Annual Discussion Meeting on Bundles

25 – 29 March, 2019

Schedule and Abstracts of Talks

School of Mathematics

Tata Institute of Fundamental Research

Title of Talks

Sorin Mihail Dumitrescu	*Holomorphic Geometric Structures on Fujiki class $\mathcal{C}$ manifolds*
Subhojoy Gupta	*Meromorphic projective structures and grafting*
Jacques Hurtubise	*Instantons on Taub-NUT manifolds, Nahm transforms and holomorphic data*
Michiaki Inaba	*Unfolding of the unramified irregular singular generalized isomonodromic deformation*
Ryoichi Kobayashi	*Toward quantization of Osserman's theory of complete minimal surfaces with finite total curvature*
Xavier Machu	*Parabolic bundle, parabolic connection, ramified torus bundle, parabolic direct image*
André Oliveria	*Torsion line bundles and branes on the Hitchin system*
Pranav Pandit	*Gradient flows, iterated logarithms, and semistability*
Vamsi Pingali	*Coupled Kahler-Einstein metrics*
Georg Schumacher	*Variation of Energy Functionals for Families of Khler Manifolds*
Ken-Ichi Yosikawa	*Enriques 2n-folds and analytic torsion*

Abstracts

Monday, 25 March 2018 (11:30-12:30)
Speaker   :   Jacques Hurtubise
Title   :   Instantons on Taub-NUT manifolds, Nahm transforms and holomorphic data

Following on recent work explaining the case of SU(2) instantons on the first Taub-NUT manifold, it has now become clear what the situation is for the case of more general groups over the general ALF Taub-NUT manifold. One can relate: 1) Instantons on the Taub-NUT for the classical groups; 2) Holomorphic bundles on a suitable rational surface; 3) Nahm data for solutions to Nahms equations on the circle. This is a joint work with Sergey Cherkis.

Monday, 25 March 2018 (14:30-15:30)
Speaker   :   Vamsi Pingali
Title   :   Coupled Kahler-Einstein metrics

Kahler-Einstein (KE) metrics are known to exist or not exist in several situations, and also have algebro-geometric relevance because they help with the construction of moduli spaces. In cases where KE metrics do not exist, one might wish to find appropriate substitutes. One such substitute is the notion of coupled KE metrics introduced by Hultgren-Nystrom. I shall introduce these metrics and describe the results known so far.

Tuesday, 26 March 2018 (11:30-12:30)

Speaker : Ryoichi Kobayashi

Title : Toward quantization of Osserman's theory of complete minimal surfaces with finite total curvature

The key quantity in Osserman's theory of complete minimal surfaces with finite totla curvature is the ratio of the sphrical area against the hyperbolic area of minimal surfaces. Here the spherical area is defined in terms of the Gauss map. In this lecture, I propose a partition function Z_h counting the number of paths in the fundamental group. Making $hto0$ first and summation second reproduces formally Osserman's ratio. Changing the order (Summation first and $hto0$ second), we encounter various interesting asymptotic problems. I will discuss how these problrms are related to Osserman's problem of finding the best possible estimate for the number of exceptional values of the Gauss map.

Tuesday, 26 March 2018 (14:30-15:30)

Speaker : André Oliveira

Title : Torsion line bundles and branes on the Hitchin system

We study the fixed point loci on the moduli space M of GL(n,C)-Higgs bundles (over a curve) for the action of tensorisation by a line bundle of order n.This is a hyperholomorphic loci which can be equipped with a hyperholomorphic sheaf, hence is constitutes a BBB-brane on M. Such a brane is expected to be dual, via mirror symmetry, to a BAA-brane on M, i.e. to a complex Lagrangian subvariety equipped with a flat bundle. We find this BAA-brane and show that it can described via certain Hecke modifications. Finally we prove the duality statement via explicit Fourier-Mukai transform. It is noteworthy that these branes lie over the singular locus of the Hitchin fibration. Joint work together with E. Franco, P. Gothen and A.Peon-Nieto.

Wednesday, 27 March 2018 (11:30-12:30)

Speaker **:** **Michiaki Inaba**
Title **:** **Unfolding of the unramified irregular singular generalized isomonodromic deformation**

The unramified irregular singular generalized isomonodromic deformation in the zero genus case is completely described in the theory by Jimbo, Miwa and Ueno. The unramified irregular singular generalized isomonodromic deformation in a higher genus case can be given in a moduli theoretic way, which is a subbundle of the tangent bundle of the moduli space of unramified irregular singular connections on smooth projective curves, satisfying the integrability condition. We will give a non-canonical local extension of this subbundle to a subbundle of the relative tangent bundle of an analytic open subset of the relative moduli space of connections whose generic fiber is the moduli space of regular singular connections and whose special fiber is the moduli space of unramified irregular singular connections. We call this extension an unfolding of the irregular singular generalized isomonodromic deformation and we will give an idea of its construction in this talk. Our unfolding of the unramified irregular singular generalized isomonodromic deformation has no straightforward compatibility with the asymptotic property given in the unfolding theory by Hurtubise, Lambert and Rousseau.

Wednesday, 27 March 2018 (14:30-15:30)

Speaker **:** **Ken-Ichi Yosikawa**
Title **:** **Enriques 2n-folds and analytic torsion**

In this talk, a compact connected Kahler manifold of even dimension is called simple Enriques if it is not simply connected and its universal covering is either Calabi-Yau or hyperkahler. These manifolds were introduced and studied independently by Boissi'ere-Nieper-Weisskirchen-Sarti and Oguiso-Schroer. We introduce a holomorphic torsion invariant of simple Enriques 2n-folds and study the function on the moduli space of simple Enriques 2n-folds obtained in this way. In the talk, we report its basic properties such as the plurisubharmonicity and the automorphy, as well as their applications. If time allows, we will also report an explicit formula for the invariant as an automorphic function on the moduli space in some cases.

Speaker : **Georg Schumacher**
Title : **Variation of Energy Functionals for Families of Khler Manifolds**

We compute the first and second variation for the geodesic length function and the energy along geodesics for Teichmueller families. The results are generalized to families of Kaehler-Einstein manifolds of negative curvature. Furthermore recent results of about the energy of families of harmonic maps into Teichmueller families will be discussed.

Thursday, 28 March 2018 (14:30-15:30)
Speaker : **Pranav Pandit**
Title : **Gradient flows, iterated logarithms, and semistability**

Ideas from string theory and homological mirror symmetry suggest the existence of an analogue of the Donaldson-Uhlenbeck-Yau correspondence in the setting of derived noncommutative geometry. After outlining a framework for studying this correspondence, I will explain how this leads to the study of certain dynamical systems whose asymptotic behaviour is controlled by iterated logarithms, and to the discovery of a canonical refinement of the Harder-Narasimhan filtration in a variety of contexts. This is a report on joint work with Fabian Haiden, Ludmil Katzarkov, and Maxim Kontsevich.

Tuesday, 28 March 2018 (16:00-17:00)
Speaker : **Xavier Machu**
Title : **Parabolic bundle, parabolic connection, ramified torus bundle, parabolic direct image**

Let $\varphi : Y \longrightarrow X$ be a finite surjective morphism between smooth complex projective curves, where X is irreducible but Y need not be. Let V_* be a parabolic vector bundle on Y. We construct a parabolic structure on $\varphi_* V$, where V is the vector bundle underlying V_*. The parabolic vector bundle $\varphi_* V_*$ on X obtained this way has a ramified torus subbundle; it is a torus bundle of $\mathrm{Ad}(\varphi_* V)$ outside the parabolic divisor that satisfies certain conditions at the parabolic points. Conversely, given a parabolic vector bundle E_* on X and a ramified torus subbundle $\mathcal{T}$ for it, we construct a ramified covering Z of X and a parabolic vector bundle W_* on Z, such that the parabolic bundle E_* is the direct image of W_*. A connection on V_* produces a connection on $\varphi_* V_*$. The ramified torus subbundle for $\varphi_* V_*$ is preserved by the logarithmic connection on $\mathrm{End}(\varphi_* V)$ induced by this connection on $\varphi_* V_*$. If the parabolic vector bundle E_* on X is equipped with a connection D such that the connection on the endomorphism bundle induced by it preserves the ramified torus subbundle $\mathcal{T}$, then we prove that the corresponding parabolic vector bundle W_* on Z has a connection that produces the connection D on the direct image E_*.

Friday, 29 March 2018 (11:30-12:30)
Speaker : Subhojoy Gupta
Title : Meromorphic projective structures and grafting

A projective structure on a Riemann surface is determined by a holomorphic quadratic differential via the Schwarzian differential equation. Thurston showed that on a closed surface, any such structure is obtained by the geometric operation of grafting a hyperbolic surface along a measured geodesic lamination. I shall discuss the analogue of Thurstons theorem in the case of a punctured Riemann surface, when the quadratic differential has higher order poles at the punctures. This is joint work with Mahan Mj.

Friday, 29 March 2018 (14:30-15:30)
Speaker : Sorin Dumitrescu
Title : Holomorphic Geometric Structures on Fujiki class $\mathcal{C}$ manifolds

We present a Bochner type vanishing theorem for compact complex manifolds Y in Fujiki class $\mathcal{C}$, with vanishing first Chern class, that admit a cohomology class $[\alpha] \in H^{1,1}(Y, \mathbf{R})$ which is numerically effective (nef) and has positive self-intersection (meaning $\int_Y \alpha^n > 0$, where $n = \dim_{\mathbf{C}} Y$). Using it, we prove that all holomorphic geometric structures of affine type on such a manifold Y are locally homogeneous on a non-empty Zariski open subset. Consequently, if the geometric structure is rigid in the sense of Gromov, then the fundamental group of Y must be infinite. In the particular case where the geometric structure is a holomorphic Riemannian metric, we show that the manifold Y admits a finite unramified cover by a complex torus with the property that the pulled back holomorphic Riemannian metric on the torus is translation invariant. This is joint work with I. Biswas (TIFR, Mumbai) and H. Guenancia (IMT, Toulouse).