Dmitri Leonidovich Vainchtein

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E-mail: dlv36@drexel.edu

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:

Associate Research Professor
10/20 - present
Nyheim Plasma Institute, Drexel University, Camden, NJ

Assistant Research Professor
07/17 - 09/20
Nyheim Plasma Institute, Drexel University, Camden, NJ

Visiting Research Professor
09/16 - 06/17
Nyheim Plasma Institute, Drexel University, Camden, NJ

Associate Professor of Instruction
07/15 - 06/16
Department of Mechanical Engineering, Temple University, Philadelphia, PA

Assistant Professor
09/08 - 06/15
Department of Mechanical Engineering, Temple University, Philadelphia, PA

J. Ford Postdoctoral fellow
10/05 - 05/08
School of Physics, Georgia Institute of Technology, Atlanta, GA
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, UCSB

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, Department of Mechanical Engineering, Temple University

Instructor, Department of Mechanical & Environmental Engineering, UCSB

Recent Funding Received:

NASA HSR (PI – Vainchtein)
Radiation belt losses through electron deceleration due to the nonlinear interaction with whistler-mode waves (08/01/22 - 07/31/25); Total Amount: $737,242

NASA HGI (Drexel-PI – Vainchtein, with PI – Zhang)
Energetic Electron Scattering by Kinetic Alfven Waves in the Radiation Belts (03/01/22 - 02/28/25); Total Drexel Amount: $198,786

NASA HSR (PI – Vainchtein)
Quantification of the nonlinear wave-particle interaction in radiation belts (08/01/20 - 07/31/23); Total Amount: $680,000

NASA HGI (PI – Vainchtein)
Low frequency modulation of the resonant electron scattering by whistler waves (03/01/19 - 02/28/23); Total Amount: $524,000

NSF (PI – Vainchtein)
Mixing by Resonances in Multi-Scale Systems (06/01/14 - 05/31/19); Total Amount: $300,000

Petroleum Research Fund (Co-PI – Vainchtein)
Geophysical Characterization of Biogenic Structures in Siliciclastic and Carbonate Media (09/01/15 - 08/31/17) (PI – Buynevich, Dept. of Earth and Environmental Science, Temple University); D.V. share $40,000

NSF (PI – Vainchtein)
Collaborative Research: Long-term chaotic transport in volume-preserving flows (09/09 - 08/12); D.V. share $139,728

Advising:

9 Graduate Students from College of Engineering at Temple University obtained Ph.D. and M.S. degrees.

Service:

NSF Panel member CMMI Dynamical Systems (DS) and Sensors, Dynamics, and Control Systems (SDC) Programs

NASA Reviewer EPSCoR and FINNEST Programs

Reviewer CNSNS, Chaos, Physica D, SIADS, NONRWA, Physics of Fluids, Technological and Economic Development of Economy, Symmetry, Molecules, JMP

Book Chapters:

4. **Resonances and mixing in near-integrable volume-preserving systems** (2012)
   Dmitri L. Vainchtein, in "Transport and Mixing in Laminar Flows: From Microfluidics to Oceanic Currents", R. Grigoriev and H.-G. Schuster, eds., John Wiley & Sons., pp. 5-33.

3. **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 Bookseries, Vol. 6 Borisov, A.V.; Kozlov, V.V.; Mamaev, I.S.; Sokolovskiy, M.A., eds., Springer Verlag, Berlin, pp. 89-108.

2. **Vortex-based control algorithms** (2006)
   Dmitri L. Vainchtein and Igor Mezic, *Advances in Flow Control, Lecture Notes in Computational Science and Engineering*, P. Koumoutsakos and I. Mezic, eds., Springer Verlag, Berlin, **330**, pp. 189-212.

1. **Turbulent statistical dynamics of a system of point vortices** (1999)
   H. Aref, P. L. Boyland, M. A. Stremler, and D. L. Vainchtein, *Fundamental Problematic Issues in Turbulence*, A. Gyr, W. Kinzelbach, A. Tsinober, eds., Springer Verlag, Berlin, pp. 151-161.

Refereed Journal Publications:

65. **Effects of Plasma on Physical Properties of Water: Nanocrystalline-to-Amorphous Phase Transition and Improving Produce Washing** (2022)
    J. He, A. Rabinovich, D. Vainchtein, A. Fridman, C. Sales, M.N. Shneider, *Plasma*, **5**, 462-469.

64. **Regimes of ion dynamics in current sheets: The machine learning approach** (2022)
    A. S. Lukin, A.V. Artemyev, D. Vainchtein, A. A. Petrukovich, *Phys. Rev. E*, **106**, 065205.

63. **Comparison of Energetic Electron Fluxes Measured by GPS and THEMIS Spacecraft in the Inner Magnetosphere** (2022)
    R. Curtis, A.V. Artemyev, D. Vainchtein, A. Kellerman, S.K. Morley, V. Angelopoulos *J. Geophys. Res.: Space Physics*, **127**, e2022JA030724.

62. **On the Incorporation of Nonlinear Resonant Wave-Particle Interactions Into Radiation Belt Models** (2022)
    A.V. Artemyev, D. Mourenas, X.J. Zhang, D. Vainchtein *J. Geophys. Res.: Space Physics*, **127**, e2022JA030853.

61. **Statistics of Whistler-Mode Waves in the Near-Earth Plasma Sheets** (2022)
    L. Gao, D. Vainchtein, A.V. Artemyev, X.J. Zhang *J. Geophys. Res.: Space Physics*, **127**, e2022JA030603.

60. **Resonance broadening effect for relativistic electron interaction with electromagnetic ion cyclotron waves** (2022)

D.S. Tonoian, A.V. Artemyev, X.J. Zhang, M.M. Shevelev, D. Vainchtein, *Physics of Plasma*, **29**, 082903.

59. On the Nature of Intense Sub-Relativistic Electron Precipitation (2022)
A.V. Artemyev, X.J. Zhang, Y. Zou, D. Mourenas, V. Angelopoulos, D. Vainchtein, E. Tsail, C. Wilkins *J. Geophys. Res.: Space Physics*, **127**, e2022JA030571.

58. Numerical investigation of flow deflectors for the improvement of condensing air flux through the air-conditioning unit on high-speed trains (2022)
X. Li, F. Wu, Y. Tao, M. Yang, R. Xu, and Dmitri Vainchtein, *Building and Environment*, **215**, 1089490.

57. Model and parameter identification of soft tissue response to a movement of remotely navigated magnetic sphere (2021)
Yulia Malova, Sijie Ran, Dmitri Vainchtein, and Gary Friedman *J. of the Mechanical Behavior of Biomedical Materials*, **126**, 105040.

56. Solar Wind Discontinuity Transformation at the Bow Shock (2021)
Kropotina, Julia, Webster, Lee, Artemyev, Anton, Bykov, Andrei, Vainchtein, Dmitri, Vasko, Ivan *Astrophysical Journal*, **93**, 142.

55. Solar Wind Discontinuity Interaction with the Bow Shock: Current Density Growth and Dawn-Dusk Asymmetry (2021)
Webster, Lee, Vainchtein, Dmitri, Artemyev, Anton *Space Physics*, **296**, 87.

54. Long-term dynamics driven by resonant wave-particle interactions: from Hamiltonian resonance theory to phase space mapping (2021)
A.V. Artemyev, A.I. Neishtadt, A.A. Vasiliev, X.J. Zhang, D. Mourenas, and D. Vainchtein *J. of Plasma Physics*, **87**, 835870201.

53. Ionosphere Feedback to Equatorial Electron Scattering by Equatorial Whistler-Mode Waves (2020)
A.V. Artemyev, X.-J. Zhang, V. Angelopoulos, D. Mourenas, D. Vainchtein, Y. Shen, I. Vasko, A. Runov *J. Geophys. Res.: Space Physics*, **125**, e2020JA028373.

52. Solar wind transient currents: statistical properties and impact on Earth's magnetosphere (2020)
Robert Newman, Dmitri Vainchtein, and Anton Artemyev *Solar Physics*, **295**, 129.

51. A Numerical Approach for Simulating a High-Speed Train Passing through a Tornado-Like Vortex (2020)
R.Z. Xu, F. Wu, W.H. Su, J.F. Ding, and D. Vainchtein *Journal of Applied Fluid Mechanics*, **13**, pp.1635-1648.

50. On the Role of Size Differences in Synchronized Motion of Magnetic Particles in Fluid: A Study on Trimers (2020)
Sijie Ran, Dmitri Vainchtein, and Gary Friedman *IEEE Transactions on Magnetics*, **56**, pp.1-7 (Front Cover).

49. Aortic Hemodynamics of Spiral-Flow-Generated Mechanical Assistance (2020)
P. Huang Zhang, C. Tkatch, Dmitri Vainchtein, J.Y. Kresh *The Annals of Thoracic Surgery*, **109**, pp. 1449-1457.

48. A novel numerical approach for investigation of the heat transport in a full 3D brake system of high-speed trains (2019)
Peng Ji, Fan Wu, Guoliang Zhang, Xiaofang Yin, and Dmitri Vainchtein *Numerical Heat Transfer Part A-Applications*, **75**, pp. 824-840.

47. The Mechanics of Spiral Flow: Enhanced Washout and Transport (2019)
P. Huang Zhang, C. Tkatch, R. Newman, W. Grimme, D. Vainchtein, J.Y. Kresh *Artificial Organs*, **43**, pp. 1144-1153.

46. Numerical study of the air flow through an air-conditioning unit on high-speed trains (2019)
Xueliang Li, Fan Wu, Yu Tao, Mingzhi Yang, Robert Newman, and Dmitri Vainchtein *Journal of Wind Engineering & Industrial Aerodynamics*, **187**, pp. 26-35.

45. Can the "Maximum Power Principle" be Applied to Pulsed Dielectric Barrier Discharge? (2019)
Danil Dobrynin, Dmitri Vainchtein, Matteo Gherardi, Vittorio Colombo, and Alexander Fridman *IEEE Transactions on Plasma Science*, **47**, pp.4052-4057 .

44. Nonlinear resonances generate large-scale convection cells in phase space (2019)
Fan Wu, Dmitri Vainchtein, and Anton Artemyev *Physical Review E*, **99**, 020201(R) (Editors' Suggestion).

43. Evolution of Electron Distribution Driven by Nonlinear Resonances With Intense Field-Aligned Chorus Waves (2018)
D. Vainchtein, X.-J. Zhang, A.V. Artemyev, D. Mourenas , V. Angelopoulos, and R. M. Thorne *Journal of Geophysical Research: Space Physics*, **123**, pp. 8149-8169.

42. Trapping (capture) into resonance and scattering on resonance: Summary of results for space plasma systems (2018) A.V. Artemyev, A.I. Neishtadt, D.L. Vainchtein, A.A. Vasiliev, I.Y. Vasko, and L.M. Zelenyi *Communications in Nonlinear Science and Numerical Simulation* **65**, pp. 111-160.

41. Generation of discrete structures in phase-space via charged particle trapping by an electrostatic wave (2017)
Dmitri Vainchtein, Anton Artemyev, Greg Fridman *Communications in Nonlinear Science and Numerical Simulation* **51**, pp. 133-140.

40. Charged particle dynamics in turbulent current sheets (2016)
Anton Artemyev, Dmitri Vainchtein, Anatoly Neishtadt, and Lev Zelenyi, *Physical Review E* **93**, art.# 053207.

39. Perturbation analysis of steady and unsteady electrohydrodynamic chaotic advection inside translating drops (2015)
Fan Wu, Dmitri L. Vainchtein, and Thomas Ward, *Physical Review E* **92**, art.# 023030.

38. Stability of relativistic electron trapping by strong whistler or electromagnetic ion cyclotron waves (2015)
A.V. Artemyev, D. Mourenas, O.V. Agapitov, D.L. Vainchtein, F.S. Mozer, and V. Krasnoselskikh, *Physics of Plasmas* **22**, art.# 082901.

37. Comparative numerical-experimental analysis on the universal impact of arbitrary perturbations on transport in three-dimensional unsteady flows (2014)
Fan Wu, Michel Speetjens, Dmitri L. Vainchtein, Ruben Trieling, and Herman Clercx, *Physical Review E* **90**, art.# 063002.

36. Stability of relativistic surfatron acceleration (2014)
Anton Artemyev, Dmitri Vainchtein, Anatoly Neishtadt, and Lev Zelenyi, *Physical Review E* **89**, art.# 043106.

35. On localized mixing in action-action-angle flows (2014)
Wu Fan and Dmitri Vainchtein, *Communications in Nonlinear Science and Numerical Simulation* **19**, pp.67-73.

34. Quasiadiabatic dynamics of charged particles in a space plasma (2013)
Lev Zelenyi, Anatoly Neishtadt, Anton Artemyev, Dmitri Vainchtein, and Helga Malova, *Physics-Uspekhi* **56**, pp.347-394.

33. Resonance phenomena and long-term chaotic advection in volume-preserving systems (2012)
Dmitri L. Vainchtein and Alimu Abudu, *Chaos* **22**, art.# 013103.

32. Resonant acceleration of charged particles in the presence of random fluctuations (2011)
Anton Artemyev, Dmitri Vainchtein, Anatoly Neishtadt, and Lev Zelenyi, *Physical Review E* **84**, art.# 046213.

31. Dynamics of electrons in a parabolic magnetic field perturbed by an electromagnetic wave (2011)
Anatoly I. Neishtadt, Dmitri L. Vainchtein, and Alexei A. Vasiliev, *Plasma Physics and Controlled Fusion* **53**, art.# 085014.

30. Limit sets for natural extensions of Schelling's segregation model (2011)
Abhinav Singh, Dmitri L. Vainchtein, and Howard Weiss, *Communications in Nonlinear Science and Numerical Simulation*, **16**, pp. 2822-2831.

29. Adiabatic description of capture into resonance and surfatron acceleration of charged particles by electromagnetic waves (2010)
Anton V. Artemyev, Anatoly I. Neishtadt, Lev M. Zelenyi, and Dmitri L. Vainshtein, *Chaos* **20**, art.# 043128.

28. Using resonances to control chaotic mixing within a translating and rotating droplet (2010)
Rodolphe Chabreyrie, Dmitri L. Vainchtein, Cristel Chandre, Pushpendra Singh, and Nadine Aubry, *Communications in Nonlinear Science and Numerical Simulation* **15**, pp. 2124-2132.

27. Electron dynamics in a parabolic magnetic field in the presence of an electrostatic wave (2009)
Dmitri L. Vainchtein, Alexei A. Vasiliev, and Anatoly I. Neishtadt, *Plasma Physics Reports* **35**, pp. 1021-1031.

26. Surfatron acceleration in electromagnetic waves with a low phase velocity (2009)

Anatoly I. Neishtadt, Anton V. Artemyev, Lev M. Zelenyi, and Dmitri L. Vainshtein, *JETP Letters* **89**, pp. 441-447.

25. Schelling's Segregation Model: Parameters, Scaling, and Aggregation (2009)
Abhinav Singh, Dmitri L. Vainchtein, and Howard Weiss, *Demographic Research* **21**, pp. 342-366.

24. Robustness of tuned mixing within a droplet for digital microfluidics (2009)
Rodolphe Chabreyrie, Dmitri L. Vainchtein, Cristel Chandre, Pushpendra Singh, and Nadine Aubry, *Mechanics Research Communications* **36**, pp. 130-136.

23. Resonant mixing in perturbed action-action-angle flow (2008)
Dmitri L. Vainchtein, John Widloski, and Roman O. Grigoriev, *Physical Review E* **78**, art.# 026302.

22. Tailoring mixing inside a translating drop (2008)
Rodolphe Chabreyrie, Dmitri L. Vainchtein, Cristel Chandre, Pushpendra Singh, and Nadine Aubry, *Physical Review E* **77**, art.# 036314.

21. Resonant chaotic mixing in a cellular flow (2007)
Dmitri L. Vainchtein, John Widloski, and Roman O. Grigoriev, *Physical Review Letters* **99**, art. #094501.

20. 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.

19. On passage through resonances in volume-preserving systems (2006)
Dmitri L. Vainchtein, Anatoly I. Neishtadt, and Igor Mezic, *Chaos* **16**, art. #043123.

18. 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.

17. Capture into resonance: a method for efficient control (2004)
Dmitri L. Vainchtein and Igor Mezic, *Physical Review Letters* **93**, art.# 084301.

16. 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.

15 Resonances and particle stochastization in nonhomogeneous electromagnetic fields (2004)
Dmitri L. Vainchtein, Eugene V. Rovinsky, Lev M. Zelenyi, and Anatoly I. Neishtadt, *Journal of Nonlinear Science* **14**, pp. 173-205.

14. Vortex crystals (2003)
H. Aref, P. K. Newton, M. A. Stremler, T. Tokieda, and D. L. Vainchtein, *Advances in Applied Mechanics* **39**, pp. 1-79.

13. Control of a vortex pair using a weak external flow (2002)
Dmitri L. Vainchtein and Igor Mezic, *Journal of Turbulence* **3**, art. #051.

12. Morphological transition in compressible foam (2001)
Dmitri L. Vainchtein and Hassan Aref, *Physics of Fluids* **13**, pp. 2152-2160.

11. The Equation of state of a foam (2000)
Hassan Aref and Dmitri L. Vainchtein, *Physics of Fluids* **12**, pp. 23-28.

10. Motion of charged particles in the field of a monochromatic wave in the earth's magnetospheric tail (1999)
Dmitri L. Vainchtein, Lev M. Zelenyi, and Anatoly I. Neishtadt, *Plasma Physics Reports* **25**, pp. 817-826.

9. 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.

8. Point vortices exhibit asymmetric equilibria (1998)
Hassan Aref and Dmitri L. Vainchtein, *Nature* **392**, pp. 769-770.

7. The regular and stochastic motion of charged particles near O-type neutral line (1998)
Dmitri L. Vainchtein, *Cosmic Research* **36**, pp. 451-456.

6. Chaotic advection in a cubic Stokes flow (1998)
Anatoly I. Neishtadt, Dmitri L. Vainchtein, and Alexei A. Vasiliev, *Physica D* **111**, pp. 227-242.

5. 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.

4. Adiabatic chaos in a two-dimensional mapping (1996)
Dmitri L. Vainchtein, Anatoly I. Neishtadt, and Alexei A. Vasiliev, *CHAOS* **6**, pp. 514-518.

3. 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.

2. 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.

1. 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.

60+ Conference and invited Presentations