Schedule of Talks
Topology Discussion Meet, 2013

2nd May 2013 (Thursday).
Venue: Morning session–Alladi Ramakrishnan Hall (Fourth Floor, New Building).
Afternoon session– Chandrasekhar Hall, First Floor, Main building.

09:30–10:10. Rama Mishra, IISER-Pune, *On 3-superbridge knots.*

10:10–10:50. Ritwik Mukherjee, IMSc, *Counting curves via topology.*

10:50–11:10. **Coffee/tea**

11:10–11:50. T. Mubeena, IMSc, *Twisted conjugacy in certain linear groups*

12:00–13:00. Mahan Mj, RMKVU, Belur, *Homotopical height.*

13:00–14:15. **LUNCH**

14:15–14:55. V. Siwach, IIT-Ropar, *On unknotting operations for torus knots.*

14:55–15:30. **Coffee/tea**

15:30–16:10. Shilpa Gondhali, ISI-Kolkata, *Topology of m-projective Stiefel manifolds.*

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3rd May 2013 (Friday).
Venue: Chandrasekhar Hall, First Floor, Main building.

09:30–10:10. Micah Miller, IISc, *Hochschild chain complex as a twisted tensor product*

10:10–10:50. Dheeraj Kulkarni, IISc, *Relative symplectic caps, 4-genus and fibered knots.*

10:50–11:20. **Coffee/tea**

11:20–12:00. T V H Prathamesh, IISc, *Knots, braids, and first order logic.*

12:00–12:40. Sauvik Mukherjee ISI-Kolkata, *Submersion on open contact manifolds.*

12:45–14:15. **LUNCH**

14:15–14:55. D. Divakaran, IISc, *Distance measure spaces*

14:55–15:30. **Coffee/tea**

15:30–16:30. Goutam Mukherjee, ISI-Kolkata, *Equivariant cobordism.*
(Venue: Alladi Ramakrishan Hall.)

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4th May 2013 (Saturday).
Venue: Chandrasekhar Hall, First Floor, Main building.

09:30–10:10. Girja S. Tripathy, TIFR *Motivic homotopy theory*

10:10–10:50. David Farris, IISc, *Embedded compact homology of circle bundles.*

10:50–11:20. **Coffee/tea**

11:20–12:00. Abhijit Pal, CMI, *Convex cocompact subgroups of mapping class groups*

12:00–12:40. Prateep Chakraborty IMSc, *Formality of even dimensional CW complexes.*

12:45–14:15. **LUNCH**

14:15–14:55. H. K. Singh, Delhi Univ. *On orbit spaces of certain transformation groups.*

14:55–15:30. **Coffee/tea**

15:30–16:30. Siddhartha Gadgil, IISc, *Metric measure spaces and random matrices*
(Venue: Alladi Ramakrishnan Hall)
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Abstracts of Talks

On 3-superbridge knots

Rama Mishra (IISER Pune)

It is known that there are only finitely many knots with super bridge index 3. Jin and Jeon have provided a list of possible such candidates. However, they conjectured that the only knots with super bridge index 3 are trefoil and the figure eight knot. In this paper, we prove that the 5_2 knot and the 6_2 knot are also 3-super bridge knots by providing a polynomial representation of these knots in degree 6. This also answers a question asked by Durfee and O'Shea in their paper on polynomial knots: is there any 5-crossing knot in degree 6?

Counting curves via Topology

Ritwik Mukherjee (IMSc. Chennai)

The general goal of enumerative geometry is to count how many geometric objects are there that satisfy certain conditions. The simplest example is: "How many lines pass through two distinct points?" A more interesting example is: "How many lines are there in three dimensional space that intersect four generic lines?" In this talk we will describe a topological method to approach problems in enumerative geometry. We will use this approach to solve concrete questions in enumerative geometry. In particular we will try to count how many degree d curves are there in $\mathbb{CP}^2$ (the two dimensional complex projective space) that pass through certain number of points and have certain singularities.

Twisted conjugacy classes in certain linear groups

T. Mubeena (IMSc. Chennai)

Given a group automorphism $\phi : \Gamma \to \Gamma$, one has an action of Γ on itself given by $g.x := gx\phi(g^{-1})$. The orbits of this action are called ϕ-conjugacy classes. One says that Γ has the R_∞-property if there are infinitely many ϕ-conjugacy classes for every automorphism ϕ of Γ. We will show the R_∞-property for certain linear groups and their countable abelian extensions. If time permits, we will state a result about lattices in semisimple Lie groups.

Homotopical Height

Mahan Maharaj (RMKVU, Kolkata)

We introduce the notion of homotopical height $ht_{\mathcal{C}}(G)$ of a finitely presented group G within a class $\mathcal{C}$ of smooth manifolds with an extra structure (e.g. symplectic, contact, Kähler etc). Homotopical height provides an obstruction to finding a $K(G,1)$ space within the given class $\mathcal{C}$. This leads to a hierarchy of these classes in terms of "softness" or "hardness" a la Gromov. We show that the classes of closed contact, CR, and almost complex manifolds as well as the class of (open) Stein manifolds are soft.

The classes $\mathcal{SP}$ and $\mathcal{CA}$ of closed symplectic and complex manifolds exhibit intermediate "softness" in the sense that every finitely presented group G can be realized as the fundamental group of a manifold in $\mathcal{SP}$ and a manifold in $\mathcal{CA}$. For these classes, $ht_{\mathcal{C}}(G)$ provides a numerical invariant for finitely presented groups. We give explicit computations of these invariants for some standard finitely presented groups.

We use the notion of homotopical height within the "hard" category of Kähler groups to obtain partial answers to questions of Toledo regarding second cohomology and second group cohomology of Kähler groups. We also modify and generalize a construction due to Dimca, Papadima and Suciu to give a large class of projective groups (fundamental group of complex projective manifolds) violating property FP. These provide counterexamples to a question of Kollár.

This is joint work with Indranil Biswas, Dishant Pancholi.

On unknotting operations for torus knots

Vikash Siwach (IIT Ropar)

I would like to give a talk on a new method to find the positions of crossings for a given torus knot to transform it to trivial knot. Also, as an application of this method, a sharp upper bound for Region unknotting number for torus knots and links.

Topology of m-projective Stiefel manifold

Shilpa Gondhali (ISI Kolkata)

We will discuss some aspect of topology of m-projective Stiefel manifolds which would help us to have better understanding of the space.

Hochschild chain complex as a twisted tensor product

Micah Miller (IISc Bangalore)

Brown's theory of twisting cochains provides a a chain model description of the total space of a bundle in terms of the base and fiber. It can be used to describe the homology of the free loop space of a manifold. The Hochschild homology of the homology of a manifold also describes the homology of the free loop space. We show that the Hochschild chain complex is a special case of Brown's twisted tensor product and use this to describe various algebraic structures on these chain complexes.

Relative symplectic caps, 4-genus and fibered knots

Dheeraj Kulkarni (IISc. Bangalore)

The 4-genus of a knot is an important measure of complexity, related to the unknotting number. A fundamental result used to study the 4-genus and related invariants of homology classes is the *Thom conjecture*, proved by Kronheimer-Mrowka, and its symplectic extension due to Ozsvath-Szabo, which say that *closed* symplectic surfaces minimize genus.

Suppose (X, ω) is a symplectic 4-manifold with contact type boundary ∂X and Σ is a symplectic surface in X such that $\partial\Sigma$ is a transverse knot in ∂X. In this talk we show that there is a closed symplectic 4-manifold Y with a closed symplectic submanifold S such that the pair (X, Σ) embeds symplectically into (Y, S). This gives a proof of the relative version of Symplectic Thom Conjecture. We use this to study 4-genus of fibered knots in $\mathbb{S}^3$.

We also discuss the symplectic convexity of unit circle bundle in a Hermitian holomorphic line bundle over a Riemann surface.

This is joint work with Prof. Siddhartha Gadgil.

Knots, braids and first order logic

T.V.H. Prathamesh (IISc, Bangalore)

Determining when two knots are equivalent (more precisely isotopic) is a fundamental problem in topology. Here we formulate this problem in terms of logic, using the formulation of knots in terms of braids and some basic topological results. More concretely, we describe a finite set of axioms in first order logic, such that models of these axioms can be used to distinguish knots. We also intend to discuss further results obtained with regards to this formulation.

Submersions on open contact manifolds

Sauvik Mukherjee (ISI, Kolkata)

An existence result of submersions on open contact manifolds with contact level sets will be presented. As an application it will be proved that for the existence of a submersion on an open contact manifold to some euclidean space of dimension $2n$ it is enough to show the existence of a symplectic $2n$-frame on it.

Distance measure spaces

D. Divakaran (IISc., Bangalore)

Distance space is a generalisation of metric space where distance between two points can be infinity. Distance measure space is a distance space with a finite measure on it. In this talk I will prove generalisations of well known theorems about metric measure spaces to distance measure spaces. Also, generalise the Gromov-Hausdorff-Prokhorov distance to the space of distance measure spaces and prove theorems analogous to the well known theorems about the Gromov-Hausdorff-Prokhorov distance. Finally, as an application, give a natural statement of the Deligne Mumford compactification (of the space of Riemann surfaces), in the language of distance measure spaces.

Equivariant Cobordism

Goutam Mukherjee (ISI Kolkata)

The aim of the talk is to explain equivariant cobordism algebra $Z_*((\mathbb{Z}_2)^n)$ associated to smooth closed manifolds, equipped with an action of $(\mathbb{Z}_2)^n$ having finite number of stationary points. This cobordism algebra is known for $n \leq 2$, however, for $n > 2$, the structure of algebra is not known. We have the forgetful homormorphism $\epsilon_* : Z_*((\mathbb{Z}_2)^n) \to \aleph_*$. , whose image is known. So, to understand the structure of the algebra, it is necessary to have complete information about the indecomposable elements of $Ker\epsilon_*$. The associated tangential representations at the fixed points play an important role to this end and I will explain what are known about it so far.

Motivic homotopy theory

Girja S Tripathy (TIFR)

I will describe the foundations of motivic homotopy theory which is modelled on the ordinary homotopy theory. For real varieties I will describe the relation of these theories via realization functors giving us a direct relation between topological and algebraic K-theory.

Embedded contact homology of circle bundles

David Farris(IISc.)

Embedded contact homology is a topological invariant of three-manifolds defined by choosing a contact structure on the manifold and studying pseudoholomorphic curves in the four-dimensional symplectization. We compute this invariant for circle bundles over Riemann surfaces (prequantization spaces).

Convex cocompact subgroups of mapping class group

Abhijit Pal (CMI, Chennai)

For a hyperbolic surface S, the mapping class group MCG(S) of S is isotopy classes of automorphisms of S and the Teichmuller space Teich (S) is the space of all hyperbolic structures on S. A fintely generated, discrete subgroup of MCG(S) is said to be Convex cocompact if its orbit, under the action of MCG(S) on Teich(S), is a quasiconvex set in Teich(S). The aim of this talk is to give some examples of convex cocompact subgroups of MCG(S).

Formality of even dimensional CW complexes

Prateep Chakraborty (IMSc., Chennai)

Let (A, d) be a differential graded commutative k-algebra (d.g.c.a.), where k is a field of characteristic 0. Now, we say that (A, d) is formal if (A, d) is connected with its cohomology algebra by a chain of quasi-isomorphisms. For each space we have a d.g.c.a.,namely $A_{PL}(X)$. X is formal when $A_{PL}(X)$ is formal as a d.g.c.a. I shall prove that quasi-toric manifold and schubert varieties are formal spaces.

On orbit spaces of certain transformation groups

Hemant Kumar Singh, (Delhi Univ, Delhi)

Let X be a topological space and G be a topological group acting continuously on X. We determine the cohomology algebra of the orbit space X/G for projective spaces, lens spaces and spaces of type (a,b) and groups $G = Z_2, Z_p$ and S^1. Moreover, we obtain whether there exist an equivariant map $S^m \to X$ or not where X a projective space or a space of type (a, b) and S^m is equipped with standard $G = Z_2$ or S^1 actions.

We will also discuss some criteria for nonexistence of continuous free actions of $G = Z_2$ or S^1 on projective spaces or spaces of type (a, b).

Metric Measure spaces and Random matrices

Siddhartha Gadgil (IISc Bangalore)

The geometry of Metric spaces equipped with a probability measure is a very dynamic field. One motivation for the study of such spaces is that they are the natural limits of Riemannian manifolds in many contexts.

In this talk, I will introduce basic properties of metric measure spaces and the Gromov-Prohorov distance on them. I will also discuss joint work with Manjunath Krishnapur in which we show that independently sampling points according to the given measure gives an asymptotically bi-Lipschitz correspondence between Metric measure spaces and Random matrices. Finally, I will briefly discuss work with Divakaran in which we study the compactification of the Moduli space of Riemann surfaces in terms of metric measure spaces.