Workshop on Topology and Invariants of 4-Manifolds Talk Schedule

Events for:
Saturday, August 23rd - Wednesday, August 27th

Saturday, August 23rd

9:00am **Registration/breakfast - SCGP Lobby and Cafe**

10:00am **Mustafa Korkmaz - SCGP 102**

Title: Arbitrarily Long Factorizations in Mapping Class Groups

Abstract: On a compact oriented surface of genus g with one boundary component, the right Dehn twist about the boundary component can be written as a product of right Dehn twists about nonseperating simple closed curves. A question of D. Auroux motivated by Stein llings of contact three mani- folds asks whether the number of Dehn twists about nonseperating simple closed curves in the factorization can be taken arbitrarily large. As a re- lated problem, B. Ozbagci and A. Stipsicz conjectured that the set of Euler characteristics of Stein llings of tight contact three manifolds is bounded. Auroux's question was answered for g 8 by I. Baykur and J. Van Horn- Morris: The number of nonseperating Dehn twists in factorizations of Dehn twist about the boundary component can be arbitrarily large. We prove the same result for all g 3 using simpler ideas. We also prove some extensions of it and give some applications. This is a joint work with Elif Dalyan and Mehmetcik Pamuk. (1 hour long talk)

11:00am **Coffee Break - SCGP Cafe**

11:30am **Emmy Murphy - SCGP 102**

Title: Existence of overtwisted contact structures on high dimensional manifolds

Abstract: The Lutz-Martinet theorem states that any 2-plane field on a 3-manifold is homotopic to a contact structure. This construction lead to Eliashberg's definition of overtwisted contact manifolds, and in this context the existence theorem of Lutz-Martinet can be extended to a uniqueness result: any two overtwisted contact structures which are homotopic as plane fields are in fact isotopic. We discuss a recent extension of these results to contact manifolds of all dimensions. We will focus on showing that any almost contact structure is homotopic to a contact structure, and seeing how this leads to a new definition of overtwistedness in high dimensions. As time allows we will discuss a proof that a homotopy class of almost contact structures is realized by a unique isotopy class of overtwisted contact structure. This project is joint work with Borman and Eliashberg. (1 hour long talk)

12:30pm **Lunch - SCGP Cafe**

1:30pm **Francesco Lin - SCGP 102**

Title: A Morse-Bott approach to the Triangulation conjecture

Abstract: Manolescu has recently given a negative answer to the celebrated Triangulation conjecture. His disproof relies on the construction of a new invariant of rational homology three spheres equipped with a spin structure. This is obtained by studying the Seiberg-Witten equations from the point of view of Conley index theory. In the present talk we discuss how to construct the analogous invariants in the Morse-theoretic framework of Kronheimer and Mrowka's monopole Floer homology. This approach works on every three manifold and is functorial under cobordisms. (1 hour long talk)

2:30pm **Coffee Break - SCGP Cafe**

3:00pm **Laura Starkston - SCGP 102**

Title: Star surgery operations on symplectic 4-manifolds

Abstract: Star surgery operations cut out a neighborhood of a union of symplectic 2-spheres intersecting according to a negative definite star-shaped graph, and replace this neighborhood with an alternate symplectic filling of the induced contact boundary. As with rational blow-downs, these operations reduce Euler characteristic, and their effect on the Seiberg-Witten invariants is well understood. This talk will discuss how to look for useful examples of star surgeries through understanding parts of the classification of symplectic fillings of the corresponding boundary Seifert fibered spaces. Additionally, I will explain some applications to constructions of small exotic 4-manifolds (joint with Cagri Karakurt). (1 hour long talk)

4:00pm **Alyson Hildum - SCGP 102**

Title: The minimum b_2 problem for right-angled Artin groups

Abstract: This talk will focus on tools for constructing 4-manifolds which have fundamental group G isomorphic to a right-angled Artin group which are also minimal, in the sense that they minimize $b_2(M)$, the dimension of $H_2(M;Q)$. A right-angled Artin group has a presentation with a finite number of generators with relations consisting of commutators between generators. Right-angled Artin groups are also known as graph groups because their presentations can uniquely be represented by graphs, where each vertex represents a generator and each edge between vertices represents a commutator relation between those generators. For a finitely presented group G, define $h(G) = \min\{ b_2(M) \mid \pi_1(M)=G \}$. I will refer to the problem of calculating h for a particular group G as the minimal b_2 problem for G. (This is essentially equivalent to calculating the Hausmann-Weinberger invariant of G, the minimal Euler characteristic over all 4-manifolds with fundamental group G.) Calculations of h are known for free groups and free abelian groups, but little more. We investigate the generalization of these calculations for right-angled Artin groups, of which free and free abelian groups are special cases. We will explore the ways in which we can bound h from below using group cohomology and the tools necessary to build 4-manifolds that realize these lower bounds. (30 min long talk)

Sunday, August 24th

9:00am **Breakfast - SCGP Cafe**

10:00am **Ioana Suvaina - SCGP 102**

Title: Yamabe invariant of a class of symplectic 4-manifolds

Abstract: We compute the Yamabe invariant for a class of symplectic 4-manifolds obtained by taking the rational blow-down of Kähler surfaces. In particular, for any point on the half-Noether line we show that there is a minimal symplectic manifold with known Yamabe invariant. (1 hour long talk)

11:00am **Coffee Break - SCGP Cafe**

11:30am **Aliakbar Daemi - SCGP 102**

Title: Abelian Gauge Theory, Knots and Odd Khovanov Homology

Abstract: We define a functor from the category of 3-manifolds and cobordisms to the category of modules with the aid of abelian gauge theory. This invariant, which is called plane Floer homology, can be utilized to define plane knot homology, itself an invariant of knots and links in the 3-dimensional sphere. Coming from abelian gauge theory, these invariants are computable in terms of classical invariants. However, the functoriality of plane Floer homology lets us prove a generalization of the surgery exact triangle for the above-said invariant. The generalization, known as link surgery spectral sequence, enriches the algebraic structure for plane knot homology to the extent that it can recover odd Khovanov homology. As an application, we will show how we can use this enriched structure to define a family of knot concordance homomorphisms. (1 hour long talk)

12:30pm **Lunch - SCGP Cafe**

2:15pm **Jonny Evans - SCGP 102**

Title: Exotic spheres and the topology of symplectomorphism groups

Abstract: Joint work with G. Dimitroglou Rizell. We detect nontrivial topology in the compactly-supported symplectomorphism groups of cotangent bundles of high-dimensional spheres. (1 hour long talk)

3:30pm **Tea Time - SCGP Lobby/Patio**

4:00pm **Mikio Furuta - SCGP 102**

Title: The perturbation of the Seiberg-Witten equations revisited

Abstract: We introduce a new kind of perturbations of the Seiberg-Witten equations. Our perturbations offer flexibility in the way the Seiberg-Witten invariants are constructed and also shed a new light to LeBrun's curvature inequalities. Joint work with Shinichiroh Matsuo. (30 min long talk)

6:00pm **Workshop Banquet - SCGP Cafe**

Monday, August 25th

9:00am **Breakfast - SCGP Cafe**

10:00am **Sai-Kee Yeung - SCGP 102**

Title: Classification of fake projective planes and related geometric problems

Abstract: The main purpose of the talk is to explain the recent classification of fake projective planes. A fake projective plane is a smooth complex surface with the same Betti numbers as the complex projective plane but not biholomorphic to it. Recently, from a joint work with Gopal Prasad, as well as the work of Donald Cartwright and Tim Steger, it is shown that there are precisely one hundred such surfaces up to biholomorphism. We would also explain some exotic fourfolds arising naturally from fake projective planes. (1 hour long talk)

11:00am **Coffee Break - SCGP Cafe**

11:30am **Inanc Baykur - SCGP 102**

Title: Multisections of Lefschetz fibrations and topology of symplectic 4-manifolds

Abstract: We initiate an extensive study of multisections of Lefschetz fibrations via positive factorizations in framed mapping class groups. Using our techniques, we can reformulate and tackle various interesting conjectures and problems related to the topology of symplectic 4-manifolds, such as the smooth classification of symplectic Calabi-Yaus, Stipsicz's conjectures on minimality and fiber sum decompositions, constructions of inequivalent Lefschetz fibrations and exotic pencils. In the talk, we will discuss and present as many of these applications as time permits. (Joint work with Kenta Hayano.) (1 hour long talk)

12:30pm **Lunch - SCGP Cafe**

2:15pm **Robert Gompf - SCGP 102**

Title: Stein domains inside complex surfaces

Abstract: Eliashberg's topological characterization of Stein surfaces leads to a practical method for locating Stein surfaces biholomorphically embedded in a preassigned complex surface X. When X is C^2 or another Stein surface, these are called "domains of holomorphy" and are a classical object of study in complex analysis. Applications include: Domains of holomorphy in C^2 realizing uncountably many exotic smoothings, compact Stein domains embedded with pseudoconvex boundary, pseudoconvex embeddings of Brieskorn spheres, pseudoconCAVE fillings with controlled topology, and pseudoconcave, compact, contractible manifolds inside any closed, simply connected complex surface. (1 hour long talk)

3:30pm **Tea Time - SCGP Lobby/Patio**

4:00pm **Weiyi Zhang - SCGP 102**

Title: Geometric structures, Gromov norm and Kodaira dimensions

Abstract: Kodaira dimension provides a very successful classification scheme for complex manifolds. The notion was extended to symplectic 4-manifolds. In this talk, we will define the Kodaira dimension for 3-manifolds through Thurston's eight geometries. This is compatible with other Kodaira dimensions in the sense of "additivity". We will then explore the relations of geometric structures and mapping orders with various Kodaira dimensions and other invariants like Gromov norm. (1 hour long talk)

5:00pm **Arunima Ray - SCGP 102**

Title: Shake concordance of knots (joint work with Tim Cochran)

Abstract: If K is a knot in $S^3 = \partial B^4$, then the 4-manifold W_K obtained by adding a single 2-handle to S^3 along K with zero framing has $H_2(W_K) \cong \mathbb{Z}$. If a generator of $H_2(W_K)$ can be represented by an embedded sphere, K is called \textit{shake-slice}. Any slice knot is shake-slice, but the converse is unknown. We define a relative version of this concept, known as \textit{shake-concordance}, and construct infinite families of knots that are pairwise shake-concordant but not concordant. We show that the concordance invariants τ, s, and slice genus are not invariants of shake-concordance. We also give a characterization of shake-concordant and shake-slice knots in terms of concordance. (30 min long talk)

Tuesday, August 26th

9:00am **Breakfast - SCGP Cafe**

10:00am **Peter Ozsvath - SCGP 102**

Title: Concordance homomorphisms from knot Floer homology

Abstract: I will describe an infinite family of homomorphisms from the smooth knot concordance group to Z, defined using a simple modification of knot Floer homology. I will also explain some applications of these homomorphisms. This is joint work with Andras Stipsicz and Zoltan Szabo. (1 hour long talk)

11:00am **Coffee Break - SCGP Cafe**

11:30am **AST-105 - SCGP 103**

11:30am **Naoyuki Monden - SCGP 102**

Title: Twisted substitutions and fundamental groups of Lefschetz fibraitons

Abstract: Every finitely presented group can be realized as the fundamental group of the total space of a Lefschetz fibration over the 2-sphere admitting a (-1)-section. This follows from the works of Gompf and Donaldson. In this talk, we give the explicit monodromy of a Lefschetz fibration admitting a (-1)-section whose fundamental group is a given finitely presented group using "twisted substitution" techniques. This is the joint work with Ryoma Kobayashi in Tokyo University of Science. (1 hour long talk)

12:30pm **Lunch - SCGP Cafe**

2:15pm **Kouichi Yasui - SCGP 102**

Title: Partial twists and exotic Stein fillings

Abstract: We give an algorithm which produces infinitely many pairwise exotic Stein fillings of the same contact 3-manifolds. Furthermore, we determine the support genera of their boundary contact 3-manifolds under some condition. This algorithm uses positive allowable Lefschetz fibrations over the disk, certain modifications of vanishing cycles and fibers, and monodromy substitutions. (1 hour long talk)

3:30pm **Tea Time - SCGP Lobby/Patio**

4:00pm **Claude LeBrun - SCGP 102**

Title: Einstein metrics, 4-manifolds, and differential topology

Abstract: While we are very far from being able to completely determine which smooth compact 4-manifolds admit Einstein metrics, the problem becomes much more tractable if we restrict our attention to those 4-manifolds which also admit a symplectic structure. In this context, we now have a complete answer to the question when Einstein constant is also assumed to be non-negative, and we even know know a great deal about the negative case. In this lecture, I will present a new result regarding the question of whether the corresponding Einstein moduli spaces are connected in the positive case. If time allows, I will then survey some interesting open questions regarding the negative case. (1 hour long talk)

Wednesday, August 27th

9:00am **Breakfast - SCGP Cafe**

10:00am **Kenji Fukaya - SCGP 102**

Title: How we shortcut Lagrangian Floer theory in 4 dimensional case

Abstract: The Lagrangian Floer theory for general symplectic manifold is rather cumbersome. In case of symplectic manifold of dimension 4 (but without extra assumption) we can shortcut various parts. I propose to explain how and how much it can be simplified in this case. For example: 1. A infinity algebra is defined over Z always. 2. Floer homology between a Lagrangian submanifold L and itself is always defined. 3. The obstruction for Floer homology between two different Lagrangian submanifolds to be defined is described by a single function on H^1. (1 hour long talk)

11:00am **Coffee Break - SCGP Cafe**

11:30am **Andy Wand - SCGP 102**

Title: Tightness and Legendrian surgery

Abstract: A well known result of Giroux tells us that isotopy classes of contact structures on a closed three manifold are in one to one correspondence with stabilization classes of open book decompositions of the manifold. We will introduce a characterization of tightness of a contact structure in terms of corresponding open book decompositions, and show how this can be used to resolve the question of whether tightness is preserved under Legendrian surgery. (1 hour long talk)

12:30pm **Lunch - SCGP Cafe**

2:15pm **Akram Sheikh Alishahi - SCGP 102**

Title: Cobordisms between tangles

Abstract: Sutured manifolds were first introduced by Gabai in his study of taut foliations on three-manifolds. Joint with Eaman Eftekhary, we defined the sutured Floer chain complex as a refinement of Juhasz's sutured Floer homology. In this talk, we introduce a new description of sutured manifolds as "tangles" and describe a notion of cobordism between them. Cobordisms between decorated knots and links are a special case of these cobordisms. Using this construction, we define a cobordism map between the corresponding sutured Floer chain complexes. We also discuss some possible applications. This is joint work in progress with Eaman Eftekhary. (1 hour long talk)

3:30pm **Tea Time - SCGP Lobby/Patio**

4:00pm **Cheuk Yu Mak - SCGP 102**

Title: Symplectic Divisorial Capping in Dimension 4

Abstract: We investigate the notion of symplectic divisorial compactification for symplectic 4-manifold with either convex or concave type boundary. This is motivated by the notion of compactifying divisors for open algebraic surfaces. We classify symplectic compactifying divisor having finite boundary fundamental group. This is a joint work with Tian-Jun Li. (30 min long talk)