

# DANIEL J. CROSS

## *Mathematical Physicist*

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## Education

- Graduate: Ph.D. Physics (2010), Drexel University, Philadelphia, PA.  
Advisor: Dr. Robert Gilmore. Title: *Representation Theory of Dynamical Systems*.  
M.S. Physics (2005), Drexel University.
- Undergraduate: B.S. Mathematics and B.A. Physics (2002), Cedarville University, Cedarville, OH.  
Minors in Philosophy, Bible, and Honors.
- Organizations: American Association for the Advancement of Science (AAAS), American Scientific Affiliation (ASA),  
Physics Honors Society ( $\Sigma\Pi\Sigma$ ).

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## Research Interests

- Physics: Understanding low dimensional chaos.  
On rainy days, Mach's principle and Machian theories of gravitation.
- Mathematics: Applying topology and group theory to physics (aka making life easier through math).

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## Teaching Experience

- Bryn Mawr: Instructor for *Advanced Quantum Mechanics*, PHYS 302, at the level of Griffiths (2011).  
Instructor for *Classical Mechanics*, PHYS 122, an introductory class for majors (2011).  
Laboratory Instructor for *Introductory Labs*, a combined lab for all introductory level classes, including undergraduate and postbaccalaureate premedical students and physics majors (2010-2011).  
Instructor for *Introductory Physics I*, PHYS 101, the classical half of an algebra-based course for postbaccalaureate premedical students (2010-2011).  
Instructor for *Introductory Physics II*, PHYS 102, the modern half of an algebra-based course for postbaccalaureate premedical students (2010).
- Drexel: Teaching Assistant for *Advanced Computational Physics*, PHYS 405, an introduction to parallel computation on the MPI and CUDA platforms (2009).  
Chief lecturer in a graduate student physics study group. Topics include Manifolds, Fiber Bundles, Classical Mechanics, General Relativity, Lie Groups, Clifford Algebras, and Spinors (2008-2010).  
Teaching Assistant for *Energy I*, TDEC 201, a sophomore engineering class covering wave phenomenon, quantum mechanics, and special relativity (2005-2007).  
Teaching Assistant for *Physical Foundations of Engineering I-III*, TDEC 111, 113, & 115, an introductory physics for freshman engineers (2003-2005).  
Teaching Assistant for *Physics Practicum I-III*, TDEC 140-142, help sessions complementing the freshman engineering physics classes, (2003-2005).  
Teaching Assistant for *Fundamental of Physics I*, PHYS 101, a calculus-based introductory course for non-physics science majors (2002-2003).
- Cedarville: Grader for *General Physics*, PHYS 2110, 2120, & 2130, a calculus-based introductory course for non-physics science majors (2001-2002).  
Grader for *Intermediate Physics Lab*, PHYS 3110, a lab for physics major (2001-2002).  
Mathematics tutor at Cedar Cliff Middle / High School, Cedarville, OH (1998-2002).

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## Other Experience

- Academic: Rewrote Introductory Physics labs (Chaos; Magnetism; Forced, Damped Harmonic Oscillator) for the Bryn Mawr lab restructuring (2011).  
Co-founder of and major contributor to the Linux Wiki, designed to help both users and sysadmins of the Physics Department's computer systems (<http://www.physics.drexel.edu/like>).  
Created an interactive flash animation illustrating Zeeman's Catastrophe Machine, which has been linked on Wikipedia and is the first hit on Google (<http://lagrange.physics.drexel.edu/flash/zcm>).  
Created a java applet to help illustrate Arnold's chaotic "Cat" map.  
Referee for Journal of Discrete and Continuous Dynamical Systems-B.
- Computer: Designed and maintained the Drexel Physics Department and Nonlinear Dynamics Research Group webpages (2007-2009).  
System Administrator for the Drexel Astrophysics Group. Originally a Gentoo Linux and later an Ubuntu Linux cluster with approximately 15 stand alone machines and one 48 node (96 core) Beowulf cluster. (2005-2007).  
Improved and maintained a  $\text{\LaTeX}$  class file conforming to Drexel thesis guidelines.

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## Papers

- Published: *Complete Set of Representations for Dissipative Chaotic Three-Dimensional Dynamical Systems*, Daniel J. Cross and R. Gilmore, Phys. Rev. E., **82**, 056211 (2010).  
*A Schwinger Disentangling Theorem*, Daniel J. Cross and R. Gilmore, J. Math. Phys., **51**, 103515 (2010).  
*Equivariant Differential Embeddings*, Daniel J. Cross and R. Gilmore, J. Math. Phys., **51**, 092706 (2010).  
*Differential Embedding of the Lorenz Attractor*, Daniel J. Cross and R. Gilmore, Phys. Rev. E., **81**, 066220 (2010).  
*A Biological Algorithm for Data Reconstruction*, Daniel J. Cross, Ryan Michaluk, and R. Gilmore, Phys. Rev. E., **81**, 036217 (2010).  
*Representation Theory for Strange Attractors*, Daniel J. Cross and R. Gilmore, Phys. Rev. E., **80**, 056207 (2009).
- In Preparation: *From Force to Torque: A Simple Model of a Rigid Body*, to be submitted Am. J. Phys.  
*A Piecewise Linear Train Track Algorithm for Homeomorphisms of Punctured Disks*.  
*Dressed Return Maps Distinguish Chaotic Mechanisms*, with R. Gilmore.
- Unpublished: *Solution to the Charge-Curvature Problem in Two Dimensions*.  
*Comment on "CPT symmetry and antimatter gravity in general relativity,"* (arXiv:1108.5117)  
*Linking Integral Projection* (arXiv:0907.3446).  
*Comments on the Cooperstock-Tieu Galaxy Model* (arXiv:astro-ph/0701019).  
*Anisotropy of Inertia from the CMB Anisotropy*.  
*On the Flux Rule*.  
*On the Relation between Real and Complex Jacobian Determinants*.

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## Presentations & Conferences

- Talks: *Representation Theory of Dynamical Systems*, From Lasers to Topology Workshop, Rouen, France (2011).  
*A Biological Algorithm for Data Reconstruction*, Eleventh Experimental Chaos and Complexity Conference, Lille, France (2010).  
*Why Spinors?*, Drexel PGSA (2010).  
*Solving the Schrödinger Equation with Lie Algebras*, Drexel Analysis Seminar (2009).  
*From Quantum Mechanics to Maxwell's Equations*, Drexel PGSA (2009).  
*Paradoxical Twins: Beyond an Introduction*, Drexel PGSA (2008).

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## Presentations & Conferences (continued)

- Posters: *Differential Embeddings of The Lorenz Attractor*, Eleventh Experimental Chaos and Complexity Conference, Lille, France (2010), & Drexel University Research Day and CoAS Research Day (2010).  
*Representation Theory for Strange Attractors*, Topology and Physics Seminar, Drexel University (2008), Drexel University Research Day, & CoAS Research Day (2009).  
*A Biological Algorithm for Data Reconstruction*, Drexel University Research Day and CoAS Research Day (2008).
- Conferences: From Lasers to Topology Workshop, Rouen, France (2011).  
Eleventh Experimental Chaos and Complexity Conference, Lille, France (2010).  
Frontiers in Applied and Computational Mathematics, NJIT (2009).  
Drexel Topology and Physics Seminar (2008).

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## Awards & Honors

- Drexel: Four-time TA Excellence Award recipient (2004-2007).  
Nominated for University Research Award (2009).  
Full fellowship and teaching assistantship (2002-2010).
- Cedarville: Science Award in Physics (2002).
- Erdős Number: Three.

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## Computer Skills

- Programming: C, Perl, HTML, CSS, PHP, L<sup>A</sup>T<sub>E</sub>X, Flash (Action Script), Maple.
- Systems: Linux (Gentoo, RedHat, Fedora, Ubuntu), Windows.
- Parallel: MPI, MPE, CUDA.

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## Course Work

- Physics: Group Theory, Nonlinear Dynamics, General Relativity, Cosmology, Particle Physics, Classical Mechanics, Statistical Mechanics, Quantum Mechanics.
- Mathematics: Bifurcations and Chaos, Algebraic Topology, Cohomology, Differential Topology, Real Analysis, Complex Analysis, Topology, Non-Euclidean Geometry, Mathematical Physics, Linear Algebra.