ICTS Meeting on
Complex Analytic Geometry

26–30 March, 2012

Schedule and Abstracts of Talks

Tata Institute of Fundamental Research
Homi Bhabha Road, Mumbai 400 005

DAY& DATE		11.30 a.m.-12.30 p.m.		2.30 p.m. –3.30 p.m.		4.00 p.m – 5.00 p.m
MONDAY MARCH 26	**T**	U.N. Bhosle$^{@@}$	**L**	C. Florentino$^{@@}$	**T**	C. Mourougane$^{@@}$
TUESDAY MARCH 27		U. Bruzzo$^{@}$	**U**	M. Logares^{++}		A. Hogadi^{++}
WEDNESDAY MARCH 28	**E**	G. Schumacher$^{@}$	**N**	J. Loftin^{++}	**E**	A. Dey^{++}
THURSDAY MARCH 29		J. Amoros$^{@}$	**C**	A. Szenes$^{@}$		M. Stemmler$^{@}$
FRIDAY MARCH 30	**A**	T. Gomez$^{@}$	**H**	J. Baptista^{++}	**A**	N. Hoffmann^{++}

$@@$ In the lecture theatre AG–66

$++$ In the lecture room AG–69

$@$ In the lecture room AG-80

Title of Talks

U.N. Bhosle   *Grassmannian framed bundles and Hitchin-Kobayashi correspondence.*

C. Florentino   *Geometric quantization of moduli spaces of bundles.*

C. Mourougane   *On Calabi families of hyperkhler manifolds.*

U. Bruzzo   *Noether-Lefschetz for hypersurfaces in toric 3-folds.*

M. Logares   *$Sp(6,R)$-Higgs bundles and conic bundles.*

A. Hogadi   *The Brauer group of the moduli space of vector bundles on a curve.*

G. Schumacher   *Moduli of Riemann Surfaces: A View from Kähler Geometry.*

J. Loftin   *Flat bundles over affine manifolds.*

A. Dey   *SYZ duality for parabolic Higgs moduli spaces.*

J. Amoros   *Projective manifolds with elliptic homotopy type.*

A. Szenes   *Cohomology of Higgs moduli.*

M. Stemmler   *Orthogonal and symplectic parabolic Higgs bundles.*

T. Gomez   *A GIT interpretation of the Harder-Narasimhan filtration.*

J. Baptista   *Vortex moduli spaces and their natural metrics.*

N. Hoffmann   *Constructing stable vector bundles on Calabi-Yau three-folds.*

Abstracts

Monday, 26 March 2012 (11:30-12:30)

Speaker   :   **U.B. Bhosle**
Title   :   **Grassmannian framed bundles and Hitchin-Kobayashi correspondence.**

We build compact moduli spaces of Grassmannian framed bundles over a Riemann surface, essentially replacing a group by its biinvariant compactification. We do this both in the algebraic and symplectic settings, and prove a Hitchin-Kobayashi correspondence between the two. The spaces are master spaces for parabolic bundles, and the reduction to parabolic bundles commutes with the correspondence. An analogous correspondence is proved for the generalized parabolic bundles of Bhosle, and the Hitchin Kobayashi correspondence is outlined.

Monday, 26 March 2012 (2:30–3:30)

Speaker   :   **C. Florentino**
Title   :   **Geometric quantization of moduli spaces of bundles**

We describe the general procedure of geometric quantization of a manifold that admits both Khler and real polarizations. In the cases of abelian varieties, and some moduli spaces of bundles over an elliptic curve and of parabolic bundles over P^1, we obtain a unified approach to quantization where real and Khler quantizations perfectly agree. Our method relies on a generalized Segal-Bargmann transform for Lie groups under which certain distributions naturally associated with Borh-Sommerfeld fibers appear as limits of abelian and non-abelian theta functions, reproducing the correct Hermitian structures on the quantization spaces.

Monday, 26 March 2012 (4:00–5:00)

Speaker   :   **C. Mourougane**
Title   :   **On Calabi families of hyperkhler manifolds.**

Let (M, g) be a Riemannian hyperkhler manifold and $T \to P^1$ a corresponding Calabi family parametrising deformations of holomorphic symplectic structures on the underlying manifold M. Like twistor spaces, the total space T comes equipped with a natural complex structure and a natural hermitian metric h, that is usually not kaehler. We compute the complex hessian of the natural metric form $Im(h)$.
It is conjectured that every holomorphic symplectic manifold contains an entire curve. Campana used deformations of twistor lines to produce entire curves in one member of every Calabi family. We derive from our computations a convexity property of the component of the cycle space that contains the twistor lines.
This is a joint work with Guillaume Deschamps and Nol Le Du.

Tuesday, 27 March 2012 (11:30–12:30)

Speaker : **U. Bruzzo**
Title : **Noether-Lefschetz for hypersurfaces in toric 3-folds**

I will characterize the loci in the moduli space of hypersurfaces in toric 3-folds where the Picard number of the hypersurface is minimal or has a larger value. This is joint work with Antonella Grassi.

Tuesday, 27 March 2012 (2:30–3:30)

Speaker : **M. Logares**
Title : $Sp(6, R)$**-Higgs bundles and conic bundles.**

We will give a different approach to the theory of conic bundles in relation with the study of the moduli space of Sp(6,R)-Higgs bundles. This is work in progress with I. Mundet i Riera.

Tuesday, 27 March 2012 (4:00–5:00)

Speaker : **A. Hogadi**
Title : **The Brauer group of the moduli space of vector bundles on a curve.**

Let X be a smooth projective curve of genus at least 2 over an algebraically closed field of characteristic zero. Let M denote the coarse moduli space of semistable vector bundles on X of fixed rank and determinant. It is not known in general whether M is a rational variety. If M is a rational variety, then the Brauer group of any smooth projective model of M should vanish. In this talk I will describe a recent joint work with Indranil Biswas and Yogish Holla, which confirms that this is indeed true.

Wednesday, 28 March 2012 (11:30–12:30)

Speaker : **G. Schumacher**
Title : **Moduli of Riemann Surfaces: A View from Kähler Geometry**

We apply methods of Kähler geometry to moduli spaces of Riemann surfaces. We use methods of the theory of Kähler-Einstein manifolds and study the first an second variation of the geodesic length function and twist parameters for families of compact Riemann surfaces. Applications concern plurisubharmonic exhaustion functions, the equivalence of the Fenchel-Nielsen symplectic and Weil-Petersson forms and positive line bundles on moduli spaces. Furthermore, we introduce a Weil-Petersson geometry on Hurwitz spaces.

Wednesday, 28 March 2012 (2:30–3:30)

Speaker : **J. Loftin**
Title : **Flat bundles over affine manifolds.**

Affine manifolds are real manifolds with coordinate charts in R^n and affine gluing maps. An affine manifold is called special if the linear part of the gluing maps is unimodular. The tangent bundle of an affine manifold naturally carries a complex structure, and thus affine manifolds can be considered as real slices of complex manifolds. We outline a dictionary of geometric objects on affine and complex manifolds. In particular, we discuss a Donaldson-Uhlenbeck-Yau theorem for flat vector bundles over closed special affine manifolds equipped with a Gauduchon metric. We also address recent work with Biswas on flat principal bundles over affine manifolds and with Biswas-Stemmler on Higgs bundles over affine manifolds.

Wednesday, 28 March 2012 (4:00–5:00)

Speaker : **A. Dey**
Title : **SYZ duality for parabolic Higgs moduli spaces.**

We prove the SYZ (Strominger-Yau-Zaslow) duality for the moduli space of full flag parabolic Higgs bundles over a compact Riemann surface. SYZ duality was proved for moduli spaces of Higgs vector bundles over a compact Riemann surface by Hausel-Thaddeus. This is a joint work with Indranil Biswas.

Thursday, 29 March 2012 (11:00–12:30)

Speaker : **J. Amoros**
Title : **Projective manifolds with elliptic homotopy type.**

A topological space has elliptic homotopy type if the sum of ranks of all its homotopy groups is finite. Homogeneous spaces have this property, which may be seen as a homotopical obstruction to homogeneity of the space.
In the case of compact Kaehler/complex projective manifolds, ellipticity of the homotopy type may be determined from an algebraic analysis of the singular cohomology ring of the manifold. In joint work with I. Biswas, we apply such analysis to manifolds up to complex dimension 4. We show that the ellipticity of the homotopy type is determined by the Hodge diamond of the manifold, and list all such diamonds.
The found examples include homogeneous and nonhomogeneous manifolds, but are all rationally connected. If this property were true for all complex projective manifolds with elliptic homotopy type, it would provide a negative answer to a question of Hirzebruch about the existence of simply connected 'fake quadrics'.

Thursday, 29 March 2012 (2:30–3:30)

Speaker : **A. Szenes**
Title : **Cohomology of Higgs moduli.**

The moduli spaces of Higgs bundles on Riemann surfaces are remarkable complex manifolds, which have recently become the focal points of several fields of Algebra and Geometry. In this talk, I will describe several conjectural descriptions of the cohomology of these spaces, and recent progress towards the proof of these conjectures.

Thursday, 29 March 2012 (4:00–5:00)

Speaker : **M. Stemmler**
Title : **Orthogonal and symplectic parabolic Higgs bundles.**

Let X be a smooth complex projective curve, and let S be a finite subset of X. We introduce Higgs fields on orthogonal and symplectic parabolic vector bundles over X with parabolic divisor S, and establish the following Hitchin-Kobayashi type correspondence: An orthogonal or symplectic parabolic Higgs bundle admits a Hermitian-Einstein connection if and only if it is polystable. (Joint work with Indranil Biswas).

Friday, 30 March 2012 (11:00–12:30)

Speaker : **T. Gomez**
Title : **A GIT interpretation of the Harder-Narasimhan filtration.**

An unstable torsion free sheaf on a smooth projective variety gives a GIT-unstable point in certain Quot scheme. To a GIT-unstable point, Kempf associates a "maximally destabilizing" 1-parameter subgroup, and this induces a filtration of the torsion free sheaf. We show that this coincides with the Harder-Narasimhan filtration (joint work with I. Sols and A. Zamora).

Friday, 30 March 2012 (2:30–3:30)

Speaker : **J. Baptista**
Title : **Vortex moduli spaces and their natural metrics.**

I will start by recalling the vortex equations and some of its simplest moduli space of solutions. Then I will describe the natural L^2-metrics on these moduli spaces and explain how, in certain cases, one can explicitly compute the Kahler class and total volume. As a by-product this leads to conjectural formulae for the volume of the space of holomorphic maps of fixed degree from a compact Riemann surface to projective space. Finally I will report on recent work with Indranil Biswas about vortices on parabolic line-bundles and singular surfaces.

Friday, 30 March 2012 (4:00–5:00)

Speaker : **N. Hoffmann**
Title : **Constructing stable vector bundles on Calabi-Yau threefolds.**

I'll describe a method to construct examples of stable vector bundles over Calabi-Yau threefolds with given Chern classes, motivated by string theory model building. This is joint work with Bjoern Andreas.