

Danny Ruberman

Title: Positive scalar curvature and diffeomorphisms of 4-manifolds

Abstract: We will discuss two interrelated questions about the geometry and topology of smooth 4-manifolds. The first is the topology of the space of Riemannian metrics of positive scalar curvature. We show that for many 4-manifolds, the space of such metrics is disconnected, and provide a method for detecting higher homotopy groups of this space. The second question deals with the topology of the group of diffeomorphisms of a simply connected 4-manifold. We show that this group is disconnected, and conclude that homotopy does not imply isotopy in dimension 4. These results use a parameterized version of the Seiberg-Witten equations.

S. Vidussi

Title: Nonisotopic symplectic tori in the fiber class of elliptic surfaces

Abstract: An interesting question in symplectic topology of 4-manifolds concerns the existence of exotic symplectic curves in a fixed homology class. The first result in that sense, due to Fintushel-Stern, states that in an elliptic surface with fiber F the class $2m[F]$, for $m > 1$, can be represented by infinitely many symplectic nonisotopic tori. Smith has provided higher genus examples for the class $2m[\beta_g]$, for $m > 1$, in the surface $\beta_g \times S^2$. In this talk, using a variation of link surgery construction, we will construct nonisotopic symplectic tori representing the class $q[F]$, for any $q \geq 1$, in the elliptic surface $E(n)$ (for $n \geq 3$). In particular, when $q = 1$, this is the first such example for a primitive homology class.

Hans Boden

Title: The integer valued $SU(3)$ Casson invariant for Brieskorn spheres.

Abstract: Using $SU(3)$ gauge theory, one can define a Casson type invariant $\Pi_{SU(3)}$ for integral homology 3-spheres. This invariant includes a correction term which is closely analogous to Walker's correction term in his extension of Casson's $SU(2)$ invariant to rational homology 3-spheres. In joint work with Chris Herald and Paul Kirk, we defined an integer valued $SU(3)$ Casson invariant which, like $\Pi_{SU(3)}$ is well-behaved under change of orientation and connected sum, but is much easier to compute.

In this talk, I will report on recent computations of the integer valued $SU(3)$ Casson invariant for Brieskorn spheres and discuss several conjectures related to a surgery formula for the $SU(3)$ Casson invariant.

Bruce Williams

Title: Higher Reidemeister Torsion

Abstract: Higher Whitehead and Reidemeister torsion invariants are defined for smooth bundles with compact manifold fibers. The classical situation is when the base is a point. In that case Cheeger and Muller have shown that the analytic and combinatorial Reidemeister torsion invariants are equal.

In this talk we report on progress in computing the analytic and "combinatorial" higher Reidemeister torsion, in particular the problem of showing they are equal. The analytic definition is due to Bismut-Lott with computations given by Bunke and Bismut-Goette. "Combinatorial" definitions are due to Igusa-Klein and Dwyer-Weiss-Williams with computations given by Dorabiala and Igusa.

Erik Pedersen

Title: Assembly maps in K- and L-theory

Abstract: I will talk about assembly

Paul Feehan

Title: $SO(3)$ monopoles and 4-manifold invariants

Abstract: We describe how the $SO(3)$ -monopole cobordism can be used to prove a qualitative version of Witten's conjecture concerning the relation between Donaldson and Seiberg-Witten invariants, namely that there exists a formula expressing Donaldson invariants in terms of Seiberg-Witten invariants, though many of the polynomial coefficients are not known exactly (though they are known to be topological invariants). We also discuss work in progress on the problem of showing that this "qualitative Witten formula" implies Witten's conjecture. Finally, we consider possible applications of the $SO(3)$ -monopole cobordism to symplectic four-manifolds.

M. Marcolli

Title: Non-commutative modular curves

Abstract: I will discuss the appearance of non-commutative spaces, in the sense of A. Connes, in the compactification of modular curves. The invariants of these non-commutative spaces recover some classical invariants of modular curves, and are related to properties of the geodesic flow. (This is part of joint work with Yu.I. Manin.)

John Morgan

Title: K3 surfaces and principal bundles over elliptic curves

Abstract: Dualities in quantum field theory and string theory result in some of the most surprising and mathematically unexpected conjectures. One of the string theory dualities predicts a close relationship between the moduli spaces of elliptically fibered K3 surfaces and the moduli space of principal bundles over elliptic curves. The purpose of this work is to study the two moduli spaces involved in this proposed duality and find the mathematical relationship between them and thus turn into rigorous mathematics this example of physical duality.

Slava Krushkal

Title: Surgery and involutions on 4-manifolds

Abstract: Central open questions in the classification theory of topological 4-manifolds are known to be equivalent to the existence of certain canonical examples with free fundamental group.

I will present a construction of a double cover of such examples. As a corollary, the surgery conjecture is equivalent to the existence of free involutions for a certain family of 4-manifolds with boundary. I will describe some approaches to this new formulation; the corresponding problem for closed manifolds is solved.

Allan Edmonds

Title: Periodic maps on a connected sum of copies of $\mathbb{C}P^2$

Abstract: We investigate what kinds of permutation representations arise on homology from a periodic map on a connected sum of copies of $\mathbb{C}P^2$.

Tian-Jun Li

Title: Moduli space of symplectic structures on 4-manifolds

Abstract: Let M be a closed oriented smooth 4-manifold admitting symplectic structures. If M is minimal and has $b^+ = 1$, we prove that there is a unique symplectic canonical class up to sign, and any real second cohomology class of positive square is represented by symplectic forms. Similar results hold when M is not minimal and has $b^+ = 1$. We may also discuss some partial results when $b^+ > 1$.

Saso Strle

Title: Genus bounds for divisible classes of positive self-intersection

Abstract: We present a way to obtain a lower bound for the genus of a divisible class of positive self-intersection in a smooth 4-manifold with $b^+ = 1$. The idea is to study the Seiberg-Witten equations on an associated cylindrical end manifold. The

results do not depend on a symplectic structure on the manifold and in particular do not require any knowledge of basic classes.

Frank Quinn

Title: Heegard decompositions of smooth 4-manifolds

Abstract: A Heegard decomposition of a 4-manifold is a presentation as a union of two handlebodies with handles of index $\sum 2$. These are quite different in flavor from the 3-dimensional versions, for instance in that we don't understand the component pieces (2-handlebodies). However they seem to be basic to the understanding of relations with knot and link theory, the interplay between structure of 4-manifolds and the fundamental groups of their boundaries, and development of "quantum" invariants. We give existence and weak forms of uniqueness for decompositions satisfying various conditions, and sketch applications.

Ralph Cohen

Title: On the stable topology of moduli space

Let $M_{g;n}$ be the moduli space of Riemann surfaces of genus g with n boundary components. Topologically, this space can be viewed as a quotient,

$$M_{g;n} = T_{g;n} / \circ_{g;n}$$

where $T_{g;n}$ is the Teichmuller space of complex structures on the underlying smooth surface, $F_{g;n}$, and $\circ_{g;n}$ is the mapping class group, $\circ_{g;n} = \circ_0(\text{Diff}(F_{g;n}; @F))$.

The cohomology $H^s(M_{g;n})$ is notoriously difficult to compute. However a famous conjecture of Mumford, Morita, and Miller asserts that as the genus gets large, the resulting "stable cohomology" is rationally a cohomology algebra. In this talk I will discuss the homotopy theoretic approach to this conjecture by Madsen and Tillmann. I will also discuss a recent result of mine which describes the stable moduli space as an "isotopy functor" in the sense of Goodwillie and Weiss, and will describe how Madsen's strengthening of Mumford's conjecture will follow if the stable moduli space functor is "linear".

Bob Gompf

Title: Topologically characterizing symplectic manifolds

Abstract: Symplectic forms can be viewed as skew-symmetric analogs of constant curvature Riemannian metrics. This leads to the question of whether symplectic manifolds can be characterized topologically, as is the case for constant curvature

manifolds. We define a topological structure called a hyperpencil on a compact $2n$ -manifold, generalizing Lefschetz pencils on 4-manifolds and linear systems of curves on algebraic manifolds. A deformation class of hyperpencils uniquely determines a symplectic structure (up to isotopy) on the underlying manifold. This correspondence seems to be essentially an inverse to the technique of Donaldson and Auroux for constructing linear systems on symplectic manifolds. The likely end result is that any symplectic form whose cohomology class is rational should be realized up to scale by a hyperpencil. This would topologically characterize symplectic manifolds as being those smooth manifolds admitting hyperpencils, and put a dense subset of all symplectic forms on a manifold (up to scale and isotopy) in bijective correspondence with the set of all hyperpencils on it modulo a suitable equivalence relation.

Michael McCooey

Title: Rank two abelian group actions on four-manifolds

Abstract: Let M be a closed, simply-connected four-manifold with a locally linear, homologically trivial action of $G = \mathbb{Z}_p \times \mathbb{Z}_p$. Then β , the singular set of the action, has a rather rigid structure, consisting of $b_2(M) + 2$ intersecting copies of S^2 . We apply this structure to study the possible actions on M .

It turns out that any such G -action must be equivariantly homeomorphic to a connected sum of standard actions on $S^2 \times S^2$, $\mathbb{C}P^2$, $\overline{\mathbb{C}P^2}$, and $\mathbb{C}P^2 \# \overline{\mathbb{C}P^2}$, together with a possibly nonstandard action on (a homotopy) S^4 . The splitting is smooth if the action is, and it follows that most known "exotic" four-manifolds admit no homologically trivial actions by rank two groups.

Finally, we discuss some work in progress concerning actions on S^4 , with a focus on possible knotting of the singular set.

Greg Friedman

Title: Polynomial invariants of non-locally-flat knots

Abstract: We study two different generalizations of the Alexander polynomials to PL-knots which are not necessarily locally-flat. The first is based upon the usual homology theories. For this, we give a nearly complete characterization of Alexander polynomials of knots with point singularities and some further necessary conditions and constructions for knots with more general singularities. Our second extension of Alexander polynomials uses intersection homology. We obtain some analogous properties for these and present several relations with the first set of invariants.

Heather Johnston, Vassar College, Poughkeepsie, NY 12604

Title: The coarse Novikov conjecture and bounded surgery over non uniformly contractible spaces.

Abstract: The Novikov conjecture is about the injectivity of the assembly map in the surgery exact sequence, making it parallel to the Baum-Connes conjecture. John Roe invented coarse (exotic) homology along with his study of the coarse Baum-Connes conjecture. The appropriate coarse Novikov conjecture for non uniformly contractible spaces asserts that the coarse assembly map from coarse homology with coefficients in L-theory to bounded surgery obstruction groups of the space controlled over itself by the identity is injective. Both groups are computed for some non uniformly contractible spaces constructed out of spheres of fixed dimension and increasing radii. The results support the conjecture.

Jim Davis

Title: Stable diffeomorphisms of 4-manifolds

Abstract: I will give several conjectures concerning the homotopy invariance of the stable diffeomorphism type of 4-manifolds and of the Kirby-Siebenmann invariant, will connect these conjectures to the Borel/Novikov Conjectures, and thereby prove my conjectures in many cases. The simplest conjecture is that if the M and N are smooth, closed, orientable, homotopy equivalent 4-manifolds with torsion-free fundamental group, then they are stably diffeomorphic, i.e. they become diffeomorphic after connect sum with a sufficient number of $S^2 \# S^2$'s.

Brendan Owens

Title: Floer cohomology of a surface times a circle and holomorphic bundles

Abstract: Let \mathcal{B} be a Riemann surface. We describe a Hitchin-Kobayashi correspondence for the cylinder $\mathcal{B} \times S^1 \times \mathbb{R}$, and discuss progress in applying this result to questions involving the instanton Floer cohomology of the 3-manifold $\mathcal{B} \times S^1$.

Sylvain Cappell

Title: Holonomy and characteristic classes of singular variety

Abstract: I will speak of my joint work with Markus Banagl.

Edward Miller

Title: The computation of general $U(n)$ -rho invariants of Seifert 3-manifolds

Abstract: I will speak of my joint work with Cappell and Ronnie Lee.

Reinhard Schultz

Title: Exotic spheres with no 3-torus actions

Edmonds

Title: Periodic maps on a connected sum of copies of $\mathbb{C}P^2$