Report on the **CASCADE TOPOLOGY SEMINAR**

Location: PIMS -UBC

Organizers: Alexandra Pettet and Alejandro Adem (UBC)

Dates: April 28 – 29, 2012

Number of participants: 30

Summary: this event was part of a series that takes place twice a year and brings together topologists from the Pacific Northwest and Western Canada in an informal setting. On this occasion we had participants from U.Oregon, Portland State University, U.Washington, U.Victoria, U.Calgary, Okanagan College and UBC. Ten of the participants were graduate students. The conference featured six lectures broadly representing algebraic and geometric topology. The titles and abstracts are appended below. The quality of the lectures was excellent and there was ample discussion during coffee and lunch breaks. This event also marked the 70th birthday of Dale Rolfsen, and there was a special dinner party to celebrate this. This event was funded by PIMS, the US National Science Foundation as well as individual NSERC grants.

List of lectures with abstracts:

Ian Hambleton (McMaster)

"Finite group actions on Kervaire manifolds"

The Kervaire manifolds are closed, oriented, almost framed PL manifolds in dimension 4k+2 with Arf invariant 1. The usual examples are constructed by "plumbing", and the resulting manifolds are 2k-connected with the same homology as a product of spheres. In certain exceptional dimensions (2, 6, 14, 30, 62 and perhaps 126) there exist smooth Kervaire manifolds. The talk will be about the existence of free smooth or PL actions of finite groups on Kervaire manifolds, starting with the existence of free involutions. In contrast with a product of spheres $S^{2k+1} \times S^{2k+1}$, it turns out that the Kervaire manifolds have very restricted symmetry. This is joint work (in progress) with Diarmuid Crowley.

Ian Biringer (Yale)

"Random samplings of locally symmetric spaces"

Suppose that Mi is a sequence of closed locally symmetric spaces modeled on a fixed symmetric space X, e.g. a sequence of hyperbolic n-manifolds. We introduce a tool to understand how the geometry of Mi near a random sample point develops as i tends to infinity. Applications include a control on the growth of the Betti numbers of Mi when X has higher rank.

Joan Birman (Barnard-Columbia)

"The dilatation of a pseudo-Anosov maps and its invariant polynomials"

Let S be a fixed orientable surface. The dilatation D(F) of a pseudo-Anosov diffeomorphism of S is a real number >1 and an invariant of the conjugacy class [F] of F in Mod(S). The work we will discuss was motivated by the question: What is the minimum value D(F), as F ranges over all possible

diffeomorphisms of S? It's known that D_{min} exists, is > 1, and is realized by some F in Diff(S), but the actual value has proved to be elusive except in special cases. We will discuss our efforts, in recent joint work with Brinkmann and Kawamuro, to study this problem from a new point of view, asking about the minimum polynomial of $D(F)$ over the integers. In the course of our work we turned up two new polynomials, both invariants of [F]. Alas, there are cases when they are both reducible over Z, so we didn't answer the question that had motivated our work!

Jack Morava (Johns Hopkins)

"Theories of Anything"

Many theories of classification -- conic sections are a classical example -- can be formulated in terms of the quotient of an action of a nice group on a nice topological space; which might however have a terrible (e.g., non-Hausdorff) quotient. Thom's theory of structurally stable forms elaborates this idea, and I claim [arXiv:1202.0684] that the categorical knowledge representation systems [ologs] of D Spivak conveneniently encode the structure of these bad quotients as databases. Arnold's classification of isolated singularities of holomorphic functions provides a good example of this claim, as do knot tables; and there are many others, such as the phase diagrams of condensed matter physics; but fitting them into a nice framework calls for a categorification of the functor \pi_0 which assigns to a space, its set of components. This is pretty easy to do for global group actions, but finding a more general construction, applicable to topological groupoids and stacks, seems an interesting problem in geometric topology.

Dev Sinha (Oregon)

"Cohomology of symmetric groups"

We have recently made progress on understanding the cohomology of symmetric groups by fully using the geometry of the Fox-Neuwirth cell structure and the algebra of Strickland-Turner's Hopf ring structure. We share progress including a full description mod-p and an almost complete description two-locally. There is still perhaps some interesting geometry which needs to be revealed at odd primes. We also touch on related topics such as invariant theory, characteristic classes for covering maps, and the cohomology of alternating groups.

Juan Souto (UBC)

"Metrics on manifolds with large volume and spectral gap"

I will explain how to construct, for d > 2, metrics on d-dimensional manifolds with bounded geometry, arbitrarily large volume, and spectral gap bounded from below away from zero. As a consequence we obtain that there are hyperbolic knot complements M_i whose volume tends to infinity and whose Cheeger constant is larger than some e>0$ for all i. This is joint work with Marc Lackenby.