

# Curriculum Vitae for Cory D. Hauck

## CURRENT EMPLOYMENT

**Position:** Research Staff

**Institution:** Oak Ridge National Laboratory

**Group:** Computational Mathematics

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## EDUCATION

- Ph.D., Applied Mathematics, University of Maryland, 2006.
- M.S., Electrical Engineering, University of Maryland, 2004.
- B.S., Physics and Mathematics, University of South Carolina, 1997.

## RESEARCH INTERESTS

- Computational Physics and Scientific Computing.
- Kinetic Equations and Hyperbolic PDE.
- Multi-Scale Modeling and Simulation.
- Optimization Methods for Moment Closure Problems.

## EMPLOYMENT HISTORY

- 05/11-current: Joint Faculty Assistant Professor, Dept. of Mathematics, University of Tennessee.
- 08/10-05/11: Adjunct Assistant Professor, Dept. of Mathematics, University of Tennessee.
- 06/06-08/09: Postdoctoral Research Associate, Los Alamos National Laboratory.
- 09/99-06/06: Graduate Research/Teaching Assistant, University of Maryland.
- 10/97-08/99: Engineering Physicist, Doty Scientific, Columbia, SC.
- 05/96-09/97: Undergraduate Research Assistant, University of South Carolina / Brookhaven National Laboratory.

## RECENT RESEARCH SUPPORT

- ORNL Laboratory Directed Research and Development, Project: *Toward Scalable Algorithms for Kinetic Equations: A New Hybrid Approach to Capturing Multiscale Phenomena*, PI: Cory Hauck.
- ORNL Laboratory Directed Research and Development, Project: *Attacking the Supernova Problem: Nonlinear Moment Models for Simulated Neutrino Radiation*, PI: Cory Hauck.
- NSF, Division of Mathematical Sciences, Project: *Optimization-Based Moment Models for Multi-scale Kinetic Equations*, PI: Cory Hauck (U. Tennessee-Knoxville).
- NSF Research Network in Mathematical Sciences (RNMS) Grant: *Kinetic Description of Emerging Challenges in Multiscale Problems of Natural Sciences*, PI's: Irene Gamba (U. Texas-Austin), Shi Jin (U. Wisconsin-Madison), Eitan Tadmor (U. Maryland).

- DOE Applied Math Program, Project: *Advanced Dynamically Adaptive Algorithms for Stochastic Simulations on Extreme Scales*, PI's: Richard K. Archibald (ORNL) and Dongbin Xiu (Purdue), 2010-2012.
- DOE Applied Math Program, Householder Fellowship, 2009-2011.
- DOE Applied Math Program, Project: *Advanced Optimization Techniques for Entropy-Based Moment Closures*, PI's: Cory Hauck (ORNL) and André Tits (U. Maryland), 2009-2012.
- DOE Applied Math Program, Project: *Mimetic Methods for Partial Differential Equations*, PI: Misha Shashkov, 2006-2009.

### JOURNAL PUBLICATIONS

- “A Collision-Based Hybrid Method for Time Dependent, Linear, Kinetic Transport Equations”, with R. G. McClarren, to appear in *Multiscale Modeling and Simulation*, (2013).
- “Sparse Dynamics for Partial Differential Equations”, with H. Schaeffer, R. Caflisch, and S. Osher, *Proceedings of the National Academy of Sciences*, 110 (2013), 6634-6639.
- “Perturbed, Entropy-Based Closure for Radiative Transfer”, with M. Frank and E. Olbrant, *Kinetic and Related Models*, 33 (2013).
- “Radiation Transport Modeling using Extended Quadrature Method Of Moments”, with V. Vikas, Z.J. Wang, and R.O. Fox, 246 (2013), pp. 221–241.
- “High-Order Entropy-Based Closures for Linear Transport in Slab Geometries II: A Computational Study of the Optimization Problem”, with G. W. Alldredge and A. L. Tits, to appear in *SIAM J. Sci. Comput.*, 34 (2012), pp. B361-B391
- “A Realizability-Preserving Discontinuous Galerkin Method for the M1 Model of Radiative Transfer”, with E. Olbrant and M. Frank, to appear in *J. Comput. Phys.*, 231 (2012), pp. 5612-5639.
- “High-Order Entropy-Based Closures for Linear Transport in Slab Geometries”, *Commun. Math. Sci.*, 9 (2011), pp. 187–205.
- “Positive  $P_N$  Closures”, with R. G. McClarren *SIAM J. Sci. Comput.*, 32 (2010), pp. 1497–1524..
- “Robust and Accurate Filtered Spherical Harmonics Expansions for Radiative Transfer”, with R. G. McClarren, *J. Comput. Phys.*, 229 (2010), pp. 5597–5614.
- “Simulating Radiative Transfer with Filtered Spherical Harmonics”, *Physics Letters A*, 374 (2010), pp. 2290–2296.
- “Methods for Diffusion Relaxation in the  $P_N$  Equations”, with R. B. Lowrie, and R. G. McClarren, in *Numerical Methods for Relaxation Systems and Balance Equations*, Quaderni di Matematica International Series, edited by G. Puppo and G. Russo, 2010.
- “Oscillatory Behavior of Asymptotic-Preserving Splitting Methods for a Linear Model of Diffusive Relaxation”, *Kinetic and Related Models*, 1 (2008), pp. 573–590.
- “Temporal Regularization of the  $P_N$  Equations”, with R.B. Lowrie, *SIAM J. Multiscale Model. Simul.* 7 (2009), pp. 1497–1524.
- “Convex Duality and Entropy-Based Moment Closures: Characterizing Degenerate Densities”, with C.D. Levermore and A.L. Tits, *SIAM J. Control Optim.* 47 (2008), pp. 1977–2015.
- “Volume Determination for Bulk Materials in Bunkers”, with S.A. Ahmed, R. Buckingham, P.A. Gremaud, C.M. Kuster, M. Prodanovic, T.A. Royal and V. Silantyev, *Int. J. Numer. Meth. Eng.*, 61 (2004), pp. 2239–2249
- “Error-tolerant RF Litz Coils for NMR/MRI”, with F.D. Doty and G.E. Entzminger Jr., *J. Magn. Res.* 140 (1999), pp. 17–31.
- “Practical Aspects of Birdcage Coils”, with F.D. Doty and G.E. Entzminger Jr., and J. P. Staab, *J. Magn. Res.* 138 (1999), pp. 144–154.

### PEER-REVIEWED PROCEEDINGS

- “Positive  $P_N$  Closures with Local Optimization”, with R. G. McClarren, *Transactions of the American Nuclear Society*, Winter 2009.
- “Filtered Spherical Harmonic Methods for Transport Equations”, with R. G. McClarren and R. B. Lowrie, *Proceedings of the International Conference on Mathematics, Computational Methods, and Reactor Physics*, Saratoga Springs, NY, 2009.
- “Convex Duality and Entropy-Based Moment Closures: Characterizing Degenerate Densities”, with C.D. Levermore and A.L. Tits, *Proceedings of the 47th IEEE Conference on Decision and Control*, Cancun, Mexico, 2009.

### REPORTS AND UNPUBLISHED MANUSCRIPTS

- *Numerical Splitting for Hydrodynamic Semiconductor Models*, Los Alamos Report LA-UR 06-8584, 2006.
- *Entropy-based Closures in Semiconductor Models*, Ph.D. Thesis, University of Maryland, 2006.

### TALKS AND PRESENTATIONS

- 01/2013: *A Collision-Based Hybrid Method for Linear Transport*, **Invited Talk**, Institute for Pure and Applied Mathematics (IPAM).
- 02/2012: *Entropy-Based Closures for Linear Transport*, **Invited Talk**, Department of Mathematics, Simon Fraser University.
- 04/2012: *High-order, Entropy-based Models for Linear Transport in Slab Geometries*, **Invited Talk**, Center for Mathematical Modeling, Simulation, and Optimization / Mathematics Division (MathCCES), RWTH, Aachen, Germany
- 03/2012: *High-order, Entropy-based Models for Linear Transport in Slab Geometries*, **Invited Talk**, Workshop on *Hot Dense Plasmas*, Institute for Pure and Applied Mathematics (IPAM).
- 12/2011: *High-order, Entropy-based Models for Linear Transport in Slab Geometries*, **Invited Talk**, Second Reunion Conference on Quantum and Kinetic Transport, Institute for Pure and Applied Mathematics (IPAM).
- 11/2011: *A Collision-Based Hybrid Method for Linear Transport*, **Invited Talk**, Workshop on *Boltzmann Models in Kinetic Theory*, Institute for Computational and Experimental Research in Mathematics (ICERM).
- 10/2011: *Optimization-Based Closures for Radiative Transport*, **Invited Talk**, Computational Fluid Dynamics Seminar, Iowa State University.
- 10/2011: *High-order, Entropy-based Models for Linear Transport in Slab Geometries*, **Invited Talk**, Workshop on *Novel Applications of Kinetic Theory and Computations*, Institute for Computational and Experimental Research in Mathematics (ICERM).
- 10/2011: *Optimization-Based Methods for Discretization of Partial Differential Equations*, **Invited Talk**, Center for Scientific Computation and Mathematical Modeling, University of Maryland, College Park.
- 11/2011: *A Collision-Based Hybrid Method for Multiscale, Linear Transport*, Poster Presentation, Applied Mathematics PI Meeting, Office of Advanced Scientific Computing Research, Berkeley, California.
- 07/2011: *Topics in Kinetic Simulation: Part 1*, **Contributed Talk**, Minisymposium on *Advanced Numerical Methods for Kinetic Simulations and Their Applications*, Seventh International Congress on Industrial and Applied Mathematics, ICIAM 2011.

- 05/2011: **Invited Talk**, Annual Meeting, NSF Focused Research Group on Kinetic Theory.
- 01/2011: *A Collision-Based Hybrid Method for Linear Transport*, **Invited Talk**, Institute for Computational and Engineering Sciences (ICES), University of Texas at Austin.
- 11/2010: *A Collision-Based Hybrid Method for Linear Transport*, **Invited Talk**, Center for Computational Engineering Sciences, Mathematics Division, RWTH Aachen, Germany.
- 10/2010: *Optimization-Based Moment Closures in Kinetic Theory and Transport*, **Invited Talk**, Applied Mathematics and Mathematical Physics Seminar, Imperial College, London.
- 05/2010: *Advanced Optimization Techniques for Entropy-Based Moment Closures*, 2010 DOE Applied Mathematics Program Meeting, Berkeley, CA.
- 03/2010: *Optimization-Based Closures for Radiation Transport*, **Invited Talk**, Numerical Analysis Seminar, North Carolina State University.
- 03/2010: *Discontinuous Galerkin Methods with Entropy Variables and Explicit Time Integrators: A Numerical Study with the Shallow Water Equations*, SIAM SEAS 2010 Annual Meeting, Raleigh, NC.
- 03/2010: *Optimization-Based Moment Closures in Kinetic Theory and Transport*, **Invited Talk**, Mathematics and Statistics Colloquium, Old Dominion University.
- 02/2010: *A numerical regularization technique for multi-scale, linear transport models*, **Invited Talk**, Computational and Applied Math Seminar, University of Tennessee.
- 11/2009: *Optimization-Based Closures for Radiation Transport*, **Invited Talk**, Applied Mathematics /20 PDE Seminar, University of Wisconsin.
- 11/2009: *Optimization-Based Closures for Radiation Transport*, **Invited Talk**, Applied Mathematics Seminar, Michigan State University.
- 07/2009: *Discontinuous Galerkin Methods with Entropy Variables and Explicit Time Integrators: A Numerical Study with the Shallow Water Equations*, Contributed Talk, *Mini-Symposium on Moment Closures for Kinetic and Hyperbolic Equations*, SIAM 2009 Annual Meeting, Denver, CO
- 04/2009: *Realizability in Entropy-Based Moment Closures for Gas Dynamics*, **Invited Talk**, Workshop on “The Boltzmann Equation: DiPerna-Lions Plus 20 Years”, Institute for Pure and Applied Mathematics, UCLA.
- 03/2009: *Positive  $P_N$  Closures*, Contributed Talk, Working Seminar for Program on Kinetic Theory and Transport, Institute for Pure and Applied Mathematics, UCLA.
- 02/2009: *Model Reduction and Asymptotic Preserving Numerical Methods for Kinetic Transport Equations*, **Invited Talk**, Computer Science and Mathematics Division Seminar, Oak Ridge National Laboratory.
- 02/2009: *Some Computational Aspects of Kinetic Transport Equations*, **Invited Talk**, Mathematics Colloquium, University of South Carolina.
- 11/2008: *A Numerical Regularization Technique for Multi-Scale, Linear Transport Models*, **Invited Talk**, Applied Mathematics Seminar, Texas A&M University.
- 09/2008: *A Numerical Regularization Technique for Multi-Scale, Linear Transport Models*, **Invited Talk**, Applied Mathematics Seminar, North Carolina State University.
- 02/2008: *Temporal Regularization of the  $P_N$  Equations*, **Invited Talk**, Applied Mathematics Seminar, University of Wisconsin.
- 05/2007: *Convex Duality and Entropy-Based Moment Closures: Characterizing Degenerate Densities*, Poster Presentation, Applied Mathematics PI Meeting, Office of Advanced Scientific Computing Research, Lawrence Livermore National Laboratory.
- 05/2007: *Mimetic Schemes for Hyperbolic Balance Laws of Kinetic Transport with Diffusive Relaxation*, Contributed Talk, SIAM Southeastern/20Atlantic Sectional Meeting, University of Mem-

phis.

- 02/2007: *Convex Duality in Entropy-Based Moment Closures*, Contributed Talk, “Los Alamos/20Arizona Days” Applied Mathematics Conference, University of Arizona.
- 11/2006: *Multi-scale Modeling and Simulation of Kinetic Systems*, Postdoc Seminar, Center for Nonlinear Studies, Los Alamos National Laboratory.
- 08/2005: *Perturbations to Entropy Minimization Hydrodynamic Closures*, **Invited Talk**, Mathematics Department, University of Texas at Austin.
- 08/2005: *A Numerical Splitting Method for a Hydrodynamic Model of Electron Transport*, **Invited Talk**, Los Alamos National Laboratory.
- 09/2004: *How to Build Mathematical Models of Complicated Systems*, Graduate Series Minicourse Lecture, University of Maryland.
- 03/2004: *Semiconductor Device Modeling*, Award Winning Talk, Spotlight on Graduate Research Competition, University of Maryland.
- 07/2002: *Volume Determination for Bulk Materials in Bunkers*, Industrial Mathematics Modeling Workshop, North Carolina State University.

#### AWARDS, HONORS, INVITATIONS

- Householder Fellowship, Oak Ridge National Laboratory, 2009-2011.
- Visiting Fellow: Newton Institute for Mathematical Sciences, University of Cambridge, 2010 Program on *Partial Differential Equations in Kinetic Theory*.
- Invited Fellow: Institute for Pure and Applied Mathematics (IPAM), Spring 2009 Program on *Quantum and Kinetic Transport: Analysis, Computations, and New Applications*.
- Invited Participant: Young Investigators Symposium, Oak Ridge National Laboratory, October 2008
- VIGRE research grant, Spring 2005.
- Award Winner, Spotlight on Graduate Research, Department of Mathematics, University of Maryland, 2004.
- Distinguished Teaching Assistant, University of Maryland, 2002-2003.
- Nominee, Excellence in Teaching Award for Graduate Teaching Assistants, Department of Mathematics, University of Maryland, 2001 and 2004.
- “TOAST” Award for Outstanding Graduating Senior, College of Science and Mathematics, University of South Carolina, 1997.
- National Merit Scholarship, 1993-1997.

#### PROFESSIONAL MEMBERSHIPS

- Society for Industrial and Applied Mathematics (SIAM).

#### OUTREACH AND PROFESSIONAL SERVICE

- Referee: *SIAM Journal on Applied Mathematics*, *SIAM Review*, *SIAM Journal on Numerical Analysis*, *SIAM Journal on Scientific Computing*, *SIAM Journal on Uncertainty Quantification*, *Communications in Mathematical Sciences*, *Mathematical Modeling and Numerical Analysis*, *Journal of Quantitative Spectroscopy and Radiative Transfer*, *Transport Theory and Statistical Physics*, *Analysis and Mathematical Physics*
- Organizer, SIAM 2013 Southeastern-Atlantic Sectional Meeting.

- Co-Organizer, Mini-symposium on *Computational Methods for Kinetic Equations and Related Models*, SIAM Conference on Computational Science & Engineering SIAM Conference on Computational Science & Engineering, 2013.
- Co-Organizer, Mini-symposium on *Advanced Numerical Methods for Kinetic Simulations and Their Applications*, ICIAM 2011.
- Co-Organizer, Mini-symposium on *Numerical Methods for Kinetic Equations and Related Models*, SIAM 2010 Annual Meeting.
- Organizer, Mini-symposium on *Moment Closures for Kinetic and Hyperbolic Equations*, SIAM 2009 Annual Meeting.
- Research Mentor: Summer Student Program, Center for Nonlinear Studies, 2008 and 2009.
- Judge: Los Alamos Summer Student Symposium, 2008.
- Organizer: Postdoc Seminar, Center for Nonlinear Studies, LANL, 09/07-09/08.
- Guest Lecturer: Los Alamos Summer School in Physics, 2007 and 2008.
- Science Fair Judge: McCurdy Schools, Espanola, NM, January 2007.
- Judge: Spotlight on Graduate Research, Department of Mathematics, University of Maryland, 2003.

#### COMPUTER EXPERIENCE

- Operating Systems: Windows, MacOS, Linux.
- Math Packages: MATLAB, Mathematica, Maple, L<sup>A</sup>T<sub>E</sub>X.
- Programming Languages: C, FORTRAN