

Nikola P. Petrov

CONTACT INFORMATION

University of Oklahoma
Department of Mathematics
601 Elm Avenue
Norman, OK 73019, USA

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EDUCATION

University of Texas, Austin, Texas, USA

Ph.D., Physics, 2002. Advisor: Rafael de la Llave

- Dissertation: “Methods of Dynamical Systems, Harmonic Analysis and Wavelets Applied to Several Physical Systems”

M.A., Mathematics, 2002. Advisor: Rafael de la Llave

- Thesis: “Tree Structures and Nonlinear Approximation with Wavelets”

University of Sofia, Bulgaria

B.S., Nuclear and Elementary Particle Physics, 1990. Advisor: Petko Nikolov

- Thesis: “Obtaining Conformally Invariant Equations by Dimensional Reduction of the 6-Dimensional Maxwell Equations”

RESEARCH INTERESTS

Applied nonlinear dynamics; Applied differential geometry; Applications of stochastic processes; Numerical applications of wavelet and harmonic analysis; Fluid dynamics, turbulence.

EMPLOYMENT

University of Oklahoma, Norman, Oklahoma, USA

Chair, Department of Mathematics 8/20–present

Professor, Department of Mathematics 7/14–present

Associate Professor, Department of Mathematics 7/09–6/14

Assistant Professor, Department of Mathematics 8/05–6/09

University of Michigan, Ann Arbor, Michigan, USA

Postdoctoral Associate, Michigan Center for Theoretical Physics (part-time) 9/03–5/05

Assistant Professor, Department of Mathematics, University of Michigan 9/02–8/05

Los Alamos National Laboratory, Los Alamos, New Mexico, USA

Affiliate, Modeling, Algorithms and Informatics Group (CCS-3) 6/02–8/02

Research Assistant, Space and Remote Sensing Sciences Group (NIS-2) 5/01–8/01

University of Texas, Austin, Texas, USA

Research Assistant, Department of Mathematics 8/98–5/99, 1/00–5/00

Assistant Instructor, Department of Physics 8/97–12/99, 6/00–5/02

Teaching Assistant, Department of Physics 9/95–8/97

Technical University, Sofia, Bulgaria

Lecturer, Experimental Technological School for Electronic Systems 9/93–8/95

University of Sofia, Sofia, Bulgaria

Lecturer (part-time), Department of Physics 9/89–5/95

GRANTS AND
FELLOWSHIPS

Senior Faculty Summer Fellowship, “Finsler geometry, Morse families, and waves in anisotropic medium” (Spring 2023)

NSF grant DMS-0807658 (Division of Mathematical Sciences, Applied Mathematics program), Principal Investigator, “Small-scale structures in dynamical systems: Accurate numerics and renormalization” (September 2008 – August 2012)

Big XII Faculty Fellowship, Office of the Provost, University of Oklahoma (Spring 2010)

Junior Faculty Research Program Grant from the University of Oklahoma Research Council, “Combined routes to complex behavior in dynamical systems: Numerical studies and renormalization group” (Summer 2008)

Big XII Faculty Fellowship, Office of the Provost, University of Oklahoma (Fall 2007)

NSF grant DMS-0405903, continued as DMS-0603721 (Division of Mathematical Sciences, Applied Mathematics program), Principal Investigator, “Regularity and scale invariant properties of critical dynamical systems: Harmonic analysis and numerical implementations” (September 2004 – August 2008)

Rackham Faculty Fellowship, Horace H. Rackham School of Graduate Studies, University of Michigan, “Fourier and wavelet methods for analysis of the regularity and fractal properties of functions” (Summer 2003)

PUBLICATIONS
IN REFEREED
JOURNALS

S. Bauer, N. P. Petrov. On the existence of KAM tori for presymplectic vector fields. *Electron. J. Differential Equations* 2020, Paper No. 126, 26 pp.

P. A. Nikolov, N. P. Petrov. Restriction and dimensional reduction of differential operators. *Int. J. Geom. Methods Mod. Phys.* **16:6** (2019) 1950094, 37 pp.

J. Broda, A. Grigo, N. P. Petrov. Convergence rates for semistochastic processes. *Discrete Contin. Dyn. Syst. Ser. B* **24:1** (2019) 109–125

P. A. Nikolov, N. P. Petrov. Dimensional reduction of invariant fields and differential operators. I. Reduction of invariant fields. *Ann. Henri Poincaré* **13:3** (2012) 449–480

M. Leite, N. P. Petrov, E. Weng. Stationary distributions of semistochastic processes with disturbances at random times and random severity. *Nonlinear Anal. Real World Appl.* **13:2** (2012) 497–512

R. de la Llave, A. Olvera, N. P. Petrov. Combination laws for scaling exponents and relation to the geometry of renormalization operators. The principle of approximate combination of scaling exponents. *J. Stat. Phys.* **143:5** (2011) 889–920

J. D. Mitchell, N. P. Petrov. Temperature distribution in a uniformly moving medium. *Eur. J. Phys.* **30:2** (2009) 417–426

R. de la Llave, N. P. Petrov. Boundaries of Siegel disks – numerical studies of their dynamics and regularity. *Chaos* **18:3** (2008) 033135, 11 pp.

A. Olvera, N. P. Petrov. Regularity properties of critical invariant circles of twist maps, and their universality. *SIAM J. Appl. Dyn. Syst.* **7:3** (2008) 962–987

A. Cheskidov, C. R. Doering, N. P. Petrov. Energy dissipation in fractal-forced flow. *J. Math. Phys.* **48:6** (2007) 065208, 10 pp.

R. de la Llave, A. Olvera, N. P. Petrov. Universal scalings of universal scaling exponents. *J. Phys. A: Math. Theor.* **40:22** (2007) F427–F434

A. Apte, R. de la Llave, N. P. Petrov. Regularity of critical invariant circles of non-twist maps.

Nonlinearity **18**:3 (2005) 1173–1187

N. P. Petrov. Dynamical Casimir effect in a periodically changing domain: A dynamical systems approach. *J. Opt. B: Quantum Semiclass. Opt.* **7**:3 (2005) S89–S99

N. P. Petrov, L. Lu, C. R. Doering. Variational bounds on the energy dissipation rate in body-forced shear flow. *J. Turbulence* **6**:17 (2005) 1–17

N. P. Petrov, R. de la Llave, J. A. Vano. Torus maps and the problem of one-dimensional optical resonator with a quasiperiodically moving wall. *Physica D* **180**:3–4 (2003) 140–184

P. A. Nikolov, N. P. Petrov. A local approach to dimensional reduction. I. General formalism. *J. Geom. Phys.* **44**:4 (2003) 523–538

P. A. Nikolov, N. P. Petrov. A local approach to dimensional reduction. II. Conformal invariance in Minkowski space. *J. Geom. Phys.* **44**:4 (2003) 539–554

R. de la Llave, N. P. Petrov. Regularity of conjugacies between critical circle maps: An experimental study. *Experiment. Math.* **11**:2 (2002) 219–241

R. de la Llave, N. P. Petrov. Theory of circle maps and the problem of one-dimensional optical resonator with a periodically moving wall. *Phys. Rev. E* **59**:6 (1999) 6637–6651

NON-REFEREED
PUBLICATIONS

N. P. Petrov. Mechanics. In *Encyclopedia of Sciences and Religions*, Editors-in-chief: A. Runehov, L. Oviedo. Springer-Verlag, ISBN: 978-1402082641, May 2013

C. R. Doering, N. P. Petrov. Low-wavenumber forcing and turbulent energy dissipation. In *Progress in Turbulence*, Eds. J. Peinke, A. Kittel, S. Barth, M. Oberlack. Springer-Verlag, 2005, pp. 11–18

A. B. Davis, N. P. Petrov, E. E. Clothiaux. Semi-discrete wavelet characterization of stratus cloud structure from mm-radar and satellite data. In: *Proceedings of the 11th American Meteorological Society Conference on Cloud Physics (Ogden, UT, June 3–7, 2002)*, available online at ams.confex.com/ams/11AR11CP/techprogram/programexpanded_102.htm

A. B. Davis, N. P. Petrov, E. E. Clothiaux, A. Marshak. Stratus cloud structure from mm-radar transects and satellite images: Scaling properties and artifact detection with semi-discrete wavelet analyses. In: *Proceedings of the 12th Atmospheric Radiation Measurement (ARM) Science Team Meeting (St. Petersburg, FL, April 8–12, 2002)*, www.arm.gov/publications/proceedings/conf12/

SUBMITTED

G. Alston, N. P. Petrov, M. Sunkula. On the geometric quantization of focus-focus singularities

PREPRINTS

A. Olvera, R. de la Llave, N. P. Petrov. A shadowing theorem with localization, and applications to heteroclinic cycles and to properties of scaling exponents, 69 pp (2019)

IN PROGRESS

D. Sheaih, N. P. Petrov, A. Shapiro. Resonance phenomena in periodically heated fluids

BOOKS

P. A. Nikolov, N. Petrov, L. Z. Chorbadzhiev. *A Problem Book on Partial Differential Equations for Physicists*, iv + 209 pp. (in Bulgarian; accepted for publication by Sofia University Press)

OTHER
PUBLICATIONS

Co-translator (with L. Z. Chorbadzhiev, Y. P. Vlahov, O. Stoychev) of the book A. Pais, ‘*Subtle is the Lord...*’ *The Science and Life of Albert Einstein* (Oxford University Press, 1982), Sofia University Press, Sofia, 2004, 641 pp., ISBN 954-07-1692-6

TEACHING
EXPERIENCE

Department of Mathematics, University of Oklahoma, Norman, Oklahoma, USA

MATH 1823 “Calculus and Analytic Geometry I” – Fa 12, Sp 10

MATH 2423 “Calculus and Analytic Geometry II” – Sp 15, Fa 08

MATH 2433 “Calculus and Analytic Geometry III” – Fa 20, Sp 16, Fa 14, Sp 09 (Honors)
 MATH 2443 “Calculus and Analytic Geometry IV” – Su 13 (two sections), Sp 13, Su 12, Fa 09 (Honors)
 MATH 1914 “Differential and Integral Calculus I” – Fa 17
 MATH 2924 “Differential and Integral Calculus II” – Fa 15 (Honors)
 MATH 2934 “Differential and Integral Calculus III” – Su 14
 MATH 2513 “Discrete Mathematical Structures” – Sp 19, Sp 07
 MATH 3113 “Introduction to Ordinary Differential Equations” – Fa 13, Sp 06
 MATH 3413 “Physical Mathematics I” – Sp 20, Sp 14, Sp 12, Fa 10, Fa 06, Sp 06
 MATH 3423 “Physical Mathematics II” – Fa 22, Fa 19, Fa 16, Fa 13, Fa 07
 MATH 4073 “Numerical Analysis” – Fa 21, Fa 16, Fa 13, Fa 10, Fa 09, Fa 06, Fa 05
 MATH 4093/5093 “Applied Numerical Methods” – Sp 11, Fa 10
 MATH 4103 “Introduction to Functions of a Complex Variable” – Sp 16, Sp 12
 MATH 4163 “Introduction to Partial Differential Equations” – Sp 21, Sp 18, Fa 12
 MATH 4193/5103 “Introductory Mathematical Modeling / Mathematical Models” – Sp 22, Sp 20, Sp 17, Sp 13, Fa 05
 MATH 4433 “Introduction to Analysis I” – Sp 17, Fa 14, Sp 07
 MATH 4443/5443 “Introduction to Analysis II” – Sp 18
 MATH 4513 “Senior Seminar” – Fa 15
 MATH 4733 “Mathematical Theory of Probability” – Fa 07
 MATH 5093 “Applied Numerical Methods” – Fa 10
 MATH 5163 “Partial Differential Equations” – Sp 14
 MATH 5403 “Calculus of Variations” – Fa 19
 MATH 5453 “Real Analysis I” – Fa 08
 MATH 5463 “Real Analysis II” – Sp 09
 MATH 5483 “Wavelets” – Sp 08
 MATH 5763 “Introduction to Stochastic Processes” – Sp 19, Fa 15, Sp 11, Sp 08

Department of Mathematics, University of Michigan, Ann Arbor, Michigan, USA

MATH/STATS 526 “Discrete Stochastic Processes” – Winter 05
 MATH/STATS 525 “Probability Theory” – Fa 04
 MATH 156 “Applied Honors Calculus II” – Fa 03
 MATH/STATS 425 “Introduction to Probability” – Sp 03, Su 04, Fa 04
 MATH 255 “Applied Honors Calculus III” – Winter 03
 MATH 115 “Calculus I” – Fa 02, Winter 03

Department of Physics, University of Texas, Austin, Texas, USA

PS 303 “Introduction to Physical Science I” – Fa 97–Sp 02
 PHY 103M “Laboratory for Engineering Students” – Sp 96–Su 97

Department of Physics, University of Sofia, Bulgaria

“Acoustic Waves in Fluids” (designed and taught) – Fa 94
 “Partial Differential Equations” – Sp 91–Sp 95

“Mathematical Methods in Physics” (vector and tensor calculus, ODEs, complex analysis) – Fa 91–Sp 93

“Mechanics and Molecular Physics” – Fa 89–Fa 90

Experimental Technological School for Electronic Systems, Technical University, Sofia

“General Physics” – Fa 93–Fa 95

OTHER TEACHING ACTIVITIES **Advising and mentoring**

Postdoctoral mentor of Maria Leite, Department of Mathematics, OU (2008–2011) – presently a tenure-track Assistant Professor at the Department of Mathematics, University of South Florida, St. Petersburg

Ph. D. advisor (co-advisor: Pengfei Zhang) of Martin Carlson, Department of Mathematics, OU (2018–present)

Ph. D. advisor of Mahesh Sunkula, Department of Mathematics, OU (2014–2019, defended in June 2019), dissertation: “Geometric quantization of a semi-global model of a focus-focus singularity”

Ph. D. co-advisor (advisor: Alexander Grigo) of Dania Sheaih, Department of Mathematics, OU (2013–2019, defended in April 2019), dissertation: “Dynamics and stability of buoyancy-induced flows”

Ph. D. advisor (co-advisor: Alexander Grigo) of James Broda, Department of Mathematics, OU (2012–2017, defended in May 2017), dissertation: “Convergence rates for stationary distributions of semistochastic processes”

Ph. D. advisor of Sean Bauer, Department of Mathematics, OU (2010–2016, defended in May 2016), dissertation: “On the existence of KAM tori for presymplectic vector fields”

Undergraduate research projects directed

Directed an NSF-funded research project of Karl Schaettle on combinatorial modeling of polymer molecules (Summer 2011)

Directed an NSF-funded research project of Jacob Stinnett on bifurcation of solutions of differential equations (Summer 2011)

Directed an NSF-funded research project of Miki Jamerson on periodic solutions of differential equations (Summer 2011)

Directed an NSF-funded research project of Scott Lowe on computing stability properties of periodic orbits of autonomous systems of differential equations (Summer 2010)

Directed an NSF-funded research project of Miki Jamerson on perturbative methods for differential equations (Summer 2010)

Directed an NSF-funded research project of Justin Glick on properties of solutions of differential equations (Summer 2010)

Directed an NSF-funded research project of Jonathan Sharp and Feng Nai on dynamics of an elastic pendulum (Summer 2007)

Directed an NSF-funded research project of Clint Vrazel on formal power series solutions of functional equations (Summer 2007)

Directed an NSF-funded research project of Joseph Mitchell on stability of inverted pendulum (Summer 2006)

Directed an NSF-funded research project of Kimberly Saylor on billiards and dynamical systems

(Summer 2006)

Directed an NSF-funded research project of Will Dabney on properties of collisions of particles in a ring and in triangular billiards (Summer 2006)

Directed an NSF-funded REU (Research Experience for Undergraduates) project of Karl Weintraub on phase-locking of critical circle maps (Summer 2005, University of Michigan)

Co-directed an REU project of Murad Ahmed on stochastic modeling of disease spread (Summer 2005, University of Michigan)

Directed an REU project of Rahul Suri on wavelets and regularity of functions (Summer 2004, University of Michigan)

Directed an REU project of Ronit Yael Slyper on dynamical systems and symplectic geometry (Spring 2003, University of Michigan)

Member of doctoral committees

Carlos Villanueva (advisor: Pengfei Zhang), Mathematics, OU (2022–present)

Juan Zuñiga Castro (advisor: Robert Lewis-Swan), Physics, OU (2021–present)

Dakotah Martinez (advisor: Howard Baer), Physics, OU (2021–present)

Chenyu Fang (advisor: Chung Kao), Physics, OU (2021–present)

Philip Bretz (advisor: Miroslav Kramár), Mathematics, OU (2020–present)

Madeline Frank (advisor: Steven Cavallo), Meteorology, OU (2019–present)

Ray Niazi (advisor: Miroslav Kramár), Mathematics, OU (2019–present)

Nishaal Parmar (advisors: Thordur Runolfsson, Hazem Refai), Telecommunications Engineering, OU (2019–present)

Martin Satrio (advisors: Michael Coniglio, Erik Rasmussen), Meteorology, OU (2020–2023)

Cesar M. Salazar Aquino (advisors: Robert Palmer, Boon Leng Cheong), Electrical & Computer Engineering, OU (2018–2022)

Joshua Gebauer (advisor: Alan Shapiro), Meteorology, OU (2018–2020)

Manda Chasteen (advisors: Cameron Homeyer, Steven Koch), Meteorology, OU (2018–2021)

Ling Jin (advisor: Ying Wang), Mathematics, OU (2017–2022)

Hristo Chipilski (advisor: Xuguang Wang), Meteorology, OU (2017–2021)

Sam Lillo (advisor: David Parsons), Meteorology, OU (2017–2021)

A. Addison Alford (advisor: Michael Biggerstaff), Meteorology, OU (2017–2021)

Kyle Scarbrough (advisor: Christian Remling), Mathematics, OU (2017–2020)

Connor Davis (advisors: Alexander Grigo, Fan Yang), Mathematics, OU (2017–2020)

Rishabh Jain (advisor: Chung Kao), Physics, OU (2016–2020)

Fatma Bozkurt (advisor: Keri Kornelson), Mathematics, OU (2015–2018)

Soroush Mohammadzadeh (advisor: Jin-Song Pei), Civil Engineering & Environmental Science, OU (2015–present)

Elham Tajik (advisor: Thordur Runolfsson), Electrical & Computer Engineering, OU (2014–

2018)

Xu Dou (advisor: Bruno Uchoa), Physics, OU (2014–2018)

Feng Chen (advisor: Samuel Cheng), Electrical & Computer Engineering, OU (2013–2015)

Dan Mickelson (advisor: Howard Baer), Physics, OU (2013–2014)

Suyu Li (advisor: Meijun Zhu), Mathematics, OU (2013–2014)

Priyangika Wickramarachchi (advisor: Chung Kao), Physics, OU (2011–2015)

Maren Padeffke (advisor: Chung Kao), Physics, OU (2011–2015)

Kesheng Yang (advisor: Chung Kao), Physics, OU (2011–2013)

Nancy Ho (advisor: Kevin Grasse), Mathematics, OU (2010–2015)

Nima Pourtolami (advisor: Kimball Milton), Physics, OU (2009–2011)

Kesong Cheng (advisor: Meijun Zhu), Mathematics, OU (2009–2012)

Iroko K. Abalo (advisor: Kimball Milton), Physics, OU (2009–2012)

Jie Lu (advisor: Choon Yik Tang), Electrical & Computer Engineering, OU (2009–2011)

Prachi Parashar (advisor: Kimball Milton), Physics, OU (2009–2011)

Ensheng Weng (advisor: Yiqu Luo), Botany and Microbiology, OU (2009–2011)

Shibi Rajagopalan (advisor: Howard Baer), Physics, OU (2009–2010)

Bryan Burkholder (advisor: Alan Shapiro), Meteorology, OU (2008–present)

Lynn Greenleaf (advisor: Luther White), Mathematics, OU (2008–2013)

Michael French (advisor: Howard Bluestein), Meteorology, OU (2008–2012)

Chenxi Lin (advisor: Thordur Runolfsson), Electrical & Computer Engineering, OU (2008–2011)

Sean Crowell (advisor: Luther White), Mathematics, OU (2007–2011)

Pedro Olaya (advisor: Tomasz Przebinda), Mathematics, OU (2007)

Jie Shao (advisor: Thomas Ray), Zoology, OU (2006–2012)

Hussain Al-Zoubi (advisor: Jong-Jin Kim), Architecture and Urban Planning, University of Michigan (Minor area advisor) (2003–2005)

Satoshi Nakamura (advisor: Jong-Jin Kim), Architecture and Urban Planning, University of Michigan (2003–2005)

Talks for undergraduate and graduate students

“Johann and Jacob Bernoulli, Leibniz, Newton, and the curious birth of the Calculus of Variations” (talk at the OU Math Club, 11 November 2021)

“Bistability in ecological systems” (talk at the OU Math Recruiting & Visitation Weekend, 28–29 February 2020)

“Birds, bugs, and bifurcations” (talk at the OU Math Club, 6 November 2019)

“The curious early history of Calculus of Variations” (talk at the Graduate Student Seminar, University of Oklahoma, 1 April 2019)

“Johann and Jacob Bernoulli, Leibniz, Newton, and the curious history of the brachistochrone”

(talk at the Annual Meeting of the Oklahoma-Arkansas Section of MAA, Northeastern State University, Tahlequah, 28–30 March 2019)

“Lagrangian and Hamiltonian formalisms - Simple applications – I, II” (two talks at the Student Analysis Seminar, 7 and 14 February 2019)

“From Lagrangian to Hamiltonian” (talk at the Student Analysis Seminar, 31 January 2019)

“An introduction to Hamiltonian mechanics” (talk at the Student Analysis Seminar, 24 January 2019)

“Complex analysis and two-dimensional hydrodynamics” (talk at the Graduate Student Seminar, University of Oklahoma, 23 April, 2018)

“Will an angry dog bite you? An informal introduction to Catastrophe Theory” (talk at the Graduate Student Seminar, University of Oklahoma, 23 January, 2017)

“Johann Bernoulli’s brachistochrone challenge and the birth of Calculus of Variations” (talk at the Graduate Student Seminar, University of Oklahoma, 7 December, 2015)

“Johann Bernoulli brachistochrone and the birth of calculus of variations” (talk at the Annual Meeting of the Oklahoma-Arkansas Section of MAA, University of Tulsa, 9–11 April, 2015)

“Undergraduate research panel” (discussion at the OU Math Club, 26 February, 2014)

“Self-similarity, fractals, and dimensions” (talk at the OU Math Club, 5 December, 2012)

“Applied Math versus Pure Math: Some thoughts of a theoretical physicist working at a Math department while attending an Ecology conference” (talk at the Graduate Student Seminar, University of Oklahoma, 2 April, 2012)

“Back to the XVIIth century: Johann Bernoulli’s brachistochrone challenge and the birth of the calculus of variations” (talk at the OU Math Club, 7 September, 2011)

“Self-similarity, fractals, and dimensions” (talk at the Annual Meeting of the Oklahoma-Arkansas Section of MAA, University of Central Oklahoma, 1–2 April, 2011)

“Johann and Jakob Bernoulli, Leibniz, Newton, and the curious history of the brachistochrone” (talk at the Graduate Student Seminar, University of Oklahoma, 7 March, 2011)

“Fractals everywhere” (talk for the US National Mathematics Champion students, University of Oklahoma, 25 June, 2010)

“Fractals around us” (talk at the MathFest 2010, University of Oklahoma, 22 January, 2010)

“Physics and Math for lazy people: From non-existence of Godzilla to the energy of a nuclear explosion” (talk at the OU Math Club, 16 September, 2009)

“Temperature distribution in a uniformly moving medium” (talk at the Applied Mathematics Seminar of the OU SIAM Student Chapter, 4 September, 2009)

“Order and chaos in billiards” (talk at the Applied Mathematics Seminar of the OU SIAM Student Chapter, 20 February, 2009)

“Glimpses into the history of Dynamical Systems I, II” (talks at the Applied Mathematics Seminar of the OU SIAM Student Chapter, 3 and 10 December, 2008)

“Optical resonators and dynamical systems” (talk at the Annual Meeting of the Oklahoma-Arkansas Section of MAA, University of Arkansas-Fort Smith, AR, 1 April, 2008)

“Waiting at the bus stop: An intro to stochastic processes” (talk at the Graduate Student Seminar, University of Oklahoma, 29 October, 2007)

“The secret geometry of harmonic oscillators” (talk at the Graduate Student Seminar, University

of Oklahoma, 9 April, 2007)

“Space and time in special relativity” (talk at the Graduate Student Seminar, University of Oklahoma, 27 November, 2006)

“Introduction to the theory of billiards” (talk at the Graduate Student Seminar, University of Oklahoma, 24 April 2006)

“Billiards: Old and new problems” (talk at the 68th Annual Meeting of the Oklahoma-Arkansas Section of MAA, University of Arkansas, Fayetteville, AR, 1 April, 2006)

“Billiards: Old problems, new applications” (talk at the MathFest 2006, University of Oklahoma, 28 January, 2006)

“Pendulums, nuclear explosions and a proof of non-existence of Godzilla” (talk at Western Washington University, 18 February, 2005)

“An introduction to wavelets and self-similarity” (two talks at the VIGRE Working Group on Non-Linear Dynamical Systems, University of Michigan, 9 & 16 February, 2004)

“Talking simply about complicated phenomena: Dimensional analysis in Physics” (talk at the Undergrad Math Club at University of Michigan, 6 February, 2003)

Graduate Mathematics reading courses directed at the University of Oklahoma

Stochastic Calculus in Finance (Philip Bretz, Fall 2019)

Symplectic geometry (Martin Carlson, Fall 2019)

Mathematical Methods of Fluid Dynamics (Hristo Chipilski, Spring 2018)

Geometric Quantization (Mahesh Sunkula, Fall 2017)

Symplectic Geometry and Short-Wavelength Optics (Mahesh Sunkula, Fall 2015)

Symplectic Geometry (Mahesh Sunkula, Spring 2015)

Matrix Lie Groups and Their Representations (Andrew Ault, Spring 2015)

Differential Geometry (Mahesh Sunkula, Fall 2014)

Bifurcations of Dynamical Systems (Mahesh Sunkula, Spring 2014)

Symmetry Reduction by Lifting (Bryan Archer, Fall 2013)

Introduction to Differential Geometry and Lie Groups (Bryan Archer, James Broda, and Lee Lerner, Spring 2012)

Kolmogorov-Arnold-Moser Theorem (Sean Bauer, Spring 2011)

Introduction to Aubry-Mather Theory (Sean Bauer, Fall 2010)

Introduction to Dynamical Systems (Nancy Ho and Sean Bauer, Spring 2010)

Mathematical Models in Ecology (Ensheng Weng, Spring 2009)

Stochastic Differential Equations (Injo Hur, Fall 2008)

Introduction to Fluid Dynamics (Sean Crowell, Summer 2008)

Probability Theory (Sean Bauer, Summer 2008)

Martingales and Brownian Motion (Injo Hur, Spring 2008)

Introduction to Analysis I (Rick Rhoton, Summer 2007)

Mathematical Models in Economics (Stephen Terry, Spring 2007)

Mathematical Models (Joshua Wages, Spring 2007)

Numerical Analysis II (Jangho Yoon, Spring 2006)

Numerical Analysis I (Daniel Bakewell & David Manning, Spring 2006)

Other activities

Directed a Directed Readings course with Lydia England on Analytical mechanics and calculus of variations (Spring 2023)

Directed an Honors Research course with Nathan Leiphart on Differential forms and their applications (Fall 2022)

Directed an Physics Capstone Project with Kazsa Fahrenthold on Geometric methods for symmetries of differential equations (Fall 2019)

Directed a Mentored Research Experience (MATH 3440) with Sawyer Robertson, on Random walks on networks (Summer 2019)

Directed an Independent Study (MATH 4990) with Gulzira Huxitaer, on Complex analysis methods for two-dimensional fluid flow (Spring 2019)

Directed an Independent Study (MATH 4990) with Finn Bender, on Markov Chain Monte Carlo methods (Spring 2019)

Directed an Independent Study (MATH 4990) with Bailey Hein, on Mathematical methods for deformable media (Spring 2018)

Directed an Honors Reading (MATH 3960) with Gavin E. Jergensen, Thomas Pharis, and Duncan Walter, and Honors Research (MATH 3980) with Nathaniel Lydick and Avraham Revah, on Introduction to differential geometry (Spring 2017)

Directed an Independent Study (MATH 3990) with Karlee Oltermann, on Newton method for numerical solution of elementary problems of computer graphics (Spring 2017)

Directed an Honors Research class (MATH 3980) with Armand Ghosh, on Mathematical analysis of a population model (Fall 2016)

Directed an Honors Physics Thesis of Hunter Ash, “The Kepler manifold as a Marsden-Weinstein reduced space” (Spring 2015)

Directed a Physics Capstone Project with Hunter Ash on Symmetries of the Kepler problem in classical and quantum mechanics (Fall 2014-Spring 2015)

Directed a Physics Capstone Project with Jacob Stinnett on Lie series perturbation methods in Hamiltonian mechanics (Fall 2011-Spring 2012)

Directed a Physics Capstone Project with Matthew Whiteway on Perturbation methods for the Fermi-Pasta-Ulam problem (Fall 2010-Spring 2011)

Directed an Independent Study (MATH 4990) with Blake Eisner, Jinsan Kang, Ronald Tong on Qualitative methods for ordinary differential equations (Spring 2010)

Directed an Undergraduate Honors Research (MATH 3980) with Samuel Wilson on Stability of vertical oscillations of an elastic pendulum (Fall 2009)

Received Undergraduate Research Opportunities Program (UROP) grant “Exact solutions for temperature distribution in laminar flows” from the Honors College, University of Oklahoma, supporting undergraduate student Joseph Mitchell (Fall 2007), \$600

PRESENTATIONS

- “Stationary distributions for semistochastic processes” (talk at the Symposium in honor of the 75th birthday of Petko Nikolov, Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Sofia, 11 May, 2023)
- “Stationary distributions and convergence rates for semistochastic processes” (talk at the Charlie Doering Memorial Symposium, University of Michigan, Ann Arbor, MI, 26–27 May, 2022)
- “Stationary distributions and convergence rates for semistochastic processes” (talk at the 3rd Annual Meeting of SIAM Central States Section, Colorado State University, Fort Collins, CO, 29 September – 1 October, 2017)
- “KAM tori for presymplectic vector fields” (invited talk at the AMS Fall Central Sectional Meeting, University of North Texas, Denton, TX, 9–10 September, 2017)
- “Classical and quantum phenomena in pulsating resonators: A dynamical systems approach” (invited talk at the conference LLAVEFEST: A Broad Perspective on Finite and Infinite Dimensional Dynamical Systems, Barcelona, Spain, 12–16 June, 2017)
- “Combination of scaling exponents, renormalization, and shadowing” (talk at the conference Challenges in Nonequilibrium Statistical Physics and Fluid Dynamics, in honor of the 60th birthday of Charlie Doering, Brigham Young University, Provo, UT, 23–25 May, 2016)
- “Moving boundaries and dynamical systems: from lasers to dynamical Casimir effect” (invited talk at University of Mississippi, Oxford, MS, 5 May, 2016)
- “Circle maps everywhere: from lasers to dynamical Casimir effect” (invited talk at KU Computational and Applied Mathematics Workshop, University of Kansas, Lawrence, KS, 18–19 April, 2014)
- “Moving boundaries and dynamical systems” (invited colloquium talk at the University of Toledo, OH, 28 March, 2014)
- “Shadowing with localization, and applications to renormalization” (invited talk at the AMS Fall Central Sectional Meeting, Washington University, St. Louis, MO, 18–20 October, 2013)
- “Combination of scaling exponents, renormalization, and shadowing” (invited talk at the First Central Region Conference on Numerical Analysis and Dynamical Systems, University of Kansas, Lawrence, KS, 3–5 May, 2013)
- “Heteroclinic shadowing and applications to renormalization” (invited talk at the AMS Spring Southeastern Sectional Meeting, University of Mississippi, Oxford, MS, 1–3 March, 2013)
- “Combination of scaling exponents and geometry of the action of renormalization operators” (talk at the 18th International Conference on Difference Equations and Applications ICDEA-2012, Universitat Autònoma de Barcelona, Barcelona, Spain, 23–27 July, 2012)
- “A shadowing theorem with localization, with applications to heteroclinic cycles and to properties of scaling exponents” (invited talk at the AMS Spring Central Section Meeting, University of Kansas, Lawrence, KS, 30 March – 1 April, 2012)
- “Numerical study of regularity of functions related to critical objects” (talk at the workshop Invariant Objects in Dynamical Systems and Their Applications, Institute for Mathematics and Its Applications, University of Minnesota, Minneapolis, MN, 20 June – 1 July, 2011)
- “Dynamical systems approach to fields in pulsating resonators” (talk at the 2011 Quantum Vacuum Meeting, University of Oklahoma, Norman, OK, 18–19 May, 2011)
- “Combination of scaling exponents and properties of renormalization operators” (invited talk at the 8th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Dresden University of Technology, Dresden, Germany, 25–28 May, 2010)

“Moving boundaries and dynamical systems” (invited Franks Stones Colloquium Lecture at Texas Christian University, Fort Worth, TX, 2 February, 2010)

“Approximate combination of scaling exponents: numerical observations and renormalization explanation” (talk at the Americas Conference on Differential Equations and Nonlinear Analysis, PASI-2009, Veracruz, Mexico, 19–23 October, 2009)

“Fields in pulsating resonators: A dynamical systems approach” (talk at the Ninth conference Quantum Field Theory Under the Influence of External Conditions, University of Oklahoma, Norman, OK, 21–25 September 2009)

“Principle of approximate combinations of scaling exponents” (talk at the conference Dynamics, Topology and Computations, Będlewo, Poland, 31 May – 6 June 2009)

“Fields in pulsating resonators: Classical and quantum aspects” (invited talk at the Symposium on Evolution Equations at Tokai University, Hiratsuka, Kanagawa, Japan, 10–12 March 2009)

“Classical and quantum effects in pulsating resonators: A dynamical systems approach” (invited talk at the Fifth International Conference of Applied Mathematics and Computing, Plovdiv, Bulgaria, 12–18 August 2008)

“Boundaries of Siegel disks – numerical explorations” (invited talk at Département de mathématiques, Université de Liège, Belgium, 6 August, 2008)

“Boundaries of Siegel disks – dynamics and regularity” (invited talk at Coloquio de Matemáticas Aplicadas, Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas, UNAM, Mexico City, 9 January 2008)

“Energy dissipation in low-wavenumber-forced and fractal-forced flows” (invited talk at the Special Session on Recent Developments in 2-D Turbulence in the AMS Fall Western Section Meeting, Albuquerque, NM, 13–14 October, 2007)

“Classical and quantum effects in pulsating resonators” (talk at the International Conference on Dynamical Methods and Mathematical Modelling, Universidad de Valladolid, Spain, 18–22 September, 2007)

“Invariance and reduction – a geometric picture” (talk at Departamento de Física Teórica, Universidad de Zaragoza, Spain, 17 September, 2007)

“Critical objects in dynamical systems: Regularity, self-similarity, singular measures” (invited talk at the International Conference “Pioneers of Bulgarian Mathematics”, Sofia, Bulgaria, 8–10 July, 2006)

“Regularity of critical objects in dynamical systems” (talk at the International Conference on Complex Systems – ICCS 2006, Boston, MA, 25–30 June, 2006)

“Regularity of critical invariant circles of area-preserving maps” (talk at the Dynamical Systems Weekend, Columbia, MO, 19–21 May, 2006)

“Empirical studies of regularity in critical dynamical systems” (talk at the 94th Statistical Mechanics Conference, Rutgers University, Piscataway, NJ, 18–20 December, 2005)

“Regularity of critical invariant circles in non-twist maps” (invited talk at the SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, 22–26 May, 2005)

“Regularity of critical objects in dynamical systems: Numerical methods and results” (colloquium talk, Stevens Institute of Technology, Hoboken, NJ, 24 February, 2005)

“Moving boundaries and dynamical systems” (invited talk at the Nonlinear Dynamics Seminar, University of Houston, TX, 10 February, 2005)

“Regularity of critical objects in dynamical systems: Numerical methods and results” (colloquium talk, University of South Carolina, Columbia, SC, 27 January, 2005)

“Dynamical systems approach to effects in a pulsating cavity” (talk at the Pan-American Advanced Studies Institute on Differential Equations and Nonlinear Analysis, Universidad de Chile, Santiago, Chile, 10–21 January, 2005)

“Law-wavenumber forcing and turbulent energy dissipation” (talk at the 57th Annual Meeting of the Division of Fluid Dynamics of the APS, Seattle, WA, 21–23 November, 2004)

“Reduction of invariant fields and differential operators” (invited talk at the Analysis Seminar, University of Western Ontario, London, Canada, 17 November, 2004)

“Dynamical systems approach to resonant effects in pulsating one-dimensional resonators” (invited talk at the Special Session on Mathematical Physics in the Sixth International Joint Meeting of the AMS and the Sociedad Matemática Mexicana, Houston, TX, 13–15 May, 2004)

“Fourier and wavelet methods for regularity of critical maps” (invited talk at the Special Session on Dynamical systems in the AMS Central Regional Meeting in Athens, OH, 26–27 March, 2004)

“A simple introduction to wavelets and fractals” (a series of two invited talks at Seminari de Sistemes Dinàmics Universitat de Barcelona - Universitat Politècnica de Catalunya, Barcelona, Spain, January 28 & 30, 2004)

“Lyapunov exponents and Doppler effect in resonant cavities” (invited talk at Coloquio de Matemáticas Aplicadas, Universidad Nacional Autónoma de México, Mexico City, 8 January 2004)

“Dynamical systems approach to optical resonators with moving boundaries” (invited talk at the CAMP/Nonlinear PDE’s Seminar, University of Chicago, IL, 28 June, 2003)

“Regularity of conjugacies between critical circle maps: Fourier and wavelet methods” (talk at the Applied and Interdisciplinary Mathematics Seminar, University of Michigan, Ann Arbor, MI, 17 January, 2003)

“Pulsating resonators and dynamical systems” (talk at the Differential Equations Seminar, University of Michigan, Ann Arbor, MI, 11 December, 2002)

“Regularity of conjugacies between critical circle maps: Numerical results” (talk at the Dynamics and Geometry Seminar, Cornell University, Ithaca, NY, 18 February, 2002)

“Fourier and wavelet methods for analysis of regularity – applications to circle maps” (poster at Dynamics Days 2002, Baltimore, MD, 4–7 January, 2002)

“Hölder regularity of conjugacies between circle maps – Fourier and wavelet methods” (talk at Coloquio de Matemáticas Aplicadas, Universidad Nacional Autónoma de México, Mexico City, 10 December 2001)

“Regularity of conjugacies of critical circle maps: An experimental study” (invited talk at the Midwest Dynamical Systems Meeting, University of Colorado, Boulder, CO, 5–7 October 2001)

“Smoothness of conjugacies of circle maps: An empirical study” (talk at the Mathematical Physics Seminar, University of Texas, Austin, TX, 7 March 2001)

“Optical resonators with moving boundaries and dynamical systems” (talk at the Southwest Regional Workshop on New Directions in Dynamical Systems, University of Southern California, Los Angeles, CA, 16–19 November 2000)

“Applications of the theory of circle maps to radiation in resonant cavities” (talk at the Mathematical Physics Seminar, University of Texas, Austin, TX, 14 October 1998)

TALKS AT THE
MATHEMATICS
DEPARTMENT,
UNIVERSITY OF
OKLAHOMA

The Poincaré-Siegel theorem – the simplest KAM-type theorem - I, II, III (talks at the Dynamical Systems Working Seminar, 5, 12, and 19 February, 2020)

“Hamiltonian dynamics and symplectic geometry - I, II, III” (Dynamical Systems Working Seminar, 28 August, 4, and 11 September, 2019)

“An introduction to mathematical methods of dynamics - I, II, III” (Analysis and Convexity Seminar, 12, 19, and 26 September, 2016)

“Beautiful oldies: complex analysis and two-dimensional hydrodynamics” (Analysis and Convexity Seminar, 25 April, 2016)

“Poisson and renewal processes – I, II” (Dynamical Systems Working Seminar, 18 and 25 April, 2016)

“Bifurcation and bistability in population dynamics” (Analysis and Convexity Seminar, 7 March, 2016)

“History and significance of Maxwell’s equations of electrodynamics” (Analysis and Convexity Seminar, 27 April, 2015)

“Geometric approach to first order PDEs – I, II” (Dynamical Systems Working Seminar, 21 and 28 January, 2015)

“Circle maps, lasers, and dynamical Casimir effect” (Analysis Seminar, 14 April, 2014)

“Geometry for dynamical systems – VI, VII” (Dynamical Systems Working Seminar, 11 and 25 March, 2014)

“An introduction to Hamiltonian dynamics – I, II” (Dynamical Systems Working Seminar, 21 and 28 January, 2014)

“Shallow water waves and the Korteweg-de Vries equation” (Analysis Seminar, 6 November, 2013)

“Turbulence lite” (Analysis Seminar, 29 April, 2013)

“Periodically pulsating resonators and circle maps – I, II” (Dynamical Systems Working Seminar, 12 and 19 April, 2013)

“Geometry of dimensional reduction of invariant objects” (Analysis Seminar, 5 November, 2012)

“Hamilton’s equations” (Dynamical Systems Working Seminar, 31 August, 2012)

“Lagrangian variational principle and Euler-Lagrange equations” (Dynamical Systems Working Seminar, 24 August, 2012)

“Johann Bernoulli’s brachistochrone challenge and the calculus of variations” (Analysis Seminar, 2 May, 2011)

“Stationary distributions of semistochastic processes with random disturbances” (Analysis Seminar, 31 January, 2011)

“Heat conduction in uniformly moving media” (Analysis Seminar, 20 September, 2010)

“Low wavenumber forcing and turbulent energy dissipation” (Analysis Seminar, 9 November, 2009)

“Buckingham’s pi-theorem, estimating the energy of a nuclear explosion, Kolmogorov’s theory of turbulence, non-existence of Godzilla, and all that” (Analysis Seminar, 4 May, 2009)

“Reduction of invariant fields and differential operators – I, II” (Geometry and Topology Seminar, 13 and 20 February, 2008)

“Stochastic integration – I, II” (Analysis Seminar, 6 and 13 November, 2007)

“Brownian motion: Martingale properties – I, II” (Analysis Seminar, 23 and 30 October, 2007)

“Invariance and reduction – a geometric picture – I, II” (Analysis Seminar, 27 August and 10 September, 2007)

“Symmetries of Kepler problem” (Representation Theory Seminar, 4 May, 2007)
“An introduction to KAM theory – I, II, III” (Analysis Seminar, 29 January, 5 and 12 February, 2007)
“Moving boundaries and dynamical systems – I, II” (Analysis Seminar, 3 and 10 October, 2005)

AWARDS

Regents’ Award for Superior Teaching, University of Oklahoma (April 2020)
Nancy Scofield Presidential Professorship, University of Oklahoma (April 2014)
Irene Rothbaum Award for Outstanding Assistant Professor in the College of Arts and Sciences, University of Oklahoma (April 2009)
First prizes at the Bulgarian National Physics Olympiads for University Students (May 1987 and May 1986)
XIV International Physics Olympiad, Bucharest, Romania – Special Award for the Mechanics problem (July 1983)
Second place at the Bulgarian National Physics Olympiad (May 1983)
First place at the Bulgarian National Physics Essay Competition for the essay “Relativistic Thermodynamics” (1983)
Second place at the Bulgarian National Physics Essay Competition for the essay “Basic Principles of Special Theory of Relativity” (1982)

LANGUAGES

English (excellent), Russian (excellent), Bulgarian (native), Spanish (basic)

SUMMER/WINTER COURSES

Workshop “Invariant Objects in Dynamical Systems and Their Applications”, Institute for Mathematics and Its Applications, University of Minnesota, Minneapolis, MN, 20 June–1 July, 2011
First “DANCE” (Dinámica, Atractores y Nolinealidad: Caos y Estabilidad) Winter School “Recent Trends in Nonlinear Science 2004”, Palma de Mallorca, Spain, 2–6 February, 2004
“Equivalence of Dynamical Systems”, NSF/CBMS Regional Conference, University of Missouri, Columbia, MO, 4–8 June, 2001
UCSD/UCLA/Stanford Winter School in Chaotic Communications, University of California, San Diego, CA, 21–24 January 2001
Summer School on Ergodic Theory, University of Washington, Seattle, WA, 26 July–13 August, 1999

UNIVERSITY SERVICE

University committees

Department of Mathematics Research Liaison in the Office of the OU Vice-President for Research (2013–2016)
Provost’s 2011 Ph.D. Dissertation Prize Committee (2012)
Information Technology Committee, College of Arts and Sciences, University of Oklahoma (2008–2010)
Provost’s 2008 Ph.D. Dissertation Prize Committee (2009)
Individualized Concentration Program Committee, College of Literature, Science and the Arts, University of Michigan (2004–2005)

Departmental committees

Department Chair (2020–present)
Committee A (2009–2011, 2016–2018)
Math Day Committee (2006–2011, 2012–2020; chair 2008–2011)
Interdisciplinary Opportunities Committee (chair 2012–2020)
External Activities Committee (chair 2012–2020)
Analysis/Applied Mathematics Area Coordinator (2012–2020)
Space Utilization Committee (2012–2016)
Postdoc Search Committee (2013–2014)
Pedagogy Search Committee (2011–2013)
Undergraduate Opportunities Committee (2009–2011)
Newsletter Committee (2008–2010)
Computer Advisory Committee (2005–2006, 2007–2010)
Applied Mathematics Committee (2007–2008)
Undergraduate Committee (2005–2006)

PROFESSIONAL ASSOCIATIONS, OTHER ACTIVITIES

Member of the American Mathematical Society

Member of the Mathematical Association of America

Member of the Nominating Committee of the OK-AR Section of the Mathematical Association of America (2017–2020)

Co-organizer (with Alexander Grigo) of the mini-session “Dynamical Systems – Theory and Applications” at the 3rd Annual Meeting of SIAM Central States Section, Colorado State University, Fort Collins, 29 September – 1 October, 2017

Member of the Organizing Committee of the conference LLAVEFEST: A Broad Perspective on Finite and Infinite Dimensional Dynamical Systems, Barcelona, Spain, 12–16 June, 2017

Reviewer of the book R. L. Burden, J. D. Faires, *Numerical Analysis*, 9th edition, Brooks/Cole/Cengage Learning, 2011

Reviewer of the book P. Blanchard, R. L. Devaney, G. R. Hall, *Differential Equations*, 3rd edition, Thomson Brooks/Cole, 2006

Referee for:

- *Physics Letters A*
- *Journal of Optics B: Quantum and Semiclassical Optics*
- *Regular and Chaotic Dynamics*
- *Communications in Nonlinear Science and Numerical Simulation*
- *SIAM Journal of Applied Dynamical Systems*
- *SIAM Journal of Mathematical Analysis*

- *Journal of Physics A: Mathematical and General*
- *Physica D*
- *Serdica Mathematical Journal*
- *Ukrainian Mathematical Journal*
- *Dynamical Systems*
- *European Journal of Operational Research*
- *Communications on Pure and Applied Analysis*
- *Journal of Nonlinear Science*
- *Chaos: An Interdisciplinary Journal of Nonlinear Science*
- *Methodology and Computing in Applied Probability*

Reviewer for the Mathematical Physics Program of the Physics Division of the National Science Foundation.

Reviewer for *Mathematical Reviews*.