speaker: Jethro van Ekeren

Title: Construction and uniqueness of orbifolds

Abstract: An important class of CFTs is got at via the orbifold construction, wherein one seeks to produce a new consistent theory by piecing together $\mathfrak{g}$-equivariant sectors of some initial theory equipped with a finite order symmetry $\mathfrak{g}$. All known constructions of the remarkable moonshine module, for instance, go via the orbifold procedure.

In this talk I will discuss some recent advances in orbifold theory in the mathematical context of vertex algebras (joint work with S. Moeller and N. Scheithauer), including progress in Schelleken's program to classify holomorphic CFTs at central charge 24, as well as on Norton's generalised moonshine conjecture.

Speaker: Mario Garcia-Fernandez

Title: Ricci flow, Killing spinors, and T-duality in generalized geometry

Abstract: We introduce a notion of Ricci flow in generalized geometry, extending a previous definition by Gualtieri on exact Courant algebroids. Special stationary points of the flow are given by solutions to first-order differential equations, the Killing spinor equations, which encompass special holonomy metrics with solutions of the Strominger system. Our main result investigates a method to produce new solutions of the Ricci flow and the Killing spinor equations. For this, we consider T-duality between possibly topologically distinct torus bundles endowed with Courant structures, and demonstrate that solutions of the equations are exchanged under this symmetry. As applications, we give a mathematical explanation of the dilaton shift in string theory and prove that the Strominger system is preserved by heterotic T-duality, as defined by Baraglia and Hekmati.

Speaker: Pinhas Grossman

Title: Modular tensor categories and subfactors

Abstract: Modular tensor categories are algebraic structures which were first discovered in the context of conformal field theory. They play a central role in quantum topology and have been used to model quantum computation. A major source of examples of modular tensor categories is the representation theory of quantum groups. In recent years new examples of modular tensor categories have been discovered through the study of subfactors, which are inclusions of operator algebras.

In this talk we will explain what modular tensor categories are, where they come from, and describe some examples of modular tensor categories coming from subfactors. Finally we will list some conjectures and open questions.

Speaker: Ctirad Klimcik

Title: Poisson-Lie T-duality and integrable sigma-models

Abstract: Poisson-Lie T-duality relates sigma-models with target spaces symmetric with respect to mutually dual Poisson-Lie groups. In the special case if the Poisson-Lie symmetry reduces to the standard non-Abelian symmetry one of the corresponding mutually dual sigma-models is the standard principal chiral model which is known to enjoy the property of integrability. A natural question whether this non-Abelian integrability can be lifted to integrability of sigma model dualizable with respect to the general Poisson-Lie symmetry has been answered in the affirmative by myself in 2008.

The corresponding Poisson-Lie symmetric and integrable model is a one-parameter deformation of the principal chiral model and features a remarkable explicit appearance of the standard Yang-Baxter operator in the target space geometry. Several distinct integrable deformations of the Yang-Baxter sigma model have been then subsequently uncovered which turn out to be related by the Poisson-Lie T-duality to the so called lambda-deformed sigma models introduced independently by Sfetsos. My talk gives a review of these developments some of which found applications in string theory in the framework of the AdS/CFT correspondence.

Speaker: Marcos Jardim

Title: Branes on moduli spaces of sheaves

Abstract: Branes are special submanifolds of hyperkähler manifolds that play an important role in string theory, particularly in the Kapustin–Witten approach to the geometric Langlands program, but which also are of intrinsic geometric interest. More precisely, a brane is a submanifold of a hyperkähler manifold which is either complex of Lagrangian with respect to each of the three complex structures or Kähler forms composing the hyperkähler structure. Branes on moduli spaces of Higgs bundles have been largely studied by many authors; in this talk, I will summarize recent work done in collaboration with Franco and Marchesi and with Franco and Menet on the construction of branes on moduli spaces of framed sheaves on the projective plane, and on moduli spaces of sheaves on $K3$ and abelian surfaces.

Speaker: Alessia Mandini

Title: Hyperpolygons and parabolic Higgs bundles

Abstract: Hyperpolygons spaces are a family of (finite dimensional, non-compact) hyperkaehler spaces, that can be obtained from coadjoint orbits by hyperkähler reduction. Jointly with L. Godinho, we show that these space are diffeomorphic (in fact, symplectomorphic) to certain families of parabolic Higgs bundles. In this talk I will describe this relation and use it to analyse the fixed points locus of a natural involution on the moduli space of parabolic Higgs bundles. I will show that each connected components of the fixed point locus of this involution is identified with a moduli spaces of polygons in Minkowski 3-space.

This is based on joint works with Leonor Godinho and with Indranil Biswas, Carlos Florentino and Leonor Godinho.

Speaker: Eckhard Meinrenken

Title: On the quantization of Hamiltonian loop group spaces

Abstract: Let G be a compact Lie group, and N a Hamiltonian LG-space, with proper moment map. Associated to these data is a finite-dimensional quasi-hamiltonian G-space M with G-valued moment map. We will give a geometric construction of a canonical "twisted spin-c structure" on M. This is based on joint work with Yiannis Loizides and Yanli Song.

Speaker: Jouko Mickelsson

Title: Extensions of lattice groups, gerbes and chiral fermions on a torus

Abstract: The moduli space of $U(1)$-gauge connections over a torus with a fixed Chern class is again a torus up to homotopy. Gerbes over an n-torus can be realized in terms of extensions of the lattice group acting on a real vector space. The extension comes from the action of the lattice group (homomorphisms from the torus to $U(1)$, thought of as "large" gauge transformations) in the Fock space of chiral fermions. Interestingly, the K-theoretic classification of Dirac operators coupled to vector potentials in this setting of n dimensions can be related to families of Dirac operators on a circle with gauge group the n-torus. This should be of interest in applications to the K-theoretic classification of Hamiltonians in condensed matter physics.

Speaker: Gonçalo Oliveira

Title: Gerbes on G_2-manifolds

Abstract: On a projective complex manifold, the Abelian group of Divisors maps onto that of holomorphic line bundles (the Picard group). I shall explain a similar construction for G_2-manifolds. This uses coassociative submanifolds to define an analogue of Div, and a gauge theoretical equation for a connection on a gerbe to define an analogue of Pic.

Speaker: David Ridout

Title: Schur-Weyl duality for Heisenberg cosets

Abstract: The coset construction of Goddard, Kent and Olive is one of the most important ways of obtaining new vertex operator algebras from known ones. A natural question is whether the coset inherits a given property from its parent algebra. We study such questions for cosets that commute with a Heisenberg subalgebra, proving that in this case, the coset inherits the indecomposable structures of the parent's modules, thence that C_2-cofiniteness and rationality are also inherited. We shall discuss some applications of these results to physically important vertex operator algebras.

Joint work with T Creutzig, S Kanade and A Linshaw.

Speaker: Roberto Rubio

Title: The moduli space of generalized metrics on an exact Courant algebroid

Abstract: For an exact Courant algebroid E, generalized metrics are defined as maximally positive-definite subbundles. They correspond, by choosing an isotropic splitting of E, to a usual Riemannian metric together with a 2-form. The automorphisms of the Courant algebroid E, known as generalized diffeomorphisms and denoted by $GDiff$, act on the generalized metrics by inverse image. The orbit space is the moduli space of generalized metrics.

In order to study this space, we first endow the group of generalized diffeomorphisms with an infinite-dimensional Lie group structure, namely, we describe it as an inverse limit of Hilbert manifolds (ILH). We then prove a slice theorem for the action of $GDiff$ on generalized metrics, which allows us to show that the moduli space of generalized metrics is stratified by ILH manifolds, thus generalizing the works of Ebin and Bourguignon for usual metrics. Finally, we relate this stratification to the stratification for usual metrics. This is joint work with Carl Tipler.

Speaker: Matthew Szczesny

Title: Vertex algebras associated to toroidal algebras and factorization algebras

Abstract: I will review the approach to factorization algebras developed by Costello and Gwilliam. There is an equivalence, in complex dimension one, between holomorphic factorization algebras satisfying mild technical assumptions and vertex algebras. The factorization algebra approach lends itself to easy computations of factorization homology (aka. spaces of conformal blocks). I will illustrate this in the example of toroidal vertex algebras.
