# Peter Vorobieff
## Curriculum Vitæ[1]

**Work Address:**
Department of Mechanical Engineering
The University of New Mexico
Albuquerque, NM 87131
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**Research Interests**
- Fundamental hydrodynamic instabilities
- Meandering flows
- Multiphase flows
- Shock-accelerated flows
- Two-dimensional hydrodynamics
- Renewable energy
- Advanced flow field measurement techniques

**EXPERIENCE**

**2016 – ...** **Associate Chair and Director of Facilities,** The University of New Mexico, Albuquerque, New Mexico.
Supervised the departmental graduate program, led facilities upgrades.

**2013 – 2016** **Professor and Assistant Chair,** The University of New Mexico, Albuquerque, New Mexico.
Led award-winning graduate (N. Fathi, 2015) and undergraduate (D. Simons, 2016) research, organized successful faculty and staff hires.

**2005 – 2012** **Associate Professor,** The University of New Mexico, Albuquerque, New Mexico.
Built novel tiltable shock tube. Led discovery of a new instability in shock-driven multiphase flow. Participated in conversion of Mechanical Engineering building into a smart building with active solar energy collection and thermal storage. Supervised award-winning graduate research (M. Anderson, 2012).

**1999 – 2005** **Assistant Professor,** The University of New Mexico, Albuquerque, New Mexico.
Built state-of-the-art experimental facilities and diagnostic systems. Supervised award-winning undergraduate (D. Georgiev, J. Vigil, 2001) and graduate (A. Palekar, 2004, S. Gogte, 2005) research.

**1996 – 1999** **Research Associate**, Los Alamos National Laboratory, Los Alamos, New Mexico.
Conducted experimental studies of fluid instabilities and turbulence. Developed several first implementations of particle-image velocimetry (PIV) diagnostic. Supervised two graduate students.

[1]Date: 05-16-2017

**1995–1996** **Research Assistant**, Lehigh University, Bethlehem, Pennsylvania.
Conducted research in fluid mechanics in the areas of vortex dynamics, wakes, separated flows, visualization techniques. Developed software applications for numerically intensive experimental data processing and analysis. Proposed and implemented a new mathematical method of identification of topological features of fluid flows via wavelet filtering. Demonstrated a new energetically efficient technique of stall control on delta wings – intermittent trailing-edge blowing.

**1992-1995** **Teaching Assistant**, Lehigh University, Bethlehem, Pennsylvania.
Conducted laboratory workshops, supervised undergraduate projects. Designed and programmed computer interface for a series of laboratory experiments in mechanical vibrations.

**1991-1992** **Interpreter/Programmer**, Association of Space Explorers, Moscow, Russia.
Developed code and computer graphics for an educational computer game and several computer videos, performed synchronous Russian/English translation.

**1989-1991** **Research Assistant**, Institute for High Temperatures, Moscow, Russia.
Conducted research in theoretical gas dynamics (laser propulsion). Developed code for numerical simulation programs. Performed the duties of UNIX system administrator.

## EDUCATION

***Lehigh University***, Bethlehem, Pennsylvania. Ph.D. Mechanical Engineering, May 1996.
Research combining experimental fluid dynamics and applied mathematics. GPA 4.0. Dissertation: "Vortex breakdown on a maneuvering delta wing and related issues of flow analysis and topology."

***M.V. Lomonosov Moscow State University***, Moscow, Russia. M.S. Mechanical Engineering and Applied Mathematics, May 1989. Cum Laude.
Development of analytical methods applicable to a wide range of problems. GPA 4.0. Thesis: "On averaging parabolic equations."

## SKILLS

Experience of designing, building and operating custom PIV (particle image velocimetry) velocity field acquisition and TLC (thermochromic liquid crystal) temperature visualization systems for experiments in gas and fluid dynamics. Expert knowledge of water tunnel, tow tank, wind tunnel and shock tube experimental system operation.
Expert knowledge of PC hardware and software (Windows, Linux, OpenBSD, CygWin), and of UNIX workstations: SGI, IBM, Sun. C, C++, FORTRAN, Poco, HTML, XHTML, XML, Java, Javascript, Perl, Labview, Matlab, LaTeX.

## HONORS

**2016** University of New Mexico Golden Paw online teaching award.

**2015** New Mexico Pi Sigma Professor of the Year.

**2014** AIAA Associate Fellow.

**2009** Best presentation award, Energy for the 21st Century conference, Los Alamos National Laboratory.

**2001** American Physical Society ***Gallery of Fluid Motion*** winner, APS-DFD 2001 Meeting. With K.P. Prestridge and others.
***Junior Faculty Research Excellence Award***, School of Engineering, The University of New Mexico.

**1999** Los Alamos National Laboratory ***DX Division Teamwork Award*** (with R.F. Benjamin, P.M. Rightley, and K.P. Prestridge).

**1998** American Physical Society ***Gallery of Fluid Motion*** winner, APS-DFD 1998 Meeting. With D. Blair and I. Aronson.

**1996** American Physical Society ***Gallery of Fluid Motion*** winner, APS-DFD 1996 Meeting. With P.M. Rightley and R.F. Benjamin.

**1995** ***S.W. Kung Award*** for best graduate research, Lehigh University, Bethlehem, Pennsylvania.

**1992** ***Galactic Empire Award*** for best science fiction novel in Russian.

**1989** ***Lomonosov scholarship***, Moscow University.

**1988** ***Chebyshev scholarship***, Moscow University.

## SERVICE

Associate editor, ASME Journal of Fluids Engineering since 2010.

Member of the Editorial Board, Transactions of the Wessex Institute, since 2014.

Refereed for: AIAA Journal, Experiments in Fluids, International Journal of Imaging Systems and Technology, Journal of Fluid Mechanics, Journal of Fluids Engineering, Physical Review E, Physical Review Letters.

Membership: APS, ASME, AIAA (Associate Fellow), Pi Tau Sigma (local chapter coordinator).

Organizer of the *Nonlinear Phenomena and Dynamic Systems* workshop, Apr. 30-May 2, 1998, Boulder, CO. Minisymposium chair at the *13th Canadian Symposium on Fluid Dynamics* (CSFD), May 26-30, 1998, Vancouver, BC, Canada.

Session chair at the 1998, 2006, 2007, 2008 APS-DFD Meetings, 2012 AIAA ASM Meeting, 29th International Symposium on Shock Waves (ISSW29), 2013.

Organizing committee member, 6th International Conference on Computational and Experimental Methods in Multiphase and Complex Flow, 2011, Kos, Greece.

Organizer and chair, 7th International Conference on Computational and Experimental Methods in Multiphase and Complex Flow, 2013, A Coruña, Spain.

Organizer and chair, 8th International Conference on Computational and Experimental Methods in Multiphase and Complex Flow, 2015, Valencia, Spain.
Organizer and chair, 9th International Conference on Computational and Experimental Methods in Multiphase and Complex Flow, 2017, Tallinn, Estonia.

**Service within department**

| | |
|---|---|
| 1999-2001 | Computer committee member |
| 2000-2006 | webmaster-at-large |
| 2001-2005 | Computer committee chair |
| 2003 | Faculty search committee |
| 2004-2010 | Steering committee member |
| 2005-2007 | Lab committee chair |
| 2009 | Faculty search committee |
| 2012-2015 | Leadership committee member |
| 2014 | Staff search committee |
| 2015 | Faculty search committee |

**Service within university**

| | |
|---|---|
| 2003-2005 | KUNM board member |
| 2010-2013 | Faculty Ethics Committee member |
| 2011-2012 | Research Allocations Committee member |
| 2012-2013 | Research Allocations Committee chair |
| 2014-... | Research Policy Committee member |
| 2014-... | Information Tecnology (IT) use committee member |
| 2016-... | Chemical and Laboratory Safety committee member |
| 2016-... | UNM School of Engineering Academic Council member |

**Graduate Students**

Jonathan Gallegos, M.S. (2001), *Experimental Studies of the onset of Bénard - von Kármán instability.*
Nagoor-Gani Mohamed, M.S. (2003), *Quantitative Analysis of Disorder Growth in Transition to Turbulence.*
Tanveer Shakeel, M.S. (2003), *Far wake interactions behind a pair of cylinders*, Ph.D. (2006), *Experimental study of turbulence using soap film tunnel.*
Chris Platero, M.S. (2003, co-advised with C.R. Truman), *Fractal dimension evolution in a shear layer instability.*
Kathy Meyer, M.S. (2003, co-advised with C.R. Truman), *Planar Laser Induced Fluorescence (PLIF): Low Pressure Investigations.*
Salil Gogte, M.S. (2005), *Flow measurements near superhydrophobic surfaces.*

Richard Truesdell, Ph.D. (2006, co-advised with A.A. Mammoli), *Modification of the no-slip boundary condition by superhydrophobic wall patterning.* Charlie Booker, M.S. (2006), *Destruction of the second wake.*
Aparna Korlimarla, M.S. (2006), *Evolution of a quasi-2D shear layer in a soap-film flow.*
Greg Orlicz, M.S. (2007), *Shock driven instabilities in a varicose, heavy-gas curtain : Mach number effects.*, Ph.D. (expected 2012), *A Mach number study of shock-accelerated heavy gas curtain.*
Daniel Coughlin, M.S. (2008), *Real-time detection of biological threat agents in a cloud.*
Evan Johnson, M.S. (2009), *Planar and oblique shock wave interaction with a droplet seeded gas cylinder.*
Michael Anderson, Ph.D. (2011), *Experimental and numerical investigation of shock interaction with multiphase media.*
Joseph Conroy, M.S. (2012), *Experimental studies of particle-lag instability.*
Ross White, M.S. (2012), *Planar and oblique shock interaction with gas and particle-seeded cylinders.*
Nima Fathi, M.S. (2012), *Particle trajectories in low Reynolds number linear shear flow.*
Clinton Corbin, M.S. (2014, co-advised with C.R. Truman), *UNM Shock Tube Modernization.*
Tennille Bernard, M.S. (2014, co-advised with C.R. Truman), *Observation and Measurement of Instabilities due to Shock Focusing.*
Garrett Kuehner, M.S. (2014, co-advised with C.R. Truman), *Behavior of the Embedded Phase in a Shock-Driven Two-Phase Flow.*
Lin Zheng, M.S. (2014), *A 3D Computational Fluid Dynamics Model Validation for Candidate Molybdenum-99 Target Geometry.*
Jianwei Ju, Ph.D. (2014), *Effective colloidal particle properties from molecular dynamics simulations.*
Gregory Naranjo, M.S. (2015), *Development and analysis of a converging-diverging nozzle laboratory apparatus.*
Alfred Flores, M.S. (2015), *Design and fabrication of a flexible apparatus for a low Reynolds number particle interaction flow.*
Patrick Wayne M.S. (2015), *Analysis of Kelvin-Helmholtz instabilities developing from oblique shock interaction with a heavy gas column.*
Andrew Williams, Ph.D. (2016), *Effect of slip boundary condition in laminar flow on heat transfer using microtextured, superhydrophobic surfaces.*

**Patents**

US Patent 7,416,903, "Wavy Interface Mixer," L.A. Sklar, A.A. Mammoli, R.A. Truesdell, P. Vorobieff, 2008.

US Patent 8,567,259, "Optical Phase Shift Fluid Flow Velocity Measurement Mechanism," G. Ballard, P. Vorobieff, 2013.

N. Fathi, P. Vorobieff, A. Mammoli, S.S. Aleyasin, S. Rodriguez, "Use of waste heat to enhance solar chimney power plant (SCPP) performance (Combined Solar Cycles)," application filed with USPTO April 23, 2014, Application No. 61982950, EFS ID. 18834289.

V. Poutkaradze, P. Vorobieff, A. Mammoli, N. Fathi, F. Gay-Balmaz, and S.S. Aleyasin, "Inflatable, free-standing solar updraft tower with optimal geometry and active control," application filed with USPTO on 10/09/2015, UNM STC Ref. No. 2015-021-02.

**PUBLICATIONS (technical only)**[1]
Total number of citations (including references to Ph.D. dissertation and conference papers): about 1,920, $h-$index 24.

**Books Edited**

1. C.A. Brebbia, P. Vorobieff (eds.), "Computational Methods in Multiphase Flow VII," in series *WIT Transactions on Engineering Sciences*, WIT Press, Southhampton, UK (2013), ISBN: 9781845647346, 360 pp.

2. P. Vorobieff, C.A. Brebbia (eds.), "Computational Methods in Multiphase Flow VIII," in series *WIT Transactions on Engineering Sciences*, WIT Press, Southhampton, UK (2015), ISBN: 9781845649463, 620 pp.

3. P. Vorobieff, C.A. Brebbia (eds.), "Computational & Experimental Methods in Multiphase & Complex Flow IX," in series *WIT Transactions on Engineering Sciences*, WIT Press, Southhampton, UK (2017), ISBN: 9781784661953 , 276 pp.

**Review Papers**

1. P. Vorobieff, S. Kumar, "Experimental studies of Richtmyer-Meshkov instability," *Recent Research Developments in Fluid Dynamics* Vol. 5 (2004), pp. 33-55 [9].

**Book contributions**

2. I. Aranson, D. Blair, and P. Vorobieff, "Interface motion in a vibrated granular layer[2]," in *A gallery of fluid motion*, ed. M. Samimy, Cambridge University Press, 2003, p. 55.

3. P.M. Rightley, P. Vorobieff, and R.F. Benjamin, "Mushrooms and snakes: a visualization of Richtmyer-Meshkov instability[3]," in *A gallery of fluid motion*, ed. M. Samimy, Cambridge University Press, 2003, p. 93.

**Reviewed Journals and Proceedings**

*Nature* (38.1)

4. K. Mertens**, V. Putkaradze, and P. Vorobieff, "Braiding patterns on an inclined plane," *Nature* Vol. 430, No. 6996 (2004), p. 165 [19].

[1]Numbers in square brackets indicate number of times cited (according to ISI Citation index or Google Scholar Citation index), if known. In this section, publications are first organized by type (review papers, book contributions, research papers), then by journal, in descending order of journal 5-year impact factor (as indicated in round brackets after journal name). Names of UNM student authors are underlined, * indicates undergraduate and ** – graduate student authors.

[2]This contribution is a revised version of an entry originally published in Physics of Fluids.

[3]This contribution is a revised version of an entry originally published in Physics of Fluids.

*Physical Review Letters* (7.7)

5. M.K Rivera, P. Vorobieff, and R.E. Ecke, "Turbulence in Flowing Soap Films: Velocity, Vorticity and Thickness Fields," *Physical Review Letters* Vol. 81 No. 7 (1998), pp. 1417-1420 [123].

6. P. Vorobieff, P.M. Rightley, and R.F. Benjamin, "Power-law Spectra of Incipient Gas-Curtain Turbulence," *Physical Review Letters* Vol. 81 No. 11 (1998), pp. 2240-2243 [23].

7. K.P. Prestridge, P.M. Rightley, P. Vorobieff, and R.F. Benjamin, "Validation of an Instability Growth Model Using PIV Measurements," *Physical Review Letters* Vol. 84 No. 19 (2000), pp. 4353-4356 [48].

8. E. Ben-Naim, Z.A. Daya, P. Vorobieff, and R.E. Ecke, "Knots and random walks in vibrated granular chains," *Physical Review Letters* Vol. 86 No. 8 (2001), pp. 1414-1417 [87].

9. R. Truesdell**, A. Mammoli, P. Vorobieff, F van Swol, and C.J. Brinker, "Drag reduction on a patterned superhydrophobic surface," *Physical Review Letters* Vol. 97 No. 4 (2006), art. no. 044504 [232].

10. V. Putkaradze and P. Vorobieff, "Instabilities, Bifurcations, and Multiple Solutions in Expanding Channel Flows," *Physical Review Letters* Vol. 97 No. 14 (2006), art. no. 144502 [12].

11. B. Birnir, K. Mertens, V. Putkaradze, and P. Vorobieff, "Meandering fluid streams in the presence of flow rate fluctuations," *Physical Review Letters* Vol. 101 No. 11 (2008), art. no. 114501 [20].

12. P. Vorobieff, M. Anderson**, J. Conroy**, R. White**, C.R. Truman, and S. Kumar,"Vortex formation in a shock-accelerated gas induced by particle seeding," *Physical Review Letters* Vol. 106 (2011), art. no. 184503 [28].

*Solar Energy* (4.8)

13. C. Armenta**, P. Vorobieff, and A. Mammoli, "Summer off-peak performance enhancement for rows of fixed solar thermal collectors using flat reflective surfaces," *Solar Energy* Vol. 85 no. 9 (2011), pp. 2041-2052 [10].

14. V. Putkaradze, P. Vorobieff, A. Mammoli, and N. Fathi**, "Inflatable free-standing solar towers," *Solar Energy* Vol. 98 (A) (2013), pp. 85-98 [20].

*Journal of Rheology* (2.9)

15. M.S. Ingber, A.A. Mammoli, P. Vorobieff, T. McCollam**, and A.L. Graham, "Experimental and numerical analysis of irreversibilities among particles suspended in a Couette device," *Journal of Rheology* Vol. 50 (2006), pp. 99-114 [15].

*Applied Thermal Engineering* (2.7)

16. J. Carlson, D. Menicucci, P. Vorobieff, A. Mammoli, and H. He, "Infrared imaging method for flyby assessment of solar thermal panel operation in field settings," *Applied Thermal Engineering* Vol. 70 No. 1 (2014), pp. 163-171 [4].

17. N. Fathi**, S.S. Aleyasin, and P. Vorobieff, "Numerical-Analytical Assessment on Manzanares Prototype," *Applied Thermal Engineering* Vol. 102 No. 5 (2016), pp. 243–250 [2].

*Energy and Buildings* (3.0)

18. M. Ortiz**, H. Barsun, H. He**, P. Vorobieff, and A. Mammoli, "Modeling of a solar-assisted HVAC system with thermal storage," *Energy and Buildings* Vol. 42, No. 4 (2010), pp. 500-509 [66].

19. A. Mammoli, P. Vorobieff, H. Barsun, R. Burnett, and D. Fisher**, "Energetic, economic and environmental performance of a solar-thermal-assisted HVAC system," *Energy and Buildings* Vol. 42, No. 9 (2010), pp. 1524-1535 [52].

*Journal of Fluid Mechanics* (2.5)

20. P. Vorobieff and R.E. Ecke, "Turbulent Rotating Convection: an Experimental Study," *Journal of Fluid Mechanics* Vol. 458 (2002), pp. 191-218 [67].

21. K. Mertens**, V. Putkaradze, and P. Vorobieff, "Morphology of a stream flowing down an inclined plane. Part 1. Braiding," *Journal of Fluid Mechanics* Vol. 531 (2005), pp. 49-58 [26].

22. B. Birnir, K. Mertens, V. Putkaradze, and P. Vorobieff, "Morphology of a stream flowing down an inclined plane. Part 2: Meandering," *Journal of Fluid Mechanics* Vol. 607 (2008), pp. 401-411 [17].

*Physical Review E* (2.3)

23. P. Vorobieff and R.E. Ecke, "Cylinder Wakes in Flowing Soap Films," *Physical Review E* Vol. 60 No. 3 (1999), pp. 2953-2956 [32].

24. R.A. Truesdell**, P.V. Vorobieff, L.A. Sklar, and A.A. Mammoli, "Mixing of a continuous flow of two fluids due to unsteady flow," *Physical Review E* Vol. 67, No. 6 (2003), art. no. 066304 [28].

25. P. Vorobieff, N.-G. Mohamed**, C. Tomkins, C. Goodenough, M. Marr-Lyon, and R.F. Benjamin, "Scaling evolution in shock-induced transition to turbulence," *Physical Review E* Vol. 68, No. 6 (2003), art. no. 065301 [24].

26. M. Popova, P. Vorobieff, M.S. Ingber, and A.L. Graham, "Interaction of two particles in a shear flow," *Physical Review E* Vol. 75 no. 6 (2007), art. no 66309 [8].

*Europhysics Letters* (2.3)

27. N. Fathi, K. Mertens, V. Putkaradze, and P. Vorobieff, "Comment on 'The role of wetting heterogeneities in the meandering instability of a partial wetting rivulet' by Couvreur S. and Daerr A.," Europhysics Letters Vol. 108 No. 5 (2014), art. no. 54002.

*Physics of Fluids* (2.0)

28. J.-C. Lin, P. Vorobieff, and D.O. Rockwell, "Space-Time Imaging of a Turbulent Near-Wake by High-Image-Density Particle Image Cinematography," *Physics of Fluids* Vol. 8 No. 2 (1996), pp. 555-564 [27].

29. P.M Rightley, P. Vorobieff,and R.F. Benjamin, "Evolution of a Shock-Accelerated Thin Fluid Layer," *Physics of Fluids* Vol. 9 No. 6 (1997), pp. 1770-1782 [77].

30. P.M. Rightley, P. Vorobieff, and R.F. Benjamin, "Mushrooms+Snakes: an investigation of Richtmyer-Meshkov instability," *Physics of Fluids* Vol. 9 No. 9 (1997), Special Section p. S6 [2].

31. P. Vorobieff and R.E. Ecke, "Transient States During Spin-Up of a Rayleigh-Bénard Cell," *Physics of Fluids* Vol. 10 No. 10 (1998), pp. 2525-2538 [8].

32. P.M. Rightley, P.Vorobieff, R. Martin, and R.F. Benjamin, "Experimental Observations of the Mixing Transition in a Shock-Accelerated Gas Curtain," *Physics of Fluids* Vol. 11 No. 1 (1999), pp. 186-209 [80].

33. P. Vorobieff, M.K. Rivera, and R.E. Ecke,"Soap Film Flows: Statistics of Two-Dimensional Turbulence," *Physics of Fluids* Vol. 11 No. 8 (1999), pp. 2167-2177 [68].

34. I. Aranson, D. Blair, and P. Vorobieff, "Interface Nucleation in Vibrating Granular Media," *Physics of Fluids* Vol. 11 No. 9 (1999), p. S9 [2].

35. K.P. Prestridge, C. Tomkins, P. Rightley, P. Vorobieff, and R.F. Benjamin, "The Courtship and Mating Rituals of Vortices," *Physics of Fluids*, Vol. 14 No. 9 (2002), p. S10.

36. P. Vorobieff, D. Georgiev*, and M.S. Ingber, "Onset of the second wake: Dependence on the Reynolds number," *Physics of Fluids*, Vol. 14 No. 7 (2002), pp. L53-L56 [15].

37. C. Tomkins, K. Prestridge, P. Rightley, M. Marr-Lyon, P. Vorobieff, and R.F. Benjamin, "A quantitative study of the interaction of two Richtmyer-Meshkov unstable gas cylinders," *Physics of Fluids* Vol. 15 No. 4 (2003), pp. 986-1004 [46].

38. S. Gogte**, P. Vorobieff, R. Truesdell**, A. Mammoli, F. van Swol, P. Shah, and C.J. Brinker, "Effective slip on textured superhydrophobic surfaces," *Physics of Fluids* Vol. 17 (2005), art. no. 051701 [199].

39. S. Kumar, G. Orlicz**, C. Tomkins, C. Goodenough, K. Prestridge, P. Vorobieff, and R. Benjamin, "Stretching of material lines in shock-accelerated gaseous flows," *Physics of Fluids* Vol. 17 (2005), art. no. 082107 [42].

40. G. Orlicz, S. Balasubramanian, P. Vorobieff, and K. Prestridge."Mixing transition in a shocked variable-density flow," *Physics of Fluids* Vol. 27 No. 11 (2015), art. no. 114102 [2].

*Proceedings of the Royal Society A* (1.9)

41. M. Chi, F. Gay-Balmaz, V. Putkaradze, and P. Vorobieff, "Dynamics and optimal control of flexible solar updraft towers," *Proceedings of the Royal Society A: Mathematical, Physical, and Engineering Sciences* Vol. 471 (2015), art. no. 20140539 [4].

*Physica D – Nonlinear Phenomena* (1.8)

42. P. Vorobieff and R.E. Ecke, "Vortex Structure in Rotating Rayleigh-Bénard Convection," *Physica D* (Amsterdam) Vol. 123 (1998), pp. 153-160 [30].

43. P. Vorobieff, P.M. Rightley, and R.F. Benjamin,"Shock-driven Gas Curtain: Fractal Dimension Evolution in Transition to Turbulence," *Physica D* (Amsterdam) Vol. 133, pp. 469-476 (1999) [29].

44. S. Kumar,P. Vorobieff, G. Orlicz**, A. Palekar**, C. Tomkins, C. Goodenough, M. Marr-Lyon, K.P. Prestridge, and R.F. Benjamin, "Complex flow morphologies in shock-accelerated gaseous flows," *Physica D* (Amsterdam) Vol. 235 no. 1-2 (2007), pp. 21–28 [20].

*Experiments in Fluids* (1.8)

45. K.P. Prestridge, P.M. Rightley, P. Vorobieff, N.A. Kurnit, and R.F. Benjamin, "Simultaneous Density-Field Visualization and PIV of a Shock-Accelerated Gas Curtain," *Experiments in Fluids* Vol. 29 No. 4 (2000), pp. 339-346 [40].

46. T. Shakeel** and P. Vorobieff, "Decaying turbulence in soap films: energy and enstrophy evolution," *Experiments in Fluids* Vol. 43 no. 1 (2007), pp. 125–133 [12].

47. C. Noren**, P. Vorobieff, C.R. Truman, and T.J. Madden, "Mixing in a supersonic COIL laser: influence of trip jets," *Experiments in Fluids* Vol. 50 No. 2 (2011), pp. 443-455 [7].

48. P. Vorobieff, C.R. Truman, A.M. Ragheb, G.S. Elliott, J.K. Laystrom-Woodard, D.M. King, D.L. Carroll, and W.C. Solomon, "Mixing enhancement in a multi-stream injection nozzle," *Experiments in Fluids* Vol. 51, no. 3 (2011), pp. 711-722 [5].

49. D. Olmstead, P. Wayne, J.-H. Yoo, S. Kumar, C.R. Truman, and P. Vorobieff, "Experimental Study of Shock-Accelerated Inclined Heavy Gas Cylinder," *Experiments in Fluids* (2017), DOI: 10.1007/s00348-017-2358-2.

Other refereed publications

50. V.S. Vorob'ev, P.V. Vorob'ev, "Odnomernyj razlet sloya isparivshegosya veschestva v pustotu" ("One-dimensional expansion of a layer of evaporating matter into vacuum") *Teplofizika vysokih Temperatur* vol. 30 No. 1 (1992), pp. 122-131.

51. J.-C. Lin, P. Vorobieff, and D.O. Rockwell,"Three-Dimensional Patterns of Streamwise Vorticity in the Turbulent Near-Wake of a Cylinder," *Journal of Fluids and Structures* Vol. 9 (1995), pp. 231-234 [32].

52. P. Vorobieff and D.O. Rockwell, "Multiple-Actuator Control of Vortex Breakdown on a Pitching Delta Wing," *AIAA Journal* Vol. 34 No. 10 (1996), pp. 2184-2186 [11].

53. P. Vorobieff and D.O. Rockwell, "Wavelet Filtering for Topological Decomposition of Flow Fields," *International Journal of Imaging Systems and Technology*, Vol. 7 No. 3 (1996), pp. 211-214 [4].

54. P. Vorobieff and D.O. Rockwell, "Vortex Breakdown on Pitching Delta Wing: Control by Intermittent Trailing-Edge Blowing," *AIAA Journal* Vol. 34 No. 10 (1998), pp. 2184-2186 [24].

55. P. Vorobieff and R.E. Ecke, "Flow Structure in a Rayleigh-Bénard cell upon impulsive spin-up," *Journal of Fluids Engineering* Vol. 120 (1998), pp. 672-675.

56. P. Vorobieff and R.E. Ecke, "Fluid Instabilities and Wakes in a Soap-Film Tunnel," *American Journal of Physics* Vol. 67 No. 5 (1999), pp. 394-399 [15].

57. P. Vorobieff, K. Prestridge, R.F. Benjamin, and P.M. Rightley "Shock-driven mixing transition: quantitative analysis," *Proceedings of the 22nd International Symposium on Shock Waves*, editors: G.J. Ball, R. Hillier, G. T. Roberts, University of Southampton, UK (2000), 8 pp. [1].

58. P. Vorobieff, M.K. Rivera and R.E. Ecke, "Imaging 2D Turbulence," *Journal of Visualization* Vol. 3 No. 4 (2001), pp. 323-330 [2].

59. J.R. Kamm, W.J. Rider, P.M. Rightley, K.P. Prestridge, R.F. Benjamin, and P.V. Vorobieff, "The gas curtain experimental technique and analysis methodologies," *Computational Methods in Experimental Measurements X*, editors: Y. Villacampa Esteve, G.M. Carlomagno, and C.A. Brebbia, WIT Press, Southampton, UK (2001), 10 pp. (also published as Los Alamos Nat. Lab. report LA-UR-01-2573) [4].

60. W. Rider, J. Kamm, P. Rightley, K. Prestridge, R. Benjamin, and P. Vorobieff, "Direct statistical comparison of hydrodynamic mixing experiments and simulations," *Computational Methods in Experimental Measurements X*, editors: Y. Villacampa Esteve, G.M. Carlomagno, and C.A. Brebbia, WIT Press, Southampton, UK (2001), 10 pp [2].

61. D. Georgiev* and P. Vorobieff, "The slowest soap-film tunnel in the Southwest," *Review of Scientific Instruments* Vol. 73 No. 3 (2002), pp. 1177-1184 [24].

62. C. Tomkins, P. Rightley, P. Vorobieff, K.P. Prestridge, and R.F. Benjamin, "Flow Morphologies of Two Shock-Accelerated, Unstable Gas Cylinders," *Journal of Visualization* Vol. 5 No. 3 (2002), pp. 273-283 [26].

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**Non-Refereed Conference Papers**

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91. P. Rightley, P. Vorobieff, and R.F. Benjamin, "Experimental benchmarks: recent data from gas curtain experiments," *Proceedings of NECDC Meeting, Oct. 22-25, 1996, San Diego, California* [1].

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94. P. Vorobieff and R.E. Ecke, "Regular and chaotic flow patterns upon impulsive spin-up of a Rayleigh-Bénard convection cell," *Proceedings of the 4th Experimental Chaos Conference, Aug. 6-8, 1997, Boca Raton, Florida* (World Scientific/Singapore), pp. 129-134 [1].

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102. C. Goodenough, S. Kumar, M. Marr-Lyon, A. Boyts, K. Prestridge, P. Rightley, C. Tomkins, M. Cannon, J. Kamm, W. Rider, C. Zoldi-Sood, G. Orlicz, and P. Vorobieff, "Planar velocity and scalar concentration measurements in shock-accelerated unstable fluid interfaces," *Proceedings of SPIE – Volume 5580: 26th International Congress on High-Speed Photography and Photonics, March 2005*, pp. 186-192 [2].

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107. M.L. Chavez**, P. Vorobieff, C.R. Truman, E.P. Johnson**, "Experimental Studies of Shock Wave Interaction with Droplets and Particulates," AIAA 2009-4050, *Proceedings of the 39th AIAA Fluid Dynamics Conference*, 22 - 25 June 2009, San Antonio, Texas [2].

108. A. Williams**, P. Vorobieff, A. Mammoli, " Effect of Slip Flow on Heat Transfer: Numerical Analysis," AIAA-2012-0528, *Proceedings of 50th AIAA Aerospace Sciences Meeting*, Nashville, Tennessee, Jan. 9-12, 2012 [4].

109. P. Vorobieff, C. Davidson, "Flow ionization for hybrid MHD: an experimental study," AIAA 2015-3996, *Proceedings of 51st AIAA/SAE/ASEE Joint Propulsion Conference*, Orlando, Florida, July 27-29, 2015.

110. P. Vorobieff, C. Davidson, M. Reda Taha, C. Christodoulou, A. Prinja, S. Poroseva, M. Tehrani, D. Hanson, T. Kallas, E. Singsaas, "ArmorHab: Design Reference Architecture for Human Habitation in Deep Space," Proceedings of the 19th Annual International Mars Society Convention, 2016.

**Reports**

111. P. Vorobieff and R.E. Ecke, "Evidence of 2D turbulence," Los Alamos National Laboratory *CNLS Newsletter*, February 1998 [1].

112. P. Vorobieff, C.R. Truman, and J. Gallegos**,"PIV diagnostics for flow control applications," *Proceedings of 2000 Contractors' Meeting in Turbulence and Rotating Flows*, Air Force Office of Scientific Research, Arlington, VA, pp. 285-289.

113. P. Vorobieff, C.R. Truman, J. Gallegos**, and P. Chavez**, "PIV diagnostics for flow control applications: Part 2," *Proceedings of 2001 Contractors' Meeting in Turbulence and Rotating Flows*, Air Force Office of Scientific Research, Arlington, VA, pp. 227-232.

114. K. Prestridge, C.A. Zoldi, P. Vorobieff, P.M. Rightley, and R.F. Benjamin, "Velocity-field measurements of a shock-accelerated fluid instability," Los Alamos National Laboratory Report LA-UR-01-2682 (2001), 6 pp.

115. K. Prestridge, C.A. Zoldi, P. Vorobieff, P.M. Rightley, and R.F. Benjamin, "Experiments and Simulations of Instabilities in a Shock-Accelerated Gas Cylinder," UCRL-ID-146350, *8th International Workshop on the Physics of Compressible Turbulent Mixing (IWPCTM)*, December 9-14, 2001, Pasadena, CA, p. 36 [8].

116. C.A. Noren**, G. Rothschopf, T. Perschbacher, T.J. Madden, G.D. Hager, C.R. Truman, and P.V. Vorobieff, "PLIF Flow Visualization of a Supersonic Coil Nozzle," *Air Force Research Lab Kirtland AFB NM Directed Energy Directorate Report* A655174, Oct. 16, 2006, pp. 1-9.

117. P. Vorobieff and C.R. Truman, "Prediction of chemical laser flow," *Final Report on US DOD/DOI Contract No. FA95500510031*, Apr. 14, 2006, pp. 1-25.

118. P. Vorobieff, "Shock-driven Multiphase Flows: Complexity and Challenges," Spotlight on Science, DTRA Basic and Applied Research Program Newsletter, Volume 3, Issue 2, June 2010, 1-2.

119. J. Carlson, H. He**, A. Mammoli, D. Menicucci, P. Vorobieff, "Development of a photometric method to identify non-operating solar hot water systems in field settings," SAND2011-4759, Sandia National Laboratories report (2012), 106 pp.

120. P. Vorobieff and C.R. Truman, "Shock interaction with multiphase matter: Unraveling the puzzles," DOE/NA-0020, *2014 Stewardship Science Academic Programs Annual*, p. 7.

121. M. Ingber and P. Vorobieff, "Localized Scale Coupling and New Educational Paradigms in Multiscale Mathematics and Science," DOE Technical Report DOE-UNM-25705 2R64F (2014).

**Invited presentations**

1. "Kraichnan was right! 2D turbulence," poster presentation. Presented at the *Turbulence: Challenges for the 21st Century* conference, May 18-21, 1998, Los Alamos, New Mexico. With R.E. Ecke.

2. "Phenomenology and statistics of 2D turbulence," presented at the *13th Canadian Symposium on Fluid Dynamics* (CSFD), May 26-30, 1998, Vancouver, Canada.

3. "Fluid instabilities and turbulence: some experimental results," presented at the seminar of the Mechanical Engineering Department, University of New Mexico, Sep. 15, 1998, Albuquerque, New Mexico.

4. "Fluid instability and turbulence studies via PIV," presented at the seminar of the Department of Theoretical and Applied Mechanics, University of Illinois, Sep. 24, 1998, Urbana, Illinois.

5. "Experiments in fluid turbulence," presented at the University of California, San Diego Physics Seminar, Jan. 18, 1999, San Diego, California.

6. "Interface motion in a vibrated granular layer," video presentation. Presented at the *Centennial Meeting of the American Physical Society*, March 20-26, 1999, Atlanta, Georgia. With D. Blair and I. Aronson.

7. "Dynamics of shock-accelerated density interfaces," presented at the *Dynamics of Interfaces, Patterns and Domains '99 International Workshop*, April 22-24, 1999, Los Alamos, New Mexico.

8. "Wakes in soap films," presented at the *5th Experimental Chaos Conference*, June 28-July 1, 1999, Orlando, Florida.

9. "Experiments in nonlinear science," presented at Santa Fe Institute with R.E. Ecke, 1999, 2000.

10. "Quasi-two-dimensional studies in gravity-driven soap films," presented at Eötvös University (Physics Department) Graduate Student Seminar, Budapest, Hungary, June 2001.

11. "Bluff-body wake evolution and interaction in 2D," presented at the *4th International conference on Advances in Fluid Mechanics (AFM2002)*, Ghent, Belgium, May 14-17, 2002. With D. Georgiev* and T. Shakeel*.

12. "Experimental studies of shock-driven instabilities," presented at the Washington University in St. Loius (MAE Department) Graduate Student Seminar, St. Louis, Missouri, USA, Oct. 30, 2003.

13. "Experiments in impulsively-driven instabitities," presented at the Fluid Mechanics Series seminar, California Institute of Technology, Pasadena, California, USA, Apr. 23, 2004.

14. "Shock-driven transition to turbulence: curiouser and curiouser," presented at the Special Session on Mathematical Methods in Turbulence, Fall Western Section Meeting of the American Mathematical Society, Albuquerque, New Mexico, USA, Oct. 17, 2004.

15. "Richtmyer-Meshkov instability," presented at the University of Victoria, Victoria, British Columbia, Canada, June 30, 2006.

16. "Irreversibility and chaos in shear flow carrying particles," presented at the 2007 Spring Western Section Meeting of the American Mathematical Society, Special Session on Subjects in and Around Fluid Dynamics, Tucson, Arizona, USA, Apr. 22, 2007.

17. "Turbulence in two, three, and one dimension," presented at the Institute for High Temperatures, Russian Academy of Sciences, Moscow, Russia, June 21, 2007,

18. "Turbulence and spatial dimensionality," keynote presentation at Russian Low-Temperature Plasma Conference, St. Petersburg – Petrozavodsk, Russia, June 26, 2007.

19. "Quasi-two-dimensional turbulent decay and fossil turbulence," presented at the Fall Western Section Meeting of the American Mathematical Society, Special Session on Recent Developments in 2-D Turbulence, Albuquerque, New Mexico, USA, Oct. 13, 2007.

20. "Analogues of Rayleigh-Taylor and Richtmyer-Meshkov instabilities in flows with non-uniform particle and droplet seeding," presented at the Sixth International Conference on Computational and Experimental Methods in Multiphase and Complex Flow, Kos, Greece, June 15, 2011.

21. "Analogues of Rayleigh-Taylor and Richtmyer-Meshkov instabilities in gas and plasma with inclusions," presented at the Russian Low-Temperature Plasma Conference, Petrozavodsk, Russia, June 23, 2011.

22. "Vortex deposition and transition to turbulence in a shock-accelerated gas with particle/droplet seeding," presented at the 17th Biennial International Conference of the APS Topical Group on Shock Compression of Condensed Matter (APS-SCCM), June 26 – July 1 2011, Chicago, Illinois. With J. Conroy**, M. Anderson**, R. White**, C.R. Truman, and S. Kumar.

23. "Particle lag instability," presented at the 2011 Fall Western Section Meeting of the American Mathematical Society, University of Utah, Salt Lake City, UT, October 22-23, 2011. With M. Anderson**, J. Conroy**, R. White**, P. Wayne*, C.R. Truman, and S. Kumar.

24. "Optimal design of an inflatable, free-standing solar updraft tower," presented at the 2013 Spring Western Section Meeting of the American Mathematical Society, University of Colorado–Boulder, Boulder, CO, April 13-14, 2013. With A.A. Mammoli, V.P. Putkaradze, and N. Fathi**.

25. "Shock-driven instability in multiphase flow," presented at San Diego State University Aerospace Engineering Department, May 3, 2013.

26. "Morphology of shock-accelerated multiphase flow: experiment and modeling," presented at the 7th International Conference onc Computational and Experimental Methods in Multiphase and Complex Flow, A Coruña, Spain July 3-5, 2013. With M. Anderson, J. Conroy, C.R. Truman, and S. Kumar.

27. "Particle-lag instability and other oddities in shock-driven multiphase flow," presented at the Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico, March 12, 2014.

28. "Новая неустойчивость за ударной волной в многофазных потоках (New Shock-Driven Instability in Multiphase Flows)," presented at V.V. Fortov (President of the Russian Academy of Sciences) OIVT Seminar, Moscow, Russia, April 10, 2014.

29. "Richtmyer-Meshkov and other instabilities in compressible multiphase flow," presented at the 8th International Conference on Computational and Experimental Methods in Multiphase and Complex Flow, Valencia, Spain, April 20-22, 2015. With P. Wayne, D. Olmstead, C.R. Truman, and S. Kumar.

30. "Control of a flexible chimney under wind loading," presented at the Special Session on Inverse Problems, AMS Spring Western Sectional Meeting, University of Utah, Salt Lake City, UT, April 9-10, 2016. With M. Chi, F. Gay-Balmaz, V. Putkaradze, and N. Fathi.

31. "Flow pattern alteration near a hydrofoil due to effective slip: an experimental study," presented at the 11th International Conference on Advances in Fluid Mechanics, Ancona, Italy, September 5-7, 2016. With S. Gogte and A. Mammoli.

32. "Flexible solar updraft towers: stability and control," presented at the Special Session on Contemporary Geometric Methods in Mechanics and Control, AMS Fall Southeastern Sectional Meeting, North Carolina State University, Raleigh, NC, November 12-13, 2016. With M. Chi, F. Gay-Balmaz, V. Putkaradze, and N. Fathi.

**Funded Research**

| | |
|---|---|
| Title: | Quantification of Disorder Growth in Transition to Turbulence |
| PIs: | P. Vorobieff |
| Funding Agency: | Sandia National Laboratories |
| Start Date: | 10/01/1999 |
| End Date: | 09/30/2000 |
| Funding Level: | $ 29,073 |
| Summary: | Develop advanced analysis methods using summation concepts for studies of disorder growth in pre-turbulent mixing flows. |

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|---|---|
| Title: | PIV Diagnostics for Flow Control Applications |
| PIs: | P. Vorobieff (PI), C.R. Truman (co-PI) |
| Funding Agency: | AFOSR |
| Start Date: | 03/31/2000 |
| End Date: | 03/30/2001 |
| Funding Level: | $ 128,823 |
| Summary: | Develop capability for particle image velocimetry (PIV) diagnostics suitable for investigation of controlled flows. |

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|---|---|
| Title: | Shock-induced Instability of a Thin Fluid Layer/Instabilities in Soap-Film Flows |
| PIs: | P. Vorobieff |
| Funding Agency: | Los Alamos National Laboratory |
| Start Date: | 06/05/2000 |
| End Date: | 08/18/2000 |
| Funding Level: | $ 24,337 |
| Summary: | Perform advanced-diagnostics experiments on fluid instabilities in two and three dimensions. |

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|---|---|
| Title: | Hysteresis of Vortex-Shedding Behind a Circular Cylinder |
| PIs: | P. Vorobieff |
| Funding Agency: | Oak Ridge Associated Univerisites |
| Start Date: | 07/01/2000 |
| End Date: | 07/01/2001 |
| Funding Level: | $ 10,000 (50% cost-sharing) |
| Summary: | Investigate the recent claims of hysteretic behavior near the onset of Bénard - von Kármán instability. |

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|---|---|
| Title: | Shock-Driven Transition to Turbulence as a Code Validation Problem |
| PIs: | P. Vorobieff |
| Funding Agency: | Sandia National Laboratories |
| Start Date: | 10/01/2000 |
| End Date: | 09/30/2001 |
| Funding Level: | $ 35,000 |
| Summary: | Develop analysis methods for quantitative validation of numerical prediction of transition to turbulence. Provide a sample set of experimental benchmarks. |

| | |
|---|---|
| Title: | Experimental Flow Diagnostics and Numerical Prediction of Mixing in Chemical Lasers |
| PIs: | P. Vorobieff (PI), C.R. Truman (co-PI) |
| Funding Agency: | DARPA |
| Start Date: | 04/01/2001 |
| End Date: | 08/31/2003 |
| Funding Level: | $ 300,000 |
| Summary: | Develop an experimental system for quantitative diagnostics of flow inside a chemical laser. Examine the influence of flow hydrodynamics on laser performance. Perform numerical simulations. |

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|---|---|
| Title: | Experimental Study of Wake and Cavity Flows |
| PIs: | P. Vorobieff, C.R. Truman (subaward; program PIs: L. Crossey, D. Kauffman, program director: N. Vadiee) |
| Funding Agency: | NASA PURSUE |
| Start Date: | 01/01/2001 |
| End Date: | 12/21/2001 |
| Funding Level: | $ 25,630 |
| Summary: | Use advanced diagnostics for 2D hydrodynamics studies. Involve undergraduate students in research. |

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|---|---|
| Title: | Fluid Mechanics Studies for Aerodynamic Flow Control |
| PIs: | C.R. Truman, P. Vorobieff (subaward; program PIs: L. Crossey, D. Kauffman, program director: N. Vadiee) |
| Funding Agency: | NASA PURSUE |
| Start Date: | 06/01/2000 |
| End Date: | 12/21/2001 |
| Funding Level: | $ 32,750 |
| Summary: | Develop diagnostics for wind-tunnel studies of controlled flow. Involve undergraduate students in research. |

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|---|---|
| Title: | Experimental Analysis in Support of Physics-Based Validation |
| PI: | P. Vorobieff |
| Funding Agency: | Los Alamos National Laboratory |
| Start Date: | 10/01/2001 |
| End Date: | 09/30/2003 |
| Funding level: | $ 79,000 |
| Summary: | Perform experiments and analysis of experimental data to provide quantitative benchmarks for development of numerical codes predicting transition to turbulence. |

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|---|---|
| Title: | Flow Diagnostic System Development |
| PIs: | C.R. Truman (PI), P. Vorobieff (co-PI) |
| Funding Agency: | Boeing |
| Start Date: | 03/01/2002 |
| End Date: | 09/30/2002 |
| Funding level: | $ 97,340 |
| Summary: | Instrumentation for a high-speed laser induced fluorescence system. |

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| Title: | Experimental Analysis in Support of Physics-Based Validation |
| PI: | P. Vorobieff |
| Funding Agency: | Los Alamos National Laboratory |
| Start Date: | 04/22/2003 |
| End Date: | 04/30/2005 |
| Funding level: | $ 150,000 |
| Summary: | Perform experiments and analysis of experimental data to provide quantitative benchmarks for development of numerical codes predicting transition to turbulence. |

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|---|---|
| Title: | Bifurcations in a wedge flow |
| PI: | V. Putkaradze (PI), P. Vorobieff (co-PI) |
| Funding Agency: | Petroleum Research Foundation |
| Start Date: | 06/01/2003 |
| End Date: | 05/31/2006 |
| Funding level: | $ 80,000 |
| Summary: | Study of fundamental instabilities and bifurcations in wedge flows. |

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|---|---|
| Title: | Predictions of HYSIM HF Laser Flow |
| PI: | C.R. Truman (PI), P. Vorobieff (co-PI) |
| Funding Agency: | Missiel Defense Agency via Boeing and AFRL |
| Start Date: | 10/01/2003 |
| End Date: | 09/30/2005 |
| Funding level: | $ 231,000 |
| Summary: | Experiment and numerics to understand mixing processes inside a chemical laser. |

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|---|---|
| Title: | Experimental and Numerical Investigation of Flows in Expanding Channels |
| PI: | V. Putkaradze (PI), P. Vorobieff (co-PI) |
| Funding Agency: | US DOE |
| Start Date: | 02/01/2004 |
| End Date: | 01/31/2007 |
| Funding level: | $ 495,000 |
| Summary: | Study of fundamental instabilities and bifurcations in wedge flows. |

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|---|---|
| Title: | Experimental and numerical studies of superhydrophobic surfaces |
| PI: | A.A. Mammoli (PI), P. Vorobieff (co-PI) |
| Funding Agency: | Sandia National Laboratories |
| Start Date: | 05/01/2004 |
| End Date: | 08/30/2005 |
| Funding level: | $ 50,000 |
| Summary: | Investigation of the possibility of macroscopic fluid slip on superhydrophobic surfaces. |

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|---|---|
| Title: | Localized scale coupling and new educational paradigms in multiscale mathematics and science |
| PIs: | M.S. Ingber (PI), P. Vorobieff (co-PI) |
| Funding Agency: | US DOE |
| Start Date: | 10/01/2005 |
| End Date: | 09/30/2008 |
| Funding level: | $ 345,000 |
| Summary: | Experimental and numerical study of irreversibility in multiphase flows. |

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|---|---|
| Title: | Experimental and numerical studies of superhydrophobic surfaces |
| PI: | A.A. Mammoli (PI), P. Vorobieff (co-PI) |
| Funding Agency: | Sandia National Laboratories |
| Start Date: | 10/01/2005 |
| End Date: | 09/30/2006 |
| Funding level: | $ 50,000 |
| Summary: | Investigation of macroscopic fluid slip on textured superhydrophobic substrates. |

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|---|---|
| Title: | UNM Solar Power Testbed |
| PI: | A.A. Mammoli (PI), P. Vorobieff (co-PI) |
| Funding Agency: | State of New Mexico ENMRD |
| Start Date: | 11/01/2005 |
| End Date: | 10/31/2006 |
| Funding level: | $ 225,000 |
| Summary: | Construction and testing of a solar thermal system. |

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|---|---|
| Title: | PLIF diagnostics of iodine injection |
| PI: | C.R. Truman (PI), P. Vorobieff (co-PI) |
| Funding Agency: | DOD SBIR Phase I |
| Start Date: | 03/01/2006 |
| End Date: | 09/01/2006 |
| Funding level: | $ 30,000 |
| Summary: | Analysis of mixing in chemical laser. |

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|---|---|
| Title: | Analysis of PLIF images in iodine injection studies |
| PI: | P. Vorobieff (PI), C.R. Truman (co-PI) |
| Funding Agency: | DOD SBIR Phase II |
| Start Date: | 01/01/2007 |
| End Date: | 12/31/2008 |
| Funding level: | $ 30,000 |
| Summary: | Analysis of mixing enhancement in a chemical laser. |

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|---|---|
| Title: | Studies of High-Speed Mixing Flows with Particulates |
| PI: | F. Gilfeather (UNM lead PI), P. Vorobieff (PI), C.R. Truman (co-PI) |
| Funding Agency: | DTRA |
| Start Date: | 08/01/2007 |
| End Date: | 07/31/2008 |
| Funding level: | $ 401,000 |
| Summary: | Construction of a tiltable shock tube, experiments with shock-driven multiphase flows. |

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|---|---|
| Title: | Multiphase shock-driven hydrodynamic experiments for hydrocode validation |
| PI: | P. Vorobieff (PI), C.R. Truman (co-PI) |
| Funding Agency: | NNSA |
| Start Date: | 01/01/2010 |
| End Date: | 12/31/2012 |
| Funding level: | $ 539,080 |
| Summary: | Experiments to provide code-validation benchmarks for shock interaction with gas density interfaces and multiphase media. |

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|---|---|
| Title: | Experimental and numerical studies of respirable particle transport surfaces by acoustic/shock waves |
| PI: | C.R. Truman (PI), P. Vorobieff (co-PI) |
| Funding Agency: | DTRA |
| Start Date: | 01/01/2010 |
| End Date: | 12/31/2011 |
| Funding level: | $ 230,367 |
| Summary: | Experiments to provide code-validation benchmarks for shock interaction with gas density interfaces and multiphase media. |

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|---|---|
| Title: | Optimization of UNM solar thermal plant |
| PI: | A. Mammoli (PI), P. Vorobieff (co-PI), H. Barsun (co-PI) |
| Funding Agency: | State of New Mexico ENMRD |
| Start Date: | 03/21/2010 |
| End Date: | 09/20/2011 |
| Funding level: | $ 128,000 |
| Summary: | Installation of booster mirrors and other components to improve solar collector efficiency. |

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|---|---|
| Title: | Attracting, Motivating and Preparing Mathematics students in the Southwest by building an energetic community of students and educators. |
| PI: | M. Nitsche (PI), D. Appelo, P. Vorobieff et al. |
| Funding Agency: | NSF |
| Start Date: | 06/01/2012 |
| End Date: | 05/30/2016 |
| Funding level: | $ 1,200,000 |
| Summary: | Educational proposal to attract more US nationals to mathematical sciences. |

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|---|---|
| Title: | Collaborative research: Particle Dynamics in Viscous Shear Flows |
| PI: | P. Vorobieff |
| Funding Agency: | NSF |
| Start Date: | 09/01/2013 |
| End Date: | 08/30/2016 |
| Funding level: | $ 204,764 |
| Summary: | Experimental and numerical study of irreversibility in particle-carrying flow. |

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|---|---|
| Title: | Shock-driven complex behavior of multiphase flow: dynamics of particles and droplets |
| PI: | P. Vorobieff (PI), C.R. Truman (co-PI) |
| Funding Agency: | NNSA |
| Start Date: | 09/01/2013 |
| End Date: | 08/30/2016 |
| Funding level: | $ 399,956 |
| Summary: | Experimental study of shock-driven multiphase flows. |

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|---|---|
| Title: | A 3D CFD model validation for candidate Mo-99 target geometry |
| PI: | P. Vorobieff |
| Funding Agency: | LANL |
| Start Date: | 10/01/2013 |
| End Date: | 09/30/2015 |
| Funding level: | $ 110,500 |
| Summary: | Numerical study of a closed flow loop. |

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|---|---|
| Title: | UNM Shock Tube Facility Upgrade |
| PI: | P. Vorobieff |
| Funding Agency: | UNM OVPR Equipment Fund |
| Start Date: | 04/23/2014 |
| End Date: | 04/22/2015 |
| Funding level: | $ 50,906 |
| Summary: | Equipment grant to upgrade flow visualization. |

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|---|---|
| Title: | Ionization of Shocked Flow |
| PI: | P. Vorobieff |
| Funding Agency: | New Mexico Small Business Assistance Program |
| Start Date: | 07/01/2015 |
| End Date: | 09/30/2015 |
| Funding level: | $ 8,000 |
| Summary: | Experiments with a prototype jet engine (business partner: Dark Sea Indurstries LLC). |

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|---|---|
| Title: | Quantification of normal and oblique shock-driven phase interaction and transition to turbulence in media with multiscale density interfaces |
| PI: | P. Vorobieff |
| Funding Agency: | NNSA |
| Start Date: | 08/01/2015 |
| End Date: | 07/31/2018 |
| Funding level: | $ 600,000 |
| Summary: | Shock tube studies. |

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|---|---|
| Title: | Collaborative research: Shock interaction with a complex hydrodynamic medium |
| PI: | P. Vorobieff |
| Funding Agency: | NSF |
| Start Date: | 08/01/2016 |
| End Date: | 07/31/2019 |
| Funding level: | $ 240,001 |
| Summary: | Shock-driven multiphase flow studies. |