



*Prof. Ben Weinkove,
Math Dept Chair*

Letter From the Chair

Prof. Ben Weinkove, Dept Chair

"It was the best of times, it was the worst of times." This academic year started in the worst possible way, with the untimely passing of our beloved colleague **Steve Zelditch** on September 11, 2022. Steve is survived by his wife (our colleague and Associate Chair) **Ursula Porod**, and their two sons Benjamin and Phillip. We held a memorial event on October 26, 2022, which featured talks on some of Steve's best-known work. Next year, our Emphasis Year will be "Asymptotics in Geometry and Analysis: The Mathematics of Steve Zelditch", during which we will hear more about Steve's wide-ranging mathematical legacy. You can read more about Steve, and our memories of him, in this newsletter.

You can also read about Professor Emeritus **Yuri Manin**, Board of Trustees Professor in our department from 2002 to 2011. Manin passed away on January 7, 2023. Among his many awards, Manin was the first winner of Northwestern's Nemmer Prize in Mathematics in 1994.

This academic year saw the ending of pandemic restrictions and the department return to its busy and energetic former self. We had visits by three distinguished lecturers: **Svetlana Jitomirskaya** of UC Irvine gave the Bellow Lectures; **S.Y. Alice Chang** of Princeton gave the Yamabe Lectures and **Camillo De Lellis** of the Institute for Advanced Study gave the Pinsky Lectures. We held a week-long conference "Homotopy 2023", or more colloquially "Goerss-fest", in honor of our retiring colleague **Paul Goerss**. We also held the Midwest Probability Colloquium, the May Midwestern Microlocal Meeting and the meeting

"Algebraic Geometry and Cohomology in Mixed Characteristic" in honor of 2022 Nemmers Prize winner **Bhargav Bhatt** of Princeton/IAS. Activities related to our five-year \$2.5m RTG grant in Dynamics from the NSF are ramping up this year, thanks to the hard work of Principal Investigator **Bryna Kra** and co-PIs **Nir Avni**, **Aaron Brown**, **Ilya Khayutin** and **Jared Wunsch**. We're delighted to be back to our busy schedule of seminars, colloquia, award ceremonies and social events. Our common room is buzzing again. At tea, the pandemic era single-serve cookies are now banished (we're still working on getting through the gummi bears!)

The department's faculty continues to grow in exciting new directions. This year we were joined by Professor **Tsachik Gelfander** (groups, geometry and dynamics), Assistant Professor **Reza Gheissari** (probability), Associate Professor of Instruction **Sonja Mapes** (commutative algebra) and Professor **Gabor Szekelyhidi** (geometric analysis). This Fall, we look forward to welcoming two more faculty members. **Maksym Radziwill**, who was just awarded the 2023 AMS Cole Prize in Number Theory, will join us as professor of mathematics from the University of Texas at Austin. Radziwill works on analytic number theory and its interactions with probability theory, spectral theory and harmonic analysis. We are also excited to have **Ananth Shankar** join us as an assistant professor. Coming from the faculty of the University of Wisconsin at Madison, Shankar works in arithmetic geometry and number theory.

You'll read in this newsletter some of the many accomplishments of our students and faculty. You'll see an interview with Professor **Bryna Kra**, who started her two-year term as President of the American Mathematical Society in February 2023. Thanks to her continuing ground-breaking research, she is also garnering accolades along the way! You can read an interview with Associate Professor of Instruction **Aaron Peterson**, who was awarded the 2023 Charles Deering McCormick Distinguished Professorship of Instruction. This is the highest award given by the university for teaching track faculty, recognizing Aaron's outstanding instruction and mentoring.

Some breaking news: Professor **Aaron Naber** has just been named a Simons Investigator in Mathematics by the Simons Foundation, a prestigious award which comes with almost \$1 million in research funds over 5 years. Congratulations Aaron!

We also congratulate two of our faculty for their upcoming promotions starting this Fall: **Aaron Greicius** to Professor of Instruction and **Bao Le Hung** to Associate Professor!

This year saw exciting changes to our undergraduate curriculum. New math major requirements, years in the making, were approved by the department and the college. They include a new computing requirement and the introduction of "General" and "Pure" mathematics concentrations.

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Prof. Ben Weinkove welcoming Math faculty members, graduate students, and staff to the 2023 Mathematics Graduate and Teaching Awards celebration

Interview with NU Math Faculty Member, Prof. Bryna Kra

This year you began your term as President of the American Mathematical Society. What challenges does the AMS face? Can you tell us about some of your goals and initiatives?

Kra: The AMS aims to serve the entire mathematical community, and this is an incredibly varied and diverse group to be served by a single organization. I'm working to reinforce our existing programs, supporting research and researchers in mathematics, while finding new ways to expand our reach and broaden the constituencies we support. One of my big goals was to find way to support researchers at primarily undergraduate institutions, and this has come to fruition with the introduction of the rollout of the new AMS-Simons grants. I hope that this is just a first step in providing greater research funding for a greater number of researchers.

Last year you posted a paper proving an old conjecture of Erdős, which made a big splash. It was featured in a December 2022 article in Quanta Magazine. Can you tell us a bit about how you came to work on this conjecture, and what led to its resolution?

Kra: This was the culmination of years of work with my excellent collaborators, combining expertise from different perspectives. My three coauthors had solved the first major piece in the program in earlier work, and while some of them were postdocs here at Northwestern, we began exploring the generalizations we worked on together. Though we had been meeting in person, when everything moved online in spring 2020, it was natural to start talking with all of them over Zoom. We started by exploring every aspect of the earlier work, changing each step in the argument until we could cover the general case. There was no single breakthrough moment, but just many small steps forward over a long period.

You were elected as a Foreign Member of the Chilean Academy of Sciences. Can you tell us about your connections to Chile?

Kra: I first visited Chile in 2006, giving a mini-course at one of their summer schools. It was terrific, and not just because I got to enjoy summer during our winter.



Prof. Bryna Kra,
Sarah Rebecca Roland
Professor of Mathematics

A few years later, I began collaborating with **Alejandro Maass**, and we have worked on several different research projects and discussed many others. I've been back to Chile several times for conferences and invited lectures, serving on the scientific committee for the Center of Mathematical Modeling at the University of Chile, and interacting with numerous postdocs and students. It's an incredibly vibrant mathematical community in an amazing country.

You are the principal investigator on a \$2.5 million Research Training Grant in dynamics at Northwestern. Can you tell us about some of your planned activities, and how this will impact the department?

Kra: This grant will vastly increase the research activity in dynamics at Northwestern. This summer, we are running a Research Experience for Undergraduates, and ten students will be joining us from across the country to work on projects with six faculty, focusing on dynamics problems. **Aaron Brown** is organizing a two week summer school, with an international slate of speakers for mini-courses and lectures.

We've hired two new postdoctoral fellows in dynamics, starting in fall 2023 and in fall 2024, and will be hiring further postdocs over the next few years. Each year, we have numerous short term visitors, for the seminar and for longer visits, interacting with our faculty and students. It's already a lot of activity and is going to be a lot more.

You are juggling many things at the same time: research, teaching, and a huge amount of administrative work, including being president of the AMS. Any time-management secrets to share?

Kra: Unfortunately no great advice on this, but just that I try to carve out time for the aspects of my work that don't happen at regularly scheduled hours. In particular, I have to schedule time in my calendar for research, as otherwise all of my time gets used for other activities.

Is there one aspect of your work that you enjoy the most?

Kra: I enjoy all aspects, as otherwise I could really stop doing many of them. Each activity brings a different type of enjoyment. It's terrific when research comes together, like it did this year on the Erdős project, but that's rather infrequent given how much time is spent on it! On the other hand, joy from teaching is much more frequent, particularly when I get to see that a student has deeply understood something or even better when the student gives me a new way to understand a topic. Even committee work brings satisfaction, when I am able to get something done that will help others.

You were named a 2023 AWM Fellow for your work on creating programs to support women in math, your leadership in the community and your advocacy for women in math. What more can the profession do to help to increase the representation of women in math?

Kra: Mathematics has a long way to go in diversifying the profession, not just in terms of gender but on many axes. This is not up to a few individuals to make changes, but is really up to all of us to make the community open and welcoming, and these efforts do not have to be grandiose, but can be on a small scale by encouraging individuals at all career stages.

If you could go back in time to give your former self career advice, when would you go back and what would the advice be?

Kra: I would encourage myself to be bolder in asking for assistance to support research, whether that be financial assistance to attend a meeting or work with someone or something less tangible, like more convenient scheduling of a seminar or a class. It's only looking back that I understood that people are more willing to help than they may seem, but they might just not know what would help.

FACULTY SPOTLIGHT: AARON PETERSON



NU Math faculty members and graduate students at the 2023 Graduate Student Barbeque



Prof. Aaron Peterson

Interview with NU Math Faculty Member, Prof. Aaron Peterson

Congratulations on being named a Charles Deering McCormick Distinguished Professorship of Instruction! You have previously won a Weinberg teaching award and have been named on the ASG Honor Roll multiple times. Can you tell us about your teaching philosophy and how you became a popular and effective instructor?

Peterson: Drawing students to mathematics through compelling and accessible experiences drives all aspects of my teaching. I try to make mathematical content as transparent as possible from the student perspective, and ask my students to interact with material in ways that integrate new ideas into those they have already mastered. I also ask students to flesh out much of the content on their own (perhaps in guided activities) so that they develop ownership over the big ideas. Personal connection has a powerful effect on the way that people think and react, and I try to leverage this as much as possible to help students attain their educational goals while developing a positive relationship with mathematics. I'm not sure I can comment on popularity, but this approach has seemed to help students succeed in their courses and, even better, find reasons to keep studying mathematics after they leave my class.

Is there any person who inspired you in your career as a teaching track faculty member, such as a professor you took a class from when you were a student?

Peterson: Do I have to identify just one? Several professors (too many to name!) at Luther College inspired a great deal of excitement about mathematics by *showing* excitement, regardless of the level of course. My thesis advisor (**Alexander Nagel**) at UW-Madison illustrated how simply treating students with respect can inspire them to engage more deeply with mathematics. At Northwestern, **John Alongi** demonstrated the full potential of meticulous planning and careful framing to transform topics students sometimes find byzantine into clear, almost inevitable stories highlighting beautiful mathematical ideas.

What do you find most rewarding about teaching?

Peterson: Without a doubt, the most rewarding part of teaching (for me) is seeing students achieve their educational goals. It is even better when those goals expand to include more mathematics than the student had anticipated.



Math Dept faculty and students at the 2023 Spring Women in Math Luncheon

Letter from the Chair, Continued from Page 1

Thanks to DUS **Santiago Cañez** for overseeing these developments! Our new undergraduate colloquium saw talks by our very own **Bryna Kra** on her resolution of a conjecture of Erdős (featured in Quanta Magazine!), and by former PhD student **Boris Hanin** on machine learning.

We are sad that leaving us this year are Professor of Instruction **John Alongi**, who will take a position at the University of Chicago, and Financial Assistant **John Mocek**, who is moving to another unit at Northwestern. We will miss them both; at the same time we wish them the best of luck in their new positions.

Finally, Professor **Paul Goerss** retires this year after 25 years on our faculty. Read in these pages about his accomplishments in mathematics and in the department. We wish Paul a long and happy retirement!

WHERE ARE THEY NOW: GRADUATE STUDENT ALUMNI



Honghao Gao,
NU Math Graduate Student Alumnus

"After graduating from Northwestern in 2017, I spent 2 years in France as a postdoc -- a couple of months in Paris 6 and the rest of the time at Fourier Institute in Grenoble. Then I had another postdoc at Michigan State University from 2019-2022. Starting from September 2022, I am a tenure track assistant professor at Tsinghua University in Beijing, China.

I am doing research mathematics in symplectic and contact topology, a continuation of the direction that I pursued during my graduate study.

I had very fond memories of the common room on the second floor of Lunt Hall. The daily tea time and the Friday happy hours at the common room were perfect occasions to engage with the professors and fellow graduate students. The board there was a perfect match with Hagoromo chalks which gave me infinite inspirations when discussing mathematics. The wine and cheese party every quarter is also a memorable event in that room. The common room was expanded and renovated probably around 2015, and became more spacious and welcoming. I definitely spent more and more time in that room until I graduated.

I wish I could visit again this amazing place and the friendly math community that I loved."

-- Honghao Gao, NU Math Graduate Student Alumnus



Anh Le (left), NU Math Graduate Student Alumnus

"After graduating from Northwestern, I was a postdoc at the Ohio State University for 3 years (August 2020 - August 2023). Starting in Fall 2023, I will be a tenure track assistant professor at University of Denver.

Currently and for the foreseeable future, I will continue doing what I love: do math and teach math. I have many cherished memories about the time at Northwestern. I remember the stressful first year when preparing for the preliminary exams. Corinna, Kitty, and I spent many afternoons in Lunt basement to study together. Near the exam dates, I remembered Corinna was so worried that she almost cried. Thankfully, all three of us passed the exams. It was not fun, but looking back, it is definitely worth it. We've grown and learned a lot after that challenge."

-- Anh Le,

NU Math Grad Student Alumnus



Kitty Yang,
NU Math Graduate Student Alumna

"My previous/upcoming positions: 2020-2022: Postdoc at University of Memphis, 2022-2023: Visiting Assistant Professor at Kenyon College, 2023: Assistant Professor at UNC Asheville.

I've always been interested in teaching math, and I'm thrilled to join UNCA, a public liberal arts school where I can focus on teaching, but also have the opportunity to continue research, especially with undergrads.

When I was at Northwestern, I was deeply involved in the grad unionization effort. I'm so pleased that the grads overwhelmingly voted yes for a union this year, and I hope that all future grad students have a great experience at NU, as I did."

-- Kitty Yang, NU Math Grad Student Alumna



Elden Elmanto,
NU Math Graduate Student Alumnus

"I was a postdoc at University of Copenhagen in Fall 2018, a postdoc at MSRI (program on derived algebraic geometry) in Spring 2019 and then a Benjamin Peirce fellow at Harvard from Fall 2019 to Spring 2023. I will start a tenure track assistant professorship at the University of Toronto in Fall 2023.

I will always remember the countless hours I spent at the basement of Lunt hall - I think I actually still have some stuff hidden there in a closet somewhere! I am currently developing a general theory of motivic cohomology of schemes (with **Matthew Morrow**) and all the math I learned at Northwestern are coming together in some sort of union!"

-- Elden Elmanto, NU Math Grad Student Alumnus



Prof. Eric Zaslow,
Causeway Program Director



2023 Spring Causeway Program Celebration

The Causeway Program:

Prof. Eric Zaslow, Causeway Program Director

This was the second year of the Causeway Postbaccalaureate Certificate Program. Causeway is a year-long postbac with the aim of increasing the number of students from historically under-represented groups enrolling in competitive doctoral programs in the mathematical sciences.

This year we had four students attending Causeway, three in the Pure Math track and one in the Applied track: Alex Bisnath, Fabio Isaza, Eric Vazquez and Dasani Watkins. These students represented a diverse array of backgrounds and interests.

Causeway runs on the hard work of the students and the many faculty, postdocs and graduate students who help. Wenyan Li ran the GRE Boot Camp. Apurva Nakade and Jose Pastrana served as Causeway TA's for algebra and analysis, respectively.

Catherine Ray and Jenny Jones were graduate peer mentors, and Shuyi Weng and Katrina Morgan were postdoc mentors. Bryna Kra, Tuca Auffinger, Dave Chopp, Ezra Getzler and myself served as faculty advisors.

Causeway is governed by a committee comprised of John Alongi, Santiago Canez, Bryna Kra, Onnie Rogers (Psychology) and myself. In addition, Dave Chopp (ESAM) was a consistent help to our Applied student.

One of our four students will head off to a job in the real world after Causeway. Three of our four students will begin PhD programs in mathematics at Case Western Reserve University, University of Kansas, and University of Santa Barbara.

Many thanks to all who support Causeway, and congratulations to our students!



Math Dept members at the 2023 Graduate and Teaching Awards Celebration



Left to right: Ben Weinkove, Zhenyi Chen, Eric Zaslow, and Elton Hsu at the 2023 Graduate and Teaching Awards Celebration

NU MATH GRADUATE STUDENTS RECEIVE NSERC SCHOLARSHIPS

NU Math graduate students, Alex Karatepyan and Curtis Grant, have received a Postgraduate Scholarship from the Natural Science and Research Council of Canada (NSERC). The NSERC Postgraduate Scholarships – Doctoral (PGS D) program awards financial support to high-calibre scholars who are engaged in doctoral programs in the natural sciences and engineering.

PROF. AUFFINGER AND PROF. AVNI AWARDED 2023 SIMONS FELLOWSHIPS

NU Mathematics faculty members Prof. Antonio Auffinger and Prof. Nir Avni have been awarded 2023 Simons Fellowships.

The Simons Fellows program extends academic leaves from one term to a full year, enabling recipients to focus solely on research for the long periods often necessary for significant advances.

PROF. XIUMIN DU RECEIVES CAREER AWARD FROM NSF

NU Mathematics faculty member, Prof. Xiumin Du has received a prestigious CAREER award from the National Science Foundation, the foundation's most prestigious honor for junior faculty members.

She will receive almost \$500,000 over five years to study "Weighted Fourier extension estimates and interactions with PDEs and geometric measure theory".

BRYNA KRA ELECTED AS A MEMBER OF THE CHILEAN ACADEMY OF SCIENCES

NU Mathematics faculty member, Prof. Bryna Kra, has been elected a Corresponding Foreign Member of La Academia Chilena de Ciencias, the Chilean Academy of Sciences.

PROF. ZASLOW APPOINTED AS NEW NOYES CHAIR

NU Mathematics faculty member, Prof. Eric Zaslow, has been appointed as the new Henry Sanborn Noyes Chair in Mathematics. This endowed chair is one of the oldest in the university. This appointment acknowledges Eric's many accomplishments in research, teaching and service.

PROF. AUFFINGER ELECTED 2023 FELLOW OF AMS

NU Mathematics faculty member, Prof. Antonio Auffinger, been elected a 2023 Fellow of the American Mathematical Society. Auffinger was cited for his "contributions to probability theory, mathematical physics, and, in particular, to the study of spin glasses and percolation theory".

NU MATH FACULTY RECEIVES ASG NOMINATIONS

The Associated Student Government (ASG) collects nominations from students for the annual Honor Roll of faculty and staff who they believe made an exceptional impact on their Northwestern experience. NU Math faculty members Prof. Aaron Peterson, Prof. John Alongi, Prof. Ursula Prod, Prof. Michael Maltenfort, and Prof. Santiago Canez all received ASG nominations for the 2021-2022 academic year.

PROF. AARON PETERSON AWARDED 2023 UNIVERSITY TEACHING AWARD

NU Mathematics faculty member, Prof. Aaron Peterson, has been awarded the 2023 Charles Deering McCormick Distinguished Professorship of Instruction.

This is the highest award given by the university for teaching track faculty, recognizing Prof. Peterson's outstanding instruction and mentoring

PROF. BRYNA KRA NAMED 2023 FELLOW OF AWM

NU Math faculty member, Prof. Bryna Kra, has been named a 2023 Fellow of the Association for Women in Mathematics. Kra was named a 2023 AWM Fellow "for her vision and work creating programs to support women in mathematics, especially GROW (Graduate Research Opportunities for Women) and AWM student chapters; for her leadership in the mathematics community, including serving on the AWM Executive Committee and serving as president of AMS; and for making advocacy for women a priority throughout her career."



Director of Undergraduate Studies,
Prof. Santiago Cañez



From left to right: Inbo Gottlieb-Fenves, Daniel Luo, Gwen Cooke,
and DUS Prof. Cañez at the 2023 UG Awards Celebration

Undergraduate Program Update

Prof. Santiago Cañez,
Director of Undergraduate Studies

Our undergraduate program continued its long streak of strong and productive years! This year we will have a graduating class of 65 majors and 10 minors, a few of which warrant special recognition.

Five of our students wrote honors theses this year, which is the most we've had in over 10 years. **Mohammed Alzergani** wrote about a *Family of Approximations of Dirichlet L-functions*; **Gwen Cooke** wrote about *Invariant Rings of $Z[x]$ Under the Standard Representation of S_p* ; **Inbo Gottlieb-Fenves** wrote about *Invariant Sets of Multidimensional Tori*; **Sofia Li** wrote about *Automorphism Groups of Symbolic Shift Systems with Low Complexity*; and **Daniel Luo** wrote about *Norm Convergence of Multiple Ergodic Averages: A Complexity Approach*. Gwen will begin the PhD program in mathematics at the University of Oregon this fall; Daniel will begin the PhD program in economics at MIT; and Sofia, this year's winner of the Robert R. Welland Prize for Outstanding Achievement in Mathematics by a Graduating Senior, will begin the PhD program in Industrial Engineering and Operations Research at Columbia University.

We also recognize and thank graduating seniors **Kirsten Kash**, **Mayed Khan**, **Daniel Luo**, and **Rosalind Wang** for their work as Undergraduate Teaching Assistants over the years.

This was a year of change for our undergraduate curriculum. The Department finalized a new set of requirements for the mathematics major, which was formally approved by the Weinberg College of Arts and Sciences this winter and will be in effect for new students this fall.

The new requirements aim to provide all our majors with stronger training in the core areas of analysis and algebra and seek to expose all students to the use of computing in mathematics, while still maintaining the flexibility our majors have come to appreciate.

The development and approval of these new requirements is the culmination of a years-long effort begun by previous Director of Undergraduate Studies, **John Alongi**. In addition to John, we also acknowledge the hard work of all others who served on the undergraduate committee these last few years, without which the new requirements would not have come to fruition.

Our undergraduate community continued to grow this year. The Northwestern Undergraduate Mathematical Society continued to host talks and other events throughout the year; special thanks to **Daniel Luo** and **Leo Chang** for organizing!

The Northwestern Emerging Scholars Program also had another successful year, and special thanks should go to **Sofia Li** and **Yao Xiao** for their work as peer leaders, and to **Cherry Ng** and **Shuyi Weng** as faculty mentors. Special thanks also to **Camille Kennedy** for working to reactivate the Northwestern University Association for Women in Mathematics. We greatly look forward to all that our groups have planned for next year!

Finally, congratulations to Associate Professor of Instruction **Aaron Peterson** on winning a Charles Deering McCormick Distinguished Professorship of Instruction, which is the highest teaching award the University conveys to teaching-track faculty. The contributions of all our faculty, staff, and students help our undergraduate program thrive, and we thank also to the donors whose contributions make our events possible.

2023 NU Mathematics Undergraduate Award Winners

Robert R. Welland Prize for Outstanding Achievement in Mathematics

- Sofia Li

Michael Stein Prize for Excellence in Algebra

- Inbo Gottlieb-Fenves

Senior Career Award in Mathematics

- Gwen Cooke, Inbo Gottlieb-Fenves

Junior Career Award in Mathematics

- Aaron Lu, Jiahan Jiang

Junior Career Award, Honorable Mention

- Fiona Wang, Jacob Platnick

Award for Excellence in Mathematics by a First-Year Student

- Ella Dommert, Tyllis Xu, Issac Cross, Will Krew, Nicky Draeger, Ryan Sjobeck, IceT Thaewanarumitkul, Scott Hwang, Corbin Diaz, Chana Lyubich, Clark Mahoney, Henry Li, Charles Bevis, Irene Zhang

Award for Excellence in Mathematics by a High School Student

- Caroline Klearman, Elijah Platnick

Award for Outstanding Contributions to Undergraduate Mathematical Life

- Sofia Li

Award for Excellence as an Undergraduate Teaching Assistant

- Mayed Khan

Undergraduate Teaching Assistant Service Award

- Rosalind Wang, Kirsten Kash, Mayed Khan, Daniel Luo

MMMM 2023

The May Midwestern Microlocal Meeting on microlocal analysis and quantum dynamics was held May 20-21, 2023 and partly supported by Northwestern's NSF Research Training Group grant in Dynamics. This was the first post-pandemic installment of a conference that usually meets biennially. It was organized by Kiril Datchev (Purdue), David Sher (DePaul) and Jared Wunsch (Northwestern).

2023 Algebraic Geometry and Cohomology in Mixed Characteristic Conference

The 2022 Nemmers Prize recipient, **Bhargav Bhatt** (U-M and Princeton/IAS), visited Northwestern University Mathematics in May 2023. The AGCMC Conference was held May 15-19, 2023 in celebration of Bhatt receiving the 2022 Nemmers Prize, which he won for his "revolutionary contributions to algebraic geometry in mixed characteristic through a new synthesis of ideas in topology, algebra and arithmetic." This conference was organized by NU Math Dept faculty members Benjamin Antieau, Bao Le Hung, and Yuchen Liu.

MPC 2022 Conference

Northwestern University's Mathematics Department hosted the 43rd Midwest Probability Colloquium Oct 20-22. During the last decade, probability theory has seen a surge of tools and methods used in other branches of pure and applied mathematics. The Midwest Probability Colloquium has been an annual event for several decades, bringing together a wide-breadth of knowledge in the field of probability. Sponsors of the 43rd Midwest Probability Colloquium were the National Science Foundation and Northwestern University.

Homotopy 2023

The Homotopy 2023 conference, to honor NU Mathematics faculty member Prof. **Paul Goerss** and his contributions to the field, was hosted by Northwestern University March 20-24. This conference was organized by Ben Antieau and John Francis. This conference was organized as part of the 2022-2023 Emphasis Year on Homotopy theory.



2023 Algebraic Geometry and Cohomology in Mixed Characteristic Conference



Homotopy 2023 Conference

Graduate Program Update*Prof. Elton Hsu, Director of Graduate Studies*

Director of Graduate Studies,
Prof. Elton Hsu



*Math Dept members and families at the
2023 Mathematics Graduation Celebration*



*From left to right: Prof. Ben Weinkove, Prof. Antonio Auffinger,
Graduate Student Yuxin Zhou, and Prof. Elton Hsu.
Yuxin Zhou received the 2023 Best Thesis Prize*

At the beginning of this academic year, COVID-19 was finally behind us and we have returned completely to the modus operandi ante-pandemic. We are happy to see more graduate students and faculty gather at daily tea, discussing everything from research to politics. And thanks to **Eric West**, our department graduate assistant, there are more varieties of refreshments for our graduate and faculty to enjoy there. I also want to take this opportunity to thank Eric for keeping the administrative aspect of our graduate program in good order for the past two years since he joined our department.

The famous German poet Heinrich Heine once remarked that university students come and go but professors stay like a pyramid of knowledge (I encourage you to find the humorous ending of this remark). This year a record number (13, the largest in my memory) of our graduate students received their Ph.D. degrees and will embark on new careers in academia or industry: **Micah Darrell**, **Dan Fletcher**, **Christian Gorski**, **Yaroslav Khromenkov**, **Grigory Kondyrev**, **Wenyuan Li**, **Wanxing Liu**, **Anthony McCormick**, **Gregory Papayanov**, **Catherine Ray**, **John Snadden**, **Ruoyu Wang**, and **Yuxin Zhou**. We appreciate their contribution to our community during their time at Northwestern and wish them great success in their new life. This September the department will welcome 13 new graduate students: **Levi Borevitz** (Dartmouth University), **Haochen Cheng** (University of Wisconsin), **Sin Hang Sonia Choy** (University of Science and Technology Hong Kong), **Benjamin Cooper** (University of Chicago), **Christos Konidas** (University of Athens), **Uisun Lee** (Seoul National University), **Tristán Radić** (University of Chile), **Pavel Stoilescu** (Australian National University), **Santiago Velazquez Iannuzzelli** (University of Pennsylvania), **Yiyang Xu**, (Johns Hopkins University), **Mingze Yu** (University of California, Berkeley), **Ning Yu** (New York University), and **Huangchen Zhou** (McGill University). Their countries of origin cover five continents: North America, Asia, Europe, Oceania and South America, and Professor **Ezra Getzler** did an excellent job in leading the Graduate Admission Committee to select these new students from a large pool of applicants.

Each year the department awards prizes to a select group of graduate students who distinguished themselves in several ways in our program. This year's best thesis prize goes to **Yuxin Zhou**. Her thesis, under the supervision of **Tuca Auffinger**, analyzes the famous Parisi formula in spin glass theory in several classical examples and its results have already published in top probability journals. Yuxin will join the mathematics department at University of Chicago this fall. This year's Gelfand Prize for Service to the Graduate Community goes to **Zhenyi Chen**, who, besides making steady progress with his own research program, has done so much to make the department a more pleasant and welcoming place for both old and new students. Two graduate students, **Alex Karapetyan** and **Anthony McCormick** received this year's Award for Excellence as a Graduate Teaching Assistant. Our first year student **Arka Karmakar** and second year student **Curtis Grant** received the Award for the Best Preliminary Exam. Congratulations to all our prize winners!

Finally, I thank our graduate students, faculty, and staff for contributing to make 2022-2023 a wonderful year for our graduate program.



Math Dept Chair Prof. Weinkove (front center), DGS Prof. Hsu (front right) and the 2022-2023 new Causeway students and Graduate students



2023 Spring Graduation Reception for Math Majors, Minors and families



NU Math Dept Faculty members, graduate students, and staff at 2023 reception to toast Prof. Aaron Naber on his being named a Simons Investigator in Mathematics by the Simons Foundation

Happy Retirement, Paul!

Paul Goerss retires at the end of this academic year, after 25 years in the department. Paul received his PhD in 1983 from MIT under the supervision of **Franklin Peterson**. After postdoctoral positions at the University of Chicago and Northwestern, Paul was a faculty member at Wellesley College and then the University of Washington before joining Northwestern as Professor of mathematics in 1998.

Paul Goerss's research is in algebraic topology, where he has made seminal contributions to both structural and computational aspects of chromatic homotopy theory. One of his most famous results is the Goerss–Hopkins–Miller theorem, on the construction of multiplicative structures on Lubin–Tate theories. This was based on his development of an obstruction theory, with Michael Hopkins, which further establishes the theory of topological modular forms—the state-of-the-art in the study of the computation of stable homotopy groups of spheres. Goerss also made foundational contributions to the theory of model categories and is the author, with Jardine, of the main textbook on the subject, *Simplicial Homotopy Theory*.

Paul served as chair of our department twice, from 2003 to 2006 and then from 2015 to 2018. He also served for several years on the Weinberg College tenure and promotion committee.

Paul received an Alfred P. Sloan Fellowship in 1990, and was named a Fellow of the American Mathematical Society in 2014. He has also won several Northwestern awards: a 2012 Weinberg College Distinguished Teaching Award, a 2014 Faculty Award for Diversity from The Graduate School, and a 2016 Weinberg College Award for Mentoring Undergraduate Research. Paul has also been one of our most popular and successful PhD advisors, with 21 students graduating from Northwestern, many of whom have gone on to become highly successful mathematicians.

Thank you Paul for all your service to the department, the college and mathematics!
We wish you a long and happy retirement!



Prof. Paul Goerss (front center) and attendees of the Homotopy 2023 conference



Prof. Paul Goerss



Prof. Paul Goerss welcoming everyone to the Math Dept's 2015 Beginning of the Year reception

John Mocek, Math Dept Financial Assistant, Taking New NU Position

John Mocek has worked as the Financial Assistant since May 2019. Since day one, he was a star for the staff. Always friendly, helpful, and knowledgeable, John can process a reimbursement faster than you can say “expense report”. The incredible impact that he has had on the department will be felt long after his departure. We wish him well in his new position at Northwestern University.



John Mocek



Prof. John Alongi

John Alongi Moves to the University of Chicago

Professor of Instruction **John Alongi** leaves us at the end of this academic year to take a position at the University of Chicago as Senior Instructional Professor and Director of Student Engagement in their mathematics department.

John has a long history in our department. He received his undergraduate degree and his PhD at Northwestern (supervised by John Franks) and then returned to serve as a teaching track faculty member in our department for 17 years.

He has been one of our star instructors. His teaching was recognized by a Charles Deering McCormick University Distinguished Lectureship and a Weinberg College of Arts and Sciences Alumni Teaching Award. John served many administrative roles, including as our Director of Undergraduate Studies, Director of MENU and more recently, as the inaugural Director of the Causeway Program. He has also served on many committees for the college and university.

Since John's arrival as a faculty member at Northwestern, we have grown our faculty in the teaching track and are immensely proud of their accomplishments. We are particularly grateful to John for his central role in building up this team.

John will be greatly missed. At the same time, we wish him well on his new opportunity at the University of Chicago.



Prof. John Alongi and undergraduate student recipients of the 2017 UG Student Awards Celebration



Prof. John Alongi announcing the 2018 Undergraduate Awards

Steve Zelditch: 1953-2022

Professor **Steve Zelditch**, an esteemed and much-loved member of the NU mathematics department, tragically died of cancer on September 11, 2022. Professor Zelditch received his PhD at UC Berkeley in 1981 under **Alan Weinstein**. He was a Ritt Assistant Professor at Columbia University, and then a faculty member at Johns Hopkins University before joining Northwestern in 2010, where he became the Wayne and Elizabeth Jones Professor of Mathematics.

Zelditch was a pioneer in the mathematical theory of quantum chaos. He made the first major breakthrough in this subject shortly after receiving his PhD, in work culminating in his 1987 paper on quantum ergodicity for Riemann surfaces. His subsequent work spanned a tremendous range of fields in mathematics and mathematical physics, making progress in and drawing ideas from probability, string theory, general relativity, complex geometry, partial differential equations, and spectral and scattering theory. Zelditch's celebrated work in spectral geometry included, in 2019, the strongest positive result to date in this area (in collaboration with his former student Hamid Hezari): you can hear the shape of a nearly circular ellipse.

Among the unifying features of Zelditch's work were his taste for problems involving asymptotic expansions and his use of random objects as proxies for hard-to-reach deterministic ones.

He was a winner of the 2013 Stefan Bergman prize, whose citation stated that with his "strikingly original vision, he has found deep and diverse relations between the Bergman kernel and many other areas, including complex geometry, probability, and mathematical physics." His work on the Bergman kernel included the celebrated Tian-Yau-Zelditch expansion in complex geometry.

In his prolific career, Zelditch authored more than 180 publications and supervised 13 PhD students. He was an invited speaker at the International Congress of Mathematicians in Beijing in 2002. In 2013 he was named a Fellow of the American Mathematical Society. Zelditch served on many editorial boards, including the Annales Scientifiques de l'École Normale Supérieure, Analysis & PDE, the American Journal of Mathematics, Communications in Mathematical Physics, Journal of Geometric Analysis, the Journal of Mathematical Physics and Pure and Applied Mathematics Quarterly.

Above all else, Zelditch loved to talk mathematics. He had an infectious enthusiasm and a profligate generosity with his seemingly endless stream of ideas. When news of his illness spread in the mathematical community, his colleagues quickly organized an online 69th birthday conference, with an eminent cast of speakers from all over the world. He was, characteristically, on the Zoom call until the day before his death, still eager to hear about the latest developments. The mathematical community at large, and Northwestern's department in particular, will sorely miss him.

Steve Zelditch is survived by his wife, Ursula Porod, and their two sons Benjamin and Phillip.

(In Memoriam: Steve Zelditch, continued on next page)



Prof. Steve Zelditch, Prof. Ursula Porod, and their sons Benjamin and Phillip



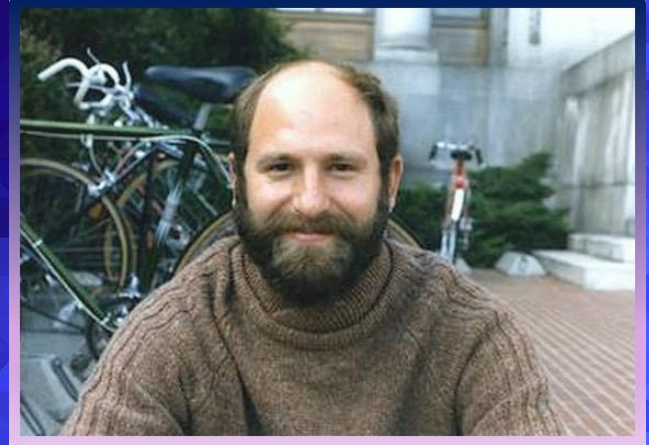
Prof. Steve Zelditch



Prof. Steve Zelditch with his sons Benjamin and Phillip



Jared Wunsch (left), Steve Zelditch (right)



Steve Zelditch

(In Memoriam: Steve Zelditch, continued from previous page)

"Steve's passion for mathematics was energizing to all of us around him. I was fortunate to share many afternoons with Steve in my office (which is across his). He would come to share ideas about a recent talk, a fresh preprint or a new insight he had early in the morning. Sometimes these conversations would go for hours with Steve doing most of the talking while I was trying to absorb at least some of his knowledge. He was a beacon of energy that had a profound impact in our faculty and students. A world-class mathematician, a terrific colleague, and a wonderful friend. I miss him dearly."

-- Prof. Tuca Auffinger

"I first met Steve, who would soon become my advisor, as an incoming PhD student at Northwestern Math Department. Many happy days in graduate school involved popping by Steve's office and speaking with him at great length first about mathematics and then, if time allowed, about everything from Russian literature to politics of the day. Over the years, what I found most inspiring about Steve was his seemingly inexhaustible drive to learn, equaled only by his capacity to synthesize and explain complex ideas with miraculous clarity. Etched in my memory is Steve seated in the front row, whether at a seminar, summer school, or conference, asking questions and trying to understand how the world works. His example as a scientist, advisor, and teacher of the highest caliber will be sorely missed and not soon forgotten."

-- Boris Hanin, Assistant Professor of Operations Research and Financial Engineering, Princeton

"Steve was an enthusiastic teacher and was willing to put a lot of time into preparing for classes. He liked to teach functional analysis so much that he offered to do it without credit. In his later years he wanted to thoroughly grasp probability and stochastic analysis and taught the second year probability sequence with carefully prepared lecture notes. It is amazing to see how much ardor Steve put into learning a new area of mathematics at his stage of career while at the same time turning out high quality research papers at a vertiginous rate. I often tell our graduate students Steve is the example that a serious research mathematician should try to emulate throughout their career."

-- Prof. Elton Hsu

"There are many things that Steve said that stuck with me, including: 'I am just taking a walk without worrying where I would end up and just let nature show me the next beautiful scenery. I don't look for where it is, it just shows up'. This is very reflective of how Steve is as a mathematician. He also told me that 'Anything can happen due to principle of large deviation', and 'You never know what's going to happen. Take it easy one moment at a time'."

-- Hy Lam, 6th year graduate student

"Steve believed in me when I didn't believe in myself, and he was the voice I considered when my thoughts were unclear. While being simultaneously the wisest and most knowledgeable person I have ever met, Steve was undeniably selfless. He would do computations with me live on latex in our meetings even when he knew all the details. Many of our meetings reached the 3 hour mark, and many of them went beyond math. He talked with me about Dostoevsky and Nietzsche, his dog Arthur, Christmas presents for his family, the use of certain words, the DMV, and politics. My friends tell me that sometimes I sound like him when I argue with them about math. In a way, this is what Steve wanted to provoke in all of us. We are all not just monkeys of mathematical theory, but we are all human beings with a heart full of interests. And we, like Steve, should follow the direction of the interests of our heart and soul even if we might not know the final destination"

-- Nick Lohr, 4th year graduate student

"I met Steve 20 years ago when I was a graduate student at Columbia. I was amazed by his energy and enthusiasm for math. He had this insatiable curiosity. I was humbled that he seemed genuinely interested even in my own work. He was generous and supportive of me as a young mathematician and I'll never forget that. I was honored to become Steve's colleague at Northwestern. As well as his great mathematics, Steve brought much more to the department. His knowledge and wisdom guided us. He entertained us with his stories and opinions. He could be a contrarian, but never took himself too seriously. I miss him very much."

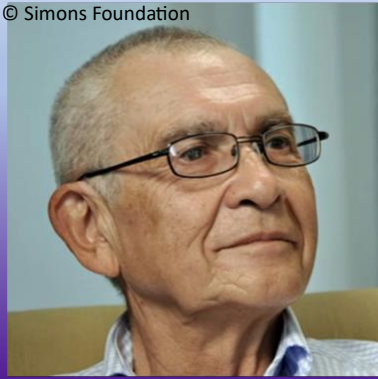
-- Prof. Ben Weinkove

"Steve had more ideas per hour than anyone I've ever met, and generously shared them with anyone who would sit still to listen. His outlook, his questions, and his style of doing math all had a great influence on my own career. Steve's personal warmth and endless willingness to talk to students and postdocs were especially important to me when I was starting out: I first met Steve when I was still a student. This made it especially exciting to have him come to Northwestern as my colleague, some years later. Occupying the office next door to Steve Zelditch was one of the great privileges of my career as a mathematician, and I miss him terribly."

~ Prof. Jared Wunsch

Yuri Ivanovich Manin: 1937-2023

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Yuri Ivanovich Manin

Yuri Manin was a Trustee Chair in the Department of Mathematics at Northwestern University from 2002 to 2011. On retirement from this department, he returned with his wife Ksenia to Bonn, Germany, where he had been the Director of the Max Planck Institute for Mathematics, in succession to its founder **Friedrich Hirzebruch**. It is with sadness that we have learned of his passing on January 7, 2023.

Moving from Simferopol in Crimea to Moscow to study at Moscow State University in 1953, he went on to receive his doctorate in 1960 under Shafarevich. All of his early work was in arithmetic and number theory, with a strong influence of classical geometry. In 1958, as an undergraduate, he introduced into arithmetic an analogue of the ordinary differential equations for elliptic integrals in complex analysis. When Grothendieck generalized this construction to several variables in 1966, he named it the Gauss-Manin connection. It must have been a source of amusement to Manin and his friends to see his name prefixed in this way by Gauss's name. At the time, he had recently been appointed to the Chair of Algebra at Moscow State University, and soon after, he received the Lenin Prize.

He used his early ideas to prove the Mordell conjecture for function fields, which states that, over a field of finite characteristic, a one-parameter family of algebraic curves of genus >1 has just a finite number of rational sections.

He took Grothendieck's speculative ideas on motives on the cohomology groups of algebraic varieties and produced a version of the theory that is simple enough to explain to a first year graduate student.

His ideas led to an active current field of research, lying at the foundations of Kontsevich's theory of motivic integration. They also motivated, in part, Voevodsky's work on the homotopy theory of motives, which remains an active area of research in this department.

In 1978, Manin and his then PhD student Drinfeld, now a distinguished professor at the University of Chicago, found an explicit parametrization of the instanton solutions of the Yang-Mills equation for the group $SU(2)$ in four-dimensional space. This equation arose in the description of the strong and weak nuclear forces (what is now known as the Standard Model), describing a class of classical solutions around which the quantum theory is to be understood by perturbative methods. The same results were obtained at the same time in Oxford by Atiyah and his then PhD student Hitchin: the four authors published their results together in an article in *Physics Letters A*. This work lies at the foundation of one of the most important developments in pure mathematics of the last decades: the work of Donaldson and Witten on topological field theories. It is also the first place that quiver varieties, central to much of modern representation theory, occur.

With time, Manin's interests branched out in many directions: mathematical physics, quantum computing, linguistics, logic. One of the attractions of Northwestern University for him was the nascent work on quantum computers being carried out by colleagues in electrical engineering and physics. He continued to be interested in mathematical physics, writing the foundational paper of the modern theory of Gromov-Witten invariants with Kontsevich.

By one count, he wrote more than 20 expository volumes. Few people can have read all of them, but they are marked by a rigor and transparency coming from a restless urge to put down on paper an account that will anchor future research. His graduate textbook on logic belongs on the bookshelf of every person with an interest in the philosophy of mathematics, and his monograph on classical integrable systems remains the key reference for its lucid exposition of the formal variational calculus. There is a variant of the Yang-Mills equation, called super-Yang-Mills, which incorporates equal numbers of bosons (such as the photon and gluon) and fermions (the particles from which matter is built, such as electrons and neutrinos). Manin wrote a textbook on this subject, which also remains one of the best places to learn about the underlying geometry of the subject, called supergeometry.

The inaugural Nemmers Prize in Mathematics was awarded to him by Northwestern University in 1994. It was in the course of his frequent visits to Northwestern in the years that followed that the idea of appointing him to a Trustee Chair took form.

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NU Math Dept 2022-2023 Newsletter
 Designed and Edited by:

Jenima Lyon
 NU Math Dept UG Program Assistant