

## MICHAL R. ZOCHOWSKI

Professor of Physics

Professor of Biophysics

Neuroscience Program, Applied Physics Program

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(Updated: 03/16/2013)

### **Education and Training:**

02/2002 Habilitation (European advanced degree), Institute of Biocybernetics and Biomedical Engineering, Polish Academy of Science, Warsaw, Poland.  
11/1995 Ph.D., Department of Physics, University of Warsaw, Warsaw, Poland.  
03/1993 M.Sc., Department of Physics, University of Warsaw, Warsaw, Poland.

### **Employment:**

09/2013- Professor, Department of Physics, Biophysics Program, University of Michigan.  
09/2008 – 09/2013 Associate Professor, Biophysics Program.  
09/2007 – 09/2013 Associate Professor, Department of Physics, University of Michigan; Associate Research Scientist, Biophysics Program, University of Michigan.  
11/2001 - 09/2007 Assistant Professor, Department of Physics, University of Michigan; Assistant Research Scientist, Biophysics Research Division, University of Michigan.  
1998, 2000, 2001 Summer Investigator at Marine Biological Laboratory in Woods Hole, MA.  
01/1998 - 11/2001 Postdoctoral fellow, Department of Molecular and Cellular Physiology, Yale University School of Medicine.  
09/1996 - 01/1998 Postdoctoral Fellow, Center for Complex Systems, Florida Atlantic University.  
01/1996 - 05/2000 Assistant Professor, Center for Theoretical Physics, Polish Academy of Science; since 09/1996 on scientific leave of absence.  
04/1993 - 1/1996 Assistant, Center for Theoretical Physics, Polish Academy of Science.  
1991 - 1994 Summer Researcher, Department of Physics, North Carolina State University.

### **Departmental and University Wide service:**

2012 Robert Deegan Tenure promotion committee, Physics.  
2011 - 2012 Member of Networks cluster hire coordinating committee, Biophysics.  
2011 - 2012 Co-organizer of Quantitative Biology seminar.  
2011 - 2013 Elected member of Physics Executive Committee.  
2010 - 2012 Member of Biophysics Search Committee.  
2010 - 2011 Member of Physics Search committee.  
2010 - Director of Biophysics REU program.  
2010 - Concentration advisor, Physics.  
2010 Robert Deegan 3rd-year review committee, Physics.  
2009 - 2012 David Lubensky faculty mentor, Physics.  
2009 - 2010 Chair of Graduate fellowships committee, Physics.  
2008 - 2010 Co-organizer of Biological Physics/Complex Systems Seminar.  
2008 - 2011 Undergraduate Advisor for Biophysics.  
2008 - 2010 Member of Michigan Center for Theoretical Physics (MCTP) executive Committee.  
2008 - 2010 Associate Chair for Undergraduate Studies, Biophysics Program.  
2008 - 2010 Member of Biophysics Curriculum Committee.  
2008 - 2010 Member of Biophysics Executive committee.

2008 - 2009 Member of Advisors/Grad Concerns Committee, Physics.  
 2008 - 2009 University Honors Program Faculty Advisory Board member.  
 2007 - 2008 Departmental Marshall, Physics.  
 2007 - 2008 Member of Biophysics search committee.  
 2007 - 2008 Co-organizer of Biophysics Luncheons.  
 2006 - NSF GRFP university-wide resource faculty.  
 2005 - 2008 Concentration Advisor, Physics.  
 2006 *Condensed Matter/Atomic, Molecular Optics* seminar organizer, Physics.  
 2005, 2006, 2007 Administered Biophysics preliminary examination  
 2004 - Molecular Biophysics Training Grant Committee, Biophysics  
 2004 Cornwall award committee, Physics  
 2003 Terwilliger award committee, Physics  
 2002-2005 Graduate Admissions Committee PIBS (Med. School), representing Biophysics  
 2002-2005 Graduate Admissions Committee, Biophysics Research Division  
 2002-2005 Graduate Admissions Committee, Department of Physics

**Grants and Awards (awarded):**

01/2012 - 12/2012 Office of Naval Research (ONR), *Funding for Experimental Chaos and Complexity Conference*, role: Principal Investigator (PI), (\$30,000 total).  
 04/2011 - 06/2012 Michigan Meetings (University of Michigan), *Funding for Experimental Chaos and Complexity Conference*, (Booth and Zochowski, PIs), (\$50,000 total).  
 11/2011 - 10/2014 NSF (PoLS), *Functional Augmentation of Existing Networks with New Neurons*, PI (\$300,000 total, \$204,200 direct).  
 06/2011 - 05/2013 Associate Professor fund (UM), *Understanding dynamic self-reorganization in adaptive neuronal networks*, (\$100,000 total).  
 09/2010 - 08/2013 NSF (CMMI), *Understanding Multimodal Interactions in Neuronal Networks*, PI, (\$340,000 total, \$235,138 direct).  
 06/2010 - 08/2012 NSF, REU site: Interdisciplinary Research Opportunities in Biophysics; PI (\$242,000 total, \$218,818 direct).  
 04/2009 - 06/2010 Center for Computational Medicine and Biology (CCMB; University of Michigan), *Cell migration and incorporation during neurogenesis and network dynamics*, PI, (\$40,000).  
 07/2008 - 06/2011 NIH (NIBIB, R-21), *Detecting functional network structures from neural activity*, PI, (\$413,320 total, \$275,000 direct).  
 06/2008 Institute for Complex Adaptive Matter (ICAM) Senior Fellowship, *Investigating structural network modifications underlying dynamics of information processing*, (\$2,500 total).  
 07/2007 Harold C. Early award, University of Michigan, (\$10,000 total).  
 11/2006 - 10/2007 Center for Computational Medicine and Biology (CCMB; University of Michigan), *Cellular pathologies and their effect on brain dynamics in temporal lobe epilepsy*; co-investigator (\$40,000 total).  
 06/2006 Harold C. Early award, University of Michigan (\$10,000 total).  
 06/2006 Office of Vice president for research faculty grant, University of Michigan, (\$10,000 total).  
 08/2005 - 07/2008 NIH (NIBIB, R-21), *Imaging the activity of cortical network*, PI, (\$394,634 total, \$275,000 direct).  
 08/2005 Harold C. Early award, University of Michigan, (\$20,000).  
 09/2004 UNCF/MERCK postdoctoral fellowship for Dr. R. Dzakpasu, (\$70,000).  
 05/2004 Margaret and Herman Sokol endowed fellowship, University of Michigan.  
 01/2004 Rackham fellowship, University of Michigan, Ann Arbor, MI. (\$15,000)  
 06/2001 - 09/2001 Stephen W. Kuffler Fellowship and Marine Biological Laboratory Associates Fellowship, Woods Hole, MA.

- 06/1999 - 08/1999 The Grass Foundation Summer Fellow in Marine Biological Laboratory at Woods Hole, MA.
- 08/1998 - 07/1999 James Hudson Brown - Alexander B. Coxe Fellowship at Yale University School of Medicine.
- 01/1994 - 12/1996 W. Tarkowski and M. Zochowski the three-year-grant, *Statistical Physics of Neural Networks*, received from Committee for Scientific Research in Poland.

### **Professional Activities:**

#### Organization of events:

- 2013 Organizer (with V. Booth and J. Moehlis) of mini-symposium at SIAM Dynamical Systems conference, Snowbird, UT
- 2012 Organizer (with V. Booth) of 12<sup>th</sup> Experimental Chaos and Complexity Conference, University of Michigan.
- 2009 Organizer (with J.W. Allen and R.D. Deegan) of ICAM workshop “Emergence in Physical, Biological and Social Systems, IV”, University of Michigan.
- 2007 Organizer (with R. Savit) of workshop “From Microscopic to Macroscopic – mechanisms underlying epileptic seizures”, University of Michigan.
- 2006 Organizer (with E. Ben-Jacob) of the symposium at the APS March meeting.
- 2005 Organizer of mini-symposium “Neural processing in a nutshell” (Department of Physics, UM).

#### Editorial boards:

- 2013-2016 Advisory Board of *Chaos: An Interdisciplinary Journal of Nonlinear Science*
- 2010 - Review Editor for *Frontiers in Neuroengineering*
- 2011 - Academic Editor for *PLoS ONE*

#### Reviewer for:

- Physics journals:** *Chaos*, *J. Phys A*, *Phys.Rev. E*, *Phys. Rev. Lett.*, *Physics Letters A*, *Physical Biology*, *Int. J Biff & Chaos*, *EuroPhysics Letters (EPL)*, *Nonlinearity*, *PLoS One*.
- Engineering journals:** *IEEE Transactions on Circuits and Systems*, *Transactions on Neural Systems & Rehabilitation Engineering*.
- Biology journals:** *Journal of Neuroscience Methods*, *J. Neurosci*, *J. Neurophysiology*, *Neuroscience*, *Cerebral Cortex*, *Biophysics Journal*, *PLoS Computational Biology*.

#### External service:

- 2011- NSF, reviewer and panelist.
- 2010 Reviewer for Netherlands Organisation for Scientific Research, Division of Physical Sciences.
- 2008 - 2013 Panelist for NSF GRFP program.
- 2006 Reviewer for U.S. Civilian Research and Development Foundation.
- 2005 External reviewer for Honors Program thesis at Kenyon College (Gambier, OH).

### **Membership in professional societies:**

- Society for Neuroscience
- American Physical Society
- Society for Industrial and applied Mathematics (SIAM)

### **Teaching (evaluation scores out of 5.0):**

#### ***Course work:***

2012 (Fall)	Physics 135	Q1: 3.77; Q2: 4.80
2012 (Winter)	Biop 290/Phys 290	Q1: 4.20; Q2: 4.59
2011 (Fall)	Physics 135	Q1: 4.01; Q2: 4.74
2011 (Winter)	Biophysics 290/Physics 290	Q1: 4.20; Q2: 4.56
2010 (Fall)	Physics 106 (Everyday Physics)	Sec 1: Q1: 4.81; Q2: 4.81 Sec 2: Q1: 4.17; Q2: 4.90
2010 (Winter)	Biophysics 290 (Physics of Body and Mind)	Q1: 4.11; Q2: 4.27
2009 (Fall)	Physics 135 (Physics for Life Sciences I)	Q1: 3.76; Q2: 4.17
2009 (Winter)	Biophysics 433 (Biocomplexity – new course)	Q1: 4.83; Q2: 5.00
2008 (Fall)	Physics 106 (Everyday Physics)	Sec 1: Q1: 4.70; Q2: 4.77 Sec 2: Q1: 4.70; Q2: 4.77
<b>2008 (Winter)</b>	<b>Sabbatical</b>	
2007 (Fall)	Physics 160 (Honors Mechanics)	
2007 (Winter)	Physics 160 (Honors Mechanics)	
2006 (Winter)	Physics 417 (Dynamical Process in Biophysics)	
2005 (Fall)	Neuroscience 700	
2004 (Winter)	Physics 106 (Everyday Physics)	
2003 (Fall)	Physics 160 (Honors Mechanics)	
2003 (Winter)	Physics 260 (Honors Electricity and Magnetism)	

#### ***Postdoctoral fellows:***

Rhonda Dzakpasu (2002-2006); currently faculty at Georgetown

#### ***Graduated Ph.D. students:***

Soyoun Kim	Physics; graduated Fall 2005
Ben Singer	M.D./Ph.D., Neuroscience Program; graduated Spring 2007
Jack Waddell	Physics; graduated Spring 2007
Sarah Feldt	Physics; graduated Spring 2009
Jane Wang	Applied Physics; graduated Summer 2010
Troy Lau	Physics, graduated Fall 2010
Christian Fink	Physics, graduated Fall 2012

#### ***Current graduate students:***

Dan Maruyama	Physics
Liz Shtrahman	Applied Physics
Tony Smith	Applied Physics
Sima Mofakham	Biophysics
James Roach	Neuroscience Program

#### ***Membership on other Ph.D. committees:***

1. Seth Koehler Biomedical Engineering, Susan Shore advisor
2. Alison Althaus Neuroscience, Jack Parent advisor
3. Kristen Herrmann Biophysics, Raul Kopelman advisor
4. Rui Huang Biophysics, Ayyalusamy Ramamoorthy advisor
5. Robin Johnson Biophysics (graduated 2012), Duncan Steele advisor
6. Krishnan Raghunathan Physics (2012), Chris Meiners advisor
7. David Adams Physics (2011), Len Sanders advisor
8. Matthew Pennington Physics (2011), David Lubensky advisor

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| 9. Casey Schneider-Mizell | Physics (2010), Leonard Sander advisor       |
| 10. Jessie Ward           | Biophysics (2009), James Penner-Hahn advisor |
| 11. Jinyao Zhang          | Physics (2009), Robert Savit advisor         |
| 12. Gourab Ghoshal        | Physics (2009), Mark Newman advisor          |
| 13. Katherine Jordan      | Physics (2008), Chris Meiners advisor        |
| 14. Bezhad Ebrahimi       | Physics (2008), Tim Chupp advisor            |
| 15. Dingzhou Li           | Physics (2005), Robert Savit advisor         |
| 16. Rhonda Dzakpasu       | Physics (2003), Daniel Axelrod advisor       |

### **Publications:**

1. <sup>1</sup>C Fink, G Murphy, V Booth, M Zochowski (2013) Acetylcholine, Network Dynamics, and Synaptic Renormalization. *PLoS Computational Biol* 9, e1002939.
2. J Wang, M Zochowski (2012) Interactions of Excitatory and Inhibitory Feedback Topologies During Memory Reactivation and Recall. *Neural Computation* 24, 32-59.
3. Lau T, M Zochowski (2011) The resonance frequency shift, pattern formation, and enhanced network reorganization via sub-threshold input. *PLoS One* 6, e18983.
4. Fink C, V Booth, M Zochowski (2011) Cellularly-driven differences in network synchronization propensity are differentially modulated by firing frequency. *PLoS Comp. Biol* 7, e1002062.
5. Lau T, M Zochowski (2011) Interaction between connectivity and oscillatory currents in a heterogeneous neuronal network. *Phys Rev E* **83**, 051908.
6. Fink C, V Booth, M Zochowski (2011) Effects of the frequency dependence of phase response curves on network synchronization. Chapter in: *Phase Response Curves in Neuroscience; Theory, Experiment & Analysis*.
7. Schneider-Mizell CM, JM Parent, E Ben-Jacob, M Zochowski, LM. Sander (2010) From network structure to network reorganization: implications for adult neurogenesis. *Phys Biol* 7, 046008.
8. <sup>2</sup>Feldt S, JX Wang, E Shtrahman, R Dzakpasu, E Olariu, and M Zochowski (2010) Functional clustering in hippocampal cultures: relating network structure and dynamics. *Phys Biol* 7, 046004.
9. Lau T, GJ Gage, JD Berke, M Zochowski (2010) Local dynamics of gap-junction-coupled interneuron networks. *Physical Biology* 7, 16015.
10. Feldt S, J Wang, VL Hetrick, JD Berke, M Zochowski (2010) Memory formation: from network structure to neural dynamics. *Philosophical Transactions of Royal Society A* 368, 2251-2267.
11. Feldt S, J Waddell, VL Hetrick, J Berke, M Zochowski (2009) A functional clustering algorithm for the analysis of neural relationships. *Phys Rev E* 79, 056104.
12. Bogaard A, JM Parent, M Zochowski, V Booth (2009) Interaction of cellular and network mechanisms in spatio-temporal pattern formation in neuronal networks. *J. Neuroscience* 29(6), 1677-1687.
13. Wang J, GR Poe, M Zochowski (2008) From network heterogeneities to familiarity detection and hippocampal memory management. *Phys Rev E* 78, 041905.
14. Waddell J, M Zochowski (2007) Intraburst versus interburst locking in networks of driven nonidentical oscillators. *Phys Rev E* 76, 056216.
15. Feldt S, H Osterhage, F Mormann, K Lehnertz, M Zochowski (2007) Inter- and intra- network communications during bursting dynamics: applications to seizure prediction. *Phys Rev E* 76, 021920.
16. Waddell J, R Dzakpasu, V Booth, BT Riley, JD Reasor, GR Poe, M Zochowski (2007) Causal Entropies – a measure for determining changes in the temporal organization of neural systems. *J. Neurosci. Meth.* 162, 320-332.
17. Jablonski P, GR Poe, M Zochowski (2007) Simple dynamical process may underlie memory reactivation during sleep. *Phys Rev E* 75, 011912.

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<sup>1</sup> Selected as featured research in March, 2013 issue of the journal.

<sup>2</sup> Selected as highlighted paper by *Physical Biology*.

18. Singer BH, S Kim, M Zochowski (2007) Binaral interaction modulates olfactory bulb response to odorant history. *Euro. J. Neurosci* 25, 576.
19. Dzakpasu R, K Patel, N Robinson, M Harrington, M Zochowski (2006) Measuring properties of phase synchronization in a network of coupled oscillators, *Chaos* 16, 043121.
20. Waddell J, M Zochowski (2006) Network reorganization driven by temporal interdependence of its elements. *Chaos* 16, 023106.
21. Singer B, M Derchansky, P Carlen, M Zochowski (2006) Local driving and global interactions in the progression of seizure dynamics. *Phys Rev E* 73, 021910.
22. Kim S, B Singer, M Zochowski (2006) The formation of temporal representation based on resolved sequences of selective feature binding. *Neural Comp.* 18, 794-816.
23. Wuskell JP, D Boudreau, MD Wei, L Jin, R Engl, R Chebolu, A Bullen, KD Hoffacker, J Kerimo, LB Cohen, M Zochowski, LM Loew (2006) Synthesis, spectra, delivery and potentiometric responses of new styryl dyes with extended spectral ranges. *J Neurosci Methods* 151, 200-15.
24. Percha B, R Dzakpasu, J Parent, M Zochowski (2005) Transition from local to global phase synchrony in small world neural network and its possible implications for epilepsy, *Phys Rev E* 72, 031909.
25. Zochowski M, LB Cohen (2005) Odorant presentation history dependent oscillations in the olfactory bulb, *J. Neurophysiol.* 94, 2667-2675.
26. Dzakpasu R, M Zochowski (2005) Changes in synchrony and phase synchrony between individual neurons in normal and epileptic brain. *Physica D* 208 : 115-122.
27. Nowak A, R Vallacher, M Zochowski (2005) The emergence of personality: Dynamic foundations of individual variation. *Developmental Review* 25, 351-385.
28. Rychwalska A, P Jablonski, M Zochowski, Nowak A. (2005) Novelty based feedback regulation in artificial neural networks. *Acta Neurobiol Exp (Wars)*. 65, 453-463.
29. Dzakpasu R, M Zochowski (2004) Adaptation through minimization of the phase lag in coupled non-identical systems, *Chaos* 14, 583-591.
30. Kim S, M Zochowski (2004) Relative spatio-temporal properties of odor evoked oscillations in turtle olfactory bulb. *Acta Neurobiol. Exp.* 64, 291-294.
31. Zochowski M, R Dzakpasu (2004) Conditional entropies; phase synchronization and changes in the directionality of information flow in neural systems, *J. Phys A* 37, 3823-3834.
32. Zochowski M, R Dzakpasu (2004) Adaptation of nonlinear systems through dynamic entropy estimation, *J. Phys A* 37, 2223-2237.
33. Lam Y-W, LB Cohen, M Zochowski (2003) Effect of odorant quality on the three oscillations and the DC signal in the turtle olfactory bulb. *Euro J Neurosci* 17, 436-446.
34. Djuriscic MR, M Zochowski, M Wachowiak, CX Falk, LB Cohen, D Zecevic (2003) Optical Monitoring of Neural Activity Using Voltage-Sensitive Dyes. In: eds: G. Marriott and I. Parker, *Methods in Enzymology* 361, 423-451.
35. Zochowski M, R Dzakpasu (2002) Adaptation and synchronization as a way to control spatio-temporal pattern formation in the system of coupled logistic maps. *Frontiers of Artificial Intelligence and Applications* 82, 927-932.
36. Jochenning FW, M Zochowski, SJ Conway, AB Holmes, P Koulen, and BE Ehrlich (2002) Distinct intracellular calcium transients in neurites and somata integrate neuronal signals. *J. Neurosci.* 22, 5344-5353.
37. Nowak A, R Vallacher, M Zochowski (2002) The Emergence of Personality: Personal Stability through Interpersonal Synchronization, in *Advances in personality science*, D. Cervone & W. Mischel (Eds.), New York: Guilford Publications.
38. Wachowiak M, LB Cohen, and M Zochowski (2002) Distributed and concentration invariant spatial representations of odorants by receptor neuron input to the turtle olfactory bulb. *J. Neurophysiology* 87, 1035-1045.
39. Wachowiak M, Y-W Lam, LB Cohen, M Zochowski, (2002) Voltage-sensitive and calcium sensitive dye imaging of activity in the olfactory bulb: presynaptic inhibition, maps of receptor input, and oscillations. In: eds. S. A. Simon and M. Nicolelis, *Methods in Chemosensory Research*, 91, CRC Press, Boca Raton, FL.

40. Wachowiak M, CX Falk, LB Cohen, M Zochowski (2002) Voltage and calcium imaging of the brain activity: examples from turtle and the mouse. In: eds. A. W. Toga and J. C. Mazziotta, *Brain Mapping: The Methods*, Second Ed., 77-95, Academic Press, San Diego.
41. Zochowski M, LB Cohen, CX Falk, M Wachowiak (2001) The olfactory bulb: Maps of receptor input and oscillations. In: ed. Ron Frostig *In vivo optical imaging of brain function*, 1, CRC Press, Boca Raton.
42. Zecevic D, CX Falk, M Djurasic, L B Cohen, M Zochowski, S Antic, M Wachowiak (2001) Imaging Nervous System Activity with Voltage-Sensitive Dyes. In: ed. by Dr. M. Rogawski, *Current Protocols in Neuroscience*. John Wiley & Sons, New York.
43. Andjelkovic AV, M Zochowski, F Morgan, JS Pachter (2001) Qualitative and quantitative analysis of monocyte transendothelial migration by confocal microscopy and three-dimensional image reconstruction. *In Vitro Cell Dev Biol Animal* 37, 111-120.
44. Liebovitch LS, D Scheurle, M Rusek, M Zochowski (2001) Fractal Methods to Analyze Ion Channel Kinetics, *Methods* 24, 359-375.
45. Zochowski M (2000) Intermittent dynamical control, *Physica D* 145, 181-190.
46. Zochowski M, LB Cohen, G Furhmann, D Kleinfeld (2000) Distributed and largely separate pools of neurons are correlated with two different components of the gill withdrawal reflex in *Aplysia*, *J. Neurosci.*, 20(22), 8485-8492.
47. Wachowiak M, M Zochowski, LB Cohen, CX Falk (2000) The spatial representation of odors by olfactory receptor neuron input to the Olfactory bulb is concentration invariant. *Biol Bull*, 199, 162-163.
48. Zochowski M, M Wachowiak, CX Falk, LB Cohen, Y-W Lam, S Antic, D Zecevic (2000) Imaging membrane potential with voltage-sensitive dyes, *Biol. Bull.* 198, 1-21.
49. Lam Y-W, LB Cohen, M Wachowiak, M Zochowski, (2000) Odors elicit three different oscillations in the turtle olfactory bulb, *J. Neurosci.* 20, 749.
50. Zochowski M, LS Liebovitch (1999) Self organizing dynamics of coupled map system, *Phys Rev E* 59, 2830.
51. Liebovitch LS, A Todorov, M Zochowski, D Scheurle, L Colgin, M. Wood, K. Ellenbogen, J Herre, C. Bernstein (1999) Fractal properties of Cardiac Rhythm Abnormalities, *Phys Rev. E* 59, 3312.
52. Antic H, LB Cohen, Y-W Lam, M Wachowiak, D Zecevic, M Zochowski (1999) Fast multisite optical measurement of membrane potential. Three examples. *FASEB* 13, S271.
53. Wu J, LB Cohen, Y Tsau, M Zochowski and CX Falk (1998) Imagining with Voltage-Sensitive Dyes: Spike Signals, Population Signals, and Retrograde Transport, in *Imaging Living Cells*, R. Yuste, F. Lanni, and A. Konnerth, Cold Spring Harbor Press.
54. Liebovitch LS, M Zochowski (1998) Significance of Updating Schemes in Computational Models: Dynamics of Neural Networks, *J. Stat. Phys.* 90, 253.
55. Zochowski M, LS Liebovitch (1997) Synchronization of the trajectory as a way to control the dynamics of the coupled system, *Phys Rev. E* 56, 3701.
56. Liebovitch LS, M Zochowski (1997) Dynamics of neural networks and their application to protein dynamics, *Cell. Molec. Biol. Lett.* 2, 166.
57. Liebovitch LS, M Zochowski (1997) Dynamics of neural networks relevant to properties of proteins, *Phys. Rev. E* 56.
58. Zochowski M, K Winkowska-Nowak, A Nowak, G Karpinski, A Budaj (1997) Autocorrelations of r-r distributions as a measure of heart variability, *Phys. Rev E* 56, 3725.
59. Nowak A, M Zochowski (1997) Afekt w modelach sieci neuronowych (in Polish), *Kosmos* 46.
60. Zochowski M, M Lewenstein, A Nowak (1995) SMARTNET - A Neural Net with Self-Controlled Learning, *Network* 6, 93.
61. Zochowski M, M Lewenstein, A Nowak (1994) Local Noise in Neural Network Models with Self-Control, *Int. J. of Neu. Sys.* 5, 287-298.
62. Zochowski M, M Lewenstein, A Nowak (1993) A Memory which tentatively forgets, *J. Phys A* 26, 2099-2112.

**Books:**

Zochowski M (2000) Synchrony in Biological and Physical Systems: An experimental and theoretical study, Series of the Institute of Biocybernetics and Biomedical Engineering PAS, Warsaw.

### **Talks:**

#### **Invited seminars:**

1. Zochowski M (2013) Understanding brain function and pathology through network dynamics. University of Ohio, Athens, OH.
2. Zochowski M (2013) Physics of brain function. Ohio Wesleyan University, Delaware, OH.
3. Zochowski M (2013) Network correlates of information processing in the brain. University of Calgary, Calgary, Canada.
4. Zochowski M (2013) Network correlates of normal and pathological brain function. University of Notre Dame, Indiana.
5. Zochowski M (2011) Structural correlates of network dynamics and their role in brain function, University of Warsaw, Poland.
6. Zochowski M (2011) Understanding structural correlates of network dynamics - possible implications for normal and pathological brain function, Rosalind Franklin University of Medicine and Science, Chicago.
7. Zochowski M (2010) Understanding structural correlates of network dynamics - possible implications for normal and pathological brain function, University of Minnesota.
8. Zochowski M (2009) From cells to networks: understanding network dynamics underlying healthy and pathological brain function, Oakland University, MI.
9. Zochowski M (2009) From cells to networks: understanding network dynamics underlying healthy and pathological brain function. Albion College, MI.
10. Zochowski M (2009) From network dynamics to brain function. Center for Theoretical Biological Physics, Department of Physics, UCSD, CA.
11. Zochowski M (2008) Understanding structural network underpinnings of healthy and pathological brain function, Dept. of Epileptology, Medical Center of University of Bonn, Germany.
12. Zochowski M (2008) Understanding role of network structure in brain function, Department of Physics, Tel Aviv University, Israel.
13. Zochowski M (2006) Detection of function from temporal dynamics in healthy and pathological brain. Ohio University, Athens, OH.
14. Zochowski M (2006) Detection of function from temporal dynamics in healthy and pathological brain. UMSL, San Louis, MS.
15. Zochowski M (2006), Detecting asymmetric temporal interdependencies during neural dynamics. University of Toronto, Toronto, Canada.
16. Zochowski M (2006) Detecting function from temporal structure: adaptive measurement of asymmetrical temporal interdependencies in neural systems. Krasnow Institute for Advance Studies, George Mason University, VA.
17. Zochowski M (2005) Measurement of information transfer in neural systems. University for Social Psychology, Warsaw, Poland.
18. Zochowski M (2005) Detecting asymmetric temporal interdependencies during neural dynamics. Institute for Experimental Biology, Polish Academy of Science, Warsaw, Poland.
19. Zochowski M (2005) Adaptive measurement of asymmetrical temporal interdependencies in neural systems. Department of Physics, University of Warsaw, Warsaw, Poland.
20. Zochowski M (2005) Network structure – network function. Institute for Social Studies, University of Warsaw, Warsaw, Poland.
21. Zochowski M (2004) Neuronal Synchrony, where, why and how to measure it? University for Social Psychology, Warsaw, Poland.
22. Zochowski M (2004) Searching for meaning of synchrony in the brain. University of Warsaw, Warsaw, Poland.
23. Zochowski M (2004) Odor evoked oscillations in turtle's olfactory bulb and their possible role in enhancement of the temporal resolution of odor representations. Electrophysiological Semiotics



of The Neuronal Systems conference, Warsaw, Poland.

24. Zochowski M (2003) Investigating the role of synchronization in neural systems. Warsaw School of Social Psychology, Warsaw, Poland.
25. Zochowski M (2003) Spatio-temporal patterning in the neural systems: its role and mechanisms of formation, University of Texas at San Antonio, San Antonio, TX.
26. Zochowski M (2002) Investigating Synchrony in Biological and Physical Systems. Universidad de Comptense de Madrid, Spain.
27. Zochowski M (2001) Synchronization in biological systems. University of Warsaw, Warsaw, Poland.
28. Zochowski M (2000) Synchrony in Coupled Biological Systems: An Experimental and Theoretical Study. The Institute of Computational Astrobiology, NASA-Ames, Moffett Field, CA.

**Invited conference presentations:**

29. Zochowski M (2013) Detecting precursors of bursting dynamics in simplified neuronal networks, SIAM Dynamical Systems Conference, SnowBird, UT
30. Zochowski M (2013) Dynamics of healthy and pathological brain – from neuronal excitability to network-wide activity and back. Mathematical Biosciences Institute (MBI), Ohio State University, Columbus, OH.
31. Zochowski M (2011) From pathological reorganization of epileptic network during adult neurogenesis to enhanced seizure. 5th International Workshop of Epileptic Seizure Prediction, Dresden, Germany.
32. Zochowski M (2011) Understanding network correlates of neuronal dynamics. The PIRE PICCS Summer School 2011 in Frauenchiemsee, Germany
33. Zochowski M (2010) Dynamics and augmentation patterns in adaptive networks. XI Experimental Chaos and Complexity Conference, Lille, France.
34. Zochowski M (2009) From network dynamics to brain function. ICAM/INTELBIOMAT meeting, Cambridge, UK.
35. Zochowski M (2008) Understanding network correlates of neural computation, NSF workshop on Emerging Models and Technologies for Computation (EMT), Princeton University, NJ.
36. Zochowski M (2008) Understanding network interactions from neural data, 10<sup>th</sup> Experimental Chaos Conference, Catania, Sicily.
37. Zochowski M (2007) From neural dynamics to macroscopic pattern formation during ictogenesis. 3rd International Workshop of Epileptic Seizure Prediction, Freiburg, Germany.
38. Zochowski M (2006) Detection of phase and lag synchrony as an adaptive measure of asymmetric neuronal interactions. Am. Phys. Soc. March Meeting, Baltimore, MD.
39. Zochowski M (2005) Adaptive measurement of asymmetrical temporal interdependencies in neural systems. Math & Neuroscience Mini-symposium, Department of Mathematics, University of Michigan.
40. Zochowski M (2005) Detecting asymmetric temporal interdependencies during neural dynamics. Symposium “Neural processing in a nutshell”, MCTP, CSCS, Department of Physics, University of Michigan.
41. Zochowski M (2003) Nonlinear dynamics in personality disorders? VIII International ISSPD Congress, Florence, Italy.

**Presentations and Abstracts:**

1. Roach JP, M Zochowski, L Sander (2013) Network topology and intrinsic excitability of the existing network drive integration patterns in a model of adult neurogenesis. 2013 Annual Computational Neuroscience Meeting, Paris, France.
2. Shtrahman E, M Zochowski (2013) Neuronal network information processing through heterogeneities and resonance frequency shifts. 2013 Annual Computational Neuroscience Meeting, Paris, France.
3. S Mofakham, M Zochowski (2013) Neuronal signatures of network transition into bursting. 2013

- Annual Computational Neuroscience Meeting, Paris, France.
4. Maruyama D, M Zochowski (2013) Dynamics of two-process astrocyte networks. 2013 Annual Computational Neuroscience Meeting, Paris, France.
  5. Shtrahman E, CG Fink, E Olariu, M Zochowski (2012) Spatial and temporal patterns of calcium signaling in developing hippocampal cultures. 8th FENS Forum of Neuroscience, Barcelona, Spain.
  6. Shtrahman E, CG Fink, E Olariu, M Zochowski (2012) Spatial and temporal patterns of calcium signaling in developing hippocampal cultures. 42nd Society for Neuroscience Annual Meeting, New Orleans, LA.
  7. Fink CG, GG Murphy, V Booth, M Zochowski (2012) Acetylcholine and synaptic homeostasis. Society for Neuroscience Annual Meeting, New Orleans, LA.
  8. Maruyama D, M Zochowski (2012) Dynamics of coupled neuron-astrocyte networks. 42nd Society for Neuroscience Annual Meeting, Washington, DC.
  9. Maruyama D, M Zochowski (2011) Exploring spatial-temporal patterns in networks with a variety of measures. 41<sup>st</sup> Society for Neuroscience Annual Meeting, Washington, DC.
  10. Berke J D, D Maruyama, D K Leventhal, B Fensterheim, J R Pettibone, A Gittis, A Kreitzer, M Zochowski (2011) Striatal projection neuron and interneuron networks show distinct functional connectivity. 41<sup>st</sup> Society for Neuroscience Annual Meeting, Washington, DC.
  11. Hill E S, S Vasireddi, J Wang, D Maruyama, M Zochowski, W Frost (2011) A method for monitoring the temporal structure of neuronal networks. 41<sup>st</sup> Society for Neuroscience Annual Meeting. Washington, DC.
  12. Bruno AM, D Maruyama, M R Zochowski, W N Frost (2011) Use of large scale optical recording to rapidly identify the structure of the Aplysia pedal ganglion locomotion network. 41<sup>st</sup> Society for Neuroscience Annual Meeting. Washington, DC.
  13. Feldt S, JX Wang, E Shtrahman, R Dzakpasu, E Olariu, M Zochowski (2011) Astrocyte Mediated Modifications in Functional Neuronal Network Structure”, SIAM Conference on Nonlinear Dynamics, Snowbird, UT.
  14. Smith T, M Zochowski (2011) The effects of conduction delay on temporal ordering in leaky integrate and fire neuronal networks. 20th Annual Computational Neuroscience Meeting, Stockholm, Sweden
  15. Smith T, M Zochowski (2011) The effects of conduction delay on temporal ordering in leaky integrate and fire neuronal networks. 41<sup>st</sup> Society for Neuroscience Annual Meeting. Washington, DC.
  16. E Shtrahman, C Fink, E Olariu, M Zochowski (2011) Combining Calcium Optical Imaging and Multi-Electrode Arrays to Study the Interaction of Astrocyte and Neuronal Network Dynamics. 41<sup>st</sup> Society for Neuroscience Annual Meeting. Washington, DC.
  17. CG Fink, V Booth, M Zochowski (2011) Phase response curve modulation, synaptic plasticity, and network connectivity renormalization. 41<sup>st</sup> Society for Neuroscience Annual Meeting, Washington, DC.
  18. CG Fink, V Booth, M Zochowski (2011) Effects of the frequency dependence of phase response curves on network synchronization. SIAM Conference on Applications of Dynamical Systems, Snowbird, UT.
  19. Lau T, M Zochowski (2010) Interaction between connectivity and oscillatory currents in a heterogeneous neuronal network. 40<sup>th</sup> Society for Neuroscience Annual Meeting, San Diego, CA.
  20. Fink C, V Booth, M Zochowski (2010) Frequency modulated network synchronization. 40<sup>th</sup> Society for Neuroscience Annual Meeting. San Diego, CA.
  21. Schneider-Mizell CM, JM Parent, E Ben-Jacob, LM. Sander, M Zochowski (2010) Network structure determines patterns of network Reorganization during adult neurogenesis. 40<sup>th</sup> Society for Neuroscience Annual Meeting. San Diego, CA.
  22. Wang J, G Poe, M Zochowski (2010) Interactions of Recurrent, Excitatory, and Inhibitory Feedback Topologies Mediating Memory Consolidation and Recall. Gordon Conference “Neurobiology of Cognition”, Waterville Valley, NH.
  23. Fink C, V Booth, M Zochowski (2010) Frequency modulated network synchronization. 19<sup>th</sup> Annual Computational Neuroscience Meeting, San Antonio, TX.

24. Lau T, G Gage, J Berke M Zochowski (2009) Dynamics of inhibitory and gap-junction coupled interneurons. 39<sup>th</sup> Society for Neuroscience Annual Meeting, Chicago, IL.
25. Wang, JX, and M Zochowski (2009) Enhancement of selective memory activation through network topological heterogeneities. 39<sup>th</sup> Society for Neuroscience Annual Meeting, Chicago, IL.
26. Bogaard A (2009) Synergy of cellular dynamics and network structure in spatio-temporal pattern formation in excitatory networks. Fourth International Workshop on Seizure Prediction, Kansas City. Invited oral presentation.
27. Bogaard A, V Booth, M Zochowski (2008) Interaction of cellular and network mechanisms in spatio-temporal pattern formation in neuronal networks and its role in seizure generation. 38<sup>th</sup> Society for Neuroscience Annual Meeting, Washington DC.
28. Wang J, G Poe, M Zochowski (2008) Network mechanisms underlying familiarity detection and hippocampal memory management. 38<sup>th</sup> Society for Neuroscience Annual Meeting, Washington DC.
29. Feldt S, J Waddell, VL Hetrick, JD Berke, M Zochowski (2008) Functional clustering of spike train data. 38<sup>th</sup> Society for Neuroscience Annual Meeting, Washington DC.
30. Feldt S, J Waddell, VL Hetrick, JD Berke, M Zochowski (2008) Functional structure from dynamic clustering of spike train data. 17<sup>th</sup> Annual Computational Neuroscience Meeting, Portland, OR.
31. Bogaard A, M Zochowski, V Booth (2008) Interaction of membrane dynamics with network structure and its effects on spatio-temporal network patterning. 17<sup>th</sup> Annual Computational Neuroscience Meeting, Portland, OR.
32. Feldt S, M Zochowski (2008) Functional structure through dynamic clustering of neuronal networks. APS March Meeting, New Orleans, LU.
33. Dzakpasu R, M Zochowski (2007) Detection of lead lag patterning in cultured hippocampal networks. 37<sup>th</sup> Society for Neuroscience Annual Meeting, San Diego, CA.
34. S. Feldt, H. Osterhage, F. Mormann, K. Lehnertz, M. Zochowski (2007) The epileptic network: a model of multiple coupled networks 37<sup>th</sup> Society for Neuroscience Annual Meeting, San Diego, CA.
35. Feldt S, M Zochowski (2007) "Deriving functional structures through dynamic clustering of neuronal spike trains". 37<sup>th</sup> Society for Neuroscience Annual Meeting, San Diego, CA.
36. Jablonski P, M Zochowski (2007) Local cooperativity versus global bursting as a function of network topology. 37<sup>th</sup> Society for Neuroscience Annual Meeting, San Diego, CA.
37. Bogaard A, M Zochowski, V Booth (2007) Possible effects of membrane dynamics on network spatio-temporal pattern formation during epileptogenesis. 37<sup>th</sup> Society for Neuroscience Annual Meeting, San Diego, CA.
38. Dzakpasu R, K Patel, N Robinson, MA Harrington, M Zochowski (2007) Detection of Causal Structure in Coupled Networks. Grand Challenges in Neural Computation, Santa Fe workshop abstracts.
39. Waddell J, M Zochowski (2007) Complex patterns of synchrony in networks undergoing exogenous drive." APS March Meeting, Denver, CO.
40. S. Feldt, H. Osterhage, F. Mormann, K. Lehnertz, M. Zochowski (2007) Measurements of synchronization between interacting networks in a model of focal epilepsy, APS March Meeting, Denver, CO.
41. Jablonski P, GR Poe, M Zochowski (2007) Structural network heterogeneities and network dynamics: a possible dynamical mechanism for hippocampal memory reactivation. APS March Meeting, Denver, CO.
42. Dzakpasu R, K Patel, N Robinson, MA Harrington M Zochowski (2006) Detection of Causal Structure in Coupled Networks. 36<sup>th</sup> Society for Neuroscience Annual Meeting, Atlanta, GA.
43. Feldt S, M Zochowski (2006) Measurement of dynamical interdependencies of two interacting networks, Society for Neuroscience, 36<sup>th</sup> Society for Neuroscience Annual Meeting, Atlanta, GA.
44. Singer BH, S Kim, M Zochowski (2006) Binaral interaction and centrifugal input enhance spatial contrast in olfactory bulb activation. 36<sup>th</sup> Society for Neuroscience Annual Meeting, Atlanta, GA.
45. Singer BH, S Kim, M Zochowski (2006) Binaral interaction and centrifugal input enhance spatial contrast in olfactory bulb activation. Society for Neuroscience, Michigan Chapter, Lansing, MI.
46. Singer BH, M Derchansky, P Carlen, M Zochowski (2006) Coupled networks and burst propagation in the evolution of seizure dynamics. 36<sup>th</sup> Society for Neuroscience Annual Meeting, Atlanta, GA.

47. Waddell J, R Dzakpasu, V Booth, B Riley, J Reasor, G Poe, M Zochowski (2006) Network Structure, Neural Synchrony and Plasticity. 36<sup>th</sup> Society for Neuroscience Annual Meeting, Atlanta, GA.
48. Jablonski P, GR Poe, M Zochowski (2006) How the brain reactivates off-line: dynamic mechanism for memory consolidation. 36<sup>th</sup> Society for Neuroscience Annual Meeting, Atlanta, GA.
49. Waddell J, M Zochowski (2006) Self-Organization of Networks Via Synchrony-Dependent Plasticity. APS March Meeting, Baltimore, MD.
50. Zochowski M (2006) Interaction between network dynamics and network structure. 6<sup>th</sup> Conference on understanding complex systems, University of Illinois at Urbana-Champaign, IL.
51. Waddell J, M Zochowski (2006) Self-Organization of Networks Via Synchrony-Dependent Plasticity. Amer. Phys. Soc. March Meeting, Baltimore, MD.
52. Dzakpasu R, M Zochowski (2006) Effect of Delays and Network Topology in Spatiotemporal Pattern Formation. Amer. Phys. Soc. March Meeting, Baltimore, MD.
53. Singer B, M Zochowski (2006) Binaral interaction modulates olfactory bulb oscillations in response to odorant history. 27<sup>th</sup> Assoc. Chemoreception Sci. Annual Meeting, Sarasota, FL.
54. Singer B, M Derchansky, P Carlen, M Zochowski (2005) Local driving and global interactions in the progression of seizure dynamics. 35<sup>th</sup> Annual Society of Neuroscience Meeting, Washington DC.
55. Kim S, Singer B, M Zochowski (2005) Changing roles of temporal representation of the odorant during the oscillatory response in the olfactory bulb. 35<sup>th</sup> Annual Society of Neuroscience Meeting, Washington DC.
56. Dzakpasu R, J Waddell, GR Poe, BT Riley, V Booth, M Zochowski (2005) Detection of asymmetries in temporal patterning in simulated and experimental systems. 35<sup>th</sup> Annual Society of Neuroscience Meeting, Washington DC.
57. M. Zochowski (2005) Measuring asymmetries during synchronization as a way to monitor direction of information transfer. 5<sup>th</sup> Understanding of Complex Systems, University of Illinois at Urbana-Champaign, IL.
58. Kim S, B Singer, M Zochowski (2005) Investigating roles of odor evoked spatio-temporal patterning in the olfactory bulb. 26<sup>th</sup> Assoc. Chemoreception Sci. Annual Meeting, Sarasota, FL.
59. Kim S, B Singer, M Zochowski (2004) Investigating the role of odor evoked oscillations during information processing in the turtle olfactory bulb. 34<sup>th</sup> Annual Society of Neuroscience Meeting, San Diego, CA.
60. Dzakpasu R, M Zochowski (2004) Condition Entropy as a Measure of Phase Synchronization in Neural Systems. 34<sup>th</sup> Annual Society of Neuroscience Meeting, San Diego, CA.
61. Dzakpasu R, M Zochowski (2004) Properties of Phase synchronization as a mechanism for parameter adaptive control. APS March meeting, Montreal.
62. Dzakpasu R, S Kim, M Zochowski (2003) Optical Imaging of Coherent Activity in the Turtle Olfactory Bulb, The 2nd Symposium on Biological Imaging (Madison, Wisconsin).
63. Dzakpasu R, S Kim, B Singer, LB Cohen, M Zochowski (2003) Monitoring odor evoked patterning in turtle olfactory bulb, 6<sup>th</sup> IBRO meeting (Prague, Czech Republic).
64. Dzakpasu R, D Makarewicz, LB Cohen, M Zochowski (2002) Correlating neuronal spiking activity with macroscopic oscillatory patterns during odorant presentation in turtle olfactory bulb, Abst Soc Neurosci 32.
65. Zochowski M, R Dzakapsu (2002) Adaptation and synchronization as a way to control spatio-temporal pattern formation in the system of coupled logic maps. 6<sup>th</sup> Knowledge-Based Intelligent Information & Engineering Systems. Crema, Italy.
66. Zochowski M, LB Cohen (2002) Optical imaging of spatio-temporal properties of odor evoked oscillations in the turtle olfactory bulb, Annual meeting of New England Complex Systems Institute (NECSI).
67. Zochowski M, LB Cohen (2001) Changes in odorant responses during multiple odorant presentations in the turtle bulb, Abst Soc Neurosci 31.
68. Engl R, M Wei, JP Wuskell, LB Cohen, M Zochowski, LM Loew (2000) Synthesis and characterization of near-IR voltage-sensitive dyes. Biophysical Society, Boston, Massachusetts.
69. Zochowski M, LB Cohen, M Wachowiak (2000) Changes in spatio-temporal properties of odor responses from multiple odor presentations in the turtle bulb, Abst Soc Neurosci 30.

70. Zochowski M, LB Cohen, M Wachowiak (2000) Spatio-temporal properties of odor responses from single and multiple odor presentations in the Turtle bulb, Complex Synchrony in Neuroscience, Krasnow Institute, Fairfax, Virginia.
71. Zochowski M, LB Cohen, D Kleinfeld (2000) Neural dynamics of the gill withdrawal reflex in *Aplysia*, Complex Synchrony in Neuroscience, Krasnow Institute, Fairfax, Virginia.
72. Wachowiak M, LB Cohen, M Zochowski (2000) Spatial patterns of olfactory receptor neuron input to turtle olfactory bulb glomeruli imaged with calcium-sensitive dyes, 21<sup>st</sup> Annual meeting of Association for Chemoreception Senses, Sarasota, Florida.
73. Zochowski M, LB Cohen, M Wachowiak (2000) Changes in spatio-temporal properties of odor responses from multiple odor presentations in the turtle bulb. 21<sup>st</sup> Annual meeting Association for Chemoreception Senses, Sarasota, Florida.
74. Zochowski M, D Kleinfeld, LB Cohen (1999) Neural dynamics of gill withdrawal reflex in *Aplysia*, Abst Soc Neurosci 29.
75. Wachowiak M, LB Cohen, M Zochowski (1999) Calcium imaging of input to the turtle olfactory bulb: presynaptic inhibition and odor representation, Abst Soc Neurosci 29.
76. Lam Y-W, LB Cohen, M Wachowiak, M Zochowski (1999) Spatio-temporal properties of odor responses in turtle olfactory bulb, Abst Soc Neurosci 29.
77. Lam Y-W, LB Cohen, M Wachowiak, M Zochowski (1999) Spatio-Temporal Properties of Odor Elicited Responses in the Turtle Olfactory Bulb, Measured with the Voltage-Sensitive Styryl Dye, RH414, 20<sup>th</sup> Annual meeting Association for Chemoreception Senses, Sarasota, Florida.
78. Leshner S, M Zochowski, NM Mellen, S Dykstra, L Guan, LB Cohen, AH Cohen (1998) Does chaotic skeleton support lamprey swimming? Abst Soc Neurosci 28.
79. Lam Y-W, LB Cohen, M Zochowski (1998) Spatio-temporal properties of odor elicited responses in the turtle olfactory bulb, Abst Soc Neurosci 28.
80. Liebovitch LS, AT Todorov, M Zochowski, D Scheurle, L Colgin, M A Wood, KA Ellenbogen, JM Herre, and RC Bernstein (1998) Scaling properties of the time intervals between arrhythmic events in the heart, Society for Chaos Theory in Psychology and the Life Sciences Newsletter 5(4): 11.
81. Liebovitch LS and M Zochowski (1998) Control of target systems using Lyapunov exponents. Bull. Am. Phys. Soc., 43(1): 237.
82. Liebovitch LS and M Zochowski (1998) Control of target systems using Liapunov exponents, APS March meeting, Los Angeles.
83. Drogosz M, A Nowak, M Lewenstein, W Tarkowski, M Zochowski (1996) Application of dynamical networks to the explanation of affective – cognitive interaction, paper given at the conference: II Konferencja Sieci Neuronowe i Ich Zastosowania, Szczyrk, Poland.
84. Drogosz M, A Nowak, M Lewenstein, W Tarkowski, M Zochowski, Memory landscapes: dynamic trips between attractors and repellers in neural networks, paper given at the conference: Computers in Psychology, York 1996, England.
85. Boguslawski P, EL Briggs, M Zochowski, and J Bernholc (1995) Theory of Native Defects and Doping in Wide Band Gap Nitrides, APS March Meeting, San Jose, California, KC.