

# CYRILL B. MURATOV

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## EDUCATION

- **Ph. D. in Physics**

Dissertation: "Theory of domain patterns in systems with long-range interactions of Coulombic type," Boston University, Boston, MA, January 1998

- **M. S. in Applied Mathematics and Physics, with Honors**

Moscow Institute of Physics and Technology, Department of General and Applied Physics, Moscow, Russia, June 1993

## EMPLOYMENT

- **Associate Professor**, Department of Mathematical Sciences, New Jersey Institute of Technology, Summer 2006 – present
- **Assistant Professor**, Department of Mathematical Sciences, New Jersey Institute of Technology, Summer 2001 – Spring 2006
- **Visiting Assistant Professor**, Department of Mathematical Sciences, New Jersey Institute of Technology, Fall 1999 – Spring 2001
- **Visiting Member**, Courant Institute of Mathematical Sciences, Summer 1997 – Fall 1999

## VISITING POSITIONS

- NASA Ames Research Center, Summer 2008
- Courant Institute of Mathematical Sciences, Spring 2008
- University of Pisa, Fall 2007

## RESEARCH INTERESTS

- Reaction-diffusion equations and their applications
- Pattern formation and propagation phenomena
- Calculus of variations, analysis of nonlinear PDEs
- Modeling and analysis of cell communication in development
- Stochastic analysis of rare events

## GRANTS AND AWARDS

- *Collaborative Research: Analysis of spatiotemporal signal processing in developmental patterning*, DMS-0718027, NSF, July 2007-2010.
- *Collaborative Research: Multiscale analysis of epithelial patterning: modeling and experiments*, NIH R01 GM076690, July 2005-2008.

- *Collaborative research: modeling and computational analysis of cell communication in Drosophila oogenesis*, DMS-0211864, NSF, August 2002-2005.
- Visiting Fellowship, Istituto Nazionale di Alta Matematica Francesco Severi, Italy, Summers 2005 – 2007.

## PUBLICATIONS

1. V. V. Osipov and C. B. Muratov, “*Properties of wide-peak autosolitons in electron-hole and gas plasma*”, Phys. Rev. E **50**, 3251–3254 (1994)
2. V. V. Osipov and C. B. Muratov, “*Ultrafast traveling spike autosolitons in reaction-diffusion systems*”, Phys Rev. Lett. **75**, 338–341 (1995)
3. C. B. Muratov and V. V. Osipov, “*General theory of instabilities for patterns with sharp interfaces in reaction-diffusion systems*”, Phys. Rev. E **53**, 3101–3116 (1996)
4. C. B. Muratov, “*Self-replication and splitting of domain patterns in reaction-diffusion systems with the fast inhibitor*”, Phys. Rev. E **54**, 3369–3376 (1996)
5. C. B. Muratov and V. V. Osipov, “*Scenarios of domain pattern formation in a reaction-diffusion system*”, Phys. Rev. E **54**, 4860–4879 (1996)
6. C. B. Muratov, “*Synchronization, chaos, and the breakdown of the collective domain oscillations in reaction-diffusion systems*”, Phys. Rev. E **55**, 1463–1477 (1997).
7. C. B. Muratov, “*Instabilities and disorder of the domain patterns in systems with competing interactions*”, Phys. Rev. Lett. **78**, 3149–3152 (1997).
8. C. B. Muratov, “*Unusual coarsening during phase separation in polymer systems*”, Phys. Rev. Lett. **81**, 3699–3702 (1998).
9. C. B. Muratov, “*Traveling wave solutions in the Burridge-Knopoff model*”, Phys. Rev. E **59**, 3847–3857 (1999).
10. C. B. Muratov and V. V. Osipov, “*Theory of spike spiral waves in a reaction-diffusion system*,” Phys Rev. E **60**, 242–246 (1999).
11. C. B. Muratov and V. V. Osipov, “*Spike autosolitons in the Gray-Scott model*”, CAMS Rep. 9900-10, New Jersey Institute of Technology, Newark, NJ, January 2000.
12. C. B. Muratov, “*A quantitative approximation scheme for the traveling wave solutions in the Hodgkin-Huxley model*,” Biophys. J. **79** 2893–2901 (2000).
13. C. B. Muratov and V. V. Osipov, “*Static spike autosolitons in the Gray-Scott model*”, J. Phys. A: Math. Gen **33**, 8893–8916 (2000).
14. C. B. Muratov and V. V. Osipov, “*Traveling spike autosolitons in the Gray-Scott model*”, Physica D **155**, 112–131 (2001).
15. C. B. Muratov, “*On the well-posedness of the equations for the smoothed phase space distribution function and irreversibility in classical statistical mechanics*,” J. Phys. A: Math. Gen. **34**, 4641–4651 (2001).
16. C. B. Muratov and V. V. Osipov, “*Spike autosolitons and pattern formation scenarios in the two-dimensional Gray-Scott model*”, Eur. Phys. J. B **22**, 213–221 (2001).
17. C. B. Muratov and W. E, “*Theory of phase separation kinetics in polymer-liquid crystal systems*”, J. Chem. Phys. **116**, 4723–4734 (2002).

18. S. Y. Shvartsman, C. B. Muratov and D. A. Lauffenburger, “*Modeling and computational analysis of EGF Receptor-mediated cell communication in Drosophila oogenesis*”, *Development* **129**, 2577–2589 (2002).
19. C. B. Muratov and V. V. Osipov, “*Stability of the static spike autosolitons in the Gray-Scott model*”, *SIAM J. Appl. Math.* **62**, 1463–1487 (2002).
20. C. B. Muratov, “*Theory of domain patterns in systems with long-range interaction of Coulomb type*”, *Phys. Rev. E* **66**, 066108 (2002).
21. M. Pribyl, C. B. Muratov and S. Y. Shvartsman, “*Transitions in the model of epithelial patterning*”, *Devel. Dynamics* **226**, 155–159 (2003).
22. M. Pribyl, C. B. Muratov and S. Y. Shvartsman, “*Long-range signal transmission in autocrine relays*”, *Biophys. J.* **84**, 883–896 (2003).
23. M. Pribyl, C.B. Muratov and S.Y. Shvartsman, “*Discrete models of autocrine cell communication in epithelial layers,*” *Biophys. J.* **84**, 3624–3635 (2003).
24. C. B. Muratov, “*Free boundary problem and its applications to reaction-diffusion systems of activator-inhibitor type*”, *Proceedings of the Conference on Dynamics of Patterns in Reaction-Diffusion Systems and the Related Topics, RIMS, Kyoto University*, 63-78 (2003).
25. C. B. Muratov and S. Y. Shvartsman, “*An asymptotic study of the inductive pattern formation mechanism in Drosophila egg development*”, *Physica D* **186**, 93–108 (2003).
26. C. B. Muratov and E. Vanden-Eijnden, “*Breakup of universality in the generalized spinodal nucleation theory,*” *J. Stat. Phys.* **114**, 605–623 (2004).
27. C. B. Muratov, “*A global variational structure and propagation of disturbances in reaction-diffusion systems of gradient type,*” *Discrete Cont. Dyn. S., Ser. B* **4**, 867–892 (2004).
28. M. Lucia, C.B. Muratov, and M. Novaga, “*Linear vs. nonlinear selection for the propagation speed of the solutions of scalar reaction-diffusion equations invading an unstable equilibrium,*” *Commun. Pure Appl. Math.* **57**, 616–636 (2004).
29. C. B. Muratov and S. Y. Shvartsman “*Signal propagation and failure in discrete autocrine relays*”, *Phys. Rev. Lett.* **93**, 118101 (2004).
30. C. B. Muratov and E. Vanden-Eijnden, and Weinan E, “*Self-induced stochastic resonance in excitable systems*”, *Physica D* **210**, 227–240 (2005).
31. R. E. L. DeVille, E. Vanden-Eijnden, and C. B. Muratov, “*Two distinct mechanisms of coherence in randomly perturbed dynamical systems*”, *Phys. Rev. E* **72**, 031105 (2005).
32. A. M. Berezhkovskii, M. I. Monine, C. B. Muratov, and S. Y. Shvartsman, “*Homogenization of boundary conditions for surfaces with regular arrays of traps*”, *J. Chem. Phys.* **124**, 036103 (2006).
33. M. Bertsch, C. B. Muratov, and I. Primi, “*Traveling wave solutions of harmonic heat flow*”, *Calc. Var. PDE* **26**, 489–509 (2006).
34. C. B. Muratov and V. V. Osipov, “*Optimal grid-based methods for thin film micromagnetics simulations*”, *J. Comput. Phys.* **216**, 637–653 (2006).
35. R. E. L. DeVille, C. B. Muratov, and E. Vanden-Eijnden, “*Non-meanfield deterministic limits in chemical reaction kinetics far from equilibrium*”, *J. Chem. Phys.* **124**, 231102 (2006).
36. G. T. Reeves, C. B. Muratov, T. Schupbach, and S. Y. Shvartsman, “*Quantitative Models of Developmental Pattern Formation*”, *Devel. Cell* **11**, 289–300 (2006).

37. C. B. Muratov, E. Vanden-Eijnden, and Weinan E, “*Noise can play an organizing role for the coherent dynamics in excitable media*”, Proc. Natl. Acad. Sci. USA **104**, 702–707 (2007).
38. C. B. Muratov and M. Novaga, “*Front propagation in infinite cylinders. II. The sharp reaction zone limit.*” Calc. Var. PDE **31**, 521–547 (2007).
39. C. B. Muratov and E. Vanden-Eijnden, “*Noise-induced mixed-mode oscillations in a relaxation oscillator near the onset of a limit cycle*”, Chaos **18**, 015111 (2008).
40. M. Lucia, C. B. Muratov, and M. Novaga, “*Existence of traveling wave solutions for Ginzburg-Landau-type problems in infinite cylinders*”, Archive Rat. Mech. Anal. **188**, 475–508 (2008).
41. C. B. Muratov and S. Y. Shvartsman, “*Boundary homogenization for periodic arrays of absorbers*”, Multiscale Model. Simul. **7**, 44–61 (2008).
42. F. Posta, S. Y. Shvartsman and C. B. Muratov, “*Compensated optimal grids for elliptic boundary-value problems*”, J. Comput. Phys. **227**, 8622–8635 (2008).
43. C. B. Muratov and V. V. Osipov, “*Theory of 360° domain walls in thin ferromagnetic films*” (to be published in J. Appl. Phys.).
44. C. B. Muratov and M. Novaga, “*Front propagation in infinite cylinders. I. A variational approach.*” (to be published in Commun. Math. Sci.).
45. C. B. Muratov, M. Novaga, G. Orlandi, and C. J. Carcía-Cervera, “*Geometric strong segregation theory for compositionally asymmetric diblock copolymer melts*” (submitted to J. Chem. Phys.).

#### SELECTED PRESENTATIONS

- Mathematical Physics Seminar, Rutgers University, April 1996.
- Special seminar, Department of Physics, Princeton University, April 1996.
- Applied Mathematics Colloquium, Courant Institute of Mathematical Sciences, December 1997.
- Special Condensed Matter Physics Seminar, Stanford University, Stanford, CA, April, 1998.
- Minisymposium talk, AMS Regional Meeting, Pennsylvania State University, State College, PA, October 1998.
- Special seminar, Department of Applied Mathematics and Statistics, SUNY at Stony Brook, March 1999.
- Applied Mathematics Colloquium, Courant Institute of Mathematical Sciences, April 1999.
- Minisymposium presentation, Fifth SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 1999.
- Minisymposium presentation, Third SIAM Conference on the Mathematical Aspects of Materials Science, Philadelphia, PA, May 2000.
- poster, The Conference on Nonlinear Analysis 2000, Courant Institute of Mathematical Sciences, May 2000.
- Applied Mathematics Colloquium, Rensselaer Polytechnic Institute, October 2000.
- Applied Mathematics Colloquium, University of Massachusetts, Amherst, November 2000.
- Dynamical Systems and Nonlinear Science Seminar, Princeton University, April 2001.
- Applied Mathematics Colloquium, NJIT, February 2002.

- Minisymposium presentation, SIAM 50th Annual Meeting, Philadelphia, PA, July 2002.
- Invited talk, Workshop “Invasion Phenomena in Biology and Ecology”, Institute Henri Poincaré, Paris, France, November 2002.
- Invited talk, Conference on “Dynamics of Patterns in Reaction-Diffusion Systems and Related Topics”, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan, November 2002.
- Invited talk, Conference on “Mathematical understanding of complex patterns in the life sciences”, Lorentz Center, Leiden, The Netherlands, March 2003.
- Applied Mathematics Seminar, Department of Applied Mathematics, University of Bonn, July 2003.
- Applied Mathematics Colloquium, Princeton University, October 2003.
- Applied Mathematics Colloquium, Courant Institute of Mathematical Sciences, October 2003.
- Applied Mathematics Colloquium, Northwestern University, February 2004.
- Invited talk, Conference on “Mathematical Aspects of Invasion Phenomena in Life Sciences,” CIRM, Luminy, France, March 2004.
- Minisymposium talk, Frontiers in Applied and Computational Mathematics, NJIT, May 2004.
- Minisymposium talk, SIAM Materials Science Meeting, Los Angeles, CA, May 2004.
- Invited short talk, Conference in Honor of Haim Brezis on the Occasion of his 60th Birthday, Paris, France, June 2004.
- Special seminar, Dipartimento di Matematica, Università di Roma 2, “Tor Vergata”, Rome, Italy, June 2004.
- 2 Minisymposium talks, SIAM Annual Meeting, Portland, OR, July 2004.
- Minisymposium talk, SIAM Conference on Nonlinear Waves and Coherent Structures, October 2004.
- BioMaPS Seminar in Quantitative Biology, Rutgers University, October, 2004.
- Minisymposium talk, SIAM Conference on PDEs, Houston, TX, December 2004.
- CAMP/PDE Seminar, University of Chicago, January 2005.
- Special PDE Seminar, Department of Mathematics, University of Tokyo, February 2005.
- Invited talk, 50th NIBB Conference, “Structure and Dynamics of Complex Biological Networks”, Okazaki Conference Center, Okazaki, Japan, February 2005.
- Applied Mathematics Colloquium, Rice University, February 2005.
- Analysis and PDEs Seminar, University of Marseille, March 2005.
- 2 Minisymposium talks, SIAM Conference on Application of Dynamical Systems, Snowbird, UT, May 2005.
- Applied mathematics seminar, Department of Mathematics, University of Pisa, June 2005.
- Applied mathematics seminar, Department of Computer Science, University of Verona, June 2005.
- Invited talk, workshop on “Mathematical Analysis of Complex Phenomena in Life Sciences”, University of Tokyo, October 2005.

- PDE seminar, Division of Applied Mathematics, Brown University, November 2005.
- CASA Colloquium, Technical University of Eindhoven, January 2006.
- Pure Mathematics Seminar, University of Bristol, March 2006.
- Applied Mathematics Colloquium, NJIT, March 2006.
- Invited talk, One-day Workshop on Variational Problems, University of Pisa, June 2006.
- Special seminar, Istituto per le Applicazioni del Calcolo “Mauro Picone”, Rome, Italy, June 2006.
- PDE seminar, Department of Mathematics, University of Cologne, July 2006.
- PDE seminar, Institute for Applied Mathematics, University of Bonn, July 2006.
- 3 Minisymposium talks, SIAM Annual Meeting and SIAM Conference on Analysis and PDEs, Boston, MA, July 2006.
- poster, GRC Conference on Oscillations and Dynamic Instabilities in Chemical Systems, Oxford University, August 2006.
- Invited talk, Workshop on Reaction-Diffusion Processes in Biological and Biomimetic Systems, Bordeaux, France, October 2006.
- Applied Mathematics Colloquium, UCLA, January 2007.
- Special lecture, Department of Mathematics, University of Minnesota, January 2007.
- Special lecture, Department of Mathematics, Rutgers University, January 2007.
- Minisymposium talk, 6th International Congress on Industrial and Applied Mathematics, Zurich, Switzerland, July 2007.
- Analysis seminar, Department of Mathematics, University of Pisa, November 2007.
- Mini-course, a workshop on “Singularities arising in nonlinear problems”, Kyoto, Japan, November 2007.
- Applied Mathematics Colloquium, Columbia University, February 2008.
- CAMP/PDE seminar, University of Chicago, February 2008.
- Analysis seminar, Courant Institute of Mathematical Sciences, March 2008.
- CIMPA Summer School on Nonlinear Analysis and Geometric PDEs, Tsakhkadzor, Armenia, June 2008.