

DMITRI LEONIDOVICH VAINCHTEIN

2515 Forrest Way,
Atlanta, GA 30305

Office: (404)-385-2508

Home: (805)-453-1789

Fax: (404)-894-9958

E-mail: dmitri@gatech.edu

OBJECTIVE:

Faculty position in Applied Mathematics

INTERESTS:

Dynamical systems (including resonant phenomena and chaos), Control theory, Population dynamics, Fluid mechanics (including mixing, vortex dynamics and transport phenomena) and Plasma physics.

EDUCATION:

Ph.D. Theoretical & Applied Mechanics, January 2001
University of Illinois at Urbana-Champaign
Dissertation: Morphological transitions in foams
Advisor: Hassan Aref
GPA: 4.0

Ph.D. Theoretical Physics, December 1997
Space Research Institute, Moscow, Russia
Dissertation: On the destruction of adiabatic invariance in some problems of plasma physics and hydrodynamics
Advisor: Anatoly I. Neishtadt

M.S. Plasma Physics, May 1995
Moscow Institute of Physics and Technology, Moscow, Russia
Advisor: Anatoly I. Neishtadt
Combined GPA (including B.S.): 4.80/5.0

RESEARCH EXPERIENCE:

J. Ford Postdoctoral fellow

10/05 - present

School of Physics, Georgia Institute of Technology

Mentor: Prof. Roman Grigoriev, School of Physics, Georgia Institute of Technology

Postdoctoral fellow

10/01 - 06/05

Mechanical & Environmental Engineering, University of California Santa Barbara

10/00 - 09/01

Division of Engineering and Applied Sciences, Harvard University

Mentor: Prof. Igor Mezic, Mechanical & Environmental Engineering, University of California Santa Barbara

Research Assistant, 5/98 – 9/00

Department of Theoretical & Applied Mechanics, UIUC

Supervisor: Prof. Hassan Aref, Dept. Theoretical & Applied Mechanics, UIUC

Junior Scientific Researcher, 9/93 – 5/98

Space Research Institute, Moscow, Russia

Supervisors: Prof. Anatoly I. Neishtadt, Space Research Institute

Prof. Lev M. Zelenyi, Space Research Institute

TEACHING EXPERIENCE:

Instructor

Vibrations (ME 163), 1/03 – 3/03

Mechanical & Environmental Engineering, University of California Santa Barbara

Teaching Assistant

Introduction to Dynamics (TAM 212), 1/97 – 5/97

Introduction to Fluid Mechanics (TAM 235), 8/96 – 1/97

Department of Theoretical & Applied Mechanics, UIUC

MAIN SCIENTIFIC ACCOMPLISHMENTS:

Dynamical Systems:

1. Development of the theory of resonance-induced chaotic advection (capture into resonance and scattering on resonance; separatrix crossings) in volume-preserving systems. The obtained results were used to describe mixing in Stokes and microscale flows.
2. Application of the theory of resonance phenomena in Hamiltonian systems to the problems of the motion of charged particles in electromagnetic fields (in particular, in the Earth magnetotail) to describe the coexisting regular and chaotic regimes.

Control Theory and Vortex Dynamics

1. A proof of the optimality of the impulsive control for a certain class of singular control problems of a system of point vortices.
2. Development of the resonance-based techniques (namely, implementation of capture into resonance) for active control of vortex patches.
3. Discovery of the new solutions for rigidly rotating configurations of point vortices.

Sociology and population Dynamics:

Description of the aggregation in Schelling models. Introduction of parameters that can be used to describe statistical properties of the equilibrium states.

Rheology of Foams:

Description of the parametrical phase transitions in the soap foams, that are an example of systems with constant mean curvature.

HONORS AND AWARDS:

The best scientific articles, 1999

Annual awards of IAPC-Nauka for the series of papers devoted to the analysis of charged particle dynamics in the Earth's magnetosphere.

Thomas J. Dolan Graduate Fellowship, 1999

Annual TAM award for a research assistant on the basis of academic excellence.

International Science Foundation Graduate award, 1997

Award to the best performing recipient of an ISF fellowship of the corresponding year.

International Science Foundation Graduate Fellowship, 1996, 1997

Annual fellowship for graduate students from the former USSR based on academic performance and research accomplishments.

REFEREED JOURNAL PUBLICATIONS:

1. **Schelling's Segregation Model: Parameters, Scaling, and Aggregation** (2007)
Abhinav Singh, Dmitri L. Vainchtein and Howard Weiss, submitted to *Science*.
2. **Resonance phenomena and chaotic advection in a cellular flow** (2007)
Dmitri L. Vainchtein, John Widloski and Roman O. Grigoriev, submitted to *Phys. Rev. E*.
3. **Tailoring mixing inside a translating drop** (2007)
Rodolphe Chabreyrie, Dmitri L. Vainchtein, Nadine Aubry, Cristel Chandre and Pushpendra Singh, submitted to *Phys. Rev. Lett.*.
4. **Adiabatic control of vortex elements** (2007)
Dmitri L. Vainchtein, Luca Cortelezzi, and Igor Mezic, to be submitted for publication in *Journal of Fluid Mechanics*.
5. **Adiabatic invariance in volume-preserving systems** (2007)
Anatoly I. Neishtadt, Dmitri L. Vainchtein, and Alexei Vasiliev, in "IUTAM Symposium on Hamiltonian Dynamics, Vortex Structures, Turbulence" Proceedings of the IUTAM Symposium held in Moscow, 25-30 August, 2006. Series: IUTAM Book-series , Vol. 6 Borisov, A.V.; Kozlov, V.V.; Mamaev, I.S.; Sokolovskiy, M.A. (Eds.), Springer Verlag, Berlin, pp. 89-108.
6. **Resonant chaotic mixing in a cellular flow** (2007)
Dmitri L. Vainchtein, John Widloski and Roman O. Grigoriev, *Phys. Rev. Letters* , **99**, art. #094501.
7. **Mixing properties of steady flow in thermocapillary driven droplets** (2007)
Dmitri L. Vainchtein, John Widloski and Roman O. Grigoriev, *Physics of Fluids* , **19**, art. #067102.
8. **On passage through resonances in volume-preserving systems** (2006)
Dmitri L. Vainchtein, Anatoly I. Neishtadt and Igor Mezic, *Chaos*, **16**, art. #043123.
9. **Vortex-based control algorithms** (2006)
Dmitri L. Vainchtein and Igor Mezic, *Advances in Flow Control, Lecture Notes in Computational Science and Engineering*, P. Koumoutsakos, I. Mezic, eds., published by Springer Verlag, Berlin, **330**, pp. 189-212.
10. **Quasi-adiabatic description of nonlinear particle dynamics in typical magnetotail configurations** (2005)
Dmitri L. Vainchtein, Lev M. Zelenyi, Anatoly I. Neishtadt and Joerg Büchner, *Nonlinear Processes in Geophysics* **12**, pp. 101-115.
11. **Capture into resonance: a method for efficient control** (2004)
Dmitri L. Vainchtein and Igor Mezic, *Physical Review Letters* **93**, Art. No. 084301.
12. **Optimal control of a co-rotating vortex pair: averaging and impulsive control** (2004)
Dmitri L. Vainchtein and Igor Mezic, *Physica D* **192**, pp. 63-82.

13. **Resonances and particle stochastization in nonhomogeneous electromagnetic fields** (2004)
Dmitri L. Vainchtein, Eugene V. Rovinsky, Lev M. Zelenyi, and Anatoly I. Neishtadt, *J. of Nonlinear Science* **14**, pp. 173-205.
14. **Vortex crystals** (2003)
H. Aref, P. K. Newton, M. A. Stremmer, T. Tokieda, and D. L. Vainchtein, *Adv. Appl. Mech.* **39**, pp. 1-79.
15. **Control of a vortex pair using a weak external flow** (2002)
Dmitri L. Vainchtein and Igor Mezic, *Journal of Turbulence* **3**, 051.
16. **Morphological transition in compressible foam** (2001)
Dmitri L. Vainchtein and Hassan Aref, *Physics of Fluids* **13**, pp. 2152-2160.
17. **The Equation of state of a foam** (2000)
Hassan Aref and Dmitri L. Vainchtein, *Physics of Fluids* **12**, pp. 23-28.
18. **On the motion of charged particles in the Earth magnetotail in the field of a monochromatic wave** (1999)
Dmitri L. Vainchtein, Lev M. Zelenyi and Anatoly I. Neishtadt, *Plasma Physics Reports* **25**, pp. 817-826.
19. **Jumps in an adiabatic invariant with small initial values** (1999)
Dmitri L. Vainchtein, Lev M. Zelenyi, Anatoly I. Neishtadt and Boris V. Savenkov, *Plasma Physics Reports* **25**, pp. 299-303.
20. **Point vortices exhibit asymmetric equilibria** (1998)
Hassan Aref and Dmitri L. Vainchtein, *Nature* **392**, pp. 769-770.
21. **The regular and stochastic motion of charged particles near O-type neutral line** (1998)
Dmitri L. Vainchtein, *Cosmic Research* **36**, pp. 451-456.
22. **Chaotic advection in a cubic Stokes flow** (1998)
Anatoly I. Neishtadt, Dmitri L. Vainchtein and Alexei A. Vasiliev, *Physica D* **111**, pp. 227-242.
23. **The quasiadiabatic description of motion of charged particles near X-line** (1998)
Dmitri L. Vainchtein, Anatoly I. Neishtadt and Lev M. Zelenyi, *Plasma Physics Reports* **22**, pp. 1039-1045.
24. **Adiabatic chaos in a two-dimensional mapping** (1996)
Dmitri L. Vainchtein, Anatoly I. Neishtadt and Alexei A. Vasiliev, *CHAOS* **6**, pp. 514-518.
25. **Changes in the adiabatic invariant and streamline chaos in confined incompressible Stokes flow** (1996)
Dmitri L. Vainchtein, Anatoly I. Neishtadt and Alexei A. Vasiliev, *CHAOS* **6**, pp. 67-77.

- 26. The quasiadiabatic description of motion of charged particles in the configurations with the reversal magnetic field (1995)**
Dmitri L. Vainchtein, Anatoly I. Neishtadt and Lev M. Zelenyi, *Plasma Physics Reports* **21**, pp. 457-464.
- 27. Regular and stochastic motion of the electron in a Hydrogen atom in a magnetic field (1994)**
Dmitri L. Vainchtein, *Physica Scripta* **50**, pp. 501-506.

CONFERENCE PRESENTATIONS AND SEMINARS:
37 Presentations, including

Resonances-induced chaotic advection in a cellular flow (2007)

Dmitri L. Vainchtein (presenting author), Igor Mezic and Anatoly Neishtadt, Presented at “Chaos, Complexity and Transport: Theory and Applications”, Marseille, France, June 4–8.

Mixing by steady flows in thermocapillary driven microdroplets (2006)

Dmitri L. Vainchtein (presenting author), John Widloski, and Roman Grigoriev, *Bulletin of the American Physical Society* **51**, p. 82. Presented at the 59th Annual Meeting of the Division of Fluid Dynamics in Tampa, FL, November 19–21.

Adiabatic Control of a Pair of Elliptical Vortex Patches (2005)

Dmitri L. Vainchtein (presenting author), Igor Mezic, and Luca Cortelezzi, *Bulletin of the American Physical Society* **50**, p. 253. Presented at the 58th Annual Meeting of the Division of Fluid Dynamics in Chicago, IL, November 20–22.

Mixing in Stokes Flows: From a Dynamical System to the Diffusion Equation (2005)

Dmitri L. Vainchtein (presenting author), Igor Mezic and Anatoly Neishtadt, Presented at “SIAM Conference on Applications of Dynamical Systems”, Snowbird, Utah, May 22-26.

Control of Resonances in Hamiltonian Systems (2005)

Dmitri L. Vainchtein (presenting author) and Igor Mezic, Presented at “SIAM Conference on Applications of Dynamical Systems”, Snowbird, Utah, May 22-26.

Resonances and Mixing in Stokes Flows (2004)

Dmitri L. Vainchtein (presenting author), Igor Mezic and Anatoly Neishtadt, Presented at the XXI International Congress of Theoretical and Applied Mechanics in Warsaw, Poland, August 15–21.

Capture into resonance: a novel method of efficient control (2003)

Dmitri L. Vainchtein (presenting author) and Igor Mezic, Presented at the “European Control Conference”, Cambridge, UK, September 1-4.

Control of vortex merger via elliptical vortex patch model (2002)

Dmitri L. Vainchtein (presenting author) and Igor Mezic, *Bulletin of the American Physical Society* **47**, p. 96. Presented at the 55th Annual Meeting of the Division of Fluid Dynamics in Dallas, TX, November 24–26.

Resonance interaction between charged particles and monochromatic waves (2002)

Dmitri L. Vainchtein (presenting author), Anatoly I. Neishtadt and Lev M. Zelenyi, Presented at “The Fourth International Conference on Dynamical Systems and Differential Equations”, University of North Carolina at Wilmington, May 24-27.

A phase transition in compressible foam (2000)

Dmitri L. Vainchtein (presenting author) and Hassan Aref, *Technical report, TAM UIUC* **950**, p. 28. Presented ICTAM 2000 in Chicago, Illinois, August 27–Sept. 2.