THE BIOLOGICAL PHYSICIST

The Newsletter of the Division of Biological Physics of the American Physical Society

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In this Issue

This issue of THE BIOLOGICAL PHYSICIST brings you a feature interview with Boston University's Mal Teich, who has recently published, with co-author Steve Lowen, a new book on *Fractal-Based Point Processes* (Wiley 2005).

We also bring you the announcement of the winner of the Biological Physics Prize, important information about the upcoming March Meeting, including a listing of all Symposia and Focus Sessions, and a tentative schedule of Symposia. **(Remember that the abstract submission deadline is Wednesday November 30!)** Finally, we bring you PRE Highlights, and a plentiful batch of job ads, as the fall academic hiring season gets into full swing. Enjoy!

-- SB

FEATURE

A Conversation with Mal Teich

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S. Bahar

Malvin Carl Teich *is a faculty member at Boston University, where he holds joint appointments in the Departments of Electrical and Computer Engineering, Physics, and Biomedical Engineering. He is Co-Director of the Quantum Imaging Laboratory and a Member of the Photonics Center, the Hearing Research Center, the Program in Neuroscience, and the Center for Adaptive Systems. He is also Professor Emeritus of Engineering Science and Applied Physics at Columbia University. His well-known research achievements extend from the development of nonlinear heterodyne detection to the role of point processes in the neurosciences. He spoke recently with* THE BIOLOGICAL PHYSICIST *about his research and his latest book, Fractal-Based Point Processes, co-authored with Steven Bradley Lowen and published in 2005 by Wiley.*

THE BIOLOGICAL PHYSICIST**: What got you interested in point processes? Was your interest initially generated by your work in engineering and photonics?**

Mal Teich: My interest in point processes began with the work I carried out for my doctoral dissertation at Cornell in the mid 1960s. With the advent of the laser a few years earlier, nonlinear optics had become an area of great interest in physics. My PhD thesis centered on observing two-photon photoemission from a metal (sodium) illuminated by laser light. This process occurs when two photons conspire to release an electron from the material, a single photon having insufficient energy to do so. The probability of a pair of photons being localized at a point in the material is determined by the point process representing the photon arrivals of the laser light. In subsequent years, as a faculty member at Columbia working with my own PhD students, I carried out many experimental and theoretical studies in photonics that involved point processes, including the generation of photon-number squeezed light, the transformation of photon statistics imparted by fiber-optic amplifiers, and the analysis of noise in avalanche photodiodes.

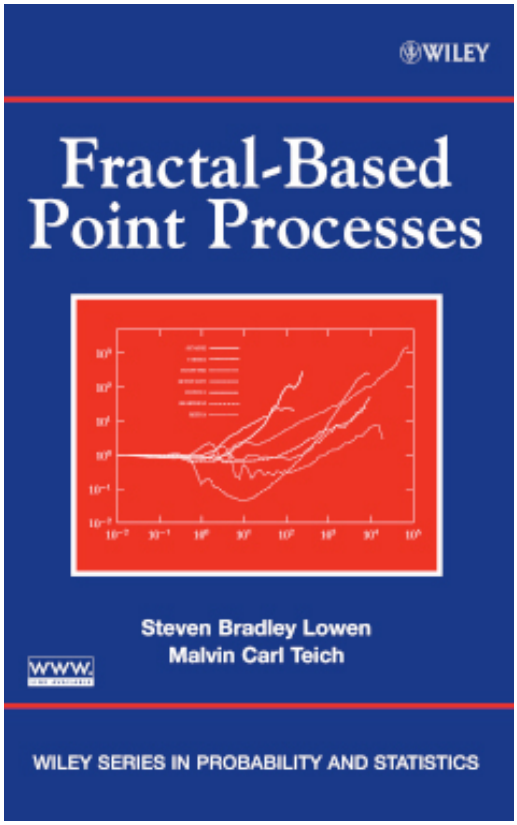
In the "About the Authors" section of the new book, one reads that "Teich's interest in point processes in the neurosciences was fostered by a chance encounter in 1974 with William J. McGill, then Professor of Psychology and President of Columbia University." Describe that "chance encounter". What exactly did you talk about with McGill?

One spring day in 1974, out of curiosity I ambled over to the Columbia Faculty House to hear what the President of the University, a mathematical psychologist named William J. McGill, had to say in a lecture entitled *Signal Detection Theory*. He was presenting a talk at the *University Seminar on Mathematical Methods in the Social Sciences*. I had never met McGill but the title of his talk intrigued me and, after all, he *was* the President of the

University. In his talk, he suggested that Poisson-based stochastic point processes were suitable for modeling information flow in the human auditory and visual systems. I was astonished by his talk because the neural-event probability distributions and generation functions that he presented were identical to those that I had used to describe laser-light photodetection. I mentioned this to him in the open discussion following the talk, and he suggested that I come over to his office to chat. We talked for the remainder of the afternoon, and that was the beginning of a lifelong collaboration on the use of stochastic point processes in sensory-system modeling. We ultimately constructed an information-transmission model in which the brain's neural network amplifies an incoming sensory stimulus. Without intending to do so, we arrived at a model for characterizing the flow of neural events that was identical to the model I had used earlier to describe the transformation of the statistical properties of photons imparted by a fiber-optic amplifier. Here were two distinct phenomena, one in physics and one in biology, described by an identical underlying point-process model.

How did you become interested in biological physics? At what point did you begin to think about point processes in biophysical systems?

My work with McGill was directed principally toward developing systems models for sensory detection. I was also anxious to see if it might be productive to apply a point-process approach to a living neural system at the cellular level. Fortunately, not too long after I met McGill, I encountered Shyam M. Khanna, Director of the *Fowler Memorial Laboratory for Auditory Biophysics* and Professor in the Department of Otolaryngology at the Columbia College of Physicians & Surgeons. In a collaboration that stretched over two decades, we recorded sequences of action potentials from afferent nerve fibers in the mammalian peripheral auditory system, using a broad range of different auditory stimuli. Point-process theory offered an excellent platform for studying these spike trains. After analyzing an enormous number of data sets, over quite a number of years, we reached the unexpected, but unmistakable, conclusion that, without exception, action-potential sequences in the auditory system exhibited power-law correlations and other features characteristic of fractal behavior. Together with my PhD students, including Steve Lowen, the co-author of *Fractal-Based Point Processes*, I developed a fractal-based point-process model that



The cover of Mal Teich and Steve Lowen's new book, Fractal-Based Point Processes, published by Wiley. For more information about the book, visit: http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471383767.html *or* http://cordelia.mclean.org/~lowen/fbpp.html.

captured the characteristics of these data, and revealed a new feature of neural coding.

What led you to write "Fractal-Based Point Processes"? Describe the genesis of the book and the process of writing it. What is the intended audience and what do you hope the audience will take away from it?

Having observed that all primary auditory-nerve spike trains exhibited fractal behavior, Lowen and I began to wonder whether other neural and neurobiological systems would behave similarly. So, in collaboration with colleagues at a number of institutions, we proceeded to examine action-potential sequences recorded from the retina, thalamus, and visual cortex; neurotransmitter exocytosis at the synapse; and human heartbeat sequences. Making use of point-process theory, we discovered the presence of fractal behavior in all of these systems as well.

Fractal behavior turned out to be so widespread in the systems we examined that we decided to develop a comprehensive theory of fractal-based point processes. This included establishing many new results, elucidating the relative merits of different metrics and estimation procedures, and considering a collection of models that lead to such behavior. We then applied the theory to many data sets in the biological and physical sciences, from the spontaneous release of neurotransmitter vesicles at a developing *Xenopus* neuromuscular junction to consecutive Ethernet-packet arrivals in a computer communication network. We felt that it would be worthwhile gathering the results together in a unified way, and the result is *Fractal-Based Point Processes*. Fortunately, we had a solid point of departure for the project: Lowen's 1992 Columbia PhD thesis entitled *Fractal Point Processes*. We decided to write the book in 1998, signed a contract with the publisher in 1999, and promised a camera-ready manuscript in 2001. We managed to deliver a preliminary manuscript in 2001, but it was not until 2005 that we completed the final camera-ready manuscript that made it into print.

The book is addressed principally to students and researchers in the physical, biological, mathematical, and medical sciences who seek to understand, explain, and make use of the ever-growing roster of phenomena that are found to exhibit fractal and point-process characteristics. An extensive set of solved problems accompanies each chapter. The website for the book contains the data sets analyzed as well the source code for all C programs used to analyze, simulate, and modify the data sets.

Is there a fundamental difference between point processes which do and which do not possess fractal characteristics?

Fractal-based point processes are a particular class of point processes, comprising two subclasses: fractal point processes and fractal-rate point processes. By virtue of their power-law features, such point processes are trickier to deal with than are nonfractal point processes and therefore require special treatment.

Describe your early work on heterodyne detection, and the applications of this to neural systems.

My first research project as a new Staff Member at MIT Lincoln Laboratory in the mid-1960s, after receiving the PhD but before joining Columbia, was to investigate heterodyne detection in the middle-infrared region of the electromagnetic spectrum using the then-new CO_2 laser in conjunction with a special semiconductor photon detector that had been developed at the Labs. I demonstrated that optimal heterodyne detection could indeed be achieved. Heterodyning offers a powerful technique for observing the velocity of a moving object. So it was natural for me to

become involved in optical heterodyne measurements of the nonlinear-dynamical motions of individual sensory cells in the cochlea, in collaboration with Shyam Khanna and researchers at the Karolinska Institute in Stockholm. We discovered, among other things, that these cells vibrate spontaneously, even in the absence of a stimulus.

Mal Teich (left), and co-author Steven Lowen.

What are your current research projects? Where do you see your work going over the next few years?

Together with Steve Lowen, I am currently examining transformations of the statistical properties of spike trains as they travel up the waysations of the visual system. I am continuing my work on sensory information transmission and expect to complete a book, tentatively entitled *Sensory Transmission and Detection*, that I began with Bill McGill many years ago. My most immediate goal, however, is to finish up the Second Edition of *Fundamentals of Photonics*, a textbook that I co-authored in 1991 with Bahaa Saleh, another long-standing collaborator. I am also continuing my joint work with Saleh in quantum optics, which is directed toward advancing the development of optical imaging systems that make use of entangled photon pairs generated via optical spontaneous parametric down-conversion.

What is your assessment of the current state of interdisciplinary science? Are we truly in the midst of a renaissance, or is that simply propaganda?

Interdisciplinary science has, I believe, become increasingly important and of increasing interest. This can be seen in the ever-growing array of interdisciplinary papers in each week's edition of *Physical Review Letters*. One of the principal impediments to the growth of interdisciplinary science, in my view, has been the hesitation of biological scientists to engage in serious mathematical analysis and modeling, and to appreciate the extent of its value. But I perceive that this state of affairs is changing for the better.

Do you have any advice for scientists in interdisciplinary fields, or for graduate students contemplating an interdisciplinary career?

I would advise those interested in interdisciplinary science to be proactive in exploring opportunities that interest them. I would also advise them to seek collaborators who complement their own talents and abilities, and who have been successful in their own right. I would consider, as especially promising, potential collaborators who are excited by the interdisciplinary aspects of a problem and who welcome a quantitative approach to analysis and modeling, even if they themselves do not have the requisite tools.

WEBSITES FOR MORE INFORMATION:

http://people.bu.edu/teich/
http://people.bu.edu/teich/books.html
http://cordelia.mclean.org/~lowen/fbpp.html
http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471383767.html

The Biological Physics Prize for 2006

has been awarded to

Alfred G. Redfield,

Brandeis University

For his seminal contributions to the theory and technical development of nuclear magnetic resonance spectroscopy, and for pioneering applications of this technique to the study of biological molecules.

Congratulations to Dr. Redfield
From all his colleagues in the Division of Biological Physics!

The prize will be officially awarded during the 2006 March Meeting.

2006 March Meeting Update: Symposia

	Symposium
Mon 1	**Bacterial flagellar dynamics, polymorphism, and conformational spread**
Mon 2	**Bionanotechnology – application and fundamental aspects of processes at nano-scale (DCMP)**
Mon3	
Mon E	**Methods in Nanobiotechnology**
Tues 1	
Tues 2	**Nanopore Biophysics:**
Tues 3	**New Methods and Algorithms for Biomolecular Modeling**
Tues E	**Flexible Molecular Recognition: The New Paradigm**
Wed 1	
Wed 2	**Physics of transcriptional regulatory networks (GSNP)**
Wed 3	**The Experimental and Theoretical Foundations of Evolution (FEd; FPS)**
Wed E	**Physics, Chemistry, and Biology of the Hydrophobic Effect**
Thurs 1	
Thurs 2	**Noise in Biological Systems (GSNP)**
Thurs 3	**Physics of Cell Elasticity, Interactions and Tissue Formation**
Thurs E	
Fri 1	Engineering biomolecules and circuits by rational design and genetic selection (DCMP) [time set]
Fri 2	**Synchrony and complexity in brain activity and function**

A tentative schedule of Symposia for the APS March Meeting (Baltimore, March 13-17, 2006) is now available from Program Chair Marilyn Gunner, and is shown in the table on the left.

A full list of the Symposia and Focus Sessions is **appended at the end of this issue**. Please look over the Focus Sessions in order to direct your abstracts (due November 30th!) to the right Session.

The APS home page for the March Meeting is

http://www.aps.org/meet/MAR06/

For more information about the city of Baltimore, visit

http://www.baltimore.org
http://bccenter.org

For information on congressional visits, see

http://ultron.aps.org/forms/aps.cgi?ID=3000

or turn to the next page…

Put Capitol Hill on your 2006 March Meeting Itinerary!

by Kimberly Regan
Science Policy Fellow, APS Office of Public Affairs

The APS Office of Public Affairs (OPA) is organizing Congressional visits during the 2006 APS March Meeting in Baltimore. The advantageous location of this year's Meeting provides an exciting opportunity to have attendees from as many districts and states as possible travel down to Washington, DC to educate Congress on the importance of science research funding. The visit days are scheduled for Wednesday, March 15th and Thursday March 16th.

Carrying the message to individual offices remains one of the best means of influencing a Member of Congress. The timing of these visits is excellent since Congress will have just started its considerations of the appropriations for the next fiscal year. In addition to influencing Congress, we hope that participants see first-hand the importance of informing their elected officials about what physicists do. While our members are getting more active in this regard and more APS meeting attendees write letters at the Contact Congress computers, there is much more to do.

OPA will assist the participants in all aspects of the congressional visits from scheduling to follow up. Leading up the Meeting, OPA will contact participants to inform them of the organizational logistics of the visits and further assist them in coordination of their meetings on the Hill with other participants in their state or district. During the March Meeting, briefings will be held in Baltimore in the evenings preceding the visits to outline a common message, offer advice on how to conduct an effective meeting, and cover the logistics of a congressional visit. We will also provide materials to be left with each office that will present useful talking points and have state specific information. Shuttle bus transportation to and from the Meeting and Washington, DC will be provided for participants.

We would like you and all APS members to view Congressional visits as part of developing a relationship with an office rather than a one-time event. We would hope that you would follow up with the Congressional office at opportune times, make visits to the home offices, and perhaps invite staff or Members of Congress to visits their labs. You may also become resources for a Member's office.

Sign up for the Congressional visits has begun. To access the sign-up form directly, click on the following link:

http://ultron.aps.org/forms/aps.cgi?ID=3000

In addition, the form can be accessed from the APS OPA website:

http://www.aps.org/public_affairs/marchmeeting.cfm

We urge you to sign up early, since the number of participants in each congressional district will be limited. If you have additional questions regarding the March Meeting Congressional Visits, please contact Kimberly Regan at regan@aps.org.

Make the Congressional visits part of your schedule for Baltimore! If your Senators and Congresspersons don't hear it from you, they won't hear it from anybody!

PRE HIGHLIGHTS

Biological Physics articles from
Physical Review E
(Statistical, Nonlinear, and Soft Matter Physics)

August 2005
Volume 72, Number 2, Articles (02xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PLEEE8&Volume=72&Issue=2

RAPID COMMUNICATIONS

Exact asymptotic results for the Bernoulli matching model of sequence alignment
Satya N. Majumdar and Sergei Nechaev
Published 2 August 2005 (*4 pages*)
020901(R)

ARTICLES

Role of chemical synapses in coupled neurons with noise
Pablo Balenzuela and Jordi García-Ojalvo
Published 1 August 2005 (*7 pages*)
021901

Signal-to-noise ratio gain of a noisy neuron that transmits subthreshold periodic spike trains
Yan Mei Kang, Jian Xue Xu, and Yong Xie
Published 2 August 2005 (*7 pages*)
021902

Frequency domain photon migration in the δ-P_1 approximation: Analysis of ballistic, transport, and diffuse regimes
J. S. You, C. K. Hayakawa, and V. Venugopalan
Published 12 August 2005 (*13 pages*)
021903

Medium effects on the selection of sequences folding into stable proteins in a simple model
You-Quan Li, Yong-Yun Ji, Jun-Wen Mao, and Xiao-Wei Tang
Published 16 August 2005 (*4 pages*)

Nonlinear statistical modeling and model discovery for cardiorespiratory data
D. G. Luchinsky, M. M. Millonas, V. N. Smelyanskiy, A. Pershakova, A. Stefanovska, and P. V. E. McClintock
Published 19 August 2005 (*10 pages*)
021905

Effect of tubulin diffusion on polymerization of microtubules
P. A. Deymier, Y. Yang, and J. Hoying
Published 19 August 2005 (*8 pages*)
021906

Fast method for estimating the energy distribution of globular states of proteins
Hai-Bo Cao, Cai-Zhuang Wang, and Kai-Ming Ho
Published 22 August 2005 (*5 pages*)
021907

Pattern reconstruction and sequence processing in feed-forward layered neural networks near saturation
F. L. Metz and W. K. Theumann
Published 23 August 2005 (*9 pages*)
021908

Randomly curved runs interrupted by tumbling: A model for bacterial motion
C. A. Condat, J. Jäckle, and S. A. Menchón
Published 24 August 2005 (*7 pages*)
021909

Mode locking the cell cycle
Frederick R. Cross and Eric D. Siggia
Published 24 August 2005 (*6 pages*)
021910

Integrate-and-fire neurons with threshold noise: A tractable model of how interspike interval correlations

affect neuronal signal transmission
Benjamin Lindner, Maurice J. Chacron, and André Longtin
Published 26 August 2005 (*21 pages*)
021911

ac conductivity in a DNA charge transport model
P. Maniadis, G. Kalosakas, K. Ø. Rasmussen, and A. R. Bishop
Published 29 August 2005 (*4 pages*)
021912

Direct stochastic simulation of Ca^{2+} motion in *Xenopus* eggs
Y.-B. Yi, H. Wang, A. M. Sastry, and C. M. Lastoskie
Published 29 August 2005 (*12 pages*)
021913

Probing mechanical properties of living cells by atomic force microscopy with blunted pyramidal cantilever tips
Félix Rico, Pere Roca-Cusachs, Núria Gavara, Ramon Farré, Mar Rotger, and Daniel Navajas
Published 29 August 2005 (*10 pages*)
021914

Recurrence plot analysis of nonstationary data: The understanding of curved patterns
A. Facchini, H. Kantz, and E. Tiezzi
Published 31 August 2005 (*6 pages*)
021915

Layered synchronous propagation of noise-induced chaotic spikes in linear arrays
G. X. Qi, H. B. Huang, H. J. Wang, X. Xie, P. Yang, and Y. J. Zhang
Published 31 August 2005 (*5 pages*)
021916

Mechanical properties of viral capsids
Roya Zandi and David Reguera
Published 31 August 2005 (*12 pages*)
021917

BRIEF REPORTS

Geometric and physical considerations for realistic protein models
Isaac A. Hubner and Eugene I. Shakhnovich
Published 17 August 2005 (*4 pages*)
022901

Scroll waves meandering in a model of an excitable medium
A. Rusakov, A. B. Medvinsky, and A. V. Panfilov
Published 25 August 2005 (*4 pages*)
022902

Chemotactic collapse and mesenchymal morphogenesis
Carlos Escudero
Published 26 August 2005 (*4 pages*)
022903

September 2005

Volume 72, Number 3, Articles (03xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PLEEE8&Volume=72&Issue=3

RAPID COMMUNICATIONS

Coupled dynamics of DNA breathing and of proteins that selectively bind to single-stranded DNA
Tobias Ambjörnsson and Ralf Metzler
Published 27 September 2005 (*4 pages*)
030901(R)

ARTICLES

Vibrons in a one-dimensional lattice of hydrogen-bonded peptide units: Influence of the inhomogeneous mass distribution in the amino acid sequence
Vincent Pouthier
Published 6 September 2005 (*12 pages*)
031901

Simulations of nanopore formation and phosphatidylserine externalization in lipid membranes subjected to a high-intensity, ultrashort electric pulse
Q. Hu, R. P. Joshi, and K. H. Schoenbach
Published 8 September 2005 (*10 pages*)
031902

Asymptotic time dependence in the fractal pharmacokinetics of a two-compartment model
P. Chelminiak, R. E. Marsh, J. A. Tuszyński, J. M. Dixon, and K. J. E. Vos

Published 9 September 2005 (*7 pages*)
031903

Fluctuation spectrum of membranes with anchored linear and star polymers
Thorsten Auth and Gerhard Gompper
Published 13 September 2005 (*12 pages*)
031904

Simple neural substrate predicts complex rhythmic structure in duetting birds
Ana Amador, M. A. Trevisan, and G. B. Mindlin
Published 13 September 2005 (*7 pages*)
031905

Modeling DNA unzipping in the presence of bound proteins
Farhat Habib and Ralf Bundschuh
Published 14 September 2005 (*6 pages*)
031906

Micromechanical mass sensors for biomolecular detection in a physiological environment
Thomas Braun, Viola Barwich, Murali Krishna Ghatkesar, Adriaan H. Bredekamp, Christoph Gerber, Martin Hegner, and Hans Peter Lang
Published 14 September 2005 (*9 pages*)
031907

Core genetic module: The mixed feedback loop
Paul François and Vincent Hakim
Published 16 September 2005 (*14 pages*)
031908

Transition from local to global phase synchrony in small world neural network and its possible implications for epilepsy
Bethany Percha, Rhonda Dzakpasu, Michał Zochowski, and Jack Parent
Published 16 September 2005 (*6 pages*)
031909

Survival probability of diffusion with trapping in cellular neurobiology
David Holcman, Avi Marchewka, and Zeev Schuss
Published 19 September 2005 (*9 pages*)
031910

Simulations of a mortality plateau in the sexual Penna model for biological aging
V. Schwämmle and S. Moss de Oliveira
Published 19 September 2005 (*5 pages*)
031911

Bayesian inference applied to macromolecular structure determination
Michael Habeck, Michael Nilges, and Wolfgang Rieping
Published 20 September 2005 (*9 pages*)
031912

Erythrocyte rouleau formation under polarized electromagnetic fields
José Luis Sebastián, Sagrario Muñoz San Martín, Miguel Sancho, José Miguel Miranda, and Gabriel Álvarez
Published 21 September 2005 (*9 pages*)
031913

Synaptic plasticity with discrete state synapses
Henry D. I. Abarbanel, Sachin S. Talathi, Leif Gibb, and M. I. Rabinovich
Published 22 September 2005 (*14 pages*)
031914

Simulated annealing algorithm for the multiple sequence alignment problem: The approach of polymers in a random medium
M. Hernández-Guía, R. Mulet, and S. Rodríguez-Pérez
Published 27 September 2005 (*9 pages*)
031915

Dynamics of competing species in a model of adaptive radiation and macroevolution
Birgitte Freiesleben De Blasio and Fabio Vittorio De Blasio
Published 28 September 2005 (*8 pages*)
031916

Effects of hydrophobic mismatch and spontaneous curvature on ion channel gating with a hinge
Kong-Ju-Bock Lee
Published 29 September 2005 (*5 pages*)
031917

Physical analysis of a processive molecular motor: The conventional kinesin
A. Ciudad, A. M. Lacasta, and J. M. Sancho
Published 29 September 2005 (*6 pages*)
031918

Wave block formation in homogeneous excitable media following premature excitations: Dependence on restitution relations
Philippe Comtois, Alain Vinet, and Stanley Nattel
Published 30 September 2005 (*5 pages*)
031919

Chaos-induced coherence in two independent food chains
Adriana Auyuanet, Arturo C. Martí, and Raúl Montagne
Published 30 September 2005 (*5 pages*)
031920

FACULTY POSITIONS IN COMPUTATIONAL BIOLOGY

The College of Science at Virginia Tech (http://www.cos.vt.edu), in cooperation with the Institute for Critical Technology and Applied Science (ICTAS, http://www.eng.vt.edu/ictas/) and the Institute for Biomedical and Public Health Sciences (IBPHS http://www.ibphs.vt.edu/), is seeking to strengthen research in **COMPUTATIONAL SCIENCE** through interdisciplinary faculty hires. As part of this initiative, the **Department of Biological Sciences** (http://www.biol.vt.edu/) anticipates filling one or more tenure-track positions at the junior and/or senior level. We encourage applications from individuals with demonstrated expertise in theoretical and computational methods applied to the following areas of biology: **COMPUTATIONAL CELL BIOLOGY,** particularly deriving the physiological properties of cells (such as signaling, motility, growth and division) from underlying molecular regulatory networks, at the level of gene, proteins, and metabolites; **COMPUTATIONAL ASPECTS OF INFECTIOUS DISEASES**, particularly the mechanisms of host-pathogen interactions at the molecular level or population level; and **ECOSYSTEM DYNAMIC MODELING**, particularly the spatial and temporal dynamics of nutrient transformations in aquatic or terrestrial ecosystems, or at the aquatic/terrestrial interface. The successful applicants must have an earned doctorate in biological, physical or mathematical sciences. Applications must be submitted online at https://jobs.vt.edu/. The application package should include a cover letter, resume, and a statement of research interests. Applicants should arrange for (at least) three letters of recommendation to be submitted directly to: Chair, Computational Biology Search Committee, Department of Biological Sciences, Virginia Tech, Blacksburg, VA 24061-0406. Review of applications will begin on December 1, 2005, and continue until the positions are filled. *Virginia Tech is an EO/AA university.* Individuals with disabilities desiring accommodations in the application process should notify Melissa Simpkins, (540) 231-4033, or call TTY 1-800-828-1120.

University of Kentucky

The University of Kentucky Center for Biomedical Engineering is expanding its current foci in biomaterials/biomechanics and systems physiology. The Center invites applications from outstanding individuals to fill three junior to mid-level tenure-track/tenured positions. These faculty members will be expected to develop distinguished research programs and contribute to teaching and mentoring within the Center's graduate program. Of particular interest are investigators in the areas of tissue engineering and regenerative medicine applied to connective, cardiovascular, or neural tissues; integrative and translational research focused on molecular or cellular aspects of cardiopulmonary or nervous system diseases; and image processing, including imaging of molecular and cellular processes. Especially desirable are investigators seeking to develop multi-investigator, interdisciplinary research programs that complement existing faculty in the Center and who will collaborate with other researchers both inside and outside the University. New faculty members will benefit from the close proximity of the Colleges of Agriculture, Arts & Sciences, Dentistry, Engineering, Medicine, and Pharmacy and of the UK Hospital, all within a five minute walk.

Applicants should submit a letter of application, curriculum vitae, a statement of research and teaching interests, and contact information for at least three references. Materials can be sent either electronically to cbmedgs@uky.edu or by postal mail to:

Search Committee
Center for Biomedical Engineering
204 Wenner-Gren Lab
University of Kentucky
Lexington, KY 40506-0070

The University of Kentucky is an Affirmative Action/Equal Opportunity Employer

Virginia Tech Department of Physics

Faculty Positions in Condensed Matter Physics: Computational Physics

The College of Science at Virginia Tech, in cooperation with the Institute for Critical Technology and Applied Science (ICTAS, http://www.eng.vt.edu/ictas/) is seeking to strengthen research in nanoscale and computational sciences through interdisciplinary faculty hires across multiple departments (http://www.cos.vt.edu). As part of this initiative, the Department of Physics anticipates tenure-track openings in Condensed Matter Physics to start in the fall of 2006. Theorists with an emphasis on computational studies of nanoscale, soft matter, or biological physics are especially encouraged to apply. The levels of the positions are open. Complementary searches across the Colleges of Science and Engineering are in progress. Further information can be found at http://www.phys.vt.edu, and questions regarding the position can be directed to Prof. Uwe C. Täuber, Chair, Condensed Matter Physics Search, Physics Department, Virginia Tech, Blacksburg, VA 24061-0435, (540) 231-8998, email: tauber@vt.edu. Applications must be submitted online at https://jobs.vt.edu/. The application package should include a cover letter, resume, and a statement of research interests. Applicants should arrange for (at least) three letters of recommendation to be submitted directly to the Search Chair. Review of applications will begin on January 16, 2006, and continue until the positions are filled. Virginia Tech is an EO/AA university, and the recipient of an NSF Advance grant which opens up a wide range of networking and development opportunities to women in science and engineering (http://www.advance.vt.edu). The physics department offers a supportive environment, including a mentoring program, to its junior faculty. Individuals with disabilities desiring accommodations in the application process should notify Kim Dix, Physics Department, (540) 231-7566, or call TTY 1-800-828-1120.

Postdoctoral Positions Available

The Applied Chaos Lab is seeking one or more postdoctoral fellows (for a period of up to three years) to work on various projects involving the application of dynamical systems to experimental biological and computational systems. In particular, we are interested in candidates with a strong grounding or interest in experimental nonlinear dynamics, biology, computing and medicine. Specific projects include the analysis and control of epilepsy, cardiac wave dynamics and the use of chaos to construct novel computing architectures in analog and digital VLSI circuitry. Ideal candidates would have both theoretical and experimental experience in dynamical systems, biological systems and/or novel computer architectures. Please email a current CV and the names and contact information of three references to:

chaos@bme.ufl.edu,
William Ditto,
Applied Chaos Lab Postdoctoral Search,
Department of Biomedical Engineering,
130 BME Building,
University of Florida,
Gainesville, FL 32611-6131

FACULTY POSITION
EXPERIMENTAL BIOLOGICAL PHYSICS
WASHINGTON UNIVERSITY IN ST. LOUIS

The Department of Physics invites applications for a tenure-track appointment in experimental biological physics at the assistant professor level, to begin Fall 2006. We seek individuals with an outstanding research record and independent creativity in applying experimental tools combined with quantitative models to study living systems at an integrated level. Applicants should have a strong background in physics and an aptitude for teaching and mentoring both undergraduate and graduate students. The successful candidate will complement and reinforce the Department's strength in biologically oriented physics and may take advantage of the top-ranked Washington University Medical School and the vigorously growing Departments of Biology and Biomedical Engineering. Applications will be considered until the position is filled, but priority will be given to those received by November 15, 2005. Applicants should send their curriculum vitae with a publication list and a statement of research interests and future plans, and ask three referees to send letters of evaluation. Correspondence should be sent to:

Professor John W. Clark
(Biological Physics Search)
Washington University
Department of Physics - Campus Box 1105 - 1 Brookings Dr.
St. Louis, MO 63130-4899

For more information call (314)-935-6276.

Washington University is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

University of Alabama at Birmingham (UAB)
Assistant Professor of Physics

Applications are invited to fill the position of a full-time, tenure-track Assistant Professor of Physics working in the field of **nanoparticles for biomedical imaging and therapeutic applications** who will be part of a multi-disciplinary team of faculty, including physicists, materials scientists, chemists, cell biologists, biomedical engineers, and clinical faculty supported by the NSF and NIH funded nanoscience, biomaterials, sensors, and spectroscopy programs. We are particularly interested in an experimentalist with a background in one or more of the following areas: biomedical imaging using nanoparticles, functionalization of nanoparticle surfaces with biomarkers, interaction of functionalized nanoparticles with cellular and sub-cellular structures, and surface enhanced Raman spectroscopy, fluorescence, and scanning near field optical microscopy used for clinical applications of nanoparticles. There are state of the art facilities available to support this multi-disciplinary research effort. See department of physics website at **www.phy.uab.edu** for more information. Preference will be given to candidates with a Ph.D. degree in physics, but all related disciplines are invited to apply. The successful applicant will be expected to seek and obtain extramural research funding and have a strong commitment to excellence in teaching and supervising research at the graduate and undergraduate levels. Applicants should send CV, descriptions of research plans, teaching plans/philosophy and names (inc. address, tel., fax, and email address) of three or more references and arrange for at least one letter of reference to be sent to David L. Shealy, Chair, Dept. of Physics, 1530 3rd Ave. South, CH310, UAB, Birmingham, AL 35294-1170 (dls@uab.edu). Screening of applicants will begin immediately, and continue until the position is filled.

Women and minorities are strongly encouraged to apply. UAB is an affirmative action, equal-opportunity employer.

SYSTEMS BIOLOGY -- UCSF

The California Institute for Quantitative Biomedical Research (QB3) at UCSF seeks candidates for multiple tenure track faculty positions at the Assistant Professor level. We seek exceptional individuals working in the area of Systems Biology, which may include development of biosensors, high throughput imaging, novel approaches to single molecules, computational analysis of natural systems, quantitative studies of biological pathways and networks, synthetic biology, and physiological systems.

Candidates are expected to hold a PhD or MD degree, or equivalent, and to have demonstrated achievement in their fields. The successful candidate will be expected to establish a dynamic research program and to be an excellent teacher in both graduate and professional school courses. Applicants should submit a curriculum vitae, 1-2 page summary of research accomplishments, a 1-2 page description of future research plans, and copies of major publications. Applicants should also have three to five letters of recommendation. We encourage women and minorities to apply. *The University of California, San Francisco is an Equal Opportunity/Affirmative Action Employer.* Please send applications and reference letters to Chair, Search Committee, c/o Ms. Leslie Spector, UCSF, Box 2542, QB3-403E, 1700-4th St, San Francisco, CA 94143. Deadline for submissions: December 1, 2005.

Arizona State University

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Assistant Professorships in Theory in Biological Physics and/or Theoretical Biochemistry

The Department of Physics & Astronomy and the Department of Chemistry & Biochemistry at Arizona State University seek candidates for two tenure-track assistant professorships in theoretical/computational biological physics and/or theoretical/computational biochemistry starting August 2006. Candidates will conduct and publish research, teach graduate and/or undergraduate courses, and perform appropriate service activities. In exceptional circumstances, an appointment at a more senior level may be made. Applicants must have a Ph.D. degree in physics, chemistry, biochemistry, or a closely related discipline by the time of appointment, a strong demonstrated research experience, the potential to attract external funding, and a commitment to effective teaching appropriate to rank. Experience working in an interdisciplinary environment is desired. As part of its development plan, Arizona State University is expanding all aspects of interdisciplinary biological research, which includes the new Biodesign Institute and the School of Life Sciences. Research in this area spans the range from the most fundamental questions through biotechnology. Joint appointments as appropriate are encouraged involving departments, the Biodesign Institute, and the School of Life Sciences. Applicants must send a résumé and a statement describing their current and future research interests, and arrange to have three letters of recommendation sent on their behalf. Initial review of applications will begin on November 15, 2005, and, if the position is not filled, will continue every two weeks until the search is closed. Further information about this position can be obtained from the chair of the search committee, Michael Thorpe (mft@asu.edu). Please send application materials to: Theory Search, ATTN: Margaret Stuart, Arizona State University, Department of Physics & Astronomy, P.O Box 871504, Tempe, AZ 85287-1504 or email materials to biotheory@asu.edu. A background check is required for employment. *ASU is an equal opportunity/affirmative action employer, and actively seeks diversity among applicants and promotes a diverse workforce.*

	Chair (organizer)		**SYMPOSIA**	
1	Philip Nelson	Bacterial flagellar dynamics, polymorphism, and conformational spread	**Howard Berg**: Recent results in bacterial taxis; **Nick Darton:** Flagellar polymorphic transformations; **Tom Powers:** Theory of polymorphic transformations of flagella; **Josh Shaevitz:** Spiroplasm swim by a processive change in body helicity: **Roger Stark:** Synchronization of rotating helices by hydrodynamic interaction.	The problem of polymorphism of bacterial flagella is a paradigm for the general problem of the spread of conformational change in macromolecular assemblies. The session reviews recent experimental and theoretical progress on this and related problems.
2	Philip Nelson (Samuel Safran)	Physics of Cell Elasticity, Interactions and Tissue Formation	**Daniel Riveline**: Cell adhesion and its response to mechanical forces; **Robijn Bruinsma**: Integrin activation and cell adhesion by mechanical forces; **Paul Janmey**: Cell morphologies depends on substrate rigidity; **Samuel Safran**: Elastic interactions and self-assembly of biological cells; **Subra Suresh:** Cell mechanics, tissue formation and human diseases.	The session focuses on cell adhesion and responses to mechanical and cytoskeletal forces. Cell elasticity physics combined with biochemical signaling lets cells sense and regulate adhesions to substrates and to each other to form tissues and organs.
3	Chao Tang (Ned Wingreen)	Physics, Chemistry, and Biology of the Hydrophobic Effect	**Je-Luen Li:** The hydrophobic effect *ab initio*; **Ben Widom**: A model for hydrophobic attraction; **David Chandler** Hydrophobicity at small and large scales: **Thomas Truskett**: Water, the hydrophobic effect and biomolecules.	Hydrophobicity ("fear of water") is the molecular driving force behind biological processes including protein folding and formation of biological membranes. This session provides a "multiscale" overview of our understanding of the hydrophobic effect.
4	Zuzanna S. Siwy	Bionanotechno-logy – application and fundamental aspects of processes at nano-scale	**Robert S Eisenberg**: Ion Channels as Nanodevices; **Ioan Kosztin**: Fluctuation Driven Active Molecular Transport in Passive Channel Proteins; **Charles R. Martin**: Abiotic analogues of voltage-gated and ligand-gated channels; **Derek Stein**: Pressure-driven DNA polymer dynamics in microfluidic and nanofluidic channels; **Clare Yu**: Transportation system in a living cell.	The session focuses on devices inspired by Nature. Engineered systems operating according to similar physical principles as biological objects will be presented. The Session considers biological objects and their synthetic mimics.
5	Christopher Roland	New Methods and Algorithms for Biomolecular Modeling	**Eric Darve**: Assessing new free energy methods for biomolecular simulations; **Celeste Sagui**: New distributed multipole methods for accurate electrostatics for large-scale biomolecular simulations; **Michael Thorpe**: Flexibility in Molecules: Beyond Molecular Dynamics; **Mark Tuckerman**: Enhanced conformational sampling via novel variable transformations and very large time-step molecular dynamics; **Weitao Yang**: Reaction path potential for complex biomolecular systems derived from mixed QM/MM methods.	This session features new methods and paradigms for biomolecular modeling. It focuses on new approaches to free energy calculations, biomolecular force fields, multiscale approaches, metadynamics simulations, coordinate transformations, and others.
6	Eshel Ben-Jacob (Michal Zochowski)	Synchrony and complexity in brain activity and function	**Vernon L Towle**: TBA; **Peter Jung**: Astrocytes, Synapses and Brain Function: A Computational Approach; **Klaus Lehnertz**: Measuring complexity and synchronization phenomena in the human epileptic brain; **Steven Schiff**: Neuronal Spatiotemporal Pattern Discrimination: The Dynamical Evolution of Seizures; **Michal Zochowski**: Detection of phase and lag synchrony as an adaptive measure of asymmetric neuronal interactions.	Novel recording techniques can detect spatio-temporal patterning on different scales in the brain. This session focuses on techniques to monitor different aspects of brain dynamics characterizing mechanisms underlying experimental observations.
7	Yuhai Tu	Noise in Biological Systems	**Philippe Cluzel**: Real time RNA profiling within a single bacterium cell; **Herbert Levine**: Noise limitations on E. Coli cell division accuracy; **Sima Setaveshgar**: Physical Limits to Biochemical Signaling; **Victor Sourjik**: Gene expression noise and robustness of signaling in bacterial chemotaxis; **Yuhai Tu**: Noise effects in bacterial motor switch.	

8	Jin Wang	Flexible Molecular Recognition: The New Paradigm	**Robert Matthews**: Protein folding and binding; **Dorothee Kern**: Dynamics of enzymes: Magnetic resonance methods; **Susan S. Taylor**: Protein kinases/signal transduction: structure/function; **Patricia A. Jennings**: Flexible protein-protein interactions; **Jin Wang**: Energy Landscape of Flexible Recognition.	The associations between bio-molecules is key to molecular recognition and function. Understanding this will lead to a new paradigm - for how molecular function is determined by the flexibility, in addition to structures alone (standard paradigm).
9	Joshua Socolar (with GSNP)	Physics of transcriptional regulatory networks	**Nicholas Buchler**: Statistical physics of transcriptional regulation; **Sui Huang**: Gene expression dynamics during cell differentiation; **Hao Li**: Combinatorial regulation in yeast transcription networks; **Alexi Vazquez**: Network theory and prediction of regulatory switches; **Linchong You**: Programming bacterial dynamics by synthetic killer circuits.	
8	Xinsheng Sean Ling	Nanopore Biophysics:	**John Kasianowicz:** DNA and protein transport through bacterial pore-forming toxins and potential applications; **Cees Dekker**: Translocation of dsDNA through solid-state nanopores; **Jiali Li**: Detecting single DNA and protein structure in a solid-state nanopore sensing system; **Liviu Movileanu**: Protein unraveling through a single protein nanopore; **Aleksei Aksimentiev**: Microscopic Kinetics of DNA Translocation through Synthetic and Biological Nanopores.	Nanopore biophysics uses electric-field driven transport of long biomolecules through nanometer-scale pores. This session focuses on DNA and protein transport through protein and solid state derived nanopores for detection and localization.
11	Herbert Levine (Bob Austin)	The Experimental and Theoretical Foundations of Evolution	**Juan Keymer; Michael Deem; Daniel Fisher; Richard Lenski; James Shapiro.**	Evolution lies at the very foundation of modern biology. This Symposium will present a snapshot of our present understanding of evolution in biology from a theoretical, experimental and biological perspectives.
12	Saw-Wai Hla	Methods in Nano-biotechnology	**Michael Roukes**: Nanomechanical Devices for Single Molecule Biophysics; **Bob Austin**: Single Molecule Dynamics of Polymers Confined in Nanochannels; **Josef Michl**: Surface Mounted Artificial Molecular Rotors; **Paul Wiseman**: Mapping Protein Transport in Living Cells with Quantum Dots and Spatio-Temporal Image Correlation Spectroscopy.	Nanobiotechnology lets us investige and transform biological processes to the single molecule level. While biology inspires developing nanoscale devices with novel functionalities. Merging these opens up new research frontiers and applications.

FOCUS SESSIONS

10.14.1 12.7.81	Molecular Machines and Motors (GSNP)	Dean Astumian	**Yale Goldman**: Biological motors: Conventional and Unconventional Myosins; **Amar Flood**: Synthetic Motors and Nanomachines.	Molecular machines are single macromolecules or macromolecular complexes that perform specific functions for a living system. Examples are molecular motors that move molecules through cells or propel cells.
10.14.2 12.7.84	Microorganism Motility (GSNP)	[Peter Jung]	**Eberhard Bodenschatz**: Dictyostelium Discoideum Chemotaxis: Threshold for Directed Motion.	
10.14.3 12.7.82 4.15.9	Cytoskeletal Dynamics (GSNP&DPOLY)	[Peter Jung]	**Gaudenz Danuser:** Probing the mechanics of cell protrusion by profiling subcellular heterogeneity of actin dynamics.	
10.14.4	Single-molecule biophysics	Ching-Hwa Kiang	**Steven Chu**: The Role of Fluctuations in Enzymatic Activity; **David Nelson**: Dynamics of molecular motors with finite processivity on heterogeneous Tracks.	This focus session intends to bring experimentalists and theorists together to discuss the physics of biology at the single molecule level. Topics of interest include dynamics, structure, and kinetics of nucleic acids and proteins.
10.14.5	Trapping of Nanoscale Biological Objects	W.E. Moerner	**Adam E. Cohen**: The Anti-Brownian Electrophoretic Trap; **Enrico Gratton**: Tracking Protein-coated Particles in 3D	New approaches for tracking and trapping nanoscale objects have recently appeared which circumvent some of the limitations of optical tweezers, thus allowing manipulation and study of biomolecules in solution without the need for surface attachment.
10.14.6 4.15.10	Nonequilibrium Fluctuations in Biomolecules and Artificial Nanodevices (DPOLY)	Ioan Kosztin	**Dean Astumian**: Least dissipation principle for single molecule dynamics; **Boldizsar Janko**: Applications of the ratchet effect at nano- and meso-scales.	This session will focus on experimental and theoretical developments in assessing the importance and characterizing quantitatively the effect of nonequilibrium fluctuations on the functioning of biomolecules and artificial nanodevices
10.14.7	Noise and Fluctuations in Biological Systems	Peter Jung	**Alexander van Oudenaarden**: Noisy cellular decision-making: from temporal to spatial choices.	Fluctuations are an important feature in many biologic systems on all levels of organization. This session is focused on new insights into the role of fluctuations in the structure and function of biological systems.
10.14.8 12.7.83	Methods of Statistical Physics in Population Dynamics & Epidemiology (GSNP)	Theo Geisel	**Dirk Brockmann**: Universal Scaling Laws In Human Traveling and the Spatiotemporal Dynamics of Epidemics	
10.14.9	Biological Networks: Structure, Dynamics & Function	Chao Tang	**Hana El-Samad**: TBA; **Michael Elowitz**: Differentiation at the single cell level: slow, noisy, and out of control .	There has been an increasing interest in quantitative studies of biological networks at various levels--from molecular, cellular, to organism and ecological. The session focuses on the relationship between networks' topology, dynamics and function
10.14.10	Physical Aspects of Morphogenesis: Computational Approaches	Shane Hutson	**Yi Jang**: TBA; **G.Wayne Brodland**: TBA	Statistical and deterministic models of the complex self-assembly of an organism from egg to adult. Topics include: morphogenetic gradients; chemotaxis; genetic regulatory networks; and non-linear cellular mechanics
10.14.11	Dynamics of nucleic acid-protein interactions: single molecules to biological systems	Mark Williams	**Michelle D. Wang**: TBA; **Guys J.L. Wuite**: DNA kept under tension reveals mechanochemical properties of protein reaction pathways	All abstracts relevant to nucleic acid-protein interactions are welcome,including DNA replication, transcription, DNA bending by proteins, protein searches on DNA, DNA-ligand binding, and molecular motors and enzymes that operate on nucleic acids.

10.14.12 08.11.1	DNA and Protein Analysis with Micro and Nano-Fluidics (DPOLY&DFD)	Steve Quake	**Carl Hansen**: Microfluidic Protein Crystallography; **Robert Riehn**: DNA in Nanofluidic Devices.	Micro and nanofabricated devices are promising technologies for biological analysis.This session will explore the fundamental physics at the interface between such technological developments and applications in DNA and protein analysis.
10.14.13	Physical & Engineering Constraints on Biological Systems	Partha Mitra	**Timothy Lezon** **John Doyle** (Lezon student)	This session focuses on fundamental physical or engineering limits to biological function. Topics include theoretical and experimental work on biological systems spanning molecular, cellular and physiological scales, with a focus on system function.
10.14.14	Counterion Dynamics in Charged Biopolymer Systems	Philip Pincus	**Gerard Wong**: Counterion liquids within polyelectrolyte bundles; **Roland Netz:** Polyelectrolytes in electric fields.	Coulombic interactions play a central role in the physical properties of many charged biopolymers. The dynamics of these systems is virtually unexplored. This Focus Session will be devoted to this rapidly developing area.
10.14.15	Physical Models of Ion Channel Function	Bob Eisenberg	**Dirk Gillespie**; **Rob Coalson**	Ion Channels are nanovalves controling an enormous range of biological function. Physical models of Ion Channels calculate the current given the electric field and ion size viewing the channel protein as a stable structure of dielectric and charge.
10.14.16	Biological Photophysics	Shane Hutson	**Dongping Zhong**; **Vasan Venugopalan**	How biology uses light and how light can be used to manipulate biology. Topics include: energy capture and conversion in photoactive proteins; laser ablation of biological tissues; FRET; FLIM; CALI; and (holographic) optical traps.
10.14.17 11.8.8	Spectroscopy of Biomolecules: from Isolated Molecules to Cell Environment (DCP)	[dcp]	**Phil Anfinrud:** Watching proteins function with picosecond X-ray crystallography and molecular dynamics simulations; **Tobias Baumgart; Mattanjah de Vries: Taekjip Ha:** Single molecule views of Nature's nano-machines: **Robin Hochstrasser:** What does 2D IR reveal about peptides in membranes; **Martin Jerrold; Michael Mons:** Probing secondary structures of peptide chains using gas phase laser spectroscopy: **John Simons:** Probing the glycosidic linkage: sugers in the gas phase; **Megan Spence; Tim Zwier:** Laser spectroscopy probes of biomolecular conformatio: Valley-to-valley searches for molecular-scale mountain passes	
10.14.18 08.11.2	Biological Hydrodynamics (DFD)	Steve Quake	**Alex Groisman**: Fluid Control over Chemotaxis; **Michael Brenner**: Biological Hydrodynamics	Many fascinating fluid phenomena occur in biological systems. This session will investigate the role of fluid mechanics both as a phenomenological tool to understand biology and as an experimental knob with which to perturb life.

10.14.1 11.8.9	Biomolecule dynamics in folding and function (DCP)	Robert Callander [Marilyn Gunner]	**Alfred Redfield (award); Ann-Francis Miller**	Motion is required for biomolecule assembly and functions. Methods to measure and calculate the range of required motions will be discussed.
10.14.20 04.15.1.	Biopolymers: Molecules, Solutions and Networks (DPOLY)	[dpoly]	**Angel Garcia (award)**	