THE BIOLOGICAL PHYSICIST

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

Vol 3 № 3 August 2003

In this Issue

The Lights are Back On!

And in laboratories everywhere, it's time to dust off those lecture notes and prepare for the new semester. But first, take a few minutes to read about an important upcoming conference, "Opportunities for Physicists in Biology", starting on page 2. Then scan through PRE Highlights to check out the latest biological physics publications. Stay tuned for the autumn issues of "The Biological Physicist", which will bring you more conference announcements, lab and department profiles, interviews, and research updates.

SB

CONFERENCE ANNOUNCEMENT: OPPORTUNITIES FOR PHYSICISTS IN BIOLOGY

The material below is also available at http://www.aps.org/meet/biology-physics2/index.html.

GENERAL INFORMATION

The American Physical Society (APS) plans to hold a second topical conference on "Opportunities in Biology for Physicists" in San Diego, CA, from January 30 to noon on February 1, 2004. The conference will be aimed predominantly at graduate students and postdocs in physics who are considering applying the methods of physics to biological topics. However, all those who are interested in entering the broad interdisciplinary area, or advising others who will do this, are urged to apply and will be welcome if space permits.

Physicists and biologists who are leaders in their fields will be asked to give broad overviews of selected areas at the interface between physics and biology. The conference schedule will allow plenty of time for discussion and opportunities to meet with the speakers informally. On the afternoon of the first day, there will be a reception, at which time there will be an opportunity for those who fund researchers in biological physics and those who hire biological physicists to meet with the participants and to display posters or provide information in other forms. Those organizations that contribute funds for the conference will get public acknowledgement at the reception. On the second day, there will be a "Lunch with the Experts," available to all the student participants free of charge. This event features round tables with one expert (in most cases one of the conference speakers) and eight or nine participants, and allows for sustained informal conversation.

Rapid strides are occurring in biology, where enormous technical and conceptual progress has been made in the last 10 years. Biology is changing from a descriptive to a quantitative and conceptually profound field. The conference is aimed at making the physics community, particularly students and postdocs, more aware of the revolution occurring in biology. We believe that physics will make a substantial contribution to this revolution, particularly if biologists and physicists work together at this critical time.

Due to size limitations, registration is restricted. All those interested in attending the conference must submit an application to participate. The application form can be downloaded below and faxed or mailed as indicated on the form when completed. THIS APPLICATION IS NOT A REGISTRATION FORM. Applications to participate must be received by October 1, 2003.

Travel grants of up to $500 are available for graduate students and postdocs. A travel grant request form must be submitted by October 1, 2003 and can be downloaded at http://www.aps.org/meet/biology-physics2/index.html.

PROGRAM OVERVIEW

General Plan for the Conference

The conference will be held in San Diego and will last for two and one half days, January 30 through noon on February 1, 2004. It is expected that there will be 15 talks and all will be plenary. Talks will average about 30 minutes, and each will be followed by a discussion period of at least 15 minutes to allow for extensive questions and answers. In addition, there will be long coffee breaks twice a day to allow participants to interact one-on-one with the speakers and to get to know each other. On the afternoon of the first day, there

will be a reception, at which time there will be an opportunity for those who fund researchers in biological physics and those who hire biological physicists to meet with the participants and to display posters or provide information in other forms. On the second day, there will be a "Lunch with the Experts," available to all the student participants free of charge. This event features round tables with one expert (in most cases one of the conference speakers) and eight or nine participants, and allows for sustained informal conversation. It was a terrific hit at the first conference.

Background and Motivation

The American Physical Society organizes 20-25 general and specialized meetings each year. At all of these meetings, the major purpose is for scientists to share the results of their own current research with colleagues. In 2001, the APS Executive Board decided that it would be advantageous to organize a different kind of meeting, a topical conference on an emerging field, that would prepare physicists for future opportunities. As a result of this decision, a conference was organized focusing on the interface between physics and biology and aimed at early career physicists who were interested in exploring the possibilities of entering this exciting field. The conference was held in Boston September 27 – 29, 2002. It was very well received and a follow-up survey revealed a great deal of interest in a second workshop. Working with the APS Division of Biological Physics and its past chair, Robert Austin, a Steering Committee for a second conference was appointed, consisting of outstanding researchers who work in the interface area between physics and biology.

Intended Audience

The conference is aimed predominantly at graduate students and postdocs in physics who are considering applying the methods of physics to biological topics. However, all those who are interested in entering this broad interdisciplinary area or advising others who will do this are welcome as space permits. We anticipate an attendance of about 200 and will not allow the attendance to grow beyond 250. Keeping the conference small will allow the participants to interact more easily with the speakers, all of whom will be major leaders in their fields.

The conference is not aimed at those who already work in the field of biological physics or biophysics and will not be a place where scientists come to present their own new *research.*

Major Topics To Be Covered

The Steering Committee chose the five topics below for special emphasis at the conference. These were not intended to be all-inclusive but instead were selected to give an introduction to a subset of areas deemed to be of particular importance for the future. It was decided that covering fewer topics would not give a sufficient overview while covering more would not allow sufficient depth. In addition to talks in these scientific areas, there will also be talks on the "how to" of moving from physics into the physics-biology interface. A detailed schedule of talks and events will be posted as soon as it becomes available. A brief summary of each scientific topic is given below.

Topic #1 Signal Transduction Networks (Chair, Ned Wingreen, NEC)

The cell is filled with networks of molecules carrying signals. These signal transduction networks regulate cellular functions in response to external conditions -- light, oxygen, nutrients, toxins, and signals from other cells -- and in response to the cell's internal state. The tools of genetics and molecular biology are well suited for

identifying the components of these signaling networks, but characterizing their functions requires additional tools from physics. Among the contributions from physics are techniques to measure internal concentrations of proteins in real time, including modifications such as phosphorylation that are used to carry signals. Also coming from physics are techniques to measure the responses of single cells. For theorists looking for opportunities in biology, signaling networks provide a rich ground for mathematical modeling. In the coming years, physicists and biologists will need to work together to understand these networks and to uncover the design principles of cellular information flow.

Topic #2 Pattern Formation and Self-organization (Chair, Herb Levine, University of California, San Diego)

Living systems clearly have the need and capability to form exquisite spatial structures on a large range of length scales. Some of these, such as the organs of multicellular organisms, are essentially static in nature; others, such as the self-assembled actin polymer networks needed for cell division and cell motility, are transient, being assembled and disassembled in response to external stimuli. In both cases, the structures are formed by the nonlinear interaction of many degrees of freedom, processes that go under the general name of nonequilibrium pattern formation. As more becomes known about the molecular underpinnings of these biological pattern-forming processes, it is becoming increasingly possible to quantitatively unravel how they manage to work stably and reproducibly in a noisy world. Physicists can play an essential role in this quest, bringing to bear advanced imaging modalities, complex-system modeling techniques, and an appreciation of the subtleties of nonequilibrium dynamics, on this exciting biological frontier.

Topic #3 Bioinformatics, genomics and proteomics (Chair, Laura Garwin, Harvard University)

The invention of rapid methods to clone and sequence DNA has revolutionized biology, culminating this year in the near-completion of the sequencing of the human genome. But knowing the string of letters that comprise an organism's genome is but the first step towards a comprehensive knowledge of its biology. The new techniques of genomics and proteomics allow one to study simultaneously hundreds or thousands of an organism's genes or proteins -- an approach that has created a problem for biologists akin to that of drinking from a fire hose. Physicists can bring to bear on this problem their long experience of analyzing and interpreting large datasets, and a habit of reducing complex problems to simpler essentials. In the burgeoning field of bioinformatics, mathematical, computational and statistical physicists can help mine and manipulate the huge quantities of information present in biological sequences. At the same time, experimental physicists can develop new methods of perturbing and probing the networks of genes and proteins that underlie biological function.

Topic #4 Biological Nanotechnology (Chair, Robert Austin, Princeton University)

Biological systems work inherently at the nanometer scale. A single cell represents an amazingly complicated and sophisticated assembly of nanoscale sensors and structures which carry out fundamental actions of life. As the physics community pushes down to the nanometer length scale in the drive to push the limits of our present technologies, biological systems offer us a great array of already functioning systems which we can study, learn from, interface to and ultimately mimic. This section will cover three basic areas of

Biological Nanotechnology: (1) Single molecule studies of biological molecules as nanomachines; (2) Biological construction of complex nanostructures; (3) nanoscale sensors which utilize a combination of biological objects and nanoscale materials from the condensed matter community.

Topic #5 Systems Neuroscience (Chair, David Kleinfeld, University of California, San Diego)

An understanding of the computational principles and biophysical elements of brain function is an essential challenge to 21st century science. Cognitive processes are algorithmic in their most basic form and thus naturally studied with the many analytical tools and didactic thinking of physics. At the systems level, the collective computations and learning rules that dominate topics that range from vocalization to sensation and motor control are, at their heart, problems that involve statistical approaches. At the level of biophysical hardware, an understanding of the molecular basis of signal transduction and communication involves much of the same reasoning that define issues in modern condensed matter physics on the one hand and issues in gene regulation logic on the other hand, such as long-range interactions and processes that occur on multiple time- and spatial-scales. Beyond conceptual issues, the push to understand the brain requires new tools in terms of data analysis and in terms of physical processes to probe function from afar. The latter range from magnetic resonance imaging to nonlinear optical microscopies. Taken together, neuroscience offers unbounded opportunities for individuals trained in physics and open to the confluence of physical reasoning and biological reality.

For further information go to
http://www.aps.org/meet/biology-physics2/index.html

or contact:

Ken Cole
American Physical Society
One Physics Ellipse
College Park, Maryland 20740
Tel: 301-209-3288
E-mail: cole@aps.org

Steering Committee:

Robert Austin, (Co-Chair)
Princeton University
Herbert Levine (Co-Chair)
University of California, San Diego
Laura Garwin
Harvard University
Ka Yee Lee
University of Chicago
Ned Wingreen
NEC
Jose Onuchic
University of California, San Diego
David Kleinfeld
University of California, San Diego
Deborah Fygenson
University of California, Santa Barbara
William Bialek
Princeton University
Aihua Xie
Oklahoma State University
Judy Franz
American Physical Society Liaison
Ken Cole
APS Staff Assistant

PRE HIGHLIGHTS

JUNE 2003
Biological Physics Articles from Physical Review E
(Statistical, Nonlinear, and Soft Matter Physics)
Volume 67, Number 6, Articles (06xxxx)
http://ojps.aip.org/dbt/dbt.jsp?KEY=PLEEE8&Volume=67&Issue=6

RAPID COMMUNICATIONS

Molecular simulations of mesoscopic bilayer phases
Marieke Kranenburg, Maddalena Venturoli, and Berend Smit
Published 18 June 2003 (3 pages)
060901(R)

Kinetic pathway of the bilayered-micelle to perforated-lamellae transition
H. Wang, M. P. Nieh, E. K. Hobbie, C. J. Glinka, and J. Katsaras
Published 30 June 2003 (4 pages)
060902(R)

ARTICLES

Distance, dissimilarity index, and network community structure
Haijun Zhou
Published 10 June 2003 (8 pages)
061901

Stability analysis of a delayed Hopfield neural network
Shangjiang Guo and Lihong Huang
Published 12 June 2003 (7 pages)
061902

Quasiequilibrium unfolding thermodynamics of a small protein studied by molecular dynamics simulation with an explicit water model
Jihua Wang, Zhiyong Zhang, Haiyan Liu, and Yunyu Shi
Published 13 June 2003 (11 pages)
061903

Stochastic model for heart-rate fluctuations
Tom Kuusela, Tony Shepherd, and Jarmo Hietarinta
Published 13 June 2003 (7 pages)
061904

Folding behaviors of lattice model proteins with three kinds of contact potentials
Meng Qin, Jun Wang, Yi Tang, and Wei Wang
Published 18 June 2003 (8 pages)
061905

Fluctuating reaction rates and their application to problems of gene expression
Tatsuo Shibata
Published 20 June 2003 (8 pages)
061906

Protein crystals and charged surfaces: Interactions and heterogeneous nucleation
R. P. Sear
Published 20 June 2003 (7 pages)
061907

Rotational magnetic endosome microrheology: Viscoelastic architecture inside living cells
C. Wilhelm, F. Gazeau, and J.-C. Bacri
Published 23 June 2003 (12 pages)
061908

Analytical solution of a generalized Penna model
J. B. Coe and Y. Mao
Published 23 June 2003 (8 pages)
061909

JULY 2003

Biological Physics Articles from Physical Review E

(Statistical, Nonlinear, and Soft Matter Physics)

Volume 68, Number 1, Articles (01xxxx)

http://ojps.aip.org/dbt/dbt.jsp?KEY=PLEEE8&Volume=68&Issue=1

ARTICLES

Dynamical mechanisms underlying contrast gain control in single neurons
Yuguo Yu and Tai Sing Lee
Published 8 July 2003 (7 pages)
011901

Comparison of asymptotics of heart and nerve excitability
Rebecca Suckley and Vadim N. Biktashev
Published 11 July 2003 (15 pages)
011902

Effective pair potentials between protein amino acids
P. Pliego-Pastrana and M. D. Carbajal-Tinoco
Published 11 July 2003 (4 pages)
011903

Thermodynamic instability in supersaturated lysozyme solutions: Effect of salt and role of concentration fluctuations
Mauro Manno, Caide Xiao, Donatella Bulone, Vincenzo Martorana, and Pier Luigi San Biagio
Published 14 July 2003 (11 pages)
011904

Effects of DNA-distorting proteins on DNA elastic response
Jie Yan and John F. Marko
Published 15 July 2003 (12 pages)
011905

Solving the riddle of the bright mismatches: Labeling and effective binding in oligonucleotide arrays
Felix Naef and Marcelo O. Magnasco
Published 16 July 2003 (4 pages)
011906

Intrinsic fluorescence spectroscopy of glutamate dehydrogenase: Integrated behavior and deconvolution analysis
P. P. Pompa, R. Cingolani, and R. Rinaldi
Published 18 July 2003 (9 pages)
011907

Spatial representation of temporal information through spike-timing-dependent plasticity
Thomas Nowotny, Misha I. Rabinovich, and Henry D. I. Abarbanel
Published 18 July 2003 (12 pages)
011908

Perimeter growth of a branched structure: Application to crackle sounds in the lung
Adriano M. Alencar, Sergey V. Buldyrev, Arnab Majumdar, H. Eugene Stanley, and Béla Suki
Published 21 July 2003 (12 pages)
011909

Synthetic nanopores with fixed charges: An electrodiffusion model for ionic transport
P. Ramírez, S. Mafé, V. M. Aguilella, and A. Alcaraz
Published 25 July 2003 (8 pages)
011910

Optimal noise-aided signal transmission through populations of neurons
Thomas Hoch, Gregor Wenning, and Klaus Obermayer
Published 29 July 2003 (11 pages)
011911