GSTGC 2014 Schedule & Abstracts

SATURDAY

Coffee & Registration
8:00-9:00am

Plenary Session #1
Saturday 9:00-10:00am

Morse 2-functions and trisections of 4-manifolds (Room 1.316)
Robion Kirby (University of California, Berkeley)
I'll talk about work with David Gay which extends the notion of a Morse function $f : M \to \mathbb{R}$ to a function from a 4-manifold X to a 2-dimensional surface. Just as the former gives an existence and uniqueness theorem for Heegaard splittings of a 3-manifold M, the latter gives existence and uniqueness of a trisection for X.

Break
10:00-10:30am

Graduate Session #1
Saturday 10:30-10:55am

Spectral cotangent space** (Room 2.256)**

Eric Peterson (University of California, Berkeley)

In the chromatic stratification of stable homotopy theory, there are a sequence of Picard groups parametrizing "twists" of the homotopy groups of a chromatic spectrum. These groups are computationally mysterious, but have appeared in certain places which suggest that they carry highly interesting data. We describe a method, inspired by basic algebraic geometry, for producing elements of these groups, and we name an application or two. All fancy terms to be explained.

Small Seifert Fibred Spaces obtained by Dehn surgery*(Room 2.304)

Fjodor Gainullin (Imperial College London)

Exceptional surgery is surgery on a hyperbolic knot which is not hyperbolic. Much work has been devoted to it, but there is still a lot we don't know. The least understood case is the case of Small Seifert Fibered spaces. I will give an overview of what we (well,I) know about this case.

On SFT invariants of complement of an ample normal crossing divisor in a projective variety** (Room 2.308)**

Khoa Nguyen (Stanford University)

Given a projective variety and consider an smooth ample divisor, in this talk, I will discuss how SFT invariants (such as symplectic cohomology, linearized contact homology) of the complement change when the divisor degenerates into a normal crossing divisor.

Strongly positive curvature* (Room 2.312)**

Renato Bettiol (University of Notre Dame)

Compact Riemannian manifolds with positive sectional curvature are very special objects that have been studied since the beginning of Riemannian geometry. Nevertheless, there are currently very few known examples and many conjectures regarding these objects remain elusive. A much stronger notion is that of manifolds with positive curvature operator, which have been completely classified through the use of Ricci flow. In this talk, I will describe an intermediate notion between the above two, that has not received much attention but essentially dates back to the work of Thorpe in the early 70's. The interest in this class arises from trying to understand the "gap" between the classes of manifolds with positive curvature operator and positive sectional curvature, with the hope to better understand the latter. This is joint work with R. Mendes (Notre Dame).

Short Break
10:55-11:10am

Graduate Session #2
Saturday 11:10-11:35am

Equivariant Chern Character on Loop Space* (Room 2.256)**
Thomas McCauley (Boston University)
The loop space of a manifold is the space of maps from the circle into the manifold. It has gathered some interest in the study of Dirac operators, because the index of the Dirac operator can be written as an integral over loop space. In the talk we will discuss the natural circle action on loop space and the resulting equivariant cohomology. The equivariant Chern character on loop space is an equivariant cohomology class constructed from a given vector bundle over the original manifold. Currently there are two proposals for the equivariant Chern character on loop space, and we will present some results comparing the two constructions.

Sutured Annular Khovanov Homology is not Mutation Invariant (Room 2.304)**
Diana Hubbard (Boston College)
Sutured Annular Khovanov Homology (SAKh) is an invariant of links embedded in a solid torus. A mutation is an operation on knots which may or may not change the knot. Knots that are related by mutation are often hard to distinguish from each other. In this talk I will define the necessary terms, prove that SAKh is not mutation invariant for knots or braids, and say a few words about future research directions suggested by this result.

New Exotic 4-Manifolds via Luttinger Surgery on Lefschetz Fibrations*(Room 2.308)**
Nur Saglam (University of Minnesota)
In this talk, I will present a new construction of symplectic 4-manifolds homeomorphic but not diffeomorphic to $(2n+2k-3)\mathbb{CP}^2\#(6n+2k-3)\overline{\mathbb{CP}}^2$ via Luttinger surgery for any $(n,k)\neq(1,1)$. First, I will introduce two symplectic building blocks for our construction: 1) the family of Lefschetz fibrations on $\Sigma_k\times\mathbb{S}^2\#4n\overline{\mathbb{CP}}^2$, constructed by M. Korkmaz and Y. Gurtas, and 2) 4- manifolds obtained from $\Sigma_g\times\mathbb{T}^2$ via Luttinger surgery. Next, I will show how to obtain the exotic copies of $(2n+2k-3)\mathbb{CP}^2\#(6n+2k-3)\overline{\mathbb{CP}}^2$ by gluing these building blocks. If time permit, I will also construct new symplectic 4-manifolds with the free group of finite rank and various other finitely generated groups as the fundamental group. This is a joint work with Anar Akhmedov.

Moving Frames and Geometric Invariants(Room 2.312)**
Benjamin McMillan (University of California, Berkeley)
For any kind of geometry on smooth manifolds (Riemannian, Complex, foliation, ...) it is of fundamental importance to be able to determine when two objects are isomorphic. The method of equivalence using G-structures is a systematic way to classify the local invariants of a particular geometry. For example, these ideas can be used to show that the only local invariants of a Riemannian manifold are the curvature form and its derivatives. In this talk I introduce G-structures and use them to develop a sketch of the classification of Riemannian invariants.

Short Break
11:35-11:50am

Graduate Session #3
Saturday 11:50-12:15pm

Representing Classes in SU-Cobordism*(Room 2.256)**

John Mosley (University of Kentucky)

A classical result of Milnor states that every class in the ring of complex cobordism contains a (not necessarily connected) non-singular algebraic variety. The work of Conner and Floyd shows the deep connections between complex cobordism and SU-cobordism. A reasonable question to ask then, is what classes, if any, in SU-cobordism contain a non-singular algebraic variety. In this talk we will discuss some answers to this question in small dimensions, and what we may need to find answers in higher dimensions.

Seiberg-Witten Theory as a Spectrum-Valued TQFT(Room 2.304)**

Henry Horton (Indiana University)

In this talk, we will give a basic description of Seiberg-Witten theory as a spectrum-valued topological quantum field theory. Our main focus will be Manolescu's construction of an equivariant spectrum from the Seiberg-Witten equations on a rational homology 3-sphere. We obtain four variants of Seiberg-Witten-Floer homology from this spectrum by applying singular homology, Borel homology, coBorel homology, and Tate homology functors. Some applications of this theory that are currently out of reach for the standard Kronheimer-Mrowka monopole Floer homology will be discussed. We will also indicate some directions for future research on this subject.

Pants decompositions and layered models*(Room 2.308)

Pengcheng Xu (Oklahoma State University)

A layered model of a 3-manifold is a way to decompose the manifold into simple pieces similar to a triangulation. The construction of these models was introduced by Minsky and is closely related to the construction of layered triangulations. In this talk, I will describe the construction of a layered model of a 3-manifold and present some background information that is necessary for the construction.

Parabolic equivariant geometry in representation theory**(Room 2.312)**

Mee Seong Im (University of Illinois at Urbana-Champaign)

Given a group action on a topological space, one studies and classifies the structure of orbits on the space. Using techniques in multilinear algebra, geometric invariant theory, algebraic geometry, homological algebra, and symplectic geometry, representations of quivers with the natural group action generalize classical results, such as Procesi and Donkin's study of Lie group actions on the Lie algebra and the Kronecker problem. A world of interesting problems arises, leading us to Nakajima's quiver varieties, Gan and Ginzburg's almost-commuting variety in representation theory, optimization and control in compactification of moduli of linear dynamical systems, etc. I will discuss the history of equivariant geometry, introduce the notion of filtered quiver varieties, and explain their relation to an important object called the Grothendieck-Springer resolution in geometric representation theory. New results will be mentioned and I will comment on some open problems.

Lunch Break
12:15-2:00pm

Young Faculty Session #1
Saturday 2:00-3:00pm

Floer homology and Dehn surgery (Room 2.246)
Josh Greene (Boston College)
I will survey some of the important results and open problems pertaining to Dehn surgery, with an emphasis on what Floer homology can and cannot say about them.

Lagrangian immersions and the Floer homotopy type (Room 1.316)
Mohammed Abouzaid (Columbia University)
A conjecture of Arnold would imply that every exact Lagrangian in a cotangent bundle is isotopic to the zero section through Lagrangian embeddings. We now know that every such Lagrangian is homotopy equivalent to the zero section. I will explain how, combining the h-principle with the spectrum-valued invariants introduced by T. Kragh, one can hope to show that such Lagrangians are in fact isotopic to the zero section through Lagrangian immersions. I will discuss partial results obtained with Kragh, constraining the Lagrangian isotopy class of Lagrangians embeddings.

Graduate Session #4
Saturday 3:10-3:35pm

Calculations using Chern Classes of equivariant bundles*(Room 2.256)

Jean Verrette (University of Hawaii at Manoa)

In this talk, I will consider some calculations using Chern classes of equivariant complex vector bundles. Fundamental statements such as the axiomatic definition and the polynomial ring structure of the cohomology of the classifying space will be stated for clarity.

Three-manifold mutations detected by Heegaard Floer homology*(Room 2.304)**

Corrin Clarkson (Columbia University)

Given a self-diffeomorphism h of a closed, orientable surface S and an embedding f of S into a three-manifold M, we construct a mutant manifold N by cutting M along $f(S)$ and regluing by h. We will consider whether there are any gluings such that for any embedding, the manifold and its mutant have isomorphic Heegaard Floer homology. In particular, we will demonstrate that if the gluing is not isotopic to the identity, then there exists an embedding of S into a three-manifold M such that the rank of the non-torsion summands of the Heegaard Floer homology of M differs from that of its mutant.

Elliptic Actions on Teichmuller Space(Room 2.308)**

Matthew Durham (University of Illinois at Chicago)

Kerckhoff's solution to the Nielsen realization problem showed that the action of any finite subgroup of the mapping class group on Teichmller space has a fixed point. The set of fixed points is a totally geodesic submanifold. We study the coarse geometry of the set of points which have bounded diameter orbits in the Teichmller metric. We show that each such almost-fixed point is within a uniformly bounded distance of the fixed point set, but that the set of almost-fixed points is not quasiconvex. In addition, the orbit of any point is shown to have a fixed barycenter. In this talk, I will discuss the machinery and ideas used in the proofs of these theorems.

Holomorphic branes correspond to perverse sheaves**(Room 2.312)**

Xin Jin (UC Berkeley)

Let X be a compact complex manifold, $D_c^b(X)$ be the bounded derived category of constructible sheaves on X, and $Fuk(T^*X)$ be the Fukaya category of T^*X. A Lagrangian brane in $Fuk(T^*X)$ is holomorphic if the underlying Lagrangian submanifold is complex analytic in $T^*X_{\mathbb{C}}$, the holomorphic cotangent bundle of X. We prove that under the quasi-equivalence between $D_c^b(X)$ and $DFuk(T^*X)$ established in [NaZa09] and [Nad09], holomorphic Lagrangian branes with appropriate grading correspond to perverse sheaves.

Tea Break
3:35-4:05pm

Graduate Session #5
Saturday 4:05-4:30pm

The Galois group of a stable homotopy theory**(Room 2.256)**

Akhil Mathew (Harvard University)

To a "stable homotopy theory" (a presentable, symmetric monoidal stable ∞-category), we naturally associate a category of finite etale algebra objects and, using Grothendieck's categorical machine, a profinite group that we call the Galois group. This construction builds on, and generalizes, ideas of many authors, and includes the etale fundamental group of algebraic geometry as a special case. We calculate the Galois groups in several examples, both in settings of rational and p-adic homotopy and in "chromatic" stable homotopy theories. For instance, we show that the Galois group of the periodic E∞-algebra of topological modular forms is trivial, and, extending work of Baker and Richter, that the Galois group of $K(n)$-local stable homotopy theory is an extended version of the Morava stabilizer group.

Stability of the Colored Jones Polynomial*(Room 2.304)

Christine Lee (Michigan State University)

The Colored Jones Polynomials is an invariant of links which assigns a sequence of Laurent polynomials to a link. Recently, it has been shown to carry interesting geometric and topological information about a knot. The talk will provide an elementary discussion of the recent advances in this area connecting the coefficients and the degree of the Colored Jones polynomial to the diagrammtic properties of the knot, including my recent work on the stability of the coefficients, joint with my advisor Efstratia Kalfagianni. Rather than a detailed proof, I will present an overview of the ideas in the subject.

Exact Lagrangian caps of Legendrian knots(Room 2.308)**

Francesco Lin (MIT)

We prove that any Legendrian knot in (S^3, ξ_{std}) bounds an exact Lagrangian surface in $\mathbb{R}^4 \setminus B^4$ after a sufficient number of stabilizations. In order to show this, we construct a family combinatorial moves on knot projections with some additional data that correspond to Lagrangian cobordisms between knots.

Length spectra and strata of flat metrics(Room 2.312)**

Ser-Wei Fu (University of Illinois at Urbana-Champaign)

When considering Euclidean cone metrics on a surface induced by quadratic differentials, there is a natural stratification by prescribing cone angles. I will describe a simple method to reconstruct the metric locally using the lengths of a finite set of closed curves. However, the main discussion will be on the surprising result that a finite set of simple closed curves cannot be length spectrally rigid when the stratum has enough complexity. This is extending a result of Duchin-Leininger-Rafi.

Break
4:30-4:55pm

Young Faculty Session #2
Saturday 4:55-5:55pm

Surgery on 4-manifolds and the importance of embedded surfaces(Room 2.246)
Nathan Sunukjian (Stony Brook University)
Four manifolds display a beguiling array of"exotic behaviors." Two principle examples are that 1) there exist infinite families of 4-manifolds that are homeomorphic but not diffeomorphic ("exotic smooth structure"), and 2) two smooth embeddings of a surface in a given 4-manifold can be topologically isotopic but not smoothly isotopic ("exotic embeddings"). This talk will explore the relationship between these two things. I will: 1) Explain why all smooth structures on a given 4-manifold can be constructed through surgery on embedded surfaces. 2) Explain the difficulties that arise when one tries to find appropriate surfaces to do surgery on. 3) Explain how surface concordance can be used to try to usefully classify surfaces in 4-manifolds for the purpose of surgery. Several open problems will be discussed.

ABCDuality (Room 1.316)
Vesna Stojanoska (Massachusetts Institute of Technology)
Anderson and Brown-Comenetz Duality are easy as ABC to define, but hide some deep mysteries about symmetries in homotopy theory and beyond. I will discuss self-duality of complex and real topological K-theory, and a few other examples of such duality, and I will muse on the relationships among them.

Dinner at Scholz Garden
Begins at 6:30pm

SUNDAY

Coffee
8:00-9:00am

Plenary Session #2
Sunday 9:00-10:00am

Tian-Todorov theorem for varieties with potentials (Room 1.316)
Tony Pantev (University of Pennsylvania)
I will report on a recent joint work with L. Katzarkov and M. Kontsevich on the deformation theory of varieties equipped with holomorphic functions. I will discuss various generalizations of the unobstructedness theorem for deformations of compact Calabi-Yau manifolds. In particular I will formulate a Tian-Todorov theorem for the deformations of Landau-Ginzburg models and will explain the new Hodge theoretic statements needed in the proof. I will also discuss the various definitions of Hodge numbers for non-commutative Hodge structures of Landau-Ginzburg type and the role they play in mirror symmetry.

Short Break
10:00-10:15am

Graduate Session #6
Sunday 10:15-10:40am

Geometric Transistions of the Cartan Subgroup in SL(n,R)(Room 2.256)**

Arielle Leitner (Univeristy of California, Santa Barbara)

A limit group is the limit under a sequence of conjugations of the Cartan subgroup in $SL(n, R)$. In $SL(3, R)$, there are 5 limit groups up to conjugacy. Each limit group is determined by a degenerate triangle. Using the hyperreal numbers, we will explore the limits of the Cartan subgroup in $SL(n, R)$ by associating them to infinitesimal (or degenerate) k-simplices.

Lescop's invariant and gauge theory*(Room 2.304)**

Prayat Poudel (University of Miami)

Taubes proved that the Casson invariant of an integral homology 3-sphere equals half the Euler characteristic of its instanton Floer homology. I wish to provide an extension of this result to all closed oriented 3-manifolds with positive first Betti number by establishing a similar relationship between the Lescop invariant of the manifold and its instanton Floer homology.

Two-component link maps in the 4-sphere*(Room 2.308)

Ash Lightfoot (Indiana University)

"Link maps" of two 2-spheres in the 4-sphere, with disjoint images but not necessarily embedded, have an interesting history which reflects the subtlety that is so common in 4-dimensional topology. It is natural to study such maps up to link homotopy (homotopy through link maps) and it remains an open question whether Kirk's link homotopy invariant σ completely characterizes whether or not a link map is link homotopically trivial. After giving the remarkably simple definition of σ, we discuss how the Schneiderman-Teichner invariant — which takes as input a map of a single 2-sphere in a 4-manifold — adapts to define a link homotopy invariant, and how this might be used to address the question.

The Concentration Principle*(Room 2.312)**

Manousos Maridakis (Michigan State University)

The symbol map of a Dirac Operator is carrying essential topological and geometrical information about the underline manifold. I will be studying Dirac type operators of the form $\mathcal{D} + s\mathcal{A} : \Gamma(E) \to \Gamma(F)$ over a Riemannian manifold (X, g) for special bundle maps $\mathcal{A} : E \to F$ and study their behavior as $s \to \infty$.

Graduate Session #7
Sunday 10:50-11:15am

Factorization homology and configuration spaces**(2.256)**

Ben Knudsen (Northwestern University)

Factorization homology is a natural analogue of ordinary homology that is well-suited to the study of manifolds. I will describe recent work, in which I use factorization homology to compute the rational homology of the unordered configuration spaces of an arbitrary manifold, possibly with boundary, generalizing theorems of Bodigheimer-Cohen-Taylor and Felix-Thomas. No familiarity with factorization homology will be assumed.

Hyperbolic pretzel knots with the same volume and systole length*(Room 2.304)**

Christian Millichap (Temple University)

The volume and systole length of a hyperbolic 3-manifold are two of the most commonly studied geometric invariants. It is natural to ask how often such manifolds can have the same volume, the same systole length, or perhaps even both. In this talk, we shall construct large families of hyperbolic pretzel knots whose complements have both the same volume and systole length. In particular, we shall show that the number of hyperbolic knot complements with the same volume and systole length grows at least factorially fast with the volume and the number of twist regions. This proof relies on Ruberman?s work on mutations along Conway spheres in least area form that preserve volume, and expanding this analysis to see when these Conway spheres could intersect short geodesics in a hyperbolic 3-manifold.

On Infection By A String Link(Room 2.308)**

Diego Vela (Rice University)

Knots and links play an important role in 3-manifolds and the equiva- lence relation of concordance of knots and links plays an important role in 4-manifolds. We will discuss our work that shows, loosely speaking, that we cannot hope to classify knot concordance without simultaneously classifying link concordance for links of an arbitrary number of components. Cochran- Friedl-Teichner considered generalized satellite operations $R : SL(m)AS$, called "infection by a string link", where SL(m) is the set of concordance classes of m-component links, AS is the set of concordance classes of algebraically slice knots, and the "pattern" knot R is some ribbon knot R. They proved that, for any such knot K there exists some R, m and L such that $R(L) = K$. We show that one cannot put an upper bound on m. Links arise from knots since the spine of a Seifert surface is essentially a link. Our obstructions are related to the Alexander polynomials of such links.

Fixed Points in Higgs Bundle Moduli Space(2.312)**

Brian Collier (University of Illinois (UIUC))

Higgs bundles are holomorphic vector bundles with an auxiliary field, called a Higgs field, over a Riemann surface. Through the nonabelian Hodge theorem the moduli space of polystable Higgs bundles is homeomorphic to the character variety of the surface. One direction of the homeomorphism is given by a Kobayashi-Hitchin correspondence relating polystable Higgs bundles to solutions of certain gauge theoretic equations which yield a special metric and a flat connection. In this talk we will review some Higgs bundle basics and examine when a holomorphic splitting is unitary with respect to the special metric.

Short Break
11:15-11:25am

Young Faculty Session #3
Sunday 11:25-12:25pm

The Fukaya category of a cubic surface (Room 2.246)
Nick Sheridan (Princeton University)
It's well-known that a cubic surface has 27 lines on it; that '27' is an example of a Gromov-Witten invariant. The Gromov-Witten invariants of a symplectic manifold M can be extracted from the Fukaya category of M, which is a category whose objects are the Lagrangian submanifolds of M. The Fukaya category contains a lot of interesting information about the symplectic topology of M. I will explain what the Fukaya category of the cubic surface looks like, where the Lagrangians are, how it relates to the 27 lines, and how it fits into the framework of Kontsevich's homological mirror symmetry conjecture.

Quasi-category theory you can use (Room 1.316)
Emily Riehl (Harvard University)
For many years, abstract statements about homotopy theory have been proven using Quillen's model categories. Recently there has been a proliferation of alternate models for homotopy theory, among them quasi-categories (aka oo-categories), which are just simplicial sets with a horn-filling property that has the interpretation that "all higher simplices can be composed." There has been spectacular progress in the development of the theory of quasi-categories, but unfortunately this can be rather hard to learn. This talk will describe a second-generation approach to quasi-category theory, with no prerequisites aside from affinity for some boilerplate abstract nonsense, that is equivalent to but independent of the standard accounts and provides new tools for proving theorems in this context.

Thanks for coming!