



# Amelia Perry

PHD CANDIDATE

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## Research interests

I design algorithms to analyze very noisy data, working at the interface of machine learning, optimization, statistical physics, and algebra. My work centers a family of noisy geometric problems arising in structural biology (cryo-EM), robotics, image processing, signals processing, and community detection in networks. Building on my work on cryo-EM, I am excited to immerse myself in the life sciences and bring data science to bear on meaningful scientific problems.

## Education

### Ph.D., Massachusetts Institute of Technology (expected)

IN APPLIED MATHEMATICS

Cambridge, MA

Sep 2013–Jun 2018

- Advised by Ankur Moitra, and co-advised by Jon Kelner.
- Thesis: *Inference with group structure: message-passing algorithms and invariant theory.*

### MMath, University of Oxford

IN MATHEMATICS

Oxford, UK

Oct 2009–Jun 2013

- First class honors in both the BA-equivalent and Master's parts.
- Advised by Christopher Douglas.
- Thesis: *Spin two-dimensional local field theories.*

## Publications

### Estimation under group actions: recovering orbits from invariants

AFONSO S. BANDEIRA, BEN BLUM-SMITH, **AMELIA PERRY**, JONATHAN WEED, AND ALEXANDER S. WEIN

2017+

- Working document in progress; available at [math.mit.edu/~awein/orbit-recovery.pdf](http://math.mit.edu/~awein/orbit-recovery.pdf)

### The sample complexity of multi-reference alignment.

**AMELIA PERRY**, JONATHAN WEED, AFONSO S. BANDEIRA, PHILIPPE RIGOLLET, AND AMIT SINGER

2017

- Under review; available at [arxiv.org/abs/1707.00943](http://arxiv.org/abs/1707.00943).

### Statistical limits of spiked tensor models.

**AMELIA PERRY**, ALEXANDER S. WEIN, AND AFONSO S. BANDEIRA

2016

- Under review; available at [arxiv.org/abs/1612.07728](http://arxiv.org/abs/1612.07728).

### Message-passing algorithms for synchronization problems over compact groups.

**AMELIA PERRY**, ALEXANDER S. WEIN, AFONSO S. BANDEIRA, AND ANKUR MOITRA

2016

- To appear in Communications on Pure and Applied Mathematics.

### Optimality and Sub-optimality of PCA I: Spiked Random Matrix Models.

**AMELIA PERRY**, ALEXANDER S. WEIN, AFONSO S. BANDEIRA, AND ANKUR MOITRA

2016

- To appear in Annals of Statistics.

### Optimality and Sub-optimality of PCA for Spiked Random Matrices and Synchronization.

**AMELIA PERRY**, ALEXANDER S. WEIN, AFONSO S. BANDEIRA, AND ANKUR MOITRA

2016

- Preprint, available at [arxiv.org/abs/1609.05573](http://arxiv.org/abs/1609.05573).

### How Robust are Reconstruction Thresholds for Community Detection?

ANKUR MOITRA, **WILLIAM PERRY**, AND ALEXANDER S. WEIN

2015

- In Proceedings of the 48th annual ACM Symposium on the Theory of Computing (STOC 2016).

## A semidefinite program for unbalanced multisection in the stochastic block model.

AMELIA PERRY AND ALEXANDER S. WEIN

2015

- In 2017 International Conference on Sampling Theory and Applications (SampTA 2017).

## Spin two-dimensional local field theories.

WILLIAM PERRY

2013

- MMath thesis, University of Oxford.

## Honors

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2013 **Best Mathematics Student**, SET Awards Europe

2013 **Dissertation Prize**, Mathematical Institute, University of Oxford

2013 **Honorable Mention**, NSF Graduate Research Fellowship

2010–2013 **Scholarship**, Keble College, Oxford

## Talks

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### Unbalanced multisection in the stochastic block model.

- Sampling Theory and Applications (SAMP TA 2017), Jul 2017.

### Computational to statistical gaps: predictions using statistical physics.

- Workshop on “Connecting communities via the block model”, American Institute for Mathematics, May 2017.
- Special lecture series at Courant Institute, New York University, May 2017.

### Optimality and sub-optimality of principal component analysis for spiked random matrices.

- Probability seminar, Courant Institute, Nov 2016.

### Message-passing algorithms for synchronization problems.

- (*poster*) New England Machine Learning Day, May 2017.
- Workshop on “Optimization and Statistical Learning”, École Physique des Houches, Apr 2017.
- (*poster*) Workshop on “Statistical Physics, Learning, Inference, and Networks”, École Physique des Houches, Feb 2017.
- LIDS Student Conference, MIT, Feb 2017.
- Simple Person’s Applied Math Seminar, MIT, Sep 2016.
- IDEAS seminar, Princeton University, May 2016.

### Statistical lower bounds for synchronization problems.

- Simple Person’s Applied Math Seminar, MIT, Apr 2016

### Models, algorithms, and lower bounds for community detection.

- Theory Lunch, MIT EECS, Feb 2016
- Simple Person’s Applied Math Seminar, MIT, Sep 2015

### Symmetric monoidal $(\infty,1)$ -categories and the stable motivic $(\infty,1)$ -category

- Talbot Workshop, Mar 2014
- Juvitop seminar, MIT, Feb 2014

## Software

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### SumOfSquaresOptimization.jl

JULIA PACKAGE FOR SOLVING CONVEX SUM-OF-SQUARES RELAXATIONS OF POLYNOMIAL PROBLEMS.

Feb 2015

- Available at [github.com/AmeliaPerry/SumOfSquaresOptimization.jl](https://github.com/AmeliaPerry/SumOfSquaresOptimization.jl).

### bpcobar

SMALL JAVA TOOL FOR COMPUTING IN THE COBAR COMPLEX FOR  $BP_*BP$ .

May 2014

- Available at [github.com/AmeliaPerry/bpcobar](https://github.com/AmeliaPerry/bpcobar).

### resolution

JAVA SOFTWARE FOR COMPUTING AND VISUALIZING  $E_2$  TERMS OF VARIOUS SPECTRAL SEQUENCES.

Nov 2013

- Available at [github.com/AmeliaPerry/resolution](https://github.com/AmeliaPerry/resolution).
- Used by several topologists for both research and pedagogy.

# Service

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## TEACHING

Spring '16	<b>Teaching assistant</b> , 18.03 Differential Equations	MIT
Fall '15	<b>Grader</b> , 18.657 Mathematics of Machine Learning	MIT
Spring '15	<b>Grader</b> , 18.330 Introduction to Numerical Analysis	MIT
Fall '14	<b>Teaching assistant</b> , 6.042 Mathematics for Computer Scientists	MIT
'12 & '13	<b>Head Counselor</b> , Program in Mathematics for Young Scientists (PROMYS), six week summer program	Boston University
'11	<b>Counselor</b> , Program in Mathematics for Young Scientists (PROMYS), six week summer program	Boston University

## MENTORING

2016	<b>Mentor</b> , Summer Program in Undergraduate Research (SPUR), six week summer project	MIT
2016	<b>Mentor</b> , Undergraduate Research Opportunity (UROP), three month summer project	MIT
Jan '16	<b>Mentor</b> , Directed Reading Program (DRP)	MIT
Jan '14	<b>Mentor</b> , Directed Reading Program (DRP)	MIT

## REVIEWING

**Conference reviewer**, RANDOM 2017, NIPS 2017, SampTA 2017, ISIT 2017, STOC 2017, SODA 2017  
**Journal reviewer**, Communications in Pure and Applied Mathematics, IEEE Transactions on Information Theory, Annals of Statistics

## ORGANIZATION

Feb 2017	<b>Event organizer</b> , Diversity event at MIT Mathematics with LBGT@MIT	MIT
2015–2016	<b>Seminar organizer</b> , Simple Person's Applied Math Seminar	MIT

# REFERENCES

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## Ankur Moitra ([moitra@mit.edu](mailto:moitra@mit.edu))

ROCKWELL INTERNATIONAL CAREER DEVELOPMENT ASSOCIATE PROFESSOR, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

## Philippe Rigollet ([rigollet@math.mit.edu](mailto:rigollet@math.mit.edu))

ASSOCIATE PROFESSOR, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

## Afonso Bandeira ([bandeira@cims.nyu.edu](mailto:bandeira@cims.nyu.edu))

ASSISTANT PROFESSOR, NEW YORK UNIVERSITY