

## PETIA M. VLAHOVSKA

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### RESEARCH INTERESTS

Micro- and nano-fluid dynamics:

- microhydrodynamics of particles with complex interfaces (vesicles, surfactant-covered drops)
- biophysics of cell membranes (electroporation, lipid membrane fusion and fission, lipid sorting)
- electrokinetic phenomena and electrohydrodynamics

Structure and dynamics of complex fluids:

- rheology and electrorheology of suspensions of soft particles (drops, vesicles, cells)
- chemo-mechanics of blood flow in the microcirculation

### EDUCATION

- 1997-2003 **Ph.D. Chemical Engineering**, Yale University  
1994-1996 **M.Sc.** Post-graduate program in "Separation processes in the industry and environmental protection" Laboratory of Chemical Physics and Engineering, University of Sofia, Bulgaria  
1989-1994 **M.Sc. Chemistry** with concentration in **chemical physics and theoretical chemistry**, University of Sofia, Bulgaria

### POSITIONS HELD

- 2009- Adjunct Assistant Professor, Physics Department, Dartmouth College  
2006- Assistant Professor, Thayer School of Engineering, Dartmouth College  
2005-2006 Visiting Scientist, Theory and Bio-systems Department, Max-Planck Institute of Colloids and Interfaces, Germany  
2003-2005 Visiting Assistant Professor, Division of Engineering, Brown University  
1996-1997 Research Associate, Laboratory of Chemical Physics and Engineering, University of Sofia, Bulgaria  
1995 Visiting student, Theoretical Fluid Mechanics Group, LSTM, University of Erlangen-Nürnberg, Germany

### AWARDS

- 2009 NSF-CAREER  
2005 Max-Planck Fellowship, to work with Dr. R. Dimova on vesicle adhesion, Max-Planck Institute of Colloids and Interfaces, Germany  
2004 David Crighton Fellowship, to work with Prof. T. J. Pedley on suspensions of swimming microorganisms, DAMTP, Cambridge, UK  
2002 Prize Teaching Fellowship, Yale University, for outstanding performance and promise as a teacher.

### FUNDING

- 2009-2014 NSF-CAREER "Dynamics of cells and cellular mimetics in flow and electric fields: An integrated biophysical and engineering approach" (\$399,181)  
2008-2010 ACS-PRF "Effect of surfactant on drop electrohydrodynamics" (\$50,000)  
2009 NSF-Travel support for students and young researchers to attend the Summer School on "Complex- and Bio- Fluids", June, 2009, Corsica, France (\$13,500)

## PUBLICATIONS

- J. Hanna and P. M. Vlahovska "Surfactant-induced migration of a spherical drop in Stokes flow" *Physics of Fluids* (accepted)
- J. Schwalbe, P. M. Vlahovska and M. Miksis "Monolayer slip effects on the dynamics of a lipid bilayer vesicle in a viscous flow", *J. Fluid Mech.* (in press)
- P.M. Vlahovska, T. Podgorski and C. Misbah "Vesicles and red blood cells: from individual dynamics to rheology" *Comptes Rendus Physique* **10** pp.775–789 (2009) (invited review)
- P.M. Vlahovska, R. S. Gracia, S. Aranda and R. Dimova, "Electrohydrodynamic model of vesicle deformation in alternating electric fields", *Biophysical Journal*, **96** pp. 4789-4803 (2009)
- G. Danker, P.M. Vlahovska and C. Misbah, "Vesicles in Poiseuille flow", *Phys. Rev. Lett.*, **102** 148102 (2009)
- R. Dimova, N. Bezlyepkina, M. D. Jordö, R. L. Knorr, K. A. Riske, M. Staykova, P.M.Vlahovska, T. Yamamoto, P. Yang, and R. Lipowsky "Vesicles in electric fields: some novel aspects of membrane response" *Soft Matter* **5** pp. 3201-3212 (2009) (review)
- P. M. Vlahovska, J. Blawdziewicz and M. Loewenberg "Small-deformation theory for a surfactant-covered drop in linear flows", *J. Fluid Mech.* **624** pp. 293-337 (2009),
- P.M.Vlahovska and R.S.Gracia "Dynamics of a viscous vesicle in linear flows", *Phys. Rev. E* **75** 016313 (2007)
- P. M. Vlahovska "Dynamics of surfactant-covered drops in linear flows", *PAMM* **7** 1101601–1101602 (2007)
- P. M. Vlahovska, J. Blawdziewicz and M. Loewenberg "Deformation of a surfactant-covered drop in a linear flow", *Phys. Fluids* **17**, 103103, (2005)
- P. Vlahovska, J. Blawdziewicz and M. Loewenberg "Nonlinear rheology of a dilute emulsion of surfactant-covered spherical drops in time-dependent flows", *J Fluid Mech.* **463**, pp. 1-24 (2002)
- J. Blawdziewicz, P. Vlahovska and M. Loewenberg, "Rheology of a dilute emulsion of surfactant covered spherical drops" *Physica A* **276**, pp. 50-85 (2000)
- K. Danov, P. M. Vlahovska, P. Kralchevsky, A. Mehreteab and G. Broze, "Adsorption kinetics of ionic surfactants with detailed account for the electrostatic interactions: 2. Effect of the presence of electrolyte", *Colloids Surfaces A* **156**, pp. 389-411 (1999)
- P. M. Vlahovska, K. Danov, A. Mehreteab and G. Broze, "Adsorption kinetics of ionic surfactants with detailed account for the electrostatic interactions:1. No added electrolyte", *J. Coll. Int. Sci.* **192**, pp. 194-206 (1997)
- K. Danov, P. M. Vlahovska, T. Horozov, P. Kralchevsky, C. Dushkin, A. Mehreteab and G. Broze, "Adsorption in micellar surfactant solutions: nonlinear theory and experiment", *J. Coll. Int. Sci.* **183**, pp.223-235 (1996)

## MANUSCRIPTS UNDER REVIEW OR IN PREPARATION

- P. M. Vlahovska "Note on the electrorheology of a dilute emulsion of slightly deformable drops", submitted to *J. Fluid Mech.*
- P. M. Vlahovska, Y. Young, G. Danker and C. Misbah, "Complex dynamics of red blood cells in shear flows"
- P. Salipante and P. M. Vlahovska "Rotation of a deformable drop an uniform electric field"

## TEACHING EXPERIENCE

### **Instructor, Dartmouth College**

- 2007-2010 "Fluid Mechanics" (undergraduate)
- 2010 "Biological Physics" (undergraduate)
- 2010 "Heat, mass, and momentum transfer" (graduate)
- 2008,2009 "Cellular and molecular biomechanics" (graduate)
- 2009 "Micro-hydrodynamics" (graduate)

### **Instructor, Brown University**

- 2003 "Fluid Mechanics" (undergraduate)
- 2004, 2005 "Fluid Mechanics II" (graduate)
- 2004 "Complex fluids" (graduate)

### **Teaching Assistant, Yale University**

- 2002 "Ordinary and Partial Differential Equations with Applications" (undergraduate)
- 2000, 2002 "Mathematical Methods I" (graduate)
- 2000, 2001 "Thermodynamics for Chemical, Mechanical and Environmental Engineers" (undergraduate)
- 1999 "Applied Numerical Methods I" (graduate)
- 1999 "Introduction to Chemical Engineering: Material and Energy Balances" (undergraduate)

### **Tutor, Yale University**

- 2000-2002 Yale College Math and Science Tutoring Program (undergraduate).

## INVITED TALKS

10/2009 Mechanical Engineering, University of Maryland Baltimore County  
09/2009 Mechanical Engineering and Applied Mechanics, University of Pennsylvania  
07/2009 Max-Planck Institute for Colloids and Interfaces, Theory and Biosystems, Germany  
04/2009 Center for Fluid Mechanics, Brown University  
02/2009 Engineering Sciences and Applied Math, Northwestern University  
12/2008 IPAM-UCLA: Cells and Materials: At the Interface between Mathematics, Biology and Engineering - Reunion Conference II  
11/2008 Department of Chemistry, Dartmouth College  
10/2008 Computations in Science Seminar, MRSEC, University of Chicago  
04/2008 Condensed Matter Theory Seminar, Harvard University  
02/2008 School of Engineering, University of Vermont  
10/2007 Engineering Sciences and Applied Math, Northwestern University  
10/2007 Condensed Matter Seminar, Physics Department, Brown University  
07/2007 ICIAM mini-symposium "Influence of surfactant on interfacial flows", Zurich, Switzerland  
05/2007 Institute Curie, Physical Chemistry Unit, France  
03/2007 Department of Mathematical Sciences, NJIT  
02/2007 Department of Physics, Dartmouth College  
07/2006 Max-Planck Institute for Polymer Research, Mainz, Germany  
03/2006 IPAM-UCLA: Membrane Protein Science and Engineering workshop  
03/2005 Flow Physics and Computation group, Mechanical Engineering, Stanford University  
02/2005 Thayer School of Engineering, Dartmouth College  
11/2004 DAMTP, University of Cambridge, UK  
04/2003 Division of Engineering, Brown University

## CONTRIBUTED TALKS

Regular presentations at the AIChE Annual Meeting and the APS-Division of Fluid Dynamics meeting.

## PROFESSIONAL ACTIVITIES

*Co-organizer:*

- Summer school on "Complex- and Bio- Fluids", Cargese, Corsica, France, 2009
- Session "Interfacial flows", AIChE annual meeting, 2009
- Mini-symposium on "Biological Cells and Capsules" at the 8th World Congress on Computational Mechanics, 2008

*Member:* APS, AIChE, SIAM

*Reviewer:* Physical Reviews, Journal of Fluid Mechanics, Biophysical Journal, Soft Matter, Journal of Applied Physics, Journal of Colloid and Interface Science, Colloids and Surfaces B: Biointerfaces, Chemical Engineering Science

*Panelist:* NSF – CBET PMP(2007, 2009), NSF-CDI (2008)

## STUDENTS

**Graduate:** Paul Salipante (MS 2009, continuing as PhD), Scott Decker (MS), Jonathan Schwalbe (PhD student in ESAM, Northwestern University, co-advisor with Prof. Miksis)

**Undergraduate:** Claudine Gregorio, Xue (Shelley) Han, Emily DeBaun

## CURRENT COLLABORATIONS

Dr. Rumiana Dimova (Max-Planck Institute of Colloids and Interfaces, Germany)

Prof. Chaouqi Misbah (Complex Systems Center, CNRS and UJF-Grenoble, France)

Prof. Michael Miksis (Engineering Sciences and Applied Math, Northwestern University)

Prof. Yuan-nan Young (Dept. Math Sciences, NJIT)

Prof. George Biroş (Computational Science and Engineering, Georgia Tech)