New trends in triangulated categories and their associated cohomology theories

2009 Fall AMS Eastern sectional meeting

October 24–25, 2009

University Park, PA

1 Schedule

Saturday, October 24, Room 119, Thomas Building.

Time	Speaker
9:30	**Enxin Wu** *A brief survey of A-infinity algebras and related triangulated structures.*
10:00	**Srikanth Iyengar** *Stratifying derived categories associated to finite groups and to commutative rings.*
10:30	**Mark Hovey** *Watts' theorems and Brown representability for derived categories.*
11:00	**Break**
3:00	**William Dwyer** *The many faces of the Bockstein.*
3:30	**Julie Bergner** *Stable homotopy theories and derived Hall algebras.*
4:00	**Peter May** *Six model structures for DG modules over DGA's.*
4:30	**Anna Marie Bohmann** *The S^1 Equivariant Generating Hypothesis.*
5:00	**Megan Shulman** *$RO(Z/p)$-graded cohomology of some classifying spaces.*

Sunday, October 25, Room 119, Thomas Building.

Time	Speaker
8:00	**Jennifer French** *Some E-local spaces modeled by maps of structured ring spectra.*
8:30	**Angelica Osorno** *An infinite loop space machine for symmetric monoidal 2-categories.*
9:00	**Jeremiah Heller** *Vanishing theorems for real algebraic cycles.*
9:30	**Jan Minac** *Tiny, spectacular Galois jewels in the midst of mysterious giants.*
10:00	**Troy Winfree** *Continuous homotopy fixed point spectra: finiteness properties and computations.*
10:30	**Kate Ponto** *Additivity of the Reidemeister trace.*

2 Talk Abstracts

Speaker: **Julie Bergner**, University of California Riverside. (1052-55-145)

Title: *Stable homotopy theories and derived Hall algebras.*

Abstract: Homotopy-theoretic approaches have been useful in recent attempts to associate a version of the Hall algebra to a triangulated category. We'll describe how to obtain such an algebra when the triangulated category is the homotopy category of a stable homotopy theory and satisfies certain finiteness assumptions, then discuss how one might generalize beyond this finitary case.

Speaker: **Anna Marie Bohmann**, University of Chicago. (1052-55-115)

Title: *The S^1 Equivariant Generating Hypothesis.*

Abstract: The Freyd generating hypothesis is a long-standing conjecture in stable homotopy theory. An analogous conjecture can be formulated in any triangulated category with a set of compact generators. Recently, Hovey, Lockridge, and Puninski characterized the rings in whose derived categories this conjecture holds. They showed in particular that the generating hypothesis holds in the derived category of a von Neumann regular ring. The rational Burnside ring of a compact Lie group is an example of such a ring. This might lead one to suspect that the generating hypothesis holds in the rational equivariant stable homotopy category of a compact Lie group. Starting from Greenlees's algebraic description of this category for the circle group, we show that this is not the case by exhibiting an explicit counterexample.

Speaker: **William G. Dwyer**, University of Notre Dame. (1052-55-132)

Title: *The many faces of the Bockstein.* Preliminary report.

Abstract: This is joint work with J. Greenlees. We look at the problem of classifying differential graded algebras (DGAs) over the integers whose homology ring is isomorphic to an exterior algebra over $\mathbb{F}_p$ on one generator of degree -1. (The generator is a type of generalized Bockstein operator.) Two DGAs are (directly) equivalent if there is a DGA map between them inducing an isomorphism on homology. The conclusion is that, with one exception, equivalence classes of these DGAs correspond bijectively to totally ramified extensions of the field of p-adic rationals.

Speaker: **Jennifer French**, Massachusetts Institute of Technology.

Title: *Some E-local spaces modeled by maps of structured ring spectra.*

Abstract: We pose the problem of recovering the E-localization of a space from an associated derived mapping space of E_∞ ring spectra. We will discuss the conditions on spaces giving rise to such models of localizations in two cases, the case that $E = Hk$ where k is the field with p elements, and the case $E = K(1)$.

Speaker: **Jeremiah Heller**, Northwestern University. (1052-14-155)

Title: *Vanishing theorems for real algebraic cycles.*

Abstract: We discuss recent joint work with M. Voineagu where we show that the reduced Lawson homology of a real algebraic variety vanishes in degrees larger than the dimension of the variety. These homology groups are defined via homotopy groups of some spaces of cycles on a real variety and are an interesting mix of topological and algebraic data, related for example to motivic cohomology and real morphic cohomology. We discuss a few applications and computations.

Speaker: **Mark Hovey**, Wesleyan University. (1052-18-33)

Title: *Watts' theorems and Brown representability for derived categories.*

Abstract: Watts' theorem in algebra determines which functors from Mod R to Mod S are tensor products. We prove an analogous theorem for functors from the triangulated derived category D(R) to D(S). In particular, we partially salvage the failure of Brown representability for homology functors on D(R).

Speaker: **Srikanth B. Iyengar**, University of Nebraska-Lincoln. (1052-18-34)

Title: *Stratifying derived categories associated to finite groups and to commutative rings.*

Abstract: My lectures will be concerned with the general problem of describing/classifying the thick subcategories of the bounded derived category of a noetherian ring. I will report on recent progress, in the context of commutative rings and of group algebras of finite groups. This is based on joint work with various collaborators, including Luchezar Avramov, Dave Benson, and Henning Krause.

Speaker: **Peter May**, University of Chicago. (1052-18-105)

Title: *Six module structures on DG modules over DGA's.*

Abstract: Let A be a differential graded algebra over a commutative ring R and let M(A) be the category of differential graded (left) A-modules. There are three obvious notions of weak equivalence in M(A): A-homotopy equivalence, R-homotopy equivalence, and quasi-isomorphism. These lead to three triangulated categories. There are (at least) six sensible model category structures on M(A), one, two, and three, respectively, for the three kinds of weak equivalences just named. In one of them, the classical bar construction B(A,A,X) is a model theoretic cofibrant approximation of X. All of these model structures seem natural and interesting. There appear to be many other contexts in algebra and topology where such a sextet of interrelated model structures is present.

Speaker: **Jan Minac**, University of Western Ontario. (1052-12-75)

Title: *Tiny, spectacular Galois jewels in the midst of mysterious giants.* Preliminary report.

Abstract: Absolute Galois groups of fields are mysterious, grotesquely large, serious and intimidating giants. However if you look carefully you will see on their giant fingers, tiny, spectacular Galois groups of exponents at most p times p (for each prime number p) and of nilpotence index at most 2. Surprisingly these gems reveal a lot about their owners and their corresponding base fields. This is a report on my joint work with Sunil Chebolu and Ido Efrat.

Speaker: **Angelica Osorno**, Massachusetts Institute of Technology.

Title: *An infinite loop space machine for symmetric monoidal 2-categories.*

Abstract: In this talk we will construct an infinite loop space machine for (some strictified version of) symmetric monoidal 2-categories, using Segal's Γ-space machine. If time permits we will mentions some applications to the K-theory of bipermutative categories.

Speaker: **Kate Ponto**, University of Notre Dame. (1052-55-167)

Title: *Additivity of the Reidemeister trace.* Preliminary report.

Abstract: One of the most important properties of the Euler characteristic is additivity: If A is a subspace of B, the Euler characteristic of B is the sum of the Euler characteristics of A and B/A. The corresponding additivity property is also fundamental to the Lefschetz number and the Reidemeister trace. I will describe how additivity of the Reidemeister trace follows from the definition of this invariant as the trace in a bicategory with shadows.

Speaker: **Megan Shulman**, University of Chicago.

Title: *$RO(Z/p)$-graded cohomology of some classifying spaces.*

Abstract: When dealing with G-spaces for a finite group G, there are many reasons to think that $RO(G)$-graded Bredon cohomology is the "correct" equivariant cohomology theory to consider. Unfortunately, it is also very difficult to compute with. Gaunce Lewis calculated the $RO(Z/p)$-graded cohomology of complex projective spaces in the 1980s, and William Kronholm calculated the $RO(Z/2)$-graded cohomology of some real projective spaces in his 2008 thesis, but to date no other calculations have been done. In this talk, I will describe an equivariant spectral sequence which can be used in conjunction with the equivariant Serre spectral sequence and the equivariant cohomology of complex projective spaces to identify the $RO(Z/p)$-graded cohomology of the equivariant classifying space $B_{Z/p}O(2)$.

Speaker: **Troy Winfree**, University of Rochester. (1052-55-138)

Title: *Continuous homotopy fixed point spectra: finiteness properties and computations.*

Abstract: Given a closed subgroup G of the Morava stabilizer group S_n, let E_n^{hG} denote the continuous homotopy fixed point spectrum of Devinatz and Hopkins. We examine the case $G = W\mathbb{F}_{p^n}^0$ via computations in the Bockstein spectral sequence

$$H_c^*((W\mathbb{F}_{p^n}^0)^{p^k}, \mathbb{F}_{p^n}[u^{\pm}]) \Rightarrow H_c^*((W\mathbb{F}_{p^n}^0)^{p^k}, \mathbb{F}_{p^n}[[u_{n-1}]][u^{\pm}]).$$

At the $n = 3$ level and for $k \geq 0$ all of the zero-line differentials can be computed. We discuss two consequences: first, that a proposed finiteness result which holds at the $n = 2$ level cannot be extended to higher n; second, letting $V(1)$ denote a finite spectrum with $BP_*V(1) = BP_*/\langle p, v_1\rangle$, that if $p > 3$ then $\pi_*(E_3^{h((W\mathbb{F}_{p^3}^0)^{p^k} \times \mathbb{F}_p^\times)} \wedge V(1))$ is of essentially finite rank.

Speaker: **Enxin Wu**, University of Western Ontario. (1052-18-124)

Title: *A brief survey of A-infinity algebras and related triangulated structures.* Preliminary report.

Abstract: I will talk about the definition of an A-infinity algebra, its basic properties, its derived category, and its relationship with a special class of triangulated categories. This is a survey talk based on Bernhard Keller's summary on A-infinity algebras, and some of the recent developments of the field.