

# Gus Loneragan

PHD CANDIDATE · MATHEMATICS

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## Education

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### Massachusetts Institute of Technology

Cambridge, MA

PHD IN MATHEMATICS

2013-present

- All graduate work (except thesis) complete. GPA 5.0/5.0

### University of Cambridge

Cambridge, UK

B.A. AND MASTER IN MATHEMATICS

2009-2013

- Best in class. Average score 98/100

## Experience

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### University of Chicago

Chicago, IL

DICKSON INSTRUCTOR

September 2018-August 2021

### Massachusetts Institute of Technology

Cambridge, MA

TEACHING ASSISTANT

February 2017-May 2017

- Teaching assistant for 18.05, introduction to probability and statistics
- Held weekly recitations and office hours

### Massachusetts Institute of Technology

Cambridge, MA

TEACHING ASSISTANT

January 2017

- Teaching assistant for 18.095, mathematics lecture series
- Held weekly recitations and office hours
- Teaching rated at 6.3/7 by students

### Massachusetts Institute of Technology

Cambridge, MA

TEACHING ASSISTANT

February 2016-May 2016

- Teaching assistant for 18.02, multivariable calculus
- Held weekly recitations and office hours
- Teaching rated at 6.3/7 by students

### Massachusetts Institute of Technology

Cambridge, MA

PRIMES MENTOR

January 2016-January 2017

- Mentored a high school student on a research project which aims to compute characters of certain irreducible representations of modular Cherednik algebras

### Massachusetts Institute of Technology

Cambridge, MA

TEACHING ASSISTANT

September 2015-December 2015

- Teaching assistant for 18.821, project laboratory in mathematics
- Mentored and managed collaborative research projects with nine groups of three undergraduate students over the course of a semester
- Teaching rated at 6.8/7 by students

### Massachusetts Institute of Technology

Cambridge, MA

UROP+ MENTOR

May 2015-September 2015

- Mentored an undergraduate student on a research project computing signature characters of  $\mathfrak{sl}_3$  Verma modules

## IAS/Park City Mathematics Institute

GRADUATE SUMMER SCHOOL TEACHING ASSISTANT

Midway, UT

June 2015-July 2015

- Teaching assistant for the course 'geometric representation theory and quasi-maps into flag varieties'
- Led problem-solving sessions and answered questions related to the course

## Research Science Institute at Massachusetts Institute of Technology

RSI MENTOR

Cambridge, MA

June 2014-July 2014

- Mentored two high school students on mathematics research projects, both due for publication

## Massachusetts Institute of Technology

PRIMES MENTOR

Cambridge, MA

January 2014-January 2015

- Mentored a high school student on a research project computing signature characters of  $\mathfrak{sl}_2$  Verma modules and using this to provide a lower bound for the number of real critical points of a master function
- The student won a \$35,000 prize with this project at the 2015 Intel Science Talent Search
- Results are due for publication

## Honors & Awards

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- 2017 **Hartley Rogers, Jr., Family Prize**, for the best SPUR project
- 2017 **Charles and Holly Housman Award**, for excellence in teaching at MIT Mathematics
- 2013 **Akamai Presidential Fellowship**, fellowship award at MIT
- 2013 **Kennedy Scholarship**, prestigious academic award for study at MIT or Harvard
- 2013 **Schuldham Plate**, award for best graduating student at Gonville and Caius College, Cambridge

## Invited Talks and Workshops

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### Group Representation Theory and Applications

PROGRAM ASSOCIATE

Mathematical Sciences Research  
Institute

January 2018 - May 2018

### Geometric Langlands seminar

STEENROD'S CONSTRUCTION AND FROBENIUS CONSTANCY OF THE COULOMB BRANCH

University of Chicago

November 2017

- Used Steenrod's construction to prove that the quantum Coulomb branch is a Frobenius constant quantization

### Geometric Representation Theory Seminar

A DERIVED FROBENIUS TWIST

University of Berkeley

November 2017

- Used Steenrod's construction to give a derived version of the Frobenius twist functor under geometric Satake

### Rational Cherednik Algebras and Categorification (AMS)

FROBENIUS CONTRACTION AND SMITH THEORY

UC Riverside

November 2017

- Explained how to construct the Frobenius contraction functor for tilting modules using Smith theory

### Interactions between representation theory and algebraic geometry

HOW TO THINK ABOUT HOPF ALGEBROIDS USING FEYNMAN DIAGRAMS (POSTER)

University of Chicago

August 2017

- Demonstrated that the axioms of Hopf algebroids are most naturally presented using Feynman diagrams. Proposed a general dictionary between Hopf algebroids and effective field theories

### Lie groups seminar

FROBENIUS TWIST ON THE AFFINE GRASSMANNIAN

Massachusetts Institute of  
Technology

April 2017

- Explained an upgrade of my previous results on the Frobenius twist under geometric Satake, with a view towards the construction of a 'derived Frobenius twist'

## Representation theory seminar

University of Massachusetts at

Amherst

FOURIER TRANSFORM AND THE QUANTUM TODA LATTICE

March 2017

- Explained a result relating modules for the quantum Toda lattice to affine Weyl group-equivariant quasicoherent sheaves on the dual torus Lie algebra

## Representations and Related Geometry in Lie Theory (JMM)

Atlanta

FROBENIUS AND EMBEDDED GRASSMANNIANS

January 2017

- Explained various results related to the block decomposition under geometric Satake

## Sheaves and modular representations of reductive groups (AIM workshop)

Palo Alto

A GEOMETRIC CONSTRUCTION OF FROBENIUS

March 2016

- Explained the geometric construction corresponding to the Frobenius twist under geometric Satake

## Representation theory seminar

MIT and Northeastern University

SEVERAL TALKS ON THE FOLLOWING TOPICS

2014-present

- Tilting perverse sheaves and Soergel's theorem, following 'Tilting Exercises' by Beilinson, Bezrukavnikov and Mirković
- Kostant's theorem, Harish-Chandra's theorem and the Beilinson-Bernstein localization theorem
- Equivariant K-theory, perverse sheaves and affine Hecke algebras, following the book 'Representation Theory and Complex Geometry' by Chriss and Ginzburg
- Nakajima quiver varieties, following the paper 'Instantons on ALE spaces, quiver varieties, and Kac-Moody algebras' by Nakajima
- Nearby and vanishing cycles functors for holonomic D-modules

## Papers

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### CURRENTLY AVAILABLE

- Steenrod operators, the Coulomb branch and the Frobenius twist, I
- Parity Sheaves and Smith Theory; 1708.08174; with S. Leslie; submitted
- A remark on descent for Coxeter groups; 1707.01156
- A Fourier transform for the quantum Toda lattice; 1706.05344
- A Strong Splitting of the Frobenius Morphism on the Algebra of Distributions of  $SL_2$ ; 1611.07512
- Signatures of Multiplicity Spaces in tensor products of  $\mathfrak{sl}_2$  and  $U_q(\mathfrak{sl}_2)$  Representations; 1506.02680; with S. Kishore; accepted by Journal of Algebra
- The Lower Central Series of the Quotient of a Free Algebra; 1503.01447; with L. Kendrick

### IN PREPARATION

- Steenrod operators, the Coulomb branch and the Frobenius twist, II
- Hopf algebroids via Feynman diagrams