

Zhiwu Lin

Contact Information

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Research Interests

Fluid dynamics, kinetic theory, nonlinear waves, stability theory

Education

- Peking University, Beijing, China
Mathematics, B.A. 1995
- Tokyo University, Tokyo, Japan
Mathematics, M.S. 1999
- Brown University, Providence, Rhode Island, USA
Mathematics, Ph. D. 2003

Appointment

- Courant Instructor, Courant Institute of New York University, 2003.9-2006.8
- Assistant professor, Department of Mathematics, University of Missouri-Columbia, 2006.8-2008.8
- Assistant professor, School of Mathematics, Georgia Institute of Technology, 2008.8-2011.7
- Associate professor, School of Mathematics, Georgia Institute of Technology, 2011.7-2018.3
- Professor, School of Mathematics, Georgia Institute of Technology, 2018.3-

Refereed Publications

1. Zhiwu Lin, *Instability of periodic BGK waves*, Math. Res. Letts., **8**, 521-534(2001).
2. Zhiwu Lin, *Stability and instability of traveling solitonic bubbles*, Adv. Differential Equations **7** (2002), no. 8, 897–918.
3. Zhiwu Lin, *Instability of some ideal plane flows*, SIAM J. Math. Anal., **35**, no. 2, 318–356 (2003).
4. Zhiwu Lin, *Some stability and instability criteria for ideal plane flows*, Comm. Math. Phys., **246**, no. 1, 87–112(2004).
5. Zhiwu Lin, *Nonlinear instability of ideal plane flows*, Int. Math. Res. Not., **41**, 2147-2178 (2004).

6. Zhiwu Lin, *Nonlinear instability of periodic waves for Vlasov-Poisson system*, Comm. Pure Appl. Math. **58**, 505–528 (2005).
7. Zhiwu Lin, *Some recent results on instability of ideal plane flows*, Nonlinear partial differential equations and related analysis, 217–229, Contemp. Math., **371**, Amer. Math. Soc., Providence, RI, 2005.
8. Zhiwu Lin and Walter Strauss, *Linear stability and instability of relativistic Vlasov-Maxwell systems*, Comm. Pure. Appl. Math. **60**, 724–787 (2007).
9. Zhiwu Lin and Walter Strauss, *Nonlinear stability and instability of relativistic Vlasov-Maxwell systems*, Comm. Pure. Appl. Math. **60**, 789–837 (2007).
10. Yan Guo and Zhiwu Lin, *Unstable and Stable Galaxy Models*, Comm. Math. Phys., **279**, 789–813 (2008).
11. Vera Hur and Zhiwu Lin, *Unstable surface waves in running water*, Comm. Math. Phys., **282**, 733–796 (2008).
12. Zhiwu Lin and Walter Strauss, *A sharp stability criterion for Vlasov-Maxwell systems*, Invent. Math., **173**, 497–546 (2008).
13. Zhiwu Lin *Instability of nonlinear dispersive solitary waves*, J. Func. Anal., **255** 1191–1224 (2008).
14. Zhiwu Lin and Yue Liu, *Stability of peakons for the Degasperis-Procesi equation*, Comm. Pure. Appl. Math., **62**, 125–146 (2009).
15. Zhiwu Lin, *Instability of large solitary water waves*, Inter. Math. Res. Not., 1247–1303, no 7., (2009).
16. Zhiwu Lin and Chongchun Zeng, *Small BGK waves and nonlinear Landau damping*, Commun. Math. Phys, **306**, 291–331, (2011).
17. Zhiwu Lin and Chongchun Zeng, *Inviscid dynamical structures near Couette flow*, Arch. Rational Mech. Anal., **200**, 1075–1097, (2011).
18. Charles Y Li and Zhiwu Lin, *A Resolution of the Sommerfeld Paradox*, SIAM J. Math. Anal., **43**, No.4, 1923–1954, (2011).
19. Zhiwu Lin and Chongchun Zeng, *Small BGK waves and nonlinear Landau damping (higher dimensions)*, Indiana U. Math. J., **61**, 1711–1735, (2012).
20. Zhiwu Lin and Chongchun Zeng, *Unstable manifolds of Euler equations*, Comm. Pure. Appl. Math., **66**, 1803–1836, (2013).
21. Zhiyu Wang; Yan Guo; Zhiwu Lin and Pingwen Zhang, *Unstable galaxy models*, Kinet. Relat. Models, **6**, 701–714, (2013).
22. Zhiwu Lin; Zhengping Wang and Chongchun Zeng, *Stability of traveling waves of nonlinear Schrödinger equation with nonzero condition at infinity*, Arch. Ration. Mech. Anal., **222**, 143– 212 (2016).
23. Yan Guo and Zhiwu Lin, *The existence of stable BGK waves*, Commun. Math. Phys., **352**, 1121–1152 (2017).
24. Jincheng Yang and Zhiwu Lin, *Linear Inviscid Damping for Couette Flow in Stratified Fluid*, J. Math. Fluid Mech., **20**, 445–472 (2018).
25. Jiayin Jin; Zhiwu Lin and Chongchun Zeng, *Invariant Manifolds of traveling waves of the 3D Gross-Pitaevskii equation in the energy space*, Comm. Math. Phys. **364**, 981–1039 (2018).
26. Jiayin Jin; Shasha Liao and Zhiwu Lin, *Nonlinear Modulational Instability of Dispersive PDE Models*, Arch. Ration. Mech. Anal. **231**, 1487–1530

(2019).

27. Zhiwu Lin and Ming Xu, *Metastability of Kolmogorov flows and inviscid damping of shear flows*, Arch. Ration. Mech. Anal. **231**, 1811–1852 (2019).

28. Zhiwu Lin and Chongchun Zeng, *Instability, index theorem, and exponential trichotomy for Linear Hamiltonian PDEs*, accepted by Memoirs of AMS.

29. Jiayin Jin; Zhiwu Lin and Chongchun Zeng, *Dynamics near the solitary waves of the supercritical gKDV Equations*, J. Differential Equations **267**, 7213–7262 (2019).

30. Zhiwu Lin; Jincheng Yang and Hao Zhu, *Barotropic instability of shear flows*, accepted by Studies in Applied Mathematics.

Submitted papers and preprints

1. Mahir Hadzic; Zhiwu Lin and Gerhard Rein, *Stability and instability of self-gravitating relativistic matter distributions*, arXiv:1810.00809.

2. Zhiwu Lin and Chongchun Zeng, *Separable Hamiltonian PDEs and Turning point principle for stability of gaseous stars*, arXiv:2005.00973.

3. Jiayin Jin; Xiaoguang Li and Zhiwu Lin, *Dynamics near unstable periodic traveling waves of the gKDV equation under multi-period perturbations*, preprint 2019.

4. Zhiwu Lin and Yucong Wang, *Stability of rotating gaseous stars*, preprint 2020.

5. Zhiwu Lin; Dongyi Wei; Zhifei Zhang and Hao Zhu, *The number of traveling wave families in a running water with Coriolis force*, preprint 2020.

6. Mahir Hadzic and Zhiwu Lin, *Turning Point Principle for relativistic stars*, preprint 2020.

Grant support

1. New York University Research Challenge Fund, 2005-2006.

2. Principal Investigator for NSF Grant DMS-0505460, 2005-2008.

3. Principal Investigator for NSF Grant DMS-0908175, 2009-2012.

4. Simons Fellowship, 2013-2014.

5. Principal Investigator for NSF Grant DMS-1411803, 2014-2017.

6. Principal Investigator for NSF Grant DMS-1715201, 2017-2020.

7. Principal Investigator for NSF Grant DMS-2007457, 2020-2023.

Conference and seminar talks

- Brown PDE and applied math seminars (2002, 2003, 2004)
- Courant Analysis and MHD seminars (2003, 2004)
- Academia Sinica summer school (06/2004)
- Northwestern PDE meetings (Evanston, IL, 2003/5)
- AMS sectional meeting, Fluid stability session (Evanston, IL, 04/2004)
- Workshop on Stability of fluid and plasmas (Bayreuth, Germany, 09/2004)

- AMS sectional meeting, Nonlinear PDE session (Bowling Green, KY, 03/2005)
- Penn State PDE seminar (04/2005)
- Mittag-Leffler Institute, Institute seminar (10/2005)
- Colloquium and Seminars at: Oklahoma State University, UC Irvine, University of Michigan, University of British Columbia, University of North Carolina-Chapel Hill, University of South Carolina, North Carolina State University (01/2006)
- Colloquium and Seminars at: University of Missouri-Columbia, University of Massachusetts-Amherst, University of Maryland (02/2006)
- The Lefschetz Center Conference on Partial Differential Equations and Fluids, Brown University, (April 20-23, 2006)
- Applied mathematics seminar, University of Illinois, Chicago, (Oct 18, 2006)
- AMS sectional meeting, Progress on Problems in Mathematical Fluid Dynamics Session, Fayetteville, AR, (Nov 3-4, 2006)
- AMS sectional meeting, Session on Euler and Navier-Stokes equations, Chicago, IL, (Oct 5-6, 2007)
- PDE seminar, University of Minnesota, (11/07)
- PDE seminar, Georgia Institute of Technology, (02/08)
- 7th AIMS conference on dynamical system and differential equations, Arlington, VA, (05/08)
- joint meeting of American Mathematical Society(AMS) and Chinese Mathematical Society (CMS), Shanghai, China, (12/08).
- PDE seminar, Zhongshan University, Guangzhou, China, (01/09).
- Workshop on wave motion, Oberwolfach, Germany, 02/2009.
- The Sixth IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, Athens, Georgia (03/09).
- ICMS conference on Analysis of Fluid Stability, Edinburgh, UK, 6/25/09-7/3/09.
- SIAM annual meeting, Session on Stability of solitary waves, Denver, Co, (July 6-10, 2009).
- Workshop on Kinetic Description of Multiscale Phenomena, U. Maryland, 9/21-9/25, 2009.

- AMS sectional meeting, Session on PDEs from Fluid Mechanics, Boca Raton, FL, 10/30-11/1, 2009.
- Workshop on Analysis and Computation of Incompressible Fluid Flow, IMA, U. Minnesota, 2/22-2/26, 2010.
- PDE seminar, University of Michigan, 10/2010.
- PDE seminar, Fudan University, Shanghai, 12/2010.
- PDE seminar, Shanghai Jiaotong University, Shanghai, 12/2010.
- PDE seminar, Beijing University, 12/2010.
- PDE seminar, China Academy of sciences, 12/2010.
- AMS sectional meeting, Session on Nonlinear Analysis of Partial Differential Equations, Statesboro, GA, 3/12-3/13, 2011.
- 7th IMACS Conference on Nonlinear Evolution Equations and Wave Phenomena, Athens, GA, 4/4-4/7, 2011.
- SIAM Conference on Analysis of Partial Differential Equations, San Diego, CA, 11/14-11/17, 2011
- AMS sectional meeting, Session on Dynamics and Stability of Nonlinear Waves, Lawrence, KS, 3/30-4/1, 2012.
- PDE seminar, University of Pittsburgh, 04/2012.
- 9th AIMS conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL, 7/1-7/5, 2012
- PDE seminar, Beijing University, 07/2012.
- PDE seminar, China Academy of sciences, 07/2012.
- 8th IMACS Conference on Nonlinear Evolution Equations and Wave Phenomena, Athens, GA, 03/2013.
- CCMA Colloquium, Penn State University, 04/2013.
- Young Mathematician Forum, Beijing International Mathematical Center, 07/2013.
- AMS sectional meeting, Session on PDEs of fluid mechanics, St. Louis, MO, 10/18-10/20, 2014.
- Colloquium, University of Tennessee, 10/2014.
- 9th IMACS Conference on Nonlinear Evolution Equations and Wave Phenomena, Athens, GA, 03/2015.
- AMS sectional meeting, Session on Nonlinear dispersive and wave equations with applications to fluids, Washington DC, 03/07-03/08, 2015.

- AMS sectional meeting, Session on Analysis on Nonlinear Integral and Partial Differential Equations, Huntsville, AB, 03/27-03/29, 2015.
- KUMUNU Conference on Nonlinear PDE and dynamical systems, Lawrence, KS, 04/2015.
- Colloquium, Sichuan University, China, 05/2015.
- Colloquium, Zhongshan University, China, 06/2015.
- PDE seminar, Beijing University, China, 06/2015.
- PDE seminar, China Academy of sciences, 06/2015.
- Conference on Recent Progresses in Collisionless models, Imperial College of London, UK, 9/07-9/11, 2015.
- PDE seminar, University of Michigan, 09/2015.
- PDE seminar, Brown University, 10/2015.
- AMS Sectional meeting, Session on Analysis of Partial Differential Equations and Fluid Dynamics, 10/03-04, 2015.
- AMS Sectional meeting, Session on Nonlinear Waves in Differential Equations, 11/14-15, 2015.
- International Conference on Nonlinear Systems of Fluid Dynamic Equations and Applications, Tsinghua Sanya International Mathematics Forum (TSIMF), 12/19-12/22, 2015.
- AIM workshop on Mixing and Nonlinear Stability, San Jose, CA, 4/11-4/15, 2016.
- ICERM workshop on Dynamics of Small Scales and Fluids, Brown University, 2/12-2/17/2017.
- 10th IMACS Conference on Nonlinear Evolution Equations and Wave Phenomena, Athens, GA, 03/2017.
- Applied mathematics seminar, University of Illinois, Chicago, 03/2017
- KUMUNU Conference on Dynamical Systems and Applications, Lincoln, NE, 4/22-4/23, 2017.
- ICERM workshop on Water Waves, Brown University, 4/24-4/28/2017.
- PDE seminar, Beijing University, China, 07/2017.
- PDE seminar, Jilin University, Changchun, China, 07/2017.
- PDE seminar, Wuhan University, China, 07/2017.
- PDE seminar and Colloquium, Shandong University, Weihai, China, 07/2017.

- PDE seminar, USTC, Hefei, China, 08/2017.
- Harmonic analysis and PDE seminar, University of Illinois at Urbana-Champaign, 09/2017.
- Colloquium, University of Pittsburgh, 10/2017.
- International Conference on Nonlinear PDEs, Tsinghua Sanya International Mathematics Forum (TSIMF), 12/2017.
- Joint AMS-CMS meeting, Special Session on Nonlinear Dispersive Equations, Shanghai, China, 06/2018.
- PDE seminar, Beijing University, China, 06/2018.
- PDE seminar, Wuhan University, China, 06/2018.
- PDE seminar, China Academy of sciences, 07/2018.
- Analysis of Fluids seminar, Princeton University, 10/2018.
- PDE seminar, University of Minnesota, 12/2018.
- KUMUNU Conference on PDE, Dynamical Systems, and Applications, Columbia, MO, 04/2019.
- The 17th Academic Conference on Nonlinear PDEs, Changchun, Jilin, China, 08/2019.
- PDE seminar, Shanghai Normal University, 08/2019.
- PDE seminar, Fuzhou University, 08/2019.
- PDE seminar, Fujian Normal University, 08/2019.
- PDE seminar, Beijing Institute of Applied Physics and Computational Mathematics, 08/2019.
- PDE seminar, Nanjing University, 08/2019.
- Workshop on Recent progress in analytical aspects of kinetic equations and related fluid models, Madison, WI, 09/2019.
- PDE seminar, Brown University, 10/2019.

Graduate students advised

- Shasha Liao, PhD student, Georgia Tech, 01/2017 to now.
- Yucong Wang, 08/2018-08/2020 (visiting from Xiamen University).
- Guanming Gai, 09/2019-09/2020 (visiting from Jilin University).
- Hao Zhu, 09/2016-08/2017 (visiting from Shandong University).

Postdocs and visiting scholars hosted

- Jiayin Jin, Hale Instructor at Georgia Tech, 08/2015-08/2019.
- Ming Cheng, Jilin University, China, visiting scholar, 12/2019-12/2020.
- Xingjie Yan, China University of Mining and Technology, visiting scholar, 04/2019-04/2020.
- Qun Dai, Changchun University of Science and Technology, China, visiting scholar, 09/2018-08/2019.
- Zhiyong Wang, Fujian Normal University, China, visiting scholar, 08/2018-07/2019.
- Yanfang Gao, Fujian Normal University, China, visiting scholar, 08/2018-07/2019.
- Xiaoguang Li, Sichuan Normal University, China, visiting scholar, 08/2017-08/2018.
- Shujun You, Huaihua University, China, visiting scholar, 09/2017-09/2018.
- Yansheng Zhong, Fujian Normal University, China, visiting scholar, 08/2016-08/2017.
- Chunxia Guang, Guandong Industrial University, China, visiting scholar, 02/2016-02/2017.
- Shihui Zhu, Sichuan Normal University, China, visiting scholar, 03/2015-09/2015.
- Zhang Chen, Shandong University, China, visiting scholar, 01/2013-01/2014.
- Ming Xu, Jinan University, Guangzhou, China, visiting scholar, 01/2013-01/2014.
- Zhengping Wang, Wuhan Institute of Physics and mathematics, China, visiting scholar, 08/2012-07/2013.

Other Professional Activities

- Invited visitor at Mittag-Leffler Institute, Sweden, September and October 2005.
- Invited visitor at Beijing Internatioanl Mathematical Center, China, March and April, 2014.
- Lecturer of Summer school in Beijing International Mathematical Center, on Stability of Hamiltonian PDEs (20 hours lectures), 07/2012.
- Lecture Series on Hamiltonian PDEs (8 hours), Chern Institute of Mathematics, Tianjing, China, 07/2013.

- Topic course on Long time behaviours of Euler equations, Beijing University, 3/03-4/30/2014.
- Lecturer of Summer school on Nonlinear PDEs (20 hours lectures), Sichuan Normal University, China, 07/2014.
- Topic course on Dynamics of incompressible fluids, Sichuan Normal University, 05/2015-06/2015.
- Lecture Series on Dynamics of Hamiltonian PDEs (6 hours), Beijing Institute of Applied Physics and Computational Mathematics, 06/2018.
- Topic Course on Hamiltonian PDEs, Xiamen University, China, 07/2018.
- Co-organizer of Session on Mathematical theory of water waves, SIAM Conference on Analysis of PDE, 12/7-12/10, 2009.
- Co-organizer of Session on Dynamics of fluids and nonlinear waves, 10th AIMS conference on Dynamical Systems, Differential Equations and Applications, Madrid, Spain, July 07 - July 11, 2014.
- Co-organizer of Session on Long Time Dynamics of Nonlinear Dispersive Waves, 9th IMACS Conference on Nonlinear Evolution Equations and Wave Phenomena, Athens, GA, 03/2015.
- Co-organizer of Session on Dynamics of Fluids and nonlinear waves, AMS annual meeting, Atlanta, GA, 01/2017.
- Co-organizer of International Conference on Nonlinear PDEs, Tsinghua Sanya International Mathematics Forum (TSIMF), 12/25-12/29/2017.
- Co-organizer of Session on Dynamics of fluids and nonlinear waves, 12th AIMS conference on Dynamical Systems, Differential Equations and Applications, Taipei, Taiwan, 07/05-07/09, 2018.
- Member of the Scientific Committee on: Tenth International Conference on Recent Advances in Applied Dynamical Systems, Xuzhou, China, 06/2016; Eleventh International Conference on Recent Advances in Applied Dynamical Systems, Xi'an, China, 06/2017; The Tenth IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena, Athens, GA, 03/29-04/01/2017; Twelfth International Conference on Recent Advances in Applied Dynamical Systems, Chongqing, China, 06/2018;
- Panel member: NSF, Simons Foundation and NSERC.
- Editorial Board Member of Journal of Partial Differential Equation
- Referee for numerous journals including: Communications in Mathematical Physics, Contemporary Mathematics, Communications in

Mathematical Sciences, Communications in Pure and Applied Mathematics, Mathematical Methods in the Applied Sciences, IMA J. Applied Math., Journal of Differential Equations, Journal of Dynamics and Differential Equations, Proceedings of AMS, Proceedings of the Royal Society A., Journal of Mathematical Physics., Arch. Rational Mech. Anal., Annals of PDE., Journal of American Mathematical Society, SIAM Journal of Mathematical Analysis, Invent. Math.

Courses Taught

- Calculus recitation sessions, Brown University (2000-2003)
- Calculus I, II and Linear algebra, New York University(2003-2006)
- Calculus for life sciences, Calculus III, Topic course on nonlinear PDE, Graduate PDE, University of Missouri-Columbia (2006-2008)
- Linear Algebra, Introduction to PDE, Classical Mathematical methods in engineering, Calculus II, Calculus III, Graduate PDE, Topic course on Hamiltonian PDEs, Georgia Institute of Technology, (2008-2019).