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Ph.D. Physics, Carnegie Mellon University, 1998
M.S. Physics, Carnegie Mellon University, 1995
Diploma Theoretical Physics, University of Bucharest, 1992
Baccalaureate Mathematics and Physics, "Dr. I. Mesota" Lyceum, 1986

EDUCATION AND RESEARCH

2001-Present: Postdoctoral Fellow, NIH. Dr. V. Adrian Parsegian, Advisor.

1998-2001: Postdoctoral Fellow, Johns Hopkins University School of Medicine, Department of Physiology. Prof. Thomas B. Woolf, Advisor.

1993-1998: Graduate Student, Carnegie Mellon University, Department of Physics, Biological Physics Laboratory. Prof. John F. Nagle, Advisor. Ph. D. Thesis: *Structure and Interactions of Fluid Phospholipid Bilayers Measured by High Resolution X-ray Scattering*.

1992-1993: Research Fellow, Ettore Majorana Center, Italy, Prof. Antonino Zichichi, Advisor.

1987-1992: Student, Department of Physics, University of Bucharest, Romania. Theoretical Physics Diploma: Neutrino Oscillations. Dr. Mihai Visinescu, Atomic Physics Institute, Romania.

AWARDS AND SCHOLARSHIPS

Outstanding Mentor of 2003/2004 Siemens Westinghouse Competition in Math, Science and Technology; Intramural Research Training Award (IRTA), NIH 2001-present; Research Assistantship, CMU 1995-1998; Teaching Assistantship, CMU 1993-1995; World Laboratory Research Scholarship, Italy 1992-1993; Governmental award for academic merit, Romania 1987-1992.

RESEARCH EXPERIENCE

Experimental: Advanced methods in small-angle X-ray scattering, including synchrotron measurements at Cornell High Energy Synchrotron Source (CHESS). Solid-state NMR spectroscopy and line-shape analysis. DSC and ITC calorimetry, Langmuir surface measurements.

Theoretical: Thermodynamics and calculation of interactions for smectic and nematic liquid crystals from X-ray and NMR data. van der Waals, hydration, and entropic forces for lipid bilayers, membrane proteins, and water soluble polymers.

Computational: Molecular dynamics (CHARMM software) and Monte Carlo simulations of biomolecular systems. Analysis methods for X-ray and NMR line-shape analysis, and to compare molecular simulations with primary experimental data.

TEACHING AND MENTORING EXPERIENCE

Lectured on Structure and Chemistry of Lipid Bilayers (ME:360.729), The Johns Hopkins University School of Medicine, Dr. Jan Hoh Course Director, 2004; Summer student mentoring, NIH 2003, 2004, and John Hopkins Univ. 1999-2002; TA recitations in Physics for Engineering/Science Students, 1995--1996.

COLLABORATIONS

Michael F. Brown, Department of Chemistry, University of Arizona; Chuck Majkrzak, Center for Neutron Research, NIST; Marjorie Gondre-Lewis, Cellular Neurobiology, NICHD, NIH; John F. Nagle and Stephanie Tristram-Nagle Departments of Physics and Biological Sciences, Carnegie Mellon University; Thomas B. Woolf, Department of Physiology, Johns Hopkins University School of Medicine; Thomas Zemb, Service de Chimie Moléculaire, C. E. A. Saclay, France.

RESEARCH INTERESTS

- Biomembrane structure and function. Thermodynamic description of lipid bilayer interactions with membrane proteins (channels and receptors), sterols, neurostimulants, salt ions: structural fluctuations, conformational changes, and entropic effects. Theory and measurement of biomembrane lateral stress (curvature and bending energies) acting on channels and receptors.
- Interactions at the lipid/water interface and intermembrane interactions (fusion, drug delivery). Theory of liquid crystals and applications to lipid membranes.
- Physical basis of signal transduction. Translocation of fatty acids and other signaling molecules across the cell membrane. Relationship between chemical and physical properties of essential fatty acids and cell function.
- X-ray, NMR, optical spectroscopy, mass spectrometry, other biophysical methods. Molecular modeling and computer simulations.

TEACHING INTERESTS

General Mathematics. Basic Physics: Mechanics, Thermodynamics, Electrodynamics. Advanced courses: Quantum Mechanics, Group Theory. Interdisciplinary: Biophysics, Physical Chemistry, Molecular Modeling, Structural Biology.

MEMBERSHIPS: American Physical Society, 1992; American Chemical Society, 2000; Biophysical Society, 1996; International Society for the Study of Fatty Acids and Lipids, 2002; Sigma Xi Scientific Society, 1998.

MANUSCRIPT REVIEWS: Biochimica et Biophysica Acta, Biophysical Journal, Langmuir, Journal of Physical Chemistry.

INVITED TALKS

- Service de Chimie Moleculaire, C. E. A. Saclay, France. May 2004.
- Bio-Colloid Symposium at the 227th ACS National Meeting, Anaheim, CA. 2004.
- Laboratory of Integrative and Medical Biophysics, NICHD, National Institutes of Health. 2002.
- Dietary Fats and Health, 5th Congress of the International Society for the Study of Fatty Acids and Lipids, Montreal, Canada. May 2002.
- Department of Biochemistry and Molecular Biophysics, University of Arizona. Oct. 2000.
- "Chocolate Talk" seminars, NIH/NIHCD. 1999.
- Workshop on Bilayer Structure from NMR, NIH/NIAAA. 1998.
- Workshop on the Vapor Pressure Paradox, NIH/DCRT. 1998.

OTHER PRESENTATIONS

- Annual Meetings of the Biophysical Society, 1996-2004.
- Polymer Networks, NIH, 2004.
- Dietary Fats and Health, 6th Congress of the International Society for the Study of Fatty Acids and Lipids, Brighton, UK. 2004.
- 61st Pittsburgh Diffraction Conference. The State University of New Jersey, Rutgers, NJ. 2003.
- Workshops and symposia at the Johns Hopkins University (1999-2001) and the National Institutes of Health, 1999-2004.
- Symposium on the Physics of Soft Materials, University of Pennsylvania, 1997.
- Triangle Biophysics Symposium on Molecular Dynamics of Biomembranes,
- The University of North Carolina at Chapel Hill, 1996.

HORIA I. PETRACHE
LIST OF PUBLICATIONS

1. Rajammorthi, K., **H. I. Petrache**, T. J. McIntosh, and M. F. Brown. Packing and viscoelasticity of polyunsaturated ω -3 and ω -6 lipid bilayers as seen by ^2H NMR and X-ray diffraction. *J. Am. Chem. Soc.* in press.
2. **Petrache, H. I.**, D. Harries, V. A. Parsegian. Alteration of lipid membrane rigidity by cholesterol and its metabolic precursors. *Macromolecular Symposia*, in press.
3. Sachs, J. N., Hirsh Nanda, **H. I. Petrache** and T. B. Woolf. Changes in phosphatidylcholine headgroup tilt and water order induced by monovalent salt: Molecular Dynamics Simulations. *Biophys. J.*, 86:3772-3782, 2004.
4. **Petrache, H. I.**, S. Tristram-Nagle, K. Gawrisch, D. Harries, V. A. Parsegian, and J. F. Nagle. Structure and fluctuations of charged phosphatidylserine bilayers in the absence of salt. *Biophys. J.* 86:1574-1586, 2004.
5. Sachs, J. N., **H. I. Petrache**, and T. B. Woolf. Interpretation of small angle X-ray measurements guided by molecular dynamics simulations of lipid bilayers. *Chem. Phys. Lipids* 126:211-223, 2004.
6. Sachs, J. N., **H. I. Petrache**, D. M. Zuckerman, and T. B. Woolf. Molecular dynamics simulations of ionic concentration gradients across model bilayers. *J. Chem. Phys.* 118:1957-1969, 2003.
7. **Petrache, H. I.**, D. M. Zuckerman, J. N. Sachs, J. A. Killian, R. E. Koeppe II, and T. B. Woolf. Hydrophobic Matching Mechanism Investigated by Molecular Dynamics Simulations. *Langmuir* 18:1340—1351, 2002.
8. **Petrache, H. I.**, A. Salmon, and M. F. Brown. Structural Properties of Docosahexaenoyl Phospholipid Bilayers Investigated by Solid-State ^2H NMR Spectroscopy. *J. Am. Chem. Soc.* 123:12611-12622, 2001.
9. **Petrache, H. I.**, A. Grossfield, K. R. MacKenzie, D. M. Engelman, and T. B. Woolf. Modulation of Glycophorin A Transmembrane Helix Interactions by Lipid Bilayers – Molecular Dynamics Calculations. *J. Mol. Biol.* 302:727-746, 2000.
10. **Petrache, H. I.**, S. W. Dodd, and M. F. Brown. Area per Lipid and Acyl Length Distributions in Fluid Phosphatidylcholines Determined by ^2H NMR Spectroscopy. *Biophys. J.* 79:3172-3192, 2000.
11. **Petrache, H. I.**, K. Tu, and J. F. Nagle. Analysis of Simulated NMR Order Parameters for Lipid Bilayer Structure Determination. *Biophys. J.* 76:2479-2487, 1999.
12. Nagle J. F., **H. I. Petrache**, N. Gouliaev, S. Tristram-Nagle, Y. Liu, R. M. Suter, and K. Gawrisch. Multiple Mechanisms for Critical Behavior in the Biologically Relevant Phase of Lecithin Bilayers. *Phys. Rev. E* 58:7769-7776, 1998.
13. **Petrache, H. I.**, S. Tristram-Nagle, and J. F. Nagle. Fluid Phase Structure of EPC and DMPC Bilayers. *Chem. Phys. Lipids*, 95:83-94, 1998.
14. Tristram-Nagle, S., **H. I. Petrache**, and J. F. Nagle. Structure and Interactions of Fully Hydrated Dioleoylphosphatidylcholine Bilayers. *Biophys. J.* 75:917-925, 1998.
15. **Petrache, H. I.**, N. Gouliaev, S. Tristram-Nagle, R. Zhang, R. M. Suter, and J. F. Nagle. Interbilayer Interactions from High Resolution X-Ray Scattering. *Phys. Rev. E* 57:7014-7024, 1998.
16. Tristram-Nagle, S., T. Moore , **H. I. Petrache**, and J. F. Nagle. DMSO Produces a New Subgel Phase in DPPC: DSC and X-Ray Diffraction Study. *Biochim. Biophys. Acta*, 1369:19-33, 1998.

17. Tristram-Nagle, S., **H. I. Petrache**, R. M. Suter, and J. F. Nagle. Effect of Substrate Roughness on D Spacing Supports Theoretical Resolution of Vapor Pressure Paradox. *Biophys. J.* 74:1421-1427, 1998.
18. **Petrache, H. I.**, S. E. Feller, and J. F. Nagle. Determination of Component Volumes of Lipid Bilayers from Simulations. *Biophys. J.* 72:2237-2242, 1997.
19. Nagle, J. F., R. Zhang, S. Tristram-Nagle, W.-J. Sun, **H. I. Petrache**, and R. M. Suter. X-Ray Structure Determination of Fully Hydrated L_α Phase Dipalmitoylphosphatidylcholine Bilayers. *Biophys. J.* 70:1419-1431, 1996.
20. Anzivino, G., F. Arzarello, G. Bari, M. Basile, L. Bellagamba, D. Boscherini, G. Bruni, P. Bruni, G. Cara Romeo, M. Chiarini, L. Cifarelli, F. Cindolo, F. Ciralli, A. Contin, M. Dardo, S. D'Auria, C. Del Papa, S. De Pasquale, F. Frasconi, P. Giusti, G. Iacobucci, G. Maccarrone, A. Margotti, T. Massam, R. Nania, **H. I. Petrache**, S. Qian, G. Sartorelli, Yu. M. Shabelski, M. A. Stepanov, O. P. Strogova, R. Timellini, L. Votano, A. Zichichi. Intrinsic Charm in $p\bar{p}$ and γp Interactions. *Nuovo Cimento A (Italy)* 107A:955-988, 1994.

SUBMITTED/IN PREPARATION

1. Exclusion of Salt at the Lipid-Water Interface: Lipids Float. Petrache H. I., I. Kimchi, D. Harries, V. A. Parsegian.
2. Swelling of Lipid Multilayers in Salt Solutions. Petrache, H. I., S. Tristram-Nagle, D. Harries, N. Kucerka, N. Chu, J. F. Nagle, V. A. Parsegian.
3. Specific Ion Adsorption on Zwitterionic Bilayers: Charge Regulation and Ionic Screening of Dispersion Forces, Petrache H. I., L. Belloni, T. Zemb, V. A. Parsegian.
4. Correspondence of States and Universal Features of Lipid Acyl Chain Packing as Determined by Solid State ²H NMR Spectroscopy. Petrache, H. I., M. F. Brown.
5. Structure of Fully Hydrated Fluid Phase DMPC and DLPC Lipid Bilayers Using X-ray Scattering From Oriented Multilamellar Arrays and From Unilamellar Vesicles. Kucerka, N., Y. Liu, N. Chu, H. I. Petrache, S. Tristram-Nagle, J. F. Nagle.
6. Environmental Effects on Glycophorin A Folding and Structure Examined by Molecular Simulations. Nanda, H., J. N. Sachs, H. I. Petrache, T. B. Woolf.
7. Membrane Curvature Elasticity of Polyunsaturated Phosphatidylethanolamine Monolayers, Teague W.E., Petrache H.I., Fuller N., Rand R.P., Gawrisch K.
8. Lanosterol and Cholesterol-Induced Variations in Bilayer Elasticity Studied by Deuterium NMR and X-ray Diffraction. Martinez G.V., Dykstra E.M., Lope-Piedrafita S., Petrache H.I., Brown M.F.