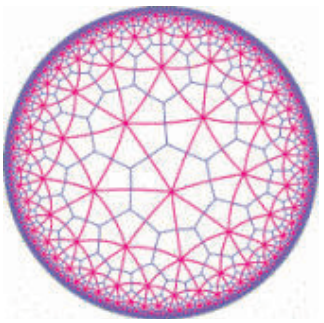
Brandeis Topology Seminar, Spring 2011
Tuesdays, 1:40-2:45 at 226 Goldsmith
(Followed by department tea in the common room.)



February 1

Speaker: **Jen Hon** (University of Pennsylvania)
Title: **Concordance and the knot Floer complex**
Abstract: We will use the knot Floer complex, in particular the invariant epsilon, to define a new smooth concordance homomorphism. Applications include a formula for tau of iterated cables, better bounds (in many cases) on the 4-ball genus than tau alone, and a new infinite family of smoothly independent topologically slice knots. We will also discuss various algebraic properties of this new homomorphism. This talk will be accessible to most graduate students.

February 8

Speaker: **Vera Vertesi** (MIT)
Title: **Positive braids are transversaly simple**
Abstract: The standard contact structure in the 3-space is a plane field given by the kernel of the 1-form dz-ydx. A knot whose tangents are transverse to the contact plane field are called transverse, and knots whose tangents lie in the contact plane field are Legendrian. In this talk we describe the building blocks of Legendrian (and transverse) representations of braids in a solid torus, and using these blocks we deduce results about Legendrian and transverse braiding. In particular we prove that positive braids are transversaly simple. This means that a topologically defined invariant (the self linking number) is enough to distinguish transverse representations of any given positive braid. This is a joint work (in progress) with J. Etnyre.

February 15

Speaker: **Vladimir Chernov** (Dartmouth College)
Title: **Causality, Low conjecture and globally hyperbolic spacetimes**
Abstract: This talk is based on joint work with Stefan Nemirovski. Let (X^{m+1}, g) be a globally hyperbolic spacetime with Cauchy surface diffeomorphic to an open subset of R^m. The Legendrian Low conjecture formulated by Natario and Tod says that two events x,y in X are causally related if and only if the Legendrian link of spheres S_x, S_y whose points are light geodesics passing through x and y is non-trivial in the contact manifold of all light geodesics in X. The Low conjecture says that for m=2 the events x,y are causally related if and only if S_x, S_y is non-trivial as a topological link. We prove the Low and the Legendrian Low conjectures. We also show that similar statements hold for any globally hyperbolic (X, g)

such that the universal cover of its Cauchy surface is an open manifold. The conjecture follows from the existence of the natural partial order on the space of Legendrian spheres in the spherical cotangent bundle of such Cauchy surfaces. We also discuss related joint works with Yuli Rudyak. If time permits we discuss which of the smooth manifolds admit a globally hyperbolic Lorentz metric, generalizing the results of Newman and Clarke.

February 22

Brandeis holiday; no seminar.

March 1

Speaker: **Danny Ruberman** (Brandeis)
Title: **Applications of Heegaard-Floer theory to link concordance**
Abstract: Invariants derived from Heegaard-Floer theory have proved to be very powerful in investigating smooth knot concordance. I will discuss some applications of these invariants, especially the so-called correction term (or d-invariant) to problems of link concordance. For example, answering a question of Jim Davis, I will describe links with trivial (two-variable) Alexander polynomial and unknotted components that are not concordant to the Hopf link.

March 8

Speaker: **Gabriel Katz** (MIT)
Title: **Topological Invariants of Gradient Flows on Manifolds with Boundary (Part I)**
Abstract: Let f: X ---> R be a Morse function on a manifold X and v its gradient-like vector field. Classically, the topology of a closed X can be described in terms of the spaces of v-trajectories that link the singular points of f. On manifolds with boundary, the situation is somewhat different: there, a massive set of nonsingular functions is available. For such Morse data (f, v), the interactions of the gradient flow with the boundary dX take central stage. I will introduce and measure the convexity and concavity of a v-flow relative to dX. "Some manifolds are intrinsically more concave than others with respect to any gradient flow" is the main slogan of the talk. Stated differently, the intrinsic concavity of X is a reflection of its complexity. I will explain how this approach leads to possibly new topological invariants, both of the flow v and of the manifold X. In 3D, I have a good grasp of these invariants and their connection to the classification of 3-folds.

March 15

Speaker: **Jonathan Yazinski** (McMaster University)
Title: **Group Actions on Exotic Smooth 4-Manifolds**
Abstract: Due to the development of new techniques, the past several years have shown remarkable progress on the discovery of exotic smooth structures on small 4-manifolds, where size is gauged by Euler characteristic. A smooth 4-manifold X admits an exotic smooth structure if there is a smooth 4-manifold Y such that Y is homeomorphic, but not diffeomorphic, to X. For the past decades, exotic smooth structures have been found on CP^2#-mCP^2 for progressively smaller m. It is now known that CP^2#-mCP^2 admits infinitely many exotic smooth structures when m is at least 2. It is a natural question to ask whether any of these manifolds admit group actions, in particular, involutions. In this talk I will show a particular construction of an infinite family of pairwise nondiffeomorphic manifolds in the case m=5 where each such manifold admits an involution not topologically conjugate to the usual complex conjugacy involution on CP^2#-5CP^2, and I will discuss some of the implications of this construction.

March 22

Speaker: **Gabriel Katz** (MIT)
Title: **Topological Invariants of Gradient Flows on Manifolds with Boundary (Part II)**

March 29

Speaker: **Jonathan Bloom** (MIT)
Title: **Links, monopoles, and mutation**
Abstract: A central question in knot theory is whether there a non-trivial knot with trivial Jones polynomial. Alas, the definition of the Jones polynomial, in terms of a link diagram, obscures its geometric content. In 1999, Khovanov introduced a bigraded homology theory of links in the 3-sphere, whose graded Euler characteristic recovers the Jones polynomial. In this talk, I'll review the Jones polynomial and Khovanov's "categorification". I'll then outline a deep connection to (more intrinsically geometric) invariants coming from Floer homology. Finally, I'll describe the implications for Khovanov homology with regard to link mutation and the central question.

April 5

Speaker: **Matt Graham** (Brandeis)
Title: **Combinatorial Heegaard Floer theory and some constructions**
Abstract: I will give two talks on Combinatorial Heegaard Floer theory. The first talk will be a basic introduction to the subject where I will discuss the various definitions and structures in detail with a couple of basic calculations. In the second talk, I will discuss a recent paper by Sucharit Sarkar, "Grid Diagrams and the Ozsvath-Szabo tau-invariant" in which he reproves Kronheimer-Mrowka's theorem (previously known as the Milnor conjecture) that |tau(K_1)-tau(K_2)|<=g, whenever there is a genus g knot cobordism joining K_1 to K_2. His proof only uses grid diagrams and the combinatorial theory.

April 12

Speaker: **Matt Graham** (Brandeis)
Title: **Combinatorial Heegaard Floer theory and some constructions (Part II)**

April 19 & 26

Brandeis holiday; no seminar.

May 3

Speaker: **Inanc Baykur** (Brandeis)
Title: **Sections of surface bundles and Lefschetz fibrations**
Abstract: In this talk, we will discuss the possible self-intersection numbers of sections of surface bundles or Lefschetz fibrations over surfaces with fixed fiber and base genera. We will also address the question of boundedness of number of critical points of a Lefschetz fibration admitting maximally self-intersecting sections. We will furthermore calculate the precise value of stable commutator length of certain elements in the mapping class groups of surfaces with boundary, and present a stabilization result drastically different than the case of mapping class groups of closed surfaces.

May 12, ***Thursday***

Speaker: **Mustafa Korkmaz** (Max-Planck-Institute / Middle East Technical University)
Title: **Low-dimensional linear representations of mapping class groups**
Abstract: Recently, Franks and Handel proved that, for g greater than 2 and n less than 2g-3, n-dimensional linear representations of the mapping class group of an orientable surface of genus g are trivial. We extend this result to n less than 2g -1, also covering the case g=2. As an application, we prove the corresponding result for nonorientable surfaces.