

IN THIS ISSUE

page 2

**Message from
the Chair**

page 3

Redistricting

page 4

Everything is Math

page 5, 6, 9-11

Biographies

page 5

**Collaboration in
the Mathematics
Classroom**

page 6

**Instantons: Nature's
Escape Route**

page 9

**Challenging Deficit
Perspectives through
Research on
Mathematical
Sense-making**

page 10

**AZ Noyce: Forming
Culturally Responsive
Mathematics Teachers**

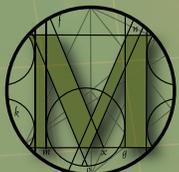
page 12

**UA Mathematics
Ph.D. Recipients, 2018**



THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE

Mathematics



Fall 2018
Volume XVIII, Single Issue

MATHEMATICS

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Message from the Department Head

By Doug Ulmer



I am very happy to report that the department had an excellent year, with progress on several exciting initiatives. A new team of associate heads is working hard to improve our academic programs. They are:

- **Marta Civil**, Associate Head for Entry-Level Instruction
- **Kevin Lin**, Associate Head for STEM Instruction
- **Rob Indik**, Associate Head for Undergraduate Programs

with **David Glickenstein** continuing as Associate Head for the Graduate Program. The team is improving mentoring for entry-level faculty, ramping up the new Bachelor's degree in Statistics and Data Science, and improving coordination with our partners in other science and engineering departments.

The department saved students well over \$600,000 on textbooks last year (more than any other department at the UA) and was honored by UA BookStores for supporting the move to Inclusive Access.

Faculty research forges ahead with new papers, grants, and projects. In particular, the TRIPODS data science project (see tripods.math.arizona.edu) is generating a lot of cutting-edge research and recently received additional funding for two "TRIPODS+X" projects.

We are very proud of the uniquely interdisciplinary Conference on Redistricting held in October with generous support from the Thomas R. Brown Foundations, our department, the College of Science, the James E. Rogers College of Law, and the College of Social and Behavioral Sciences (see page 3.) The meeting offered a robust exchange on measuring, counteracting and improving awareness about redistricting and gerrymandering.

Our faculty continue to be recognized with major external awards: **Vladimir Zakharov** was named a Fellow of the American Geophysical Union, **Sunder Sethuraman** was named a Fellow of the Institute of Mathematical Statistics, and both **Sunder** and **Shankar Venkataramani** were named Fellows of the Simons Foundation. There were two major awards from the College of Science Galileo Circle: **Helen Zhang** was named Galileo Fellow (one of the highest honors in the College of Sciences) and **Jason Aubrey** received the Copernicus Award. In recognition of their high-quality teaching, research, and service, **David Glickenstein** was promoted to full professor and **Selena Niu** was promoted to associate professor with tenure. Congratulations to all!

The biggest project for the coming year is a major proposal to the National Science Foundation for a mathematical sciences research center. The award will be for tens of millions of dollars and the competition promises to be fierce, but we have a strong history of success with major infrastructure projects and excellent support from the administration of the College and the University, so we are optimistic. Stayed tuned for more on this exciting project. ▲

Doug Ulmer is a mathematician whose research emphasizes fundamental, curiosity-driven problems in number theory and algebraic geometry. He also enjoys building academic programs and research institutions with lasting impact.

Contact him at ulmer@math.arizona.edu

Producer and Editor: Guadalupe Lozano

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Cover: A slice of the four-dimensional D4 ALF space.

Courtesy of Tamas Hausel. To see it in 3D or to order it printed visit <https://tinyurl.com/gravinst>.

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How Gerrymandering, the Voting Rights Act and the Census Affect Us All

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Paul M. Smith, J.D. Professor and U.S. Supreme Court Advocate, Georgetown Law Center & the Campaign Legal Center. Argued *Harris v. Arizona Independent Redistricting Commission* and *Gill v. Whitford*.



Justin Levitt, J.D., M.P.A. Associate Dean for Research and Professor of Law, Loyola Law School; former Deputy Assistant Attorney General, Civil Rights Division, U.S. Department of Justice.



Moon Duchin, Ph.D. Evelyn Green Davis Fellow, Radcliffe Institute for Advanced Study at Harvard University; Associate Professor, Tufts University; Director, Program in Science, Technology and Society.

Hear from National Scholars & Leading Experts on:

- How the census and redistricting affect all of us.
- How Arizona draws its voting districts and what lessons can be taken from 18 years of independent redistricting.
- What is happening in other states to adopt redistricting reform and curb gerrymandering.



Arizona's Congressional District Map

ON NOV 6, STEVE GOLDSTEIN OF NPR TWEETED:



"[...] Speakers communicated relevantly and meaningfully, explaining how mathematics can offer a perspective that serves civility and the American public, supporting the fair interpretation of the law and activism in multiple states and cases."

–Conference attendee



Organizers: Colleen Mathis, Caterpillar Inc., Harvard Institute for Quantitative Social Sciences, and Arizona Independent Redistricting Commission; **Deb Hughes Hallett**, University of Arizona Mathematics, and Harvard Kennedy School of Government

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**Shankar
Venkataramani**



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The annual **Duncan Buell Everything is Mathematics Lecture Series** gives the Tucson community a window into the mathematical research our UA faculty do here in Tucson.

The lecture series is made possible in part by a generous endowment by UA mathematics alumnus **Duncan Buell**, now Professor of Computer Science and Engineering at the University of South Carolina.

Buell, a public intellectual himself, believes in the value of raising public awareness about the relevance, beauty, and applicability of mathematics in its many forms.

Teaching learners, not content: collaboration in the mathematics classroom

By Brenae Bailey



I have always loved mathematics and sharing mathematical discoveries with others, so I thought teaching mathematics would be easy. And it's true that *presenting* mathematics is easy. But my students do not learn much from presentations. I have come to realize that my job is not teaching mathematics, but teaching people.

Teaching people requires paying attention to learning styles and needs. In recent faculty working groups we have discussed metacognition (thinking about one's own thinking), spaced retrieval (practicing problems from throughout the course content, not just the current topic), and active learning. The philosophy of active learning embraces learning mathematics by doing mathematics, through discussion, collaboration, and exploration.

My classrooms today look very different from those of a few years ago, with students sitting at tables and using whiteboards to collaborate on problem-solving. Rather than listening to me lecture, students work together on problems while my teaching assistant and I circulate asking questions and checking on progress. I frequently check in with the class as a whole by asking for thumbs up, and invite groups to explain their work rather than providing my own answers. I explicitly encourage groups to share mistakes that represent whole-class opportunities for learning.

The University of Arizona (UA) is supporting this shift in teaching practices by converting classrooms across the campus into Collaborative Learning Spaces equipped with moveable tables, tabletop whiteboards, markers, and projector screens on all four walls. There are currently 24 such rooms including the three I use, with more in the pipeline; demand is growing.

Is collaborative learning really better? Results so far have been positive. In my classes, the level of student engagement is higher than in the past, withdrawal rates are lower, and students are performing as high or higher than average on the common exams. What's more, in mid-semester feedback, not one student requested a return to traditional lecturing.

In my view, the true value of active and collaborative learning shows up in future problem-solving ability. Mathematics is much more than a set of algorithms to memorize. If, as the field increasingly suggests, active learning enables improvement in posing questions, proposing solutions, and persevering in the face of frustration and failure, then it offers true benefits to education. ▲

Brenae Bailey, Ph.D., is a Lecturer in the UA Department of Mathematics. She began her teaching career leading Intensive Calculus workshops at Oberlin College, then taught at Ivimila Secondary School in Zimbabwe and at the University of Wyoming before coming to the University of Arizona. Her work focuses on active learning in entry-level mathematics courses.

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UA Collaborative Learning space. Image credit: University of Arizona Academic Affairs, <https://academicaffairs.arizona.edu/collaborative-learning-spaces>

BIOGRAPHIES

Tenure-track Faculty



Christoph Keller grew up in a small village in Switzerland. After receiving his undergraduate degree and Ph.D. from ETH Zurich, he spent several years as a postdoctoral researcher at

Harvard University, Caltech and Rutgers University. He then returned as junior faculty to ETH Zurich. He and his wife moved to the University of Arizona in 2018. His background is in mathematical physics. In his research, he is particularly interested in the mathematical structure of Quantum Field Theory, Conformal Field Theory and String Theory. In his free time, he enjoys reading, classic movies, hiking, and biking.



Anton Izosimov grew up in Moscow, Russia and did his undergraduate work at Moscow State University. He received his Ph.D. from Loughborough University, UK in 2012. After receiving

his Ph.D., Anton taught in Moscow for a couple of years before going to the University of Toronto for a postdoc. His work is in integrable systems and geometric fluid dynamics.

Instructional Faculty



Sarah Andrews grew up in Tucson, and went to Northern Arizona University (NAU) for her Bachelor's degree in Mathematics. After gaining an interest in teaching through working in

an emporium model tutoring lab, she elected to stay at NAU and complete a Master's degree in Mathematics Education. Her interests within the field of mathematics education involve the various types and uses of assessments as well as effective technology implementation. Outside of work, Sarah enjoys country swing dance and spending time with her dog.



Eun Reeder earned two Bachelor's degrees in Math and Economics, and a Master's degree in Mathematics from Virginia Commonwealth University. She has also completed all

coursework and Ph.D. preliminary examinations except the dissertation for a Ph.D. degree in Applied Mathematics from Virginia Tech. Eun comes to the University

continued on page 6

BIOGRAPHIES

continued from page 5

of Arizona after teaching mathematics at Virginia Tech, Norfolk State University, and Virginia Commonwealth University. She has won multiple excellence in teaching awards at each institution. Her research interests are numerical analysis and mathematical modeling. She enjoys running, cooking, reading, hiking, and traveling. Her husband Rob has been teaching her CrossFit, she almost enjoys it.

Lawrence Tramer has been a mathematics educator for 40 years, with the majority of that time spent teaching at the community college level. After retiring in 2016, he decided he missed the classroom and applied for an instructor position at the University of Arizona. He has enjoyed his first semester here, and is quite excited about the new directions that freshmen/sophomore level courses are taking in the Department of Mathematics. Larry received his undergraduate degree from California State University at Long Beach, where he was a member of the Putnam Competition Team. He received his Master's degree in probability theory from Arizona State University in 1984, the first student to graduate in this area of concentration from that institution. Larry's teaching career has included serving as the Mathematics Department Chair at Yavapai College, and president of the Nevada Association of 2-Year Colleges. Larry has a deep love for teaching, when not in the classroom, he is usually playing rock and blues on the guitar.



Christopher True grew up in Omaha, Nebraska where he earned both a Bachelor's and Master's degree from the University of Nebraska, Lincoln. He is a former high school teacher and has served as the

Director of AP Mathematics for the National Math and Science Initiative grant. In this role, he developed and delivered professional development workshops for high school AP Calculus, Statistics and Computer Science teachers in an effort to increase the number of students taking and passing AP math exams. He has taught statistics and vector calculus for the past 5 years at the University of Nebraska. In addition to teaching at the University of Arizona, he is also teaching classes at Pima Community College, creating instructional videos to accompany an AP statistics book, and is currently authoring his first calculus textbook. He and his wife, Shari, have three children. His youngest daughter is a freshman at the University of Arizona where she is studying dance. Christopher loves Nebraska football, outdoor activities and is enjoying all that Tucson has to offer.

continued on page 9

Instantons: Nature's Escape Route

By Sergey Cherkis



Imagine a pebble rolling down a hillside and settling in a hollow. Our everyday experience tells that surrounded by ridges on all sides, it will stay there forever, unable to escape. In a quantum world however, this pebble will escape from the hollow and tunnel through the ridges surrounding it to the lowest valley. **What is it about the quantum world that mandates this counterintuitive pebble behavior?**

In our real space, the position along an axis is described by a real number. Imagine a complex space with each position being a complex number having a real and an imaginary part. In this complex space there are twice as many directions to move in, and **whatever originally appeared as an insurmountable obstacle, now might have a bypass available going around it**. In other words, while in the real space there is no path which allows the pebble to escape, in the complex space such a path may exist. This path passing through the complex space is called an instanton (Fig.1). But what is its meaning? And what does it have to do with quantum mechanics?

As Richard Feynman explained¹, finding the likelihood that a particle will move from location A to location B, requires summing up the contributions of all paths, however crazy, connecting A and B. This is similar to how light interference picture results from contributions of all light paths.

Our real space is a slice of the complex space. So the problem of summing up over all paths between A and B in the real space can be deformed into a different problem: summing over paths passing through another slice of the complex space. Judiciously choosing that particular slice makes the sum in real space well approximated by a single path the complex space. That path is exactly the instanton!

The story of the pebble's escape thanks to the special path called an instanton has more elaborate versions. For example, I study instantons in gravity and in gauge theory.

Gravitational instantons were introduced by Steven Hawking² in his attempt to describe the origin of the Universe and the Big Bang. Just as in the pebble story, a gravitational instanton is a solution of the Einstein equations with imaginary, instead of, real time. In this view, as we travel back in time and eventually reach the very early universe, we move out of our real world into the complex world. In so doing we avoid the Big Bang singularity. Our space-time becomes a four-

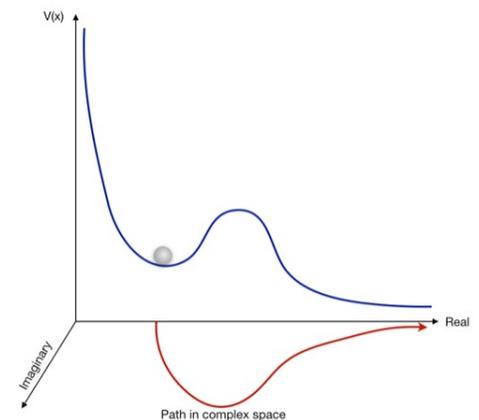


Figure 1: A particle trapped in the blue landscape and an energy preserving instanton trajectory (red) in the complex space that allows it to escape.

dimensional shape satisfying the Einstein field equations: a gravitational instanton. Such four-dimensional shapes are completely smooth - like a surface of a ball or a doughnut. **They have no sharp spikes or abrupt Big Bang-like singularities!** Yet such shapes encode a vast number of virtual histories (paths) of the early Universe.

Thus, we get a geometric perspective on the origin of the universe with no Big Bang singularity at the initial time. In this view, to quote Hawking, "asking 'What was there before the Big Bang?' is like asking 'What is South of the South Pole?'"

Garry Gibbons and Steven Hawking discovered a family of gravitational instantons, so called A-type Asymptotically Locally Flat (ALF) spaces. Nigel Hitchin (Oxford) and I found the remaining family of ALF gravitational instantons, called D-type ALF spaces³. **These are four-dimensional shapes, which can be visualized by taking various 2-dimensional slices through them.** An example of a slice of one of our spaces is in Fig. 2.

What about **gauge theory instantons**? As spectacularly predicted by Einstein and observed by Eddington, gravity (the force keeping us in our chairs) bends light (the product of gauge interactions). In other words, geometry influences gauge interactions. Thus, it is intriguing to ask how gravity can be used to understand something about gauge theory instantons. Surprisingly, putting gauge theory instantons on a curved space, such as a four-dimensional gravitational instanton described above, reveals much of their microscopic structure⁴.

In fact, there is a close relation between gravitational and gauge theory instantons that is far from obvious: **the space of gauge theory instantons of a certain kind, itself forms a gravitational instanton.** Thus, the two kinds of instantons are intricately interrelated in the manner suggested by Fig. 3. Such interrelations open new ways to solve hard problems. For example, we saw gravitational instantons are solutions of Einstein equations. Such explicit solutions of Einstein equations are few and far between. The relation to gauge theory leads to more solutions. Uncovering new connections between gravity and gauge theory, constructing new instantons, and exploring their meaning is one of my research directions. ▲

Sergey Cherkis is a Professor of Mathematics working in geometry and mathematical physics. He received his Ph.D. from Caltech. After holding research positions at UCLA and at the Institute for Advanced Study, Princeton, he was a permanent lecturer at Trinity College, Dublin and joined the University of Arizona in 2012.

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Figure 2: A slice of the four-dimensional D_4 ALF space. Courtesy of Tamas Hausel. To see it in 3D or to order it printed visit tinyurl.com/gravinst.

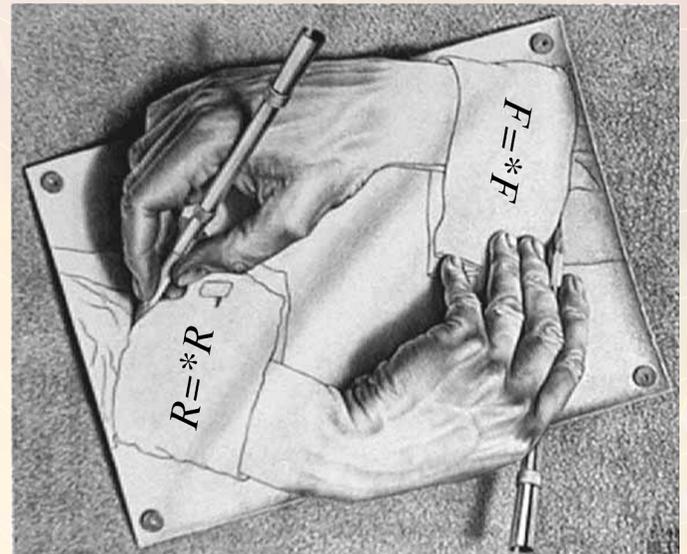


Figure 3: Gravitational and Gauge Theory instantons are interrelated, as in this M.C. Escher's (slightly modified) drawing. More specifically, the self-dual Gravitational Instanton equation is $R=*R$, while the Gauge Theory Instanton equation is $F=*F$.

¹Richard P. Feynman, *QED: The Strange Theory of Light and Matter*, Princeton University Press, 1985.

²Stephen W. Hawking, "Gravitational Instantons," *Phys. Letts.* 60A (1977) 81.

³Gary W. Gibbons and Stephen W. Hawking, "Gravitational Multi-instantons," *Physics Letters B.* 78 (4): 430-432

⁴Sergey A. Cherkis and Nigel J. Hitchin, "Gravitational Instantons of type DK ," *Commun. Math. Phys.* 260 (2005) 299-317.

⁵Sergey A. Cherkis, "Instantons on Gravitons," *Commun. Math. Phys.* 306 (2011) 449-483.

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Michael Hopkins

Lubin–Tate spaces: old and new questions

Jacob Lurie

Tamagawa numbers in the function field case

Matthew Morrow

*Topological Hochschild homology
in arithmetic geometry*

Kirsten Wickelgren

\mathbb{A}^1 -enumerative geometry

TUCSON, MARCH 2-6, 2019

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Challenging Deficit Perspectives through Research on Mathematical Sense-making

By Aditya P. Adiredja



I rarely hear mathematics students described as “creative,” “intellectually sophisticated,” or “full of productive ideas.” Instead, I often hear them described as “worse than years prior,” “lacking basic skills,” and “not a strong student.” Such deficit perspectives also intersect with implicit biases against students from underrepresented backgrounds, and shut down learning opportunities. My research aims to challenge such deficit perspectives and biases by carefully investigating how students make sense of mathematics.

In a recent study, I asked a group of women from diverse racial backgrounds to explain the concept of basis, from linear algebra, using ideas from their everyday lives. The women constructed unique, creative examples that research has never documented. One Latinx woman described basis as the core moral teachings of a religion because these can be used in making all life decisions. Other women used the context of friendships, fashion, the solar system, and a marching band to describe the concept. The findings of this study revealed creative mathematical generalizations, and challenged deficit narratives about contributions and intellectual ability of women of color in mathematics, much like the movie *Hidden Figures*.

Inspired by this study, a mathematician colleague teaching a combined linear algebra and probability course at a different institution gave a similar task to her students. She was looking for a way to change deficit narratives about her students, mostly underrepresented life-sciences majors. A woman in this course, and actually a “struggling” student by traditional standards, constructed a particularly sophisticated example. She described a basis as the different standard colors inside a paintbox, and further elaborated as to how to represent different subspaces (black and white paintings vs. all red paintings), the lack of closure of her subspace (one cannot have infinite amount of paint on a canvas), in addition to the concept of span, linear independence, and vector spaces.

By engaging students with a creative non-traditional task, and learning first-hand what it meant to not view students’ work in a deficit way, my colleague was able to get a more complete understanding of her students. More critically, she was able to challenge deficit perspectives about students and their thinking. ▲

Adi Adiredja earned a Ph.D. in Mathematics Education from the University of California, Berkeley and is an Assistant Professor in the Department of Mathematics at the University of Arizona, where he regularly teaches calculus, linear algebra, and number theory. Adi’s research lies in the intersection of mathematical cognition, equity, and undergraduate mathematics. He studies how deficit narratives and views on knowledge and learning impact our outlook on mathematical sense making by students of color.

Contact him at adiredja@math.arizona.edu

BIOGRAPHIES

continued from page 6



Catherine Yslas is a native Tucsonan and a former high school math teacher who earned both Bachelor’s and Master’s degrees in mathematics from the University of Arizona. Over the course of a 20 year teaching career, she has taught every level of mathematics from Algebra 1 through Calculus BC. She has a teenage daughter whom she takes to volleyball, swimming, and basketball. Catherine is a volunteer co-leader for Girl Scouts. Let her know if you want to buy Girl Scout Cookies in January! She first came to the University of Arizona as a student in 1990 and 28 years later she is thrilled to come back in a new role as an instructor.

Visiting Assistant Professor



Yiwen Liu completed her Ph.D. in Statistics at the University of Georgia in 2018. Her research primarily focuses on developing statistical methods and theory to harness various issues in analyzing high dimensional and complex data.



Yongtao Cheng completed her Ph.D. at the University of Wisconsin at Madison in 2014. Yongtao was a postdoc in the Department of Electric and Electronic Engineering at the University of Hong Kong. Her research interests are in the field of numerical analysis and mathematical modeling. In particular, her work is focuses on the development and application of high-order numerical methods for nonlinear partial differential equations such as Vlasov-Poisson and nonlinear Maxwell equations. Yongtao is now working on data-driven techniques for dynamic systems with randomnesses. Outside of math, she likes music, watching movies, and cooking.

Staff



Denielle Eliason grew up in Salt Lake City, Utah. She moved to Tucson to pursue her Bachelor’s and Master’s degrees in harp performance. While obtaining her degrees she was a member of HarpFusion, the world’s largest touring harp ensemble and performed on four continents.

continued on page 10

BIOGRAPHIES

continued from page 9

Prior to joining the business office in the Department of Mathematics she worked for eleven years in Room and Course Scheduling in the Office of the Registrar at UA. Denielle currently enjoys playing with both the Sierra Vista Symphony Orchestra and the Civic Orchestra of Tucson as Principal Harpist.



Manuel Martinez grew up in Tucson, and graduated with a double-major in political science and english in Spring of 2018. He has worked for the Math 100 courses as a student worker for the past three years and is excited to commit to student success as a full-time staff member. He enjoys reading and writing, and has interests in mathematics, history, and Shakespearean literature.



Michael Perkins is the Program Coordinator for the Center for Recruitment and Retention of Mathematics Teachers. The center provides numerous services for local classroom teachers, including the Induction Program where

Michael will be coaching 1st year and 2nd year math teachers. He is a University of Arizona graduate, and former teacher in the Flowing Wells School District where he taught at elementary, junior high, and high school. He is still the head coach of the Lady Cabs Varsity Basketball program. When not at work, Michael and his wife are playing games and completing puzzles with their two boys.



Julie Soulvie is a native Tucsonan. She completed her Bachelor's degree from the University of Arizona in Education. Julie taught preschool for 7 years and has held multiple positions in administrative oversight and assistance. She is

thrilled to now be a part of the Department of Mathematics. You can find her working the front desk in the Math Academic Office, room 108. Julie is married to another Tucson native and has three children. She loves living in the desert, and enjoys traveling and reading.

Postdoctoral Research Associates



Keaton Hamm is originally from Texas, and received two Bachelor's degrees in Chemical Engineering and Math from Texas A&M University. He also received his Ph.D. in Math from Texas A&M in August 2015. Prior to arriving in

Tucson this summer, he was a Postdoc at Vanderbilt

continued on page 11

AZ Noyce: Forming Culturally Responsive Mathematics Teachers

By Cynthia O. Anhalt



The AZ Noyce Program (NSF Award #1557255) aims to support and reward undergraduate commitment to becoming secondary mathematics teachers. Our

Secondary Mathematics Education Program (SMEP), currently the only STEM secondary teacher preparation program at UA, has two unique dimensions which Noyce elevates. First, SMEP provides robust content learning in the discipline of mathematics: our undergraduate students become teachers while earning a B.A. or B.S. in mathematics. Second, SMEP provides culturally relevant pedagogy immersed in the content through coursework and Noyce activities.

Through Noyce, mathematics majors can apply to become Noyce Scholars and commit to becoming mathematics teachers in secondary schools that serve underprivileged and underrepresented student populations. Noyce Scholars are awarded a \$10,000 scholarship for their junior and senior years of their undergraduate math major, and continue to participate in Noyce activities after they graduate. STEM majors can apply for a paid internship semester and engage in teaching-related activities with Noyce Scholars to consider becoming mathematics teachers.

The AZ Noyce Program is a collaborative model. It engages a community of mathematics education faculty, undergraduates, teachers, secondary students and their communities. Our Noyce Scholars and interns partake in varied experiences focused on the work of teaching. They serve as Undergraduate Teaching Assistants, lead an Afterschool Math Club at a local middle school, tutor in local schools (directed by the Center for Recruitment and Retention, crr.math.arizona.edu), and teach in the Summer Algebra Academy (directed by the UA Early Academic Outreach Office, eao.arizona.edu/algebra).

In addition to their involvement in teaching experiences, scholars and interns attend monthly AZ Noyce seminars designed to enable critical conversations on topics central to teaching mathematics responsively: identity, bias, race, equity, culture, social justice, and equitable teaching practices. These seminars integrate scholars into the mathematics education community in positive



Fall 2018 AZ Noyce Scholars: John Brewington, Sergio Andrade, Paola Chavez, Ryan Smiley, Madison Crosby, Jacob Warshawer, Marley Murrell, and Quentin Nolf.

ways that are distinct from the coursework in the mathematics major. Through these discussions, Noyce Scholars reflect on their development as mathematics teachers:

“ I reflected upon my own identity and realized how important our identities are. This opened my eyes to how oftentimes our identities are stripped away from us by other people and how our job as teachers is to celebrate our students’ identities. We were able to see how these identities [...] play a role in our perspective of mathematics and ourselves as mathematicians. Our classrooms are spaces to incorporate students’ backgrounds, everyday lives, and all of their identities [...] when we choose to ignore all these factors, we are ignoring vital parts of who our students are and limiting ourselves as teachers. ”

– Marley, Noyce Scholar 2018-19

“ This discussion helped reinforce my thoughts on the importance of building relationships with students. The more teachers know about their students’ identities, the more they can ensure that they are meeting the specific needs of all their students. ”

– Kelsey, Noyce Scholar 2017-18



AZ Noyce Scholar Graduates: Mateo Arredondo, Lucas Smith, Stephanie Lane, Stephanie Lara, and Kristen Leyva. Not pictured: Jorge Stimans, Gerardo Lopez, Marvin Portillo, and Kelsey Timms.

In addition to activities within the program, Noyce Scholars have represented our department in STEM events, such as the Southern AZ Research, Science and Engineering Foundation Annual Fair at the Tucson Convention Center.

Next February 2019, the Department of Mathematics will

host the **Western Region Noyce Conference** (smep.math.arizona.edu/content/2019-western-region-noyce-conference) which will bring together Noyce Scholars from over 100 universities in the western United States. To follow Noyce Scholars and learn more, please visit: smep.math.arizona.edu/content/az-noyce-math-program. Marta Civil, Jennifer Eli, and Rebecca McGraw are co-Principal Investigators of the AZ Noyce Project. ▲

Cynthia O. Anhalt, Ph.D., is an Associate Research Professor in the Department of Mathematics, and the Director of the Secondary Mathematics Education Program (SMEP). She is the Principal Investigator of the NSF funded AZ Noyce grant. Her research focuses on teacher knowledge in mathematical modeling and preparing K-12 teachers for culturally diverse student populations.

Contact her at canhalt@math.arizona.edu

BIOGRAPHIES

continued from page 10

University in Nashville. His research interests are in dimension reduction and signal processing methods in data science. In his spare time, Keaton enjoys board games, hiking, and indoor rock climbing.



Tiffany Jones was born and raised in southwest Louisiana where she also attended college at McNeese State University. After teaching in the local high schools, she decided to focus on her love of mathematics and its applications. She completed

her Ph.D. in Mathematics at Baylor University in August 2018. Her research interests include the development and analysis of finite difference methods for computing solutions of highly oscillatory partial differential equations, such as those used to describe the behavior of optical beams. In her free time, she enjoys sewing costumes, attending festivals, puzzling, and playing with her dog Duncan.



Melinda Lanius completed her Ph.D. in the Department of Mathematics at the University of Illinois at Urbana-Champaign in 2018. She is very excited to continue her work in Poisson geometry at the University of Arizona. In her spare

time, she enjoys going on long distance runs with her lab-boxer mix, Johnny.



Raymundo Navarrete grew up in a small town in Sonora, Mexico, only a few hours away from Tucson. He attended high school in Bisbee, Arizona, and obtained his Bachelor's degree at the University of Arizona. He completed his Ph.D. in Applied

Mathematics at the University of Michigan, where he focused on the problem of time series prediction using machine learning techniques. He is currently engaged in data science research as part of the UA-TRIPODS program. His hobbies include pottery, hiking, and capoeira.



Vahan Huroyan grew up in Armenia, and completed his Bachelor's degree at Yerevan State University, and spent one year as an exchange student at the University of Minnesota. Vahan received his Ph.D. in Mathematics from the

University of Minnesota in 2018 before coming to the University of Arizona as a Postdoctoral Research Associate. He is interested in studying mathematical foundations in various problems that arise in data analysis, machine learning and computer vision applications. In his spare time, Vahan enjoys traveling, and playing soccer and chess.



UA MATHEMATICS

Ph.D. Recipients, 2018

A complete list of graduates since 1992, including Master's degree recipients and links to recent theses, can be found online at: math.arizona.edu/people/grads/recent

Doctoral degrees

Matthew Fox - Spectrum of Random Hamiltonian Matrices

Advisor: Nicholas Ercolani

Employer: Raytheon Missile Systems

Position: Senior Engineer, Signal Processing

Cody Gunton - Torsion 1-Crystalline Representations and Néron Component Groups in the Semi-stable Case

Advisor: Bryden Cais

Employer: University of Copenhagen, Copenhagen, Denmark

Position: Postdoctoral Researcher, Department of Mathematics

Jinjin Liang - Curvature Flows on Polygons and Surface Clusters

Advisor: David Glickenstein

Employer: University of Arizona

Position: Visiting Assistant Professor

Kyle Pounder - Nearly Singular Jacobi Matrices and Applications to the Finite Toda Lattice

Advisor: Nicholas Ercolani

Employer: Emailage, Chandler, AZ

Position: Fraud Decision Scientist

Daniel Rossi - Fields of Values in Finite Groups: Characters

and Conjugacy Classes

Advisor: Pham H. Tiep

Employer: SUNY Binghamton, Binghamton, NY

Position: Visiting Assistant Professor

Doron Shahar - Hydrodynamic limits for long range asymmetric processes and probabilistic opinion dynamics.

Advisor: Sunder Sethuraman

Employer: BASIS Tucson North

Sheng-Chi Shih - On Congruence Modules Related To Hilbert Eisenstein Series

Advisors: Bryden Cais, Romyar Sharifi

Employer: University of Lille 1

Position: Postdoctoral Researcher, Department of Mathematics

Megan Stone - Eigenvalue Densities for the Hermitian Two-Matrix Model and Connections to Monotone Hurwitz Numbers

Advisor: Nicholas Ercolani

Jun Wang - Invariants of Modular Curves and Sharifi's Conjectures

Advisors: Bryden Cais, Romyar Sharifi

Employer: University of British Columbia

Position: Postdoctoral Researcher, Department of Mathematics