

Frank and Brennie Morgan Prize



The AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student is awarded annually to an undergraduate student (or students for joint work) for outstanding research in mathematics.

The prize recipient's research needn't be confined to a single paper. However, the paper (or papers) to be considered for the prize must be completed while the student is an undergraduate. Publication of research is not required.

The prize was established in 1995 and is entirely endowed by a gift from Mrs. Frank (Brennie) Morgan. The prize is made jointly by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.



Letong (Carina) Hong

Citation

Letong (Carina) Hong

The recipient of the 2023 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student is Letong (Carina) Hong of MIT. Hong has solved conjectures and proven important results in combinatorics, number theory, and probability. She has written 9 research papers, 7 of which have already been published or

accepted, including in journals such as *Research in Number Theory*, *Combinatorial Theory*, and *Advances in Applied Mathematics*. Hong's level of accomplishment is even more striking, as she graduated from MIT after only three years.

Hong has an extensive collection of impressive results in number theory. With Mertens, Ono, and fellow undergraduate Shengtong Zhang, Hong has proven a conjecture of Căldăraru, He, and Huang, the "Moonshine conjecture at Landau-Ginzburg points," which concerns the elliptic expansion of the j -function at certain cusps and the classical rational function defining the hypergeometric inversion formula for the j -function. Hong, Ono and Zhang have studied Euler-Kronecker constants for cyclotomic fields, giving strong theoretic evidence for a conjecture on their sizes. Hong and Zhang have proven a conjecture of Ballantine and Merca, giving a detailed analysis of certain congruences for products of theta functions. With Zhang,

she also made significant progress towards a conjecture of Heim and Neuhauser on the unimodality of Nekrasov-Okounkov polynomials, which play an interesting role in the representation theory of the symmetric group. Hong and Amir have proven results for newforms of weight 2 and 3, generalizable to higher odd weights, related to Lehmer's conjecture on the nonvanishing of Ramanujan's τ -function.

Hong has also done outstanding work in combinatorics and related fields. She has proven a conjecture of Defant by showing that a certain generating function defined in terms of the dynamics of the pop-stack sorting operator acting on Tamari lattices is a rational function. Hong and Zhang proved that there are no extremal squarefree words over alphabets of size at least 17, making significant progress towards the conjecture that there are no such words over alphabets of size at least 4. With Miklós she exhibited an irreducible Markov chain on edge k -colorings of bipartite graphs with small diameter and large Metropolis-Hastings acceptance ratio, with application in Latin rectangle completions. Hong has worked on additional projects about pattern avoidance in inversion sequences and local limits of high genus planar maps. The committee was very impressed by Hong's ability to work on problems in so many different mathematical areas, and to make progress on conjectures that are of significant interest to the mathematical community.

In addition to her excellent research work, Hong made extensive contributions while at MIT through her work as President of the Undergraduate Math Association, President of the International Students Association, and in executive roles with the First-Generation and/or Low-Income

student coalition and the Society of Physics Students. She received the 2022 Alice T. Schafer Mathematics Prize from the AWM. Hong will continue her studies as a graduate student at Oxford as a Rhodes Scholar and then head to Stanford.

Biographical Note

Letong (Carina) Hong is from Canton, China. For ten years she trained in contest-style problem-solving at her province's Olympiad math team. She fell in love with Legendre/Jacobi symbols and handle theory at the Ross Program and Stanford Math Camp and decided to pursue higher mathematics. With this new goal she self-studied English in order to understand the GTM [Graduate Textbooks in Mathematics] vocabulary but could not access research opportunities until college. Carina received dual bachelor's degrees in math and physics from MIT and has conducted research at the BSM, UVA, and Duluth REUs [Research Experiences for Undergraduates]. Currently, she is at Oxford working with Professor Ben Green FRS.

Growing up, Carina was heavily involved in debate, emceeing, and dance. While at MIT, she could be found stargazing at Wallace Observatory, competing in electronic trading, and chasing her classmates around in live-action mafia. She also enjoys skiing and competitive cheerleading, though she had to fall down a lot in both.

Response from Letong (Carina) Hong

I am beyond grateful to have been selected as the recipient of the 2023 Frank and Brennie Morgan Prize. I would like to extend my deepest gratitude to Mrs. Morgan and the AMS, MAA, and SIAM for encouraging undergraduates pursuing mathematical research.

I would like to especially thank my undergraduate advisor Professor Pavel Etingof whose kindness and support has been defining in my mathematical journey. He believed in me, gave me tremendous invaluable advice, and offered the most generous help during various difficult times.

I am also grateful to Professor Ken Ono for dedicating himself to develop me as a researcher since the UVA REU and throughout my entire undergraduate career. The many elegant number theory problems I was so fortunate to encounter because of him engendered in me an intense fascination in research such that I am not fearful of the problem difficulty. Further I am deeply thankful to Professor Joseph Gallian for the lasting effort, determination, and care he put into running the Duluth REU; into every field trip and into every single student. I feel blessed that I found a community that gave me a sense of security, belonging, and empowerment at Duluth, and in particular I want to thank Dr. Colin Defant for leading me on an algebraic combinatorics adventure.

Finally, I want to thank Professor István Miklós, for being an amazing mentor, collaborator, and friend since the BSM;

Professor Scott Sheffield, for walking me into the brilliant world of random surfaces with charisma and humor; and Professor Henry Cohn, for teaching me so much about an intricately charming problem and encouraging me especially during setbacks. I profoundly cherish each of these experiences.

Lastly, I thank my family for their unconditional love, and especially my mother who pours her heart into supporting me every step of the way.



Egor Lappo

Citation

Egor Lappo

Receiving Honorable Mention for the 2023 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student is Egor Lappo. Lappo has received a BS with Honors in Mathematics from Stanford University, where he is currently pursuing a doctorate in Biology. Lappo's work addresses combinatorial and probabilistic problems in

the field of mathematical evolutionary biology, within which he has formalized and resolved conjectures and opened new frameworks. This work has resulted in two published coauthored mathematical research papers (and two additional manuscripts under review) and displays expertise crossing fields including Mathematics, Statistics, Biology, and Computer Science. Furthermore, he has written an honors thesis titled "Concordance of spatial graphs" in the area of modern knot theory. In this research, Lappo generalized Taniyama's work to concordance of arbitrary spatial graphs.

Lappo's work has been described as "creative, independent, voluminous, and diverse in scope and technique". Egor Lappo is recognized with an honorable mention for the 2023 Frank and Brennie Morgan Prize for his outstanding research in combinatorics, knot theory, and mathematical evolutionary biology.

Biographical Note

Egor Lappo grew up in Tula, Russia. In high school, he was an active participant in science olympiads, and was awarded a Gold Medal at the 2017 International Biology Olympiad. As an undergraduate at Stanford University, he unexpectedly fell in love with geometric and topological topics, which led him to major in mathematics. This fall, he begins graduate studies in Biology at Stanford University, specializing in population biology and evolutionary genetics. Aside from research, you can always talk to Egor about modernist literature, Marxist political theory, or obscure video games. In his free time, you can often find

Egor cycling around Palo Alto, learning jazz guitar, or playing chess.

Response from Egor Lappo

I am incredibly honored to receive an Honorable Mention for the 2023 Morgan Prize. I would like to thank everyone who helped me on my academic journey. I am grateful to my family, especially my mother Natalia, who supported me all these years and gave me opportunities to pursue my interests. I want to thank Noah Rosenberg, to whom I owe most of my progress as a scientist. Ciprian Manolescu introduced me to the field of low-dimensional topology and provided invaluable guidance and encouragement while supervising my thesis, for which I am immensely thankful. I want to honor Yakov Eliashberg and Lenya Ryzhik for their patience with me during our lengthy discussions. I also want to thank Marcus Feldman, who encouraged me to be more independent and ambitious in my research. Finally, I am grateful to Sharon Du for her unwavering support.



Sophie Kriz

Citation

Sophie Kriz

Receiving Honorable Mention for the 2023 Frank and Brennie Morgan Prize for Outstanding Research by an Undergraduate Student is Sophie Kriz of University of Michigan. She has written ten solo-authored research papers in representation theory and category theory, and has also co-authored a textbook, *Introduction to Algebraic Geometry*. Sophie's letter writers

emphasized her independence and one wrote that the "range of subjects tackled and the sheer level of expertise exhibited are truly astonishing."

Sophie has recently given a counterexample to a long-standing conjecture in equivariant stable homotopy theory, the evenness conjecture for homotopical complex bordism. A basic and interesting question is to understand the equivariant analogue of complex cobordism. Computing the coefficient ring of homotopical equivariant complex cobordism for general groups G turns out to be a difficult problem. An old conjecture, which was established over 30 years ago for abelian groups, is that the graded coefficient rings are concentrated in even degrees. Sophie's work provides explicit counterexamples to the conjecture and her method of proof sheds light on the structure of the coefficient ring. Sophie's results establish new completion theorems for a wide class of equivariant cohomology theories and are likely to have a lasting impact in the field. Sophie has also made significant progress in the study of

the structure of FI-Modules, and has developed an original generalization of the notion of operads.

Sophie's letter writers were particularly enthusiastic about this recent work and note that her research to date "would be surprising for a graduate student" and that she has "produced a body of work that would be the envy of most post-docs."

Biographical Note

Mathematics has been **Sophie Kriz's** main interest since an early age. She began school as a non-degree student and later became a regular student at the University of Michigan. She is currently finishing her Honors Major in Mathematics this year.

She always enjoyed doing research in mathematics. She has written over 10 research papers, six of which are currently published or accepted for publication. She also co-authored a textbook in algebraic geometry. In addition, she participated in Math Corps at the University of Michigan. She also enjoys playing the piano.

Response from Sophie Kriz

My goal is to do good mathematics and I am honored to be recognized for it. I wanted to thank Professor Andrew Snowden for his mentorship and all those who supported my nomination.

Credits

Photo of Letong (Carina) Hong is courtesy of Junwei Guo. Photo of Egor Lappo is courtesy of Egor Lappo. Photo of Sophie Kriz is courtesy of Sophie Kriz.