THE √roots
A NEWSLETTER FOR THE MATHEMATICAL SCIENCES DEPARTMENT OF NEW MEXICO STATE UNIVERSITY
April 2025

EXPAND AND REJUVENATE

Greetings from the Department of Mathematical Sciences at New Mexico State University! We are back and eager to share with you the 2025 Spring newsletter highlighting the great accomplishments of our students, faculty and alumni as well as honoring former faculty members for their exemplary contributions that have enriched the history of the department.

Last year we had many new faculty hires at the assistant, college and postdoc levels that have boosted our department with fresh energy. In fall we welcomed aboard two new faculty members, **Dr. Keegan Boyle** as an assistant professor in topology and **Dr. Andre Kornell** as a postdoctoral fellow in logic.

With a total of 18 tenure track faculty, 7 of which are assistant professors, the department is engaged in various research and teaching activities. We are pleased to see seminars and colloquia organized weekly by our enthusiastic faculty throughout the year. Graduate students and faculty attended numerous national and international conferences, and successful grant proposals made possible a number of activities enhancing the undergraduate and graduate students learning experiences on campus.

We are pleased to see an increase in the number of well prepared and motivated undergraduate majors, and thanks to the outreach efforts led by **Dr. Bruce Olberding**, we hope to increase the number of majors. Thus, all the efforts are made to provide opportunities for them.

The main challenge for our department remains the space issue. Still no progress with Walden Hall's rehabilitation, as we expand each year the need for more space becomes critical. The building has been used in the past for classrooms, tutoring, offices and spaces for graduate students, and is closed since 2020. Our graduate program, with 12 Master and 21 PhD. students would greatly benefit from the office space offered by Walden Hall.

The department is committed to excellence in mathematical research and a strong undergraduate and graduate education.

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FACULTY SPOTLIGHT

THE DEPARTMENT OF MATHEMATICAL SCIENCES

WELCOMES NEW FACULTY

Keegan Boyle joined the Department of Mathematical Sciences faculty as a tenure-track assistant professor in August 2024. Originally from Colorado, Dr. Boyle received his doctoral degree from the University of Oregon under the direction of Robert Lipshitz, with the thesis On Symmetries of Knots and Their Surgeries.

Then, as a postdoctoral scholar at the University of British Columbia, Keegan worked with **Liam Watson** until June 2024.

Dr. Boyle' research interests are centered on symmetries in 3 and 4-dimensional topology using tools from geometric group theory, algebraic topology, number theory, and symplectic and hyperbolic geometry. In particular, the relationship between low-dimensional manifolds and knots has been treated in a couple of coauthored papers: Equivariant 4-genera of strongly invertible and periodic knots published in the Journal of Topology in 2022, *Equivariantly Slicing Strongly Negative Amphichiral Knots* in Indiana University Mathematics Journal, 2023, and *Equivariantly slicing strongly negative amphichiral knots*, in Algebraic & Geometric Topology, 2024, among many others.

As an undergraduate student in the Department of Mathematics at the University of Colorado, Boulder, Keegan received the **Jack Hodges Award for Excellence in Mathematics** (2011), an award that is given annually to the outstanding undergraduate students majoring in mathematics.

In 2019, as a graduate student in the Mathematics Department at University of Oregon, Keegan was awarded the **Jack and Peggy Borsting Award for Scholastic Excellence**.

Notably, he also received the **Postdoc Teaching Prize** from the Department of Mathematics at University of British Columbia in 2024.

Andre Kornell joined the Department of Mathematical Sciences as a postdoctoral fellow in August 2024. Dr. Kornell earned his doctorate in mathematics in 2015 from the University of California, Berkeley, with a thesis on Operator algebras in Solovay's model.

Andre was a visiting assistant professor and lecturer at UC Davis from 2015-2019, a postdoctoral fellow at Tulane University from 2019-2022, and a research associate at Dalhousie University from 2022-2024.

Dr. Kornell's research interests are devoted to quantum logic and adjacent areas such as mathematical logic, noncommutative geometry, and quantum information.

Andre is the 2024 recipient of the prestigious Birkhoff□von Neumann Prize from the International Quantum Structures Association for his outstanding contributions and impact to the field of quantum logic and quantic foundations.

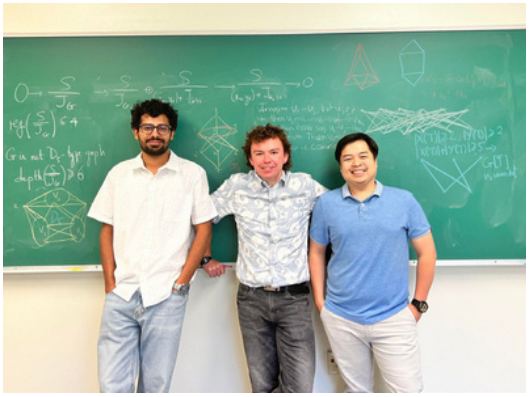
He is very excited to be part of the Research Training Group in Logic and its Applications program in our department, well known for combining teaching and research in a very organic way.

RESEARCH HIGHLIGHTS

GRADUATE AND UNDERGRADUATE STUDENTS ACTIVITIES

Our undergraduate and graduate students have gained valuable research and scholarship experiences in the past year through participation in various projects in collaboration with mathematics department faculty.

Dr. Arvind Kumar is a postdoctoral fellow in the Department of Mathematical Sciences at New Mexico State University. His research focuses on commutative algebra and its applications to combinatorics, and this summer he led a five-week Research Project titled Binomial Edge Ideals of Crown Graphs. His team consisted of an undergraduate student (Joshua Pomeroy) and a graduate student (Le Tran). Together they investigated binomial edge ideals associated with crown graphs, specifically examining when the projective dimension of their quotient aligns with the ideal's big height. Additionally, they explored the Vasconcelos number for binomial edge ideals in cycles and crown graphs and successfully proved a conjecture related to the Vasconcelos number for binomial edge ideals in cycles.



Their findings have been submitted for publication, and on the other hand this experience enriched their research skills. As an undergraduate student, Joshua learned from an already experienced graduate student, and Le had the opportunity to interact to somebody with a lesser expertise. Le Tran graduated in summer 2024 with a PhD in Mathematics, algebra specialization, under the direction of **Dr. Louiza Fouli**, and he is currently a lecturer at Texas State University. Congratulations to Le for his great accomplishments!

The Research Training Group (RTG) in Logic and Its Applications, led by mathematics faculty Drs. **Harding, Morandi, Olberding** and **Shapirovskiy**, organizes weekly seminars that provide a structured environment in which both undergraduate and graduate students are motivated. The seminars are conducted by two graduate students who present advanced material on various models, while mentoring the undergraduate students on much simpler structures. The group is funded through a 5-year $1.4 million NSF grant, that supports each year 5 undergraduate students, 2 graduate students, a postdoc and faculty. Each year the group concentrates on a thematic problem related to different aspects of logic and its applications. Last year theme was devoted to Modal Logic, while this year the focus is on Quantum Computing. The group is ready to submit a manuscript based on their discoveries.

During last summer, our undergraduate and graduate students traveled for conferences, summer schools and workshops, many of them through Simons Laufer Mathematical Institute(MSRI/SL), an NSF supported research institute offering such opportunities to students.

Two PhD students of **Dr. Bezhanishvili** participated in the prestigious conference *Topology, Algebra, and Categories in Logic* in Barcelona, July 2024: **Sebastian Melzer and Ranjitha Raviprakash**. Sebastian presented his research on the spectrum of maximal d-elements in arithmetic frames. Using Priestley duality, he provided an example of an arithmetic frame where the spectrum is not Hausdorff, tackling an open question in the field.

Ranjitha's talk on McKinsey-Tarski Algebras described the category of MT-algebras and its connections to the categories of topological spaces and frames. Her presentation highlighted how classical notions from topology and frame theory, such as separation axioms, compactness, and local compactness, are generalized and unified within this framework. She concluded with discussing open problems that encourage further investigation in the field.

Sehwan Kim, a PhD student of **Dr. Olberding**, with research focus in commutative algebra, attended a Summer Graduate School course *Multigraded and Differential Graded Methods in Commutative Algebra* at Simons Laufer Mathematical Sciences Institute. He had the great opportunity to advance his knowledge with lectures from two distinguished professors: Michael Brown (Auburn University) and Claudia Miller (Syracuse University).

The lectures in homological algebra contained specific topics on Bernstein-Gelfand correspondence, Differential Graded algebras, Koszul algebras and Koszul duality. Sam's research interest in commutative algebra is focused on Prüfer domains, valuation and holomorphy rings and he is expected to graduate in Spring 2025.

Miguel Peinado, a PhD student under the supervision of Dr. Harding went to a quantum workshop through MSRI/SL.

Another PhD student, **Mac Hayes**, attended a math camp through SL/MSRI in San Francisco. He described the experience as enriching and fun, receiving a great insight into high level geometry.

RECOGNIZING SUCCESS

Graduate Students Accomplishments

Profile of a recent graduate

Tingting Tong graduated in Spring 2024 under the direction of **Dr. Wang** with a doctoral degree in mathematics, statistics concentration. The NMSU Graduate School selected her for its **Alumni Association Outstanding Graduate Award**, Spring 2024, in the doctoral category. This is the highest honor for a student, recognized for exceptional academic, leadership and service achievements. She has a significant number of publications and she received many awards during the academic year 2023-2024: Nita Swartz Endowed Scholarship, Joseph E. Kist Department of Mathematical Sciences Graduate Studies Current Use Fund, and Arts and Sciences Spring 2024 Graduate Student Travel Award.

Her paper, co-authored with David Trafimow, Ziyuan Wang, and Tonghui Wang, "*Gain-probability diagrams as an alternative to significance testing in economics and finance*", received the **Outstanding Paper Award** by the Asian Journal of Economics and Banking in 2023. We congratulate Tingting for her success as a graduate student at NMSU, and for her new position as tenure-track assistant professor in statistics at the College of Charleston, SC. Tingting found a supportive environment during her stay at NMSU, that allowed her to pursue her academic goals: "My commitment to being an exceptional educator, researcher, and statistician was fostered through my academic journey at NMSU". We are pleased and thankful for all the funds received that allows us to support our students for traveling, tuition and scholarships.

Disseminating research

Richard Sayanagi is a graduate student working in commutative algebra under Dr. Olberding's supervision. Richard is a recipient of the Department of Defense's SMART Scholarship. In summer 2024, the SMART program granted him an internship at the Alan Turing Institute in London. There, he joined the institute's research team on mitigation against adversarial attacks on machine learning. The focus of his research was on data security using blockchain technology. From London, Richard was invited to NATO Headquarters to learn about international collaboration in security. It was a great experience for him in London, where he enjoyed not only the research, but also British music: from symphony at Royal Albert Hall, to the Beatles bus tour in Liverpool.

Richard grew up in Tokyo and New Jersey before studying physics at Harvey Mudd College and the University of Wisconsin-Madison. He moved to New Mexico in 2018 to teach high school physics and chemistry for three years before deciding to return to school to study math at NMSU. Richard also enjoys playing the cello, exploring the mountains of New Mexico, and riding fast trains when he visits family in Japan.

Richard participated in the Southwest Algebra Meeting at Arizona State University in March 2025, where he presented his research devoted to Power series Rings over zero-dimensional rings. We look forward to see other great accomplishments after his graduation in May 2025.

CAROL WALKER: SPURRING ON THE AGGIE SPIRIT

Exemplifying the Aggie Spirit

Carol Walker may not describe herself as a pioneer for women in mathematics, but her humility only showcases how she exemplifies the Aggie spirit. The first woman to receive a doctorate from NMSU, Dr. Walker went on to make serious contributions to mathematics and education, and to be instrumental in growing the department during its most prosperous era.

What births a mathematician?

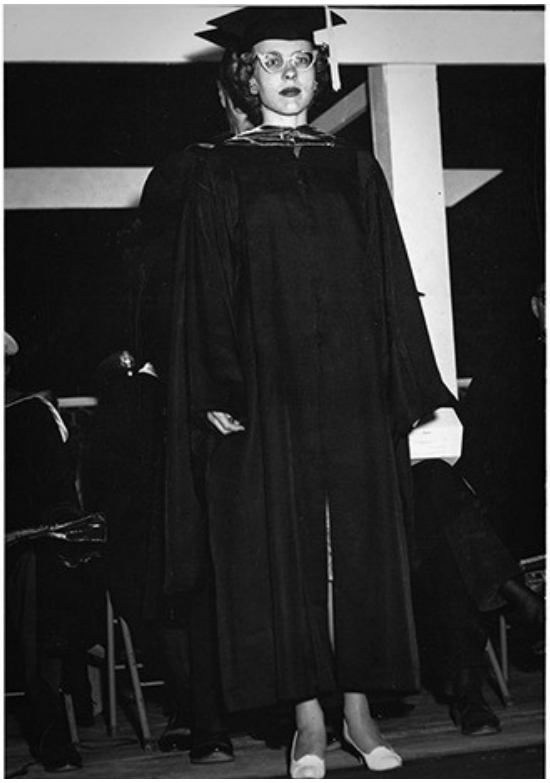
Carol Walker did not begin college with the intent of becoming a mathematician. Early on she showed an interest in music and physics, the latter of which she was reluctant to pursue due to the social climate of the 1950s. Despite her demonstrated aptitude - graduating valedictorian with a Regents Scholarship from the University of Colorado at Boulder - the potential frustration of being cut out of careers in the sciences was familiar for many women. She mentioned that her degree in music education was 'just in case' she was unable to put a degree in physics to use.

Carol's interest in mathematics was a spark she fanned with determined self-instruction. While in Boulder she met George Gamow, the author of the book "One Two Three... Infinity" that explores fundamental and pervasive mathematical ideas. This serendipitous meeting deepened her interest in math, and Carol started to teach herself. When she took a placement exam for algebra, she decided to try her hand at the placement for trigonometry—a topic she had never studied. She didn't pass, but her work drew the attention of the examiner. Carol recalls that him saying that "if I could do that much without studying it, I could fill it in as I went along."

Making Waves at NMSU

Emerging from the boom of the 1950s, the academic landscape of early 1960s America was dotted with new programs. Thus, NMSU had started its graduate program in mathematics, and they had yet to graduate any students. Carol was interested in the program due to its proximity to family, and of course the spicy food.

But Carol was a late comer to mathematics, and her degree in music education did not convince her advisor, Dr. Ebert Walker, that she was ready for advanced courses. However, like the examiner in Boulder, he saw her potential and suggested she try a graduate level math course. Carol excelled in the course and also in the program. She went on to receive her PhD in mathematics, the second in the department, but a first for women at NMSU in 1963.



CAROL WALKER: SPURRING ON THE AGGIE SPIRIT CONTINUED

After receiving her PhD, Dr. Carol Walker married her former advisor and the two of them received fellowships to the Institute for Advanced Study located at Princeton, which has been home to the likes of Albert Einstein and John von Neumann. The two returned to NMSU afterwards, and Dr. Carol Walker joined as an assistant professor.

Growing Minds and the Department

Dr. Carol Walker remained at NMSU for the rest of her career until her retirement in 1996. Her achievements as a professor include more than thirty published papers, fourteen books, and many notable proceedings. In addition to her mathematical achievements, she encouraged her students to develop individuality in mathematics and break the too-common view of mathematics as regimented.

Perhaps her greatest contribution to the department was her leadership. From 1979 to 1993 Carol served as department head, and to date she is the only woman to do so. During this time the department retained between 32 and 34 tenure‑track faculty members. She also oversaw the relocation of the department in its new home in Science Hall.

Carol Walker exemplifies what it means to be an Aggie. During a period that was challenging for women in STEM, Carol's perseverance led her to great achievements. Whether it is her self-starting attitudes for pursuing mathematics, being the first female Aggie to receive a PhD, or leading the department through its most prosperous era, Dr. Walker is an aspirational figure and a demonstration of the unconquerable spirit of the university.

MATHEMATICAL SCIENCES DEPARTMENT

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The department has been very fortunate to receive many gifts this year. These generous donations will have a great impact on our students and research mission. We are very grateful.

MATHEMATICAL SCIENCES COLLOQUIA 2024-2025

09/13/24: Mark Allen, Brigham Young University "Isoperimetric and Faber-Khran Inequalities"

10/04/24: Boyu Li, NMSU "Universality of Simple Cycle Reservoirs Using Dilation Theory"

10/11/24: Lance E. Miller, University of Arkansas "Arithmetic and Geometry of the Frobenius"

11/25/24: Sherzod Murodov, Washington State Univ. "Dynamics of Chains of Finite-Dimensional Evolution Algebras"

11/08/24: Katherine Kosoian, University of Iowa "Formalizing Mathematics in Isabelle/HOL"

11/15/24: Adam Dor-on, Haifa University, Israel "Non-commutative Boundary Theory and Arveson's Hyperrigidity Conjecture"

11/22/24: Wei Ning, Bowling Green State University "Confidence Distributions for Skew Normal Change-Point Model Based on Modified Information

01/24/25 Dustin Rossu, San Francisco State University "A Geometer's Guide to Log-concavity

01/31/25: Andre Kornell, NMSU "Entropy in Multimatrix Algebras"

02/14/25 Eva Belmont, Case Western Reserve University "Machine Computation of Unstable Homotopy Groups of Spheres"

02/28/25 Keegan Boyle, NMSU "Polynomials Are Knot Difficult"

03/21/25 Yimin Xiao, Michigan State University
"Thermal Capacity and Hausdorff Dimension Results for Brownian Motion"

03/28/25 Cong Wang, U. Nebraska "The A priori Procedure"

04/04/25 Robert Smits, NMSU
"Behavior of Absorbing and Generating p-Robin Eigenvalues in Bounded and Exterior Domains"

NEWS HIGHLIGHTS

The Department of Mathematical Sciences will host the Annual North American Meeting of the Association for Symbolic Logic on May 13-16, 2025

Pat Baggett and Andrzej Ehrenfeucht donated a large collection of old mathematics books dating from 1600s on math education and math history.

Our 2013 PhD graduate, Simplice Tchamna, was recently promoted to full professor at Georgia College

Our recent PhD graduates Ishraq Al-Awamleh and Farhana Sarower each began teaching positions at UT Austin in Fall 2024.

Milos Savic, NMSU 2012 PhD graduate, supervised by John and Annie Selden, is professor at University of Oklahoma. Recently, he got promoted to Dean of College of Professional and Continuing Education.

The Mathematics and Computer Science undergraduate NMSU alumni, Lance E. Miller, is professor at University at Arkansas. He visited our department in Fall 2024 and gave us talks in both our Colloquium and Algebra Seminar.