

# EIGHTH ANNUAL PRIMES CONFERENCE 2018

## Program for Research In Mathematics, Engineering, and Science for High School Students



Photo: Slava Gerovitch

### Saturday, May 19

#### 8:30 am Welcoming remarks

Prof. Michel Goemans, Head of the MIT Mathematics Department  
Prof. Pavel Etingof, PRIMES Chief Research Advisor  
Dr. Slava Gerovitch, PRIMES Program Director

#### 9:00 am Session 1: Combinatorics

James Lin, Carl Joshua Quines, and Espen Slettnes, *Throttling numbers for Cop vs Gambler* (mentor Dr. Jesse Geneson, Penn State)  
Nathan Ramesh, *Maximal difference avoiding subsets of  $Z$*  (mentor Christian Gaetz)  
Sean Elliott, *Anti-Ramsey type problems* (mentor Dr. Asaf Ferber)  
Ezra Erives, Srinivasan Sathiamurthy, and Theodore Baas, *Asymptotics of visibility in three-dimensional grid worlds* (mentor Dr. Zarathustra Brady)

#### 10:35 am Session 2: Geometry and Topology

Ryan Kim, *Cohomology groups of the dual Steenrod algebra* (mentor Sanath Devalapurkar)  
Daniel Liu, *New fusion products for the affine  $sl(2)$  at level  $k=1/2$*  (mentor Dr. Claude Eicher)  
Jiwon Choi, *Gromov-Hausdorff distance between metric spaces* (mentor Ao Sun)  
Sathwik Karnik, *Bounds on the maximal cardinality of an acute set in a hypercube* (mentor Ao Sun)

#### 11:50 am Session 3: Knot Theory

Max Guo, *On Khovanov homology, Bar-Natan's perturbation, and Conway mutation* (mentor Dr. Jianfeng Lin)  
Aayush Karan, *Mutation invariance of the Szabó spectral sequence* (mentor Dr. Jianfeng Lin)  
Nithin Kavi and Wendy Wu, *Width and trunk of satellite knots* (mentor Zhenkun Li)

#### 2:00 pm Session 4: PRIMES Circle

Isabel Vogt, PRIMES Circle Coordinator, *Introduction*  
Sherry Lim and Mirilla Zhu, *Permutations for preschoolers: Applications of group theory to childhood games* (mentor Margalit Glasgow)  
Sekai Carr and Laura Clervil, *Connect Spokes: An original combinatorial game* (mentor Marisa Gaetz)  
Elizabeth Ewart and Anna Rasmussen, *Graphs and the chromatic polynomial* (mentor Dhruv Ranganathan)  
Carly Maggiolo Cabrera and Elisandra Fontes, *Probability, statistical tests, and fair die* (mentor Alexis Oriole)

#### 3:40 pm Session 5: Applied Mathematics

Rinni Bhansali, *Modelling epidemics on polluted networks and m-state networks* (mentor Prof. Laura Schaposnik, University of Illinois at Chicago)  
Vincent Huang, *Mathematical and algorithmic models of refugee crises* (mentor Prof. James Unwin, University of Illinois at Chicago)  
Kaiying Hou, *Agent-based models for conservation equations* (mentor Andrew Rzezniak)

#### 4:35 pm Session 6: Algebraic Combinatorics and Probability

Melinda Sun, *Counting bimonotone subdivisions* (mentor Dr. Elina Robeva)  
Haneul Shin, *Bimonotone subdivisions in high dimensions* (mentor Dr. Elina Robeva)  
Stanley Wang, *Moduli space of planar tropical curves of genus 1* (mentor Yu Zhao)  
Gopal Goel and Andrew Yao, *Derivatives of the Gaussian free field via random matrix theory* (mentor Andrew Ahn)

#### 5:50 pm Session 7: Representation Theory and Number Theory

Yuting (Emma) Qin, *The elliptic Kashiwara-Vergne Lie algebra* (mentor Dr. Florian Naef)  
Byung Yeon Rhee, *Elliptic curves, factorization, and cryptography* (mentor Yongyi Chen)  
Merrick Cai, *The Hilbert series of the irreducible representation of the rational Cherednik algebra of type  $A_n$  in characteristic  $p$*  (mentor Daniil Kalinov)  
Archer Wang, *Hilbert series of quasi-invariant polynomials* (mentor Dr. Xiaomeng Xu)

### Sunday, May 20

#### 8:45 am Welcoming remarks

Dr. Slava Gerovitch, PRIMES Program Director  
Dr. Tanya Khovanova, PRIMES Head Mentor

#### 9:00 am Session 8: Combinatorics

Vinjai Vale, *A new paradigm for computer vision based on compositional representation* (mentor Kevin Ellis)  
Ben Chen, Richard Chen, Joshua Guo, Shane Lee, Neil Malur, Nastia Polina, Poonam Sahoo, Anuj Sakarda, Nathan Sheffield, and Armaan Tipirneni (PRIMES STEP Senior students), *On base  $3/2$  and its sequences* (mentor Dr. Tanya Khovanova)  
Matvey Borodin, Hannah Han, Kaylee Ji, Alexander Peng, David Sun, Isabel Tu, Jason Yang, William Yang, Kevin Zhang, and Kevin Zhao (PRIMES STEP Junior students), *Chips Go BOOM BOOM!!!* (mentor Dr. Tanya Khovanova)

#### 10:10 am Session 9: Combinatorics

Vincent Bian, *Packing anchored rectangles* (mentor Dr. Tanya Khovanova)  
Eric Zhang, *On quasirandom permutations* (mentor Dr. Tanya Khovanova)  
Wayne Zhao, *Counting Sudoku variants* (mentor Dr. Tanya Khovanova)

#### 11:05 am Session 10: Analysis

William Fisher, *Polynomial Wolff axioms and Kakeya-type estimates for bent tubes* (mentor Robert Burklund)  
Alan Yan, *Asymptotic counting in dynamical systems* (mentor Prof. Sergiy Merenkov, CCNY – CUNY)  
Andy Xu, *Approximating the Hurwitz zeta function* (mentor Hyun Jong Kim)

#### 12:00 pm Session 11: Algebraic combinatorics

Aurash Vatan, *Finding generators of Jacobian groups of finite graphs* (mentor Dr. Xiaomeng Xu)  
Daniel Zhu, *On the Okounkov-Olshanski formula for the number of tableaux of skew shapes* (mentor Prof. Alejandro Morales, UMass Amherst)  
Allen Wang, *Permutations with up-down signatures of nonnegative partial sums* (mentor Guangyi Yue)

#### 2:00 pm Welcoming remarks

Prof. Srinivasa Devadas, MIT EECS Department

#### 2:10 pm Session 12: Computer Science

Vivek Bhupatiraju, *accAAD: Efficient Append-Only Authenticated Dictionary for Transparency Logs* (mentor Alin Tomescu)  
Theodor Lukin Yelin, *Designing private forums using differential privacy* (mentor Albert Kwon)  
Sanjit Bhat and David Lu, *Var-CNN and DynaFlow: Improved attacks and defenses for website fingerprinting* (mentor Albert Kwon)  
Harshal Sheth and Andrew Sun, *Extending distributed-systems tracing vertically into the Linux kernel* (mentor Dr. Raja Sambasivan, Boston University)

#### 3:30 pm Session 13: Medical Informatics

Makiah Bennett, *Lexical AI for patient-centered clinical diagnoses* (mentor Prof. Gil Alterovitz)  
Andrew Gritsevskiy, *Capsule networks for low-data transfer learning* (mentors Prof. Gil Alterovitz and Maxim Korablyov)  
Kevin Hu, *Discovery of exon splicing relationships across cancer cell lines* (mentor Dr. Mahmoud Ghandi, Broad Institute)

#### 4:25 pm Session 14: Math Reading Groups

Nhat Pham and Anmol Sakarda, *Concrete mathematics: Exploring summations* (mentor Zhulin Li)  
Dylan Pentland, *The  $j$ -invariant of an elliptic curve* (mentor Chun Hong Lo)

#### 5:10 pm Session 15: PRIMES Circle

Aneesha Manne and Lara Zeng, *Generating functions in combinatorics* (mentor Uma Roy)  
Iris Yang and Victoria Zhang, *Gaussian integers and their relationship to ordinary integers* (mentor Matthew Weiss)  
Sam Costa and Elin Gu, *Inverse knots and amphicheirality* (mentor Joseph Zurier)

Room 4-370, MIT  
[web.mit.edu/primes](http://web.mit.edu/primes)

