Aaron Welters

Curriculum Vitae

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Crawford 319
Department of Mathematical Sciences
Florida Institute of Technology
Melbourne, FL 32901

Research Interests & Focuses

Mathematical physics and applied mathematics with a focus on electromagnetics, material science (composites), dissipative and dispersive systems; spectral and scattering theory focusing on wave propagation in complex and periodic media (e.g., passive media, metamaterials, composites, photonic crystals, slow light, guided modes, resonance phenomena); perturbation theory for linear operators with a focus on non-self-adjoint operators (e.g., dissipative, sectorial); linear response theory focusing on passive linear systems; Stieltjes and Herglotz-Nevanlinna function theory with a focus on its applications.

Education

Ph.D. Mathematics, June 2011
University of California, Irvine
Irvine, CA
Thesis: *On the Mathematics of Slow Light*
Advisor: Professor Alexander Figotin

B.A. Mathematics, May 2004
St. Cloud State University
St. Cloud, MN
Honors: Magna Cum Laude,
3.74 GPA

Academic Employment

Assistant Professor of Mathematical Sciences, Aug. 11, 2014–
Department of Mathematical Sciences, Florida Institute of Technology, Melbourne, FL
Applied Mathematics Instructor, Sept. 1, 2012–May 31, 2014
Department of Mathematics, Massachusetts Institute of Technology, Cambridge, MA
Assistant Project Scientist, July 10, 2012–Aug. 31, 2012
Department of Mathematics, University of California, Irvine, CA
Lead Project Scientist: Alexander Figotin
Grant Support: AFOSR grant FA9550-11-1-0163
Grant Title: *Metamaterials for Miniaturization of Optical Components and Enhancement of Light-Matter Interactions*
VIGRE Postdoctoral Researcher, Aug. 15, 2011–July 13, 2012
Department of Mathematics, Louisiana State University, Baton Rouge, LA
Graduate Student Researcher, Sept. 2007–May 2011
Department of Mathematics, University of California, Irvine, CA
Research advisor: Alexander Figotin
Grant Support: AFOSR grant FA9550-08-1-0103
Grant Title: *High-Q Photonic-Crystal Cavities for Light Amplification and Lasing*
Teaching Assistant, Sept. 2004–Aug. 2006
Department of Mathematics, University of California, Irvine, CA

Grants

Aaron Welters, PI (no co-PI's), YIP early career award, *On a Theory of Broadband Absorption Suppression in Magnetic Composites*, **Air Force Office of Science Research (AFOSR), YIP award, $264,199.41**, Apr. 1, 2015-Mar. 31, 2018, AFOSR Grant no.: FA9550-15-1-0086. AFOSR Program Officer: Dr. Arje Nachman, Electromagnetics.

Publications

1) M. Cassier, A. Welters, and G. W. Milton, "Analyticity of the Dirichlet-to-Neumann map for the time-harmonic Maxwell's equations," in *Extending the Theory of Composites to Other Areas of Science* (G. W. Milton, ed.), Chap. 4, Milton-Patton Publishing, 2016. ISBN: 978-1-4835-6919-2.
2) M. Cassier, A. Welters, and G. W. Milton, "A rigorous approach to the field recursion

method for two-component composites with isotropic phases," in *Extending the Theory of Composites to Other Areas of Science* (G. W. Milton, ed.), Chap. 10, Milton-Patton Publishing, 2016. ISBN: 978-1-4835-6919-2.
3) A. Figotin and A. Welters, *On overdamping phenomena in gyroscopic systems composed of high-loss and lossless components*, J. Math. Phys. 57, 042902 (2016).
4) S. P. Shipman and A. Welters, *Pathological scattering by a defect in a slow-light medium*, J. Math. Phys., vol. 57, no. 2, eid: 022902, pp. 1–44, 2016.
5) A. Welters, Y. Avniel, and S. G. Johnson, *Speed-of-light limitations in passive linear media*, Phys. Rev. A., vol. 90, no. 2, pp. 023847:1–17, 2014.
6) A. Figotin and A. Welters, *Lagrangian framework for systems composed of high-loss and lossless components*, J. Math. Phys., vol. 55, no. 6, eid: 062902, pp. 1–39, 2014.
7) S. P. Shipman and A. Welters, *Resonant electromagnetic scattering in anisotropic layered media*, J. Math. Phys., vol. 54, no. 10, eid: 103511, pp. 1–40, 2013.
8) S. P. Shipman and A. Welters, *Resonance in anisotropic layered media*, Proceedings of the 14th International Conference on Mathematical Methods in Electrodynamic Theory (MMET12 Kharkov), pp. 227–232, 2012.
9) A. Figotin and A. Welters, *Dissipative properties of systems composed of high-loss and lossless components*, J. Math. Phys., vol. 53, no. 12, eid: 123508, pp. 1–40, 2012.
10) A. Welters, *On Explicit Recursive Formulas in the Spectral Perturbation Analysis of a Jordan Block*, SIAM J. Matrix Anal. Appl., vol. 32, no. 1, pp. 1–22, 2011.
11) A. Welters, *On the Mathematics of Slow Light*. Thesis (Ph.D.)–Univ. of Calif., Irvine. ProQuest LLC, Ann Arbor, MI, 2011.

Awards & Fellowships

Nominated for ISSO's Award of Excellence for Staff & Faculty Service to International Students & Scholars (FIT, Nov. 2015)
Von Neumann Award ($250, 3/year given, outstanding performance as a graduate student, UCI, June 2010)

Symposium and Workshop Organizer

Upcoming: "Herglotz-Nevanlinna Theory Applied to Passive, Causal, and Active Systems," Workshop, Banff International Research Station, Banff, Alberta, Canada, Oct. 6-11, 2019 (co-organizer with Andrea Alu, Mats Gustafsson, Annemarie Luger, and Graeme Milton).
"Herglotz-Nevanlinna Function Theory and its Applications," Minisymposium, 11th Intl. Conference on the Electrical, Transport, and Optical Properties of Inhomogeneous Media, Krakow, Poland, July 16-20, 2018 (co-organized with Elena Cherkaev and Ornella Mattei).
"Applications of Herglotz-Nevanlinna Function Theory to Electromagnetics, Composites, and Dirichlet-to-Neumann maps," Minisymposium, SIAM Math. Aspects of Materials Science, Portland, OR, July 9-13, 2018 (co-organized with Ornella Mattei).
"Herglotz-Nevanlinna functions and their applications," Workshop, Institut Mittlag-Leffler, Djursholm, Sweden, May 8-12, 2017 (co-organizer with Mats Gustafsson, Annemarie Luger, and Mihai Putinar).
"Complex Analysis, Optimization, and Herglotz Functions in Passive Electromagnetics and Composite Media," Minisymposium, SIAM Math. Aspects of Materials Science, Philadelphia, PA USA, May 2016 (co-organizer with Maxence Cassier, Graeme Milton, and Mihai Putinar).
"Mathematical and Computational Issues in Electromagnetic Materials," Minisymposium, SIAM Math. Aspects of Materials Science, Philadelphia, PA USA, May 2016 (co-organizer with Robert Lipton and Stephen Shipman).

Honorary Lectures

Plenary Speaker, 11th Intl. Conference on the Electrical, Transport, and Optical Properties of Inhomogeneous Media, Krakow, Poland, July 16, 2018.

Research Presentations & Talks

Applied Inverse Problems (AIP) Conference, Minisymposium on "Anisotropic inverse problems and asymptotics, Grenoble, France, July 8, 2019 (Invited Talk).
Joint Mathematics Meetings (JMM) 2019, AMS Special Session on Advances in Operator Theory, Operator Algebras, and Operator Semigroups, Baltimore, MA, Jan. 18, 2019 (Invited Talk).
11th Intl. Conference on the Electrical, Transport, and Optical Properties of Inhomogeneous

Media, Minisymposium on "Herglotz-Nevanlinna Function Theory and its Applications," Krakow, Poland, July 16, 2018 (Invited Talk).
SIAM Conf. on Math. Aspects of Materials Science, Minisymposium on "Applications of Herglotz-Nevanlinna Function Theory to Electromagnetics, Composites, and Dirichlet-to -Neumann maps," Portland, OR, July 13, 2018 (Invited Talk).
Department of Mathematical Sciences, Kaist University, Daejeon, South Korea, July 2017 (Invited Seminar Talk).
"Herglotz-Nevanlinna functions and their applications", Workshop, Institut Mittlag-Leffler, Djursholm, Sweden, May 11, 2017 (Invited Talk).
Annual Program Seminar Series, Institute for Mathematics and its Applications (IMA), Univ. of Minnesota, Minneapolis, MN, Dec. 1, 2016 (Invited Talk).
LMS Durham Research Symposium "Mathematical and Computational Aspects of Maxwell's Equations," Department of Mathematical Sciences, Durham University, UK, July 2016 (Poster Presentation).
Operators, Operator Families and Asymptotics Conference, Department of Mathematical Sciences, Univ. of Bath, UK, May 2016 (Invited Talk).
SIAM Math. Aspects of Materials Science, Minisymposium on "Mathematical and Computational Issues in Electromagnetic Materials," Philadelphia, PA USA, May 2016 (Invited Talk).
SIAM Math. Aspects of Materials Science, Minisymposium on "Complex Analysis, Optimization, and Herglotz Functions in Passive Electromagnetics and Composite Media," Philadelphia, PA USA, May 2016 (Invited Talk).
Spectral Theory of Novel Materials Conference, Centre International de Rencontres Mathematiques (CIRM), Marseille, France, Apr. 2016 (Invited Talk).
AFOSR 2016 Electromagnetics Contractors Meeting, Arlington, VA USA, Jan. 2016 (Invited Talk).
Applied Mathematics Seminar, Department of Mathematics, University of Utah, Utah USA, Nov. 2015 (Invited Talk).
8th International Congress on Industrial and AppliedMathematics (ICIAM 2015), Minisymposium on Mathematics and Optics," Beijing, China, Aug. 2015 (Contributed Talk).
2nd International Workshop Neumann-Poincaré Operator and Related Field," Kaist University, Daejeon, South Korea, July 2015 (Invited Talk).
KMRS Intensive Lectures, Seminars and workshop, Kaist University, Daejeon, South Korea, July 2015 (Invited Talk).
(PIERS2015) Progress in Electromagnetics Research Symposium, Prague, Czech Republic, July 6-9, 2015 (Invited Talk, Special Session: Complex Analysis & Convex Optimization in Electromagnetics)
(ETOPIM 10) Electrical, Transport and Optical Properties of Inhomogeneous Media, 10th International Symposium, Neveh Ilan, Israel, June 21-26, 2015 (Contributed Talk & Poster Presentation)
IEEE AP-S Seminar, Department of Electrical and Computer Engineering, The University of Texas at Austin, Austin, TX, Oct. 2014 (Invited Talk)
Mathematics Department Colloquium, Florida Institute of Technology, Melbourne, FL, Feb. 2014 (Invited Talk)
Mathematics Department Colloquium, Colorado State University, Fort Collins, CO, Feb. 2014 (Invited Talk)
AFOSR 2014 Electromagnetics Contractors Meeting, Arlington, VA, Jan. 2014 (Poster Presentation)
UH PDE Seminar, University of Houston, Houston, TX, Oct. 2013 (Invited Talk)
UH Undergraduate Colloquium, University of Houston, Houston, TX, Oct. 2013 (Invited Talk)
American Physical Society (APS) March Meeting, Baltimore, MD, Mar. 2013

(Contributed Talk)
UCI Mathematical Physics Seminar, University of California, Irvine, CA, Aug. 2012 (Invited Talk)
Mathematics Department Colloquium, Louisiana State University, Baton Rouge, LA, Mar. 2012 (Invited Talk)
UCLA Analysis and PDE Seminar, University of California, Los Angeles, CA, Feb. 2011 (Invited Talk)
2011 AMS/MAA Joint Mathematics Meetings, AMS Session on Ordinary Differential Equations, New Orleans, LA, Jan. 2011 (Contributed Talk)
UCI Mathematics Graduate Student Colloquium, University of California, Irvine, CA, Nov. 2010 (Invited Talk)
UCI Mathematical Physics Seminar, University of California, Irvine, CA, Nov. 2010 (Invited Talk)
MAA Southern California-Nevada Section Fall 2010 Meeting, Contributed Papers Session, University of California, Irvine, CA, Oct. 2010 (Contributed Talk)
Arizona School of Analysis with Applications, Short Talk Session 2-8, University of Arizona, Tucson, AZ, Mar. 2010 (Contributed Talk)
2010 AMS/MAA Joint Mathematics Meetings, AMS Session on Matrices and Tensors, San Francisco, CA, Jan. 2010 (Contributed Talk)
UCI Mathematical Physics Seminar, University of California, Irvine, CA, Nov. 2009 (Invited Talk)
SCSU Mathematics Colloquium, St. Cloud State University, St. Cloud, MN, Nov. 2009 (Invited Talk)

Long-term visits

Visiting research professor, Annual Thematic Program on Mathematics and Optics, Institute for Mathematics and its Applications (IMA), Univ. of Minnesota, Minneapolis, MN USA, Sept.-Dec. 2016. (my visit was supported by the IMA, NSF, and the Air Force Office of Scientific Research, under the grant FA9550-15-1-0086.)

Teaching Experience

Assistant Prof. of Mathematical Sciences — Aug. 2014–
Florida Institute of Technology,
Melbourne, FL

MTH 5050: Special Topics in Math. Physics	Fall 2019
MTH 5130: Theory of Complex Variables	Fall 2019
MTH 1001: Calculus 1	Fall 2019
MTH 5050: Special Topics in Analysis	Summer 2019
MTH 5102: Linear Algebra	Spring 2019
MTH 2201 & 2202: Differential Eqs./Linear Alg.	Spring 2019
MTH 4101 & 5101: Introductory Analysis	Fall 2018
MTH 1001: Calculus 1	Fall 2018
MTH 3210: Introduction to PDEs & Applications	Spring 2018
MTH 1001: Calculus 1	Fall 2017
MTH 4101 & 5101: Introductory Analysis	Fall 2017
MTH 5102: Linear Algebra	Spring 2017
MTH 3101: Complex Variables	Spring 2017
MTH 5102: Linear Algebra	Spring 2016
MTH 2001: Calculus 3	Spring 2016
MTH 5201: Math. Methods in Sci. & Eng. 1	Fall 2015
MTH 2001: Calculus 3	Fall 2015
MTH 5202: Math. Methods in Sci. & Eng. 2	Spring 2015
MTH 5201: Math. Methods in Sci. & Eng. 1	Fall 2014

Applied Mathematics Instructor — Sept. 2012–May 2014
Massachusetts Institute of Technology,
Cambridge, MA

	MATH 18.02: Calculus (Recitation)	Spring 2014
	MATH 18.100C: Real Analysis	Fall 2013
	MATH 18.03: Differential Equations (Recitation)	Spring 2013
	MATH 18.02A: Calculus (Recitation)	Fall 2012 (last 6 weeks)
	MATH 18.01A: Calculus (Recitation)	Fall 2012 (first 6 weeks)
	VIGRE Postdoctoral Researcher Louisiana State University, Baton Rouge, LA	Sept. 2011–May 2012
	MATH 3355-1: Probability	Spring 2012
	MATH 4997-1 VIR: Electromagnetic Waves in Heterogeneous Structures	Fall 2011
	Teaching Assistant University of California, Irvine, CA	Sept. 2004–Aug. 2006
	MATH 2D: Multivariable Calculus	Summer 2006
	MATH 146: Fourier Analysis	Spring 2006
	MATH 184: History of Mathematics	Spring 2006
	MATH 2B: Single Variable Calculus	Fall 2005
	MATH 2B: Single Variable Calculus	Summer 2005
	MATH 2A: Single Variable Calculus	Summer 2005
	MATH 2J: Infinite Series and Linear Algebra	Spring 2005
	MATH 2B: Single Variable Calculus	Winter 2005
	MATH 2A: Single Variable Calculus	Fall 2004
Department & University Service	**Faculty Senate** (Dept. Nominated Member) A faculty representative for the Math. Dept. `http://www.fit.edu/senate/`	Aug. 2015– Florida Institute of Technology
	Colloquium Organizer (Appointed) Organize & lead the Dept. of Math. Sci. Colloquium `http://www.fit.edu/~awelters/colloquium`	Aug. 2014–May 2016 Florida Institute of Technology
	PRIMES mentor (Volunteered) Reading group leader/mentor of 2–3 exceptional high school students `http://web.mit.edu/primes`	Dec. 2013–Aug. 2014 Massachusetts Institute of Technology
	Faculty Freshman Advisor (Volunteered) Advisor for six freshmen MIT students	Aug. 2013–June 2014 Massachusetts Institute of Technology
	Co-Organizer (Appointed) Math Graduate Student Colloquium `http://math.uci.edu/~mgsc/`	March 2010–June 2011 University of California, Irvine
	Recruitment Speaker (Invited speaker) Math Graduate Recruitment Day Event	April 2010 University of California, Irvine
Journal Referee or Reviewer	Journal of Mathematical Physics (JMP) SIAM Journal On Mathematical Analysis (SIMA) SIAM Journal on Applied Mathematics (SIAP) SIAM Multiscale Modeling and Simulation (MMS) Journal Asymptotic Analysis Journal de Mathematiques Pures et Appliques (JMPA) Progress in Electromagnetics Research Journal (PIER) Journal of Applied Physics (JAP)	
Grant External Reviewer	Swiss National Science Foundation (SNSF): Mathematics, Nat. & Engineering Sci. (division II)	

Research References

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Stephen P. Shipman
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Steven G. Johnson
Professor of Applied Mathematics
Department of Mathematics
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Teaching References

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Department Head
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Charles N. Delzell
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Associate Chair for Instruction
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Gigliola Staffilani
Abby Rockefeller Mauze Professor of
Mathematics and Associate Department Head
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Sarah Eichhorn
Lecturer PSOE and
Assistant Vice Chair Undergrad. Studies
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