

# Justin Noel

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## Research Interests

- **Algebraic Topology**

- Power operations in generalized cohomology theories.
- The interplay between unstable and stable homotopy theory, (especially after  $K(n)$ -localization).
- $H_\infty$  and  $E_\infty$  ring structures on spectra.

## Education

- **University of Chicago**

Chicago, IL

*Ph.D. in Mathematics*

2009

- Adviser: Peter May
- Thesis: Some Applications of the Theory of Formal Groups to Algebraic Topology

*M.S. in Mathematics*

2005

- **University of California, Santa Cruz**

Santa Cruz, CA

*B.A. in Mathematics with Highest Honors*

2003

- Advisers: Chongying Dong and Richard Montgomery
- Thesis: The Endomorphism Algebra of a Vertex Operator Algebra.

*B.S. in Computer Science with Highest Honors*

2003

## Awards

HGRT Postdoctoral Research Support, Strasbourg, France	September 2009-June 2010
3 Midwest Topology Network NSF Grants	March 2009-June 2009
Summer Research Grants	2004-2008
NSF Graduate Research Fellowship Honorable Mention	2005
Stevenson College Honors	2003
UC Regents Scholar (Full Tuition Scholarship)	1999-2003
Colin C. Belin Fellowship in Computer Science (\$1000)	1999

## Preprints

- **For Complex Orientations Preserving Power Operations,  $p$ -typicality is Atypical**

Preprint: <http://arxiv.org/abs/0910.3187>

Joint with Niles Johnson

We show, at the primes 2, 3, and 5, that no map from  $MU$  to  $BP$  defining a universal  $p$ -typical formal group law on  $BP$  preserves power operations. In particular, such a map cannot define a commutative  $MU$ -algebra structure on  $BP$ . Our results apply more generally to show that the  $p$ -typical complex orientations on a number of standard spectra are not commutative  $MU$ -algebra maps.

This builds on work of Jim McClure to determine whether Quillen's orientation on  $BP$  is an  $H_\infty^2$  map. By direct computation, we show that the necessary condition he derives for Quillen's orientation to be  $H_\infty^2$  fails for the first three primes. We go on to show that this implies the more general results above. There is nothing special we see about the first three primes in this work, and we conjecture that these results hold for all primes.

We also provide a reinterpretation of McClure's conditions in the language of formal group laws.

- $H_\infty \neq E_\infty$

Preprint: <http://arxiv.org/abs/0910.3566>

We provide an example of a spectrum with an  $H_\infty$  structure which does not rigidify to an  $E_3$  structure. It follows that not every  $H_\infty$  ring spectrum comes from an underlying  $E_\infty$  ring spectrum. After comparing definitions, we obtain this example by applying  $\Sigma_+^\infty$  to the counterexample to the transfer conjecture constructed by Kraines and Lada.

## Papers in Progress

- **Generalized Witt Schemes in Algebraic Topology**

In Progress

Draft Available: <http://nullplug.org/justin/generalized-witt-schemes.pdf>

We analyze the even-periodic cohomology of the space  $BU$  and some of its relatives using the language of formal schemes as developed by Strickland. In particular, we connect  $E^0(BU)$  to the theory of Witt vectors and  $\lambda$ -rings. We use these connections to study the effect of the coproduct arising from the tensor product on generalized Chern classes. We then exploit this connection to simultaneously construct Husemoller's splitting of  $H\mathbb{Z}_{(p)}^*(BU)$  and Quillen's splitting of  $MU_{(p)}$ .

- **The Morava  $K$ -theory of Coker  $J$  And Higher Chromatic Analogues**

In Progress

Joint with Nick Kuhn We show that the  $K(2)$ -homology of the infinite loop space Coker  $J$  is isomorphic to the free Morava  $K$ -theory Dyer-Lashof algebra on a single generator. Corollaries of this computation include a description of the  $E$ -cohomology of Coker  $J$ , where  $E$  is either  $K(2)$ ,  $E_2$ ,  $tmf$ , or  $E_2^{hG}$ , where  $G$  is a subgroup of the second Morava stabilizer group.

Then we define higher chromatic analogues of Coker  $J$  to derive analogous results.

This extends the work of Hodgkin and Snaithe on the  $K$ -theory of the infinite loop spaces  $J$  and Coker  $J$ .

## Academic Experience

- **Institut de Recherche Mathématique Avancée**

Strasbourg, France

*Postdoctoral Researcher*

*September 2009-August 2010*

- Independently researched topics of interest to the HGRT research group (New links between homotopy theory, group theory, and representation theory).

- **University of Chicago**

Chicago, IL

*College Lecturer*

*September 2005-June 2009 (8 quarters)*

- Taught first and second year courses in calculus that targeted biology, chemistry and economics majors.
- Wrote syllabi, homeworks, exams and oversaw 3 course assistants.

- **University of Chicago**

Chicago, IL

*Directed Reading Program Mentor*

*September 2005-Winter 2009 (4 quarters)*

- Designed independent study projects in mathematics for 4 advanced undergraduate students and guided them through one-on-one meetings.

- **University of Chicago**

Chicago, IL

*Graduate Student Committee*

*September 2006-June 2007*

- Representative for math graduate students.
- Secured additional computer resources (hardware and software) for graduate students.

- **University of Chicago**

Chicago, IL

*REU Asst. Coordinator*

*June 2005-August 2006 (3 Summers)*

- Managed a group of 5 graduate students who were responsible for mentoring 2-3 undergraduates a piece and typing lecture notes for courses.
- Designed independent study projects in mathematics for 9 students.

- **University of Chicago**

Chicago, IL

*College Fellow*

*September 2004-June 2005*

- Teaching Assistant for real analysis.
- Led problem sessions and graded homework.

## Additional Research Experience

- **Massachusetts Institute of Technology**

Cambridge, MA

*Research Affiliate*

*March 2007-June 2007*

- Visiting scholar under the sponsorship of Mark Behrens.

- **Learning and Experimental Economics Projects**

*Student Programmer*

- Wrote “Double Market,” a Java based client/server application for simulating dishonest markets.

Santa Cruz, CA  
April 2002 - June 2003

- **Research Experience For Undergraduates**

*Mentor: Svetlana Katok*

- Studied arithmetic and geometric coding of modular flows.

State College, PA  
June 2002 - August 2002

<b>Lectures</b>
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- **Conference Talks**

- Fall 2009 - GDR Conference: Topologie Algébrique et Applications, Strasbourg, France - For Complex Orientations Preserving Power Operations,  $p$ -Typicality is Atypical.
- Spring 2009 - Conference on Algebraic Topology, Group Theory and Representation Theory, Isle of Skye, Scotland -  $H_\infty$  Orientations Which Are  $p$ -Typical Are Atypical.
- Spring 2009 - Graduate Student Topology Conference, Madison, Wisconsin -  $H_\infty$  Orientations Which Are  $p$ -Typical Are Atypical.
- Fall 2008 - Algebraic Topology Conference, Buenos Aires, Argentina - A New Perspective On Old Splittings.
- Fall 2008 - AMS Regional Conference, Kalamazoo, MI - Witt Schemes In Algebraic Topology.
- Fall 2008 - AMS Regional Conference, Vancouver, BC - Witt Schemes In Algebraic Topology.
- Winter 2008 - Graduate Student Topology Conference, University of Illinois, Urbana-Champaign - The Yoneda Lemma, Hopf Algebras, And Algebraic Topology.

- **Seminar Talks**

- Fall 2009 - University of Strasbourg, Topology Seminar -  $H_\infty$  Orientations and  $p$ -typicality (2 lectures)
- Summer 2009 - University of Chicago, Topology Seminar - Some Applications of the Theory of Formal Groups to Algebraic Topology
- Spring 2009 - Northwestern University, Topology Seminar -  $H_\infty$  Orientations on  $BP$
- Winter 2009 - University of Chicago, Topology Seminar - The Morava  $K$ -theory Of Coker  $J$  And Higher Chromatic Analogues

- **Junior Colloquium Talks**

- Fall 2008 - University Of Chicago, Graduate Student Seminar - What Is K-Theory?
- Fall 2007 - University Of Chicago, Graduate Student Seminar - Computing Homotopy Groups of Spheres.
- Winter 2007 - University Of Chicago, Graduate Student Seminar - Beating Deep Blue: How Machines Play Games.

- **Junior Seminar Talks**

- Spring 2007 - Massachusetts Institute of Technology, Juvitop Seminar - Power Operations and  $H_\infty$  Ring Spectra.
- 2004-Spring 2009 - University of Chicago, Topology Proseminar:
  - \* The Nilpotence and Periodicity Theorems (Two-part series).
  - \* Generalized Witt schemes in Algebraic Topology (Three-part series).
  - \* The  $EHP$ -sequence.
  - \* The Hopkins-Miller Theorem.
  - \* Equivariant K-Theory (Two-part series).
  - \* Étale Homotopy Theory, Galois Symmetry and the Adams Conjecture.
  - \* Stacks and Stable Homotopy Theory (Four-part series).
  - \* Fundamental Theorems in Algebraic K-Theory.
  - \* Clifford Algebras and Bott Periodicity.
  - \* Computing  $\pi_*tmf$ .
  - \* Elliptic Cohomology Theories.
  - \* The Algebraic  $K$ -theory of Spaces.
  - \* The Image of  $J$ .
  - \* Topological K-Theory.
  - \* Spectral Sequences.

### **Additional Information**

- U.S. Citizen.
- Experienced with computer programming and administration, including experience with Linux, Mathematica, Python, C, C++ and Java.
- Outside Interests: Cycling, camping, travel, puzzles, and games.