THE BIOLOGICAL PHYSICIST

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In this Issue

This issue brings you interviews with the winners of the First Annual Award for Outstanding Doctoral Thesis Research in Biological Physics. The Division also elected three new Executive Committee members in December. And of course, we bring you all the usual suspects – PRE & PRL Highlights, and some important job ads and conference announcements.

– SB & CS

FEATURE

Announcing the First Annual Award for Outstanding Doctoral Thesis Research in Biological Physics

The Division of Biological Physics of the American Physical Society is pleased to announce the first of its *Outstanding Doctoral Thesis Research in Biological Physics* Awards. These awards (http://aps.org/programs/honors/dissertation/biological.cfm) recognize outstanding graduate research in biological physics, one of the most rapidly growing, exciting & interdisciplinary branches of contemporary physics.

The Award Committee was gratified by the international reach and superb quality of the applicants. The nominees applied interdisciplinary theoretical, computational and experimental approaches to a host of complex problems drawn from biophysical chemistry, biological physics, bioengineering and medicine.

The outstanding quality and diversity of the applications made selecting a winner particularly difficult. To recognize this diversity, the Award Committee and Executive of the DBP have decided to honor Dr. Moffitt and Dr. Campelo as joint winners. Dr. Moffitt and Dr. Campelo will each receive an award of $750 and have been asked to present invited talks at the American Physical Society March Meeting to be held March 15 - 19, 2010 in Portland Oregon. Each will also receive a certificate citing his scientific contributions and travel allowances and fee waivers for the meeting. The two runners-up, Dr. Pocivavsek and Dr. Käfer will receive certificates of merit.

The Awards Committee and the DBP Executive Committee appreciate the time and effort taken by the nominators and students in preparing their dossiers and look forward to the successful continuation of this Award in 2010/2011.

For more information, or to arrange interviews with the awardees, please contact Prof. James Glazier, at glazier@indiana.edu or by telephone at (812)855-3735.

For the Award Committee (James Glazier [chair], Leon Glass, James Collins, Angel Garcia, Qing Nie):

Joint Winners

Dr. Jeffrey R. Moffitt

Department of Physics
University of California, Berkeley
Advisor: Prof. Carlos Bustamante
Thesis Title: *Viral DNA Packaging at Base-Pair Resolution*
Citation: For outstanding contributions to the design and construction of high resolution optical tweezers and use of this device to provide new insight into the packaging of DNA in bacteriophages. Dr. Moffitt's work demonstrates remarkable maturity and brilliance and has helped establish important new experimental and theoretical directions in molecular biophysics.

Dr. Felix Campelo Aubarell

Faculty of Physics, Department of the Structure and Constituents of Matter
University of Barcelona
Advisor: Dr. Aurora Hernández-Machado
Thesis Title: *Shapes in Cells. Dynamic Instabilities, Morphology, and Curvature in Biological Membranes*
Citation: For the development of a theoretical and computational framework for studying the physical mechanisms responsible for shaping cells and their internal organelles. Applied to dynamic

morphological instabilities in membranes due to the anchorage of amphiphilic molecule and to liposomes formed by a ternary mixture of lipids, these models predict the coexistence of liquid-ordered and liquid-disordered lipid phases. Dr. Campelo has also proposed a quantitative formulation of curvature generation by hydrophobic insertion, which accounts for the internal structure of membranes, and shown that his theoretical results agree with experimental data on both model lipid membranes and cells.

Honorable Mention

Dr. Luka Pocivavsek

Department of Chemistry and Medical Sciences
University of Chicago
Advisor: Prof. Ka-Yee Lee
Thesis Title: *Mechanical and Thermodynamic Focusing at Membrane Interfaces*
Citation: For outstanding work on the collapse mechanisms of thin films, especially lung surfactants. Dr. Pocivavsek has made pioneering theoretical and experimental contributions to understanding reversible folding collapse in lung surfactant monolayers and the factors that determine collapse behavior. Dr. Pocivavsek's breakthrough work provides important biophysical, mechanistic insights into how lung surfactants' mechanical characteristics maintain stability in the lungs.

Dr. Jos Käfer

Laboratoire de Spectrométrie Physique
Université Joseph Fourier, Grenoble
Advisor: Prof. François Graner
Thesis Title: *From Cells to Tissues: Physical Modelling of the Collective Behaviour of Embryonic Cells*
Citation: For outstanding contributions to understanding tissue morphogenesis. Dr. Käfer has shown that the balance between adhesion and cortical tension determines cell shape in Drosophila ommatidia and that cell-sorting in mixtures of germ layer progenitor cells in zebrafish embryos results from similar force balances.

FEATURE

Interviews with the Outstanding Doctoral Thesis Research in Biological Physics Award Winners

THE BIOLOGICAL PHYSICIST *spoke with three of the thesis award winners about their research, their views on biological physics, and their plans for the future. (The Editors hope to be able to bring you an interview with the fourth awardee in an upcoming issue.)*

Dr. Jeffrey R. Moffitt

Could you give a brief description of your research?
I studied the mechanism of a specific type of enzyme known as a molecular motor. Like many other biological enzymes these remarkable machines are several nanometers in dimension, are composed of protein and nucleic acid, and catalyze some chemical reaction. However, in the case of molecular motors a crucial part of the reaction is the conversion of chemical energy from the hydrolysis of a fuel molecule into directional motion and mechanical work. For example, the particular motor that I studied burns a small molecule known as Adenosine Triphosphate (ATP) and somehow harnesses the released chemical energy to directionally pump and compress a viral DNA genome into a small protective shell known as a capsid. When the process is complete, the genome is compressed to a pressure of about 60 atmospheres, so this is a very strong motor.

What I found particularly exciting about the packaging motor is that it is composed of five copies of the same protein; it is a multi-piston engine. While we had some basic ideas on how the engine was geared, we had no idea how the individual pistons were coordinated. To address this issue I constructed a very sensitive optical tweezers—a device that uses focused laser beams to pull and manipulate single molecules—and I followed each small increment of DNA packaged as the bacteriophage motor encapsulated its DNA.

Dr. Jeffrey Moffitt.

These increments revealed two important features of the motor. First, we were able to measure the step-size of the motor—how much DNA is packaged each cycle. This number is important in constraining how the motor engages the DNA and how efficiently it converts chemical energy into work. Second, each step of the motor clearly marked the end of one motor cycle and the beginning of the next cycle. Thus, we could measure the exact time the motor took to complete a single cycle. For a macroscopic engine operating on an energy scale much larger than thermal energy, this cycle completion time is a deterministic quantity. However, molecular motors operate on the thermal energy scale; thus, this cycle completion time is dominated by thermal fluctuations. By exploiting the relationship between these fluctuations and the mechanism of the motor, we were able to determine how the multiple pistons coordinate their action.

What got you into biological physics / interdisciplinary science?

Biophysics was attractive to me for two reasons. First, the scale of the experiments is relatively small. I could be involved in all aspects of the experiment, from instrument construction to theoretical modeling of the data. Second, the interdisciplinary aspect of biophysics brings together people that think very differently about the same problems. One person might be worried about the correct folding of a DNA binding protein on a surface while the other might be worried about the charge of that surface. Personally, I learn a lot more about the problem I'm studying when I'm in such an environment.

What are your plans for postdoctoral work over the next few years?

I have taken a position with Dr. Philippe Cluzel at Harvard University. I'll be studying fluctuations in gene networks in bacteria. There are strong parallels between the fluctuations in single molecular motors and in the output of entire biological networks, and I'm hoping to pursue these connections.

What is the best bit of advice you ever received from a senior colleague about interdisciplinary science?

Perhaps the best advice I was given was to make sure that I am asking questions that are interesting to Biologists. This advice has proven very useful to me. In my experience, the problem of a Physicist moving into Biology is not in learning new techniques, but in embracing the complexity of the cell. I think some of the best Biology questions embrace this complexity, and the best biophysics simplifies the problem without discarding the relevant Biology.

Imagine it is sometime later this decade, and you are standing in your own laboratory unpacking boxes. What research plans will you have? What

will the first experiments/ simulations/projects be that you'll set up in your own research group?
My PhD focused on in vitro techniques, and my postdoctoral work will be largely in vivo. I think that there are many interesting questions that require both approaches, and I think there is a growing need for research labs with expertise in both classes of techniques. As for specific questions, I have some ideas, but we'll have to wait and see what I find interesting in the next few years.

What was the most frustrating experience during your doctoral studies? The most joyous?
It wouldn't be a good PhD if there weren't many failed experiments, but perhaps my most frustrating experience came from one of the experiments that didn't fail. Our initial measurements of the step size of the packaging motor revealed an unexpected result—a step size that is a non-integer number of base pairs of DNA. This result seems unphysical at first. DNA is repetitive on the base pair scale; there is no common structural and chemical element every ½ base pair. The logical conclusion, at this point, was that we had a very large systematic error in our measurement. I think it is easy to imagine how frustrating that would be after 2 years of careful instrument construction and calibration. However, six months of additional cross checks and new calibration methods changed this frustrating measurement into one of the more exciting discoveries of my PhD. Our instrument had been calibrated correctly all along, and 2.5 base pairs was the correct step size. Moreover, because the step size is so unexpected, it is a much more exciting and informative measurement than a step size that is an integer number of base pairs.

Dr. Felix Campelo Aubarell

Could you give a brief description of your research?
I did my PhD thesis in theoretical biophysics, studying the mechanics of biological membranes, taking lipid bilayers as model systems, and also their biological implications. In particular, I was very interested in understanding the mechanisms by which the vast gallery of different shapes that can be found in cells are formed and maintained. Motivated by the experimental results on dynamic shape instabilities in membrane tubes with anchored polymers by the group of Prof. Joel Stavans at the Weizmann Institute, we developed a phase-field model to deal with the elastic energy of membranes. With this model we were able to theoretically characterize both the curvature-driven pearling instability in lipid tubular vesicles, and the vesicle tubulation due to the anchorage of amphiphilic polymers. Further, during my visit at Prof. Martine Ben Amar lab, at the ENS in Paris, we studied the formation of multicomponent lipid tubes which presented a periodic phase separation. The generation of membrane curvature by proteins is a hot topic in cell biology. Thus, during my stay at Tel Aviv University under the supervision of Prof. Michael M. Kozlov, we studied the hydrophobic insertion mechanism of curvature generation by proteins, developing a theoretical model based on the elasticity of the membrane as a three-dimensional medium with bulk elastic properties. We were able to calculate numerically the amount of curvature generated by this mechanism as a function of the protein insertion parameters.

What got you into biological physics?
I've always been fascinated by the beauty of nature shapes, from the simplest spherical objects to the most complex fractal shapes. After a seminar that Prof. Yves Couder gave at my University on the formation and structure of leaf venations, I realized that biology had a great potential for posing new and interesting questions on that topic. Then, after meeting Prof. Joel Stavans, together with my PhD supervisor, Prof. Aurora Hernandez-Machado, we decided to study the shapes of biological membranes.

What are your plans for postdoctoral work over the next few years?
After finishing my PhD, I started a postdoc in Vivek Malhotra's lab at the Center for Genomic Regulation in Barcelona. His lab is composed by cell biologists and biochemists, and even though I had never worked in a wet lab before, he decided to hire me to get a new "biophysical" point of view in his group. I've been doing both experiments and theory during these months, trying to understand

the mechanisms of formation of transport carriers from the Golgi apparatus.

What is the best bit of advice you ever received from a senior colleague about interdisciplinary science?
Once I was told that the first thing one should do in interdisciplinary research was to learn the language of the other discipline, in my case the language of biology. This included reading purely biological papers, with special attention to the methodological sections, something which is extremely hard for a theorist in the beginning.

Imagine it is sometime later this decade, and you are standing in your own laboratory unpacking boxes. What research plans will you have? What will the first experiments/simulations/projects be that you'll set up in your own research group?
Well, it is hard to say which research plans I would have in 5-10 years. Science evolves so fast these days that new interesting questions arise every day. In any case, I would be very interested in doing combined research with biologists and physicists working together doing experiments and theory. The mechanisms of transport carrier formation at the level of the Golgi apparatus are far from being well understood and I am sure that many questions will be still open in the future. Which is the role of specific lipids in fission and fusion of transport carriers? How is the size of such vesicles regulated? Are lipid domains important for the formation of these carriers and for the recruitment of cargo? What keeps the structure of the Golgi apparatus as it is, even when it is known that it is a very dynamic organelle?

What was the most frustrating experience during your doctoral studies? The most joyous?
Luckily I've had much more joyous experiences during my PhD than frustrating ones. Probably when our first article in the Physical Review Letters was accepted was one of the most joyous moments, but also when I got my code working for finding the stationary shapes of vesicles, something which had been known for years, but which was my first "result" as a PhD student.

Dr. Luka Pocivavsek

Could you give a brief description of your research?
My work focused on understanding the mechanical and thermodynamic stability of thin self-assembled films at air/liquid interfaces. In particular, I tried to understand how lipid monolayers respond to lateral compression in a Langmuir trough geometry. This is an old problem in interfacial science, yet what intrigued me the most was that despite many models and theories none were able to predict some clear length scales that the system offers. For instance, a lipid monolayer only a couple of nanometers thin losses mechanical stability by buckling out of plane into sharply focused and deep (microns) folds. There are two interesting phenomena here: one, the focusing problem, i.e. the monolayer chooses to collapse (go out of plane) by focusing the deformation onto small parts of the surface instead of spreading it out in little bits across the entire surface; second, the focused structures are large, very large, over three orders of magnitude larger than the thickness of the monolayer. The focusing phenomena made us think about crumpling, where stress is focused into d-cones and ridges leaving most of the membrane flat even at high compaction; so we began doing experiments with a toy model (polyester membranes on water). Using this toy system we were able to develop a generalized model for how a thin elastic membrane resting on-top of a soft substrate (liquid in our case) responds to compression. We showed that initially a membrane will respond linearly by distributing an applied stress throughout its entire length (what emerges is a wrinkling pattern). However, beyond a critical compression the wrinkled or distributed stress state looses stability and stress-focused structures such as folds begin to grow. Scaling laws developed using the toy model proved to predictive for self-assembled membranes like lipids. Another large aspect of my work focused on what chemical determinants play a role in lipid monolayer mechanical properties. The above mentioned wrinkle-to-fold model gave us a tool with which to measure parameters like bending stiffness in self-assembled films, using this we developed a mechanical phase diagram as a function of lipid and subphase composition. Surprisingly, we found that

the chemical composition of the subphase plays an intricate role in determining lipid monolayer mechanics.

What got you into biological physics / interdisciplinary science?
I have always loved chemistry and physics. Yet I had also always known that I wanted to go to medical school. My attraction to medicine was influenced far more by deep interests in the humanities and a desire to help people. The perfect marriage of these two interests was the MD/PhD program at the University of Chicago, where they were supportive of me doing a PhD in a physical science.

What are your plans for postdoctoral work over the next few years?
The next few years for me are heavily focused on clinical work. However I'm staying actively in touch with collaborators from my PhD work. Clinical work is exposing me to an incredibly vast amount of interesting biophysical problems that are also connected to patient health.

What is the best bit of advice you ever received from a senior colleague about interdisciplinary science?
Simply that the future of science is without question going be more and more interdisciplinary. Scientists need to communicate more and more with each other, but also with other professionals who use science such as engineers and clinicians.

Imagine it is sometime later this decade, and you are standing in your own laboratory unpacking boxes. What research plans will you have? What will the first experiments/simulations/projects be that you'll set up in your own research group?
I think we are at the cusp of an incredible revolution in science and medicine. The 20th century has been about breaking complex matter down into its simplest parts, whether with quantum mechanics or genetics. The 21st century I think will be about really beginning to understand how complex matter interacts and operates to generate ever more complex systems that give rise to living matter. For me the type of problems that attract me are ones dealing with surfaces and interfaces. Our bodies depend every day on the integrity of hundreds of square meters of complex interfaces. My graduate work was motivated largely by the incredible chemical and mechanical properties of the air/liquid interface that exists inside our lungs.


Dr. Luka Pocivavsek

I see myself continuing to work into the future on lung surfactant, striving to understand this system biophysically in the hope of using this knowledge to formulate a better surfactant replacement therapy. Another area which fascinates me and which also intricately combines chemistry and physics with biology and medicine is the vascular system. Arteries and veins have at their heart a highly complex interface between solid vascular tissue and the liquid blood they conduct throughout the body. Understanding some of the biophysics and surface chemistry of this interface could shed incredible light on many diseases from arteriosclerosis to diabetes. For example, we have seen that sugars preferentially enrich near certain lipid surfaces. By understanding what physical forces drive such enrichment layers to form one could then search for molecules that could disturb the enrichment; molecules that might potentially have a beneficial effect in preventing vascular pathology seen in diabetes. Another example is more mechanical, by studying and understanding how wrinkling and folding inside arteries changes global stability of these systems, we might develop a predictive model with which more precise clinical decisions could be made about the stability of say a dangerous aortic or cerebral aneurysm.

What was the most frustrating experience during your doctoral studies? The most joyous?
Doing science has been a joyous experience.

DBP ANNOUNCEMENT

Results of the December 2009 DBP Elections

Vice-Chair:
Pupa Gilbert,
Department of Physics,
University of Wisconsin-Madison

Members-at-Large:

John Bechhoefer,
Department of Physics,
Simon Fraser University

Margaret Cheung,
Department of Physics,
University of Houston

Certified by:

Thomas M. Nordlund
Secretary-Treasurer
Division of Biological Physics
American Physical Society
Associate Professor of Physics
University of Alabama at Birmingham

PRL HIGHLIGHTS

Soft Matter, Biological, &
Inter-disciplinary Physics Articles from
Physical Review Letters

2 October 2009

Volume 103, Number 14, Articles (14xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PRLTAO&Volume=103&Issue=14

Reduction of Viscosity in Suspension of Swimming Bacteria
Andrey Sokolov and Igor S. Aranson
Published 29 September 2009 // 148101

Gated Narrow Escape Time for Molecular Signaling
Jürgen Reingruber and David Holcman
Published 30 September 2009 // 148102

Thermodynamic Limit of a Nonequilibrium Steady State: Maxwell-Type Construction for a Bistable Biochemical System
Hao Ge and Hong Qian
Published 2 October 2009 // 148103

Anomalously Slow Attrition Times for Asymmetric Populations with Internal Group Dynamics
Zhenyuan Zhao, Juan Camilo Bohorquez, Alex Dixon, and Neil F. Johnson
Published 2 October 2009 // 148701

9 October 2009

Volume 103, Number 15, Articles (15xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PRLTAO&Volume=103&Issue=15

Network Topology and the Fragility of Tetrahedral Glass-Forming Liquids
Mark Wilson and Philip S. Salmon
Published 7 October 2009 //157801

Maximum Likelihood and the Single Receptor
Robert G. Endres and Ned S. Wingreen
Published 7 October 2009 // 158101

Spontaneous Oscillations of a Minimal Actomyosin System under Elastic Loading
P.-Y. Plaçais, M. Balland, T. Guérin, J.-F. Joanny, and P. Martin
Published 9 October 2009 // 158102

16 October 2009

Volume 103, Number 16, Articles (16xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PRLTAO&Volume=103&Issue=16

Mechanically Induced Biaxial Transition in a Nanoconfined Nematic Liquid Crystal with a Topological Defect
Giovanni Carbone, Giuseppe Lombardo, Riccardo Barberi, Igor Muševič, and Uroš Tkalec
Published 12 October 2009 // 167801

Liquid Crystal Cells with "Dirty" Substrates
Leo Radzihovsky and Quan Zhang
Published 12 October 2009 // 167802

Multilamellar Structures Induced by Hydrophilic and Hydrophobic Ions Added to a Binary Mixture of D2O and 3-Methylpyridine
Koichiro Sadakane, Akira Onuki, Koji Nishida, Satoshi Koizumi, and Hideki Seto
Published 14 October 2009 // 167803

Statistical Mechanics of Ecosystem Assembly
José A. Capitán, José A. Cuesta, and Jordi Bascompte
Published 13 October 2009 // 168101

Size Regulation in the Segmentation of Drosophila: Interacting Interfaces between Localized Domains of Gene Expression Ensure Robust Spatial Patterning
Sergei Vakulenko, Manu, John Reinitz, and Ovidiu Radulescu
Published 15 October 2009 // 168102

Noise and Synchronization in Pairs of Beating Eukaryotic Flagella
Raymond E. Goldstein, Marco Polin, and Idan Tuval
Published 16 October 2009 // 68103

Random Organization and Plastic Depinning
C. Reichhardt and C. J. Olson Reichhardt
Published 14 October 2009 // 168301

Explosive Percolation in Scale-Free Networks
Filippo Radicchi and Santo Fortunato
Published 13 October 2009 // 168701

23 October 2009

Volume 103, Number 17, Articles (17xxxx)
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Field-Induced Layer Thinning Transition on Free-Standing Smectic Films
Maria S. S. Pereira, Marcelo L. Lyra, and Italo N. de Oliveira
Published 20 October 2009 // 177801

Yield Stress and Shear Banding in Granular Suspensions
Abdoulaye Fall, François Bertrand, Guillaume Ovarlez, and Daniel Bonn
Published 23 October 2009 // 178301

Patterns in Flowing Sand: Understanding the Physics of Granular Flow
Tamás Börzsönyi, Robert E. Ecke, and Jim N. McElwaine
Published 23 October 2009 // 178302

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http://scitation.aip.org/dbt/dbt.jsp?KEY=PRLTAO&Volume=103&Issue=18

Dewetting-Controlled Binding of Ligands to Hydrophobic Pockets
P. Setny, Z. Wang, L.-T. Cheng, B. Li, J. A. McCammon, and J. Dzubiella
Published 30 October 2009 // 187801

Thickness Dependent Phase Behavior of Antiferroelectric Liquid Crystal Films
LiDong Pan, Shun Wang, C. S. Hsu, and C. C. Huang
Published 30 October 2009 // 187802

Why Do Red Blood Cells Have Asymmetric Shapes Even in a Symmetric Flow?
Badr Kaoui, George Biros, and Chaouqi Misbah
Published 26 October 2009 // 188101

Equilibrium Properties and Force-Driven Unfolding Pathways of RNA Molecules
A. Imparato, A. Pelizzola, and M. Zamparo
Published 29 October 2009 // 188102

Thermodynamics of Intragenic Nucleosome Ordering
G. Chevereau, L. Palmeira, C. Thermes, A. Arneodo, and C. Vaillant
Published 30 October 2009 // 188103

Quick Clay and Landslides of Clayey Soils
Asmae Khaldoun, Peder Moller, Abdoulaye Fall, Gerard Wegdam, Bert De Leeuw, Yves Méheust, Jon Otto Fossum, and Daniel Bonn
Published 28 October 2009 //188301

Efficient Method for Predicting Crystal Structures at Finite Temperature: Variable Box Shape Simulations
Laura Filion, Matthieu Marechal, Bas van Oorschot, Daniël Pelt, Frank Smallenburg, and Marjolein Dijkstra
Published 29 October 2009 // 188302

6 November 2009

Volume 103, Number 19, Articles (19xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PRLTAO&Volume=103&Issue=19

Soft X-Ray Diffraction Microscopy of a Frozen Hydrated Yeast Cell
Xiaojing Huang, Johanna Nelson, Janos Kirz, Enju Lima, Stefano Marchesini, Huijie Miao, Aaron M. Neiman, David Shapiro, Jan Steinbrener, Andrew Stewart, Joshua J. Turner, and Chris Jacobsen
Published 5 November 2009 // 198101

Cryogenic X-Ray Diffraction Microscopy for Biological Samples
Enju Lima, Lutz Wiegart, Petra Pernot, Malcolm Howells, Joanna Timmins, Federico Zontone, and Anders Madsen
Published 5 November 2009 // 198102

Dynamics of Enhanced Tracer Diffusion in Suspensions of Swimming Eukaryotic Microorganisms
Kyriacos C. Leptos, Jeffrey S. Guasto, J. P. Gollub, Adriana I. Pesci, and Raymond E. Goldstein
Published 5 November 2009 // 198103

Generalized Yvon-Born-Green Theory for Molecular Systems
J. W. Mullinax and W. G. Noid
Published 6 November 2009 // 198104

How to Define Variation of Physical Properties Normal to an Undulating One-Dimensional Object
Hsiao-Ping Hsu, Kurt Binder, and Wolfgang Paul
Published 4 November 2009 // 198301

Energy Landscape of Social Balance
Seth A. Marvel, Steven H. Strogatz, and Jon M. Kleinberg
Published 4 November 2009 // 198701

Intrinsic Noise in Game Dynamical Learning
Tobias Galla
Published 6 November 2009 // 198702

13 November 2009

Volume 103, Number 20, Articles (20xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PRLTAO&Volume=103&Issue=20

Microscopic Dynamics of the Orientation of a Hydrated Nanoparticle in an Electric Field
Christopher D. Daub, Dusan Bratko, Towshif Ali, and Alenka Luzar
Published 10 November 2009 // 207801

Elasticity of Arrested Short-Ranged Attractive Colloids: Homogeneous and Heterogeneous Glasses
Alessio Zaccone, Hua Wu, and Emanuela Del Gado
Published 9 November 2009 // 208301

Frustrated Rotator Crystals and Glasses of Brownian Pentagons
Kun Zhao and Thomas G. Mason
Published 10 November 2009 // 208302

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Volume 103, Number 21, Articles (21xxxx)
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Dynamic Length-Scale Characterization and Nonequilibrium Statistical Mechanics of Transport in Open-Cell Foams
Tyler R. Brosten, Sarah L. Codd, Robert S. Maier, and Joseph D. Seymour
Published 20 November 2009 // 218001

Dynamical Origin of the Effective Storage Capacity in the Brain's Working Memory
Christian Bick and Mikhail I. Rabinovich
Published 19 November 2009 // 218101

Tetrahydrofuran Clathrate Hydrate Formation
Heiko Conrad, Felix Lehmkühler, Christian Sternemann, Arto Sakko, Dietmar Paschek, Laura Simonelli, Simo Huotari, Omid Feroughi, Metin Tolan, and Keijo Hämäläinen
Published 19 November 2009 // 218301

Zipf's Law in the Popularity Distribution of Chess Openings
Bernd Blasius and Ralf Tönjes
Published 16 November 2009 // 218701

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Volume 103, Number 22, Articles (22xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PRLTAO&Volume=103&Issue=22

Field-Induced Self-Assembly of Suspended Colloidal Membranes
N. Osterman, I. Poberaj, J. Dobnikar, D. Frenkel, P. Ziherl, and D. Babić
Published 24 November 2009 // 228301

Does Cosmic-Ray-Induced Heterogeneous Chemistry Influence Stratospheric Polar Ozone Loss?
Rolf Müller and Jens-Uwe Grooß
Published 24 November 2009 // 228501

Variational Principle for the Pareto Power Law
Anirban Chakraborti and Marco Patriarca
Published 23 November 2009 // 228701

Dynamics and Directionality in Complex Networks
Seung-Woo Son, Beom Jun Kim, Hyunsuk Hong, and Hawoong Jeong
Published 23 November 2009 // 228702

PRE HIGHLIGHTS

Biological Physics Articles from
Physical Review E

October 2009
Volume 80, Number 4, Articles (04xxxx)
http://scitation.aip.org/dbt/dbt.jsp?KEY=PLEEE8&Volume=80&Issue=4

RAPID COMMUNICATIONS

Discontinuities at the DNA supercoiling transitionBryan C. Daniels, Scott Forth, Maxim
Y. Sheinin, Michelle D. Wang, and James P. Sethna
Published 15 October 2009 // 040901(R)

Strong associations between microbe phenotypes and their network architecture
Soumen Roy and Vladimir Filkov
Published 16 October 2009 // 040902(R)

Rebuilding cytoskeleton roads: Active-transport-induced polarization of cells
R. J. Hawkins, O. Bénichou, M. Piel, and R. Voituriez
Published 19 October 2009 // 040903(R)

ARTICLES

Compartmentalization of second messengers in neurons: A mathematical analysis
Wen Chen, Herbert Levine, and Wouter-Jan Rappel
Published 2 October 2009 // 041901

Morphogen profiles can be optimized to buffer against noise
Timothy E. Saunders and Martin Howard
Published 2 October 2009 // 041902

Evolutionary dynamics on rugged fitness landscapes: Exact dynamics and information theoretical aspects
David B. Saakian and José F. Fontanari
Published 2 October 2009 // 041903

Localized short impulses in a nerve model with self-excitable membrane
Alain M. Dikandé and Ga-Akeku Bartholomew
Published 5 October 2009 // 041904

Computational analysis of the tether-pulling experiment to probe plasma membrane-cytoskeleton interaction in cells
Kristopher R. Schumacher, Aleksander S. Popel, Bahman Anvari, William E. Brownell, and Alexander A. Spector
Published 6 October 2009 // 041905

Elongation dynamics of amyloid fibrils: A rugged energy landscape picture
Chiu Fan Lee, James Loken, Létitia Jean, and David J. Vaux
Published 6 October 2009 // 041906

Fluctuations and dispersal rates in population dynamics
David A. Kessler and Leonard M. Sander
Published 6 October 2009 // 041907

Self-similarity and protein compactness
M. A. Moret, M. C. Santana, G. F. Zebende, and P. G. Pascutti
Published 6 October 2009 // 041908

Simulations of impulsive laser scattering of biological protein assemblies: Application to M13 bacteriophage
Eric C. Dykeman, Daryn Benson, K.-T. Tsen, and Otto F. Sankey
Published 7 October 2009 // 041909

Adsorption of a hydrophobic-polar-model heteropolymer in an attractive nanotube
Handan Arkin
Published 8 October 2009 // 041910

Analytical description of Ogston-regime biomolecule separation using nanofilters and nanopores
Zi Rui Li, Gui Rong Liu, Jongyoon Han, Yuan Cheng, Yu Zong Chen, Jian-Sheng Wang, and Nicolas G. Hadjiconstantinou
Published 8 October 2009 // 041911

Dynamics of driven recurrent networks of ON and OFF cells
Jérémie Lefebvre, André Longtin, and Victor G. LeBlanc
Published 9 October 2009 // 041912

Kinetic overshoot in actin network assembly induced jointly by branching and capping proteins
Hyeran Kang, Anders E. Carlsson, and Jay X. Tang
Published 9 October 2009 // 041913

Aggregation of fibrils and plaques in amyloid molecular systems
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Job Advertisement

Software Developer

The Biocomplexity Institute
Indiana University, Bloomington

The Biocomplexity Institute at Indiana University, Bloomington, is seeking to hire research associates to fulfill the following roles as part of recent initiatives funded by the Environmental Protection Agency and the National Institute of General Medical Sciences:

A research associate level **software developer** to assist in the development of the CompuCell3D multi-cell simulation environment for Developmental Biology, Cancer and Toxicology Modeling. The candidate will develop modules to extend the capabilities of the CC3D environment and to improve user support. The candidate should have at least 4 years of experience developing C++ programs, be comfortable with open-source development and have participated in the development of large-scale scientific software. Extensive experience with using scripting languages (Python preferred) required. Experience in PyQt or Qt GUI development is a definite plus. Experience in at least two of the following is also required: modeling environment development, GUI development, data-analysis tool development, multithread optimization and symmetrical domain decomposition methods using OpenMP, multi-processor algorithm development using MPI, scientific GPU programming, lattice-gas or lattice-Boltzmann fluid dynamics solvers, reaction-kinetics modeling or finite-element environment development. Independence and the ability to develop software collaboratively are both essential as are developed writing skills. The successful candidate will also have experience documenting software and developing appropriate training materials and training exercises. Experience in domain specific XML-based language development or ontology development a plus, but not required. The applicant should have at least a B.S. level of experience in either biology, physics, biochemistry or bioengineering, and either M.S. or Ph.D.-level expertise in an appropriate computational or scientific discipline (physics, biology, chemistry, mathematics, computer science, informatics, cognitive science).

All applicants will work in an interdisciplinary team including toxicologists, geneticists, developmental biologists, computer-scientists, physicists and mathematicians to develop large-scale approaches to understanding the principles of development underlying teratogenicity, normal development and developmental diseases like cancer. Interest in regenerative biology and tissue engineering appreciated. Starting salary range will be between $30,000 and $70,000 dependant on experience and qualifications. Appointments may be at the level of staff scientist, postdoctoral fellow or research assistant professor depending on qualifications. Initial appointment for one year, renewable for up to three years depending on performance and funding availability.

Send CV, research summary and 2 papers or projects, along with a brief statement of relevance of background to position applied for, to Prof. James A. Glazier, glazier@indiana.edu. Please arrange to have three letters of reference sent separately. Searches will begin immediately and will continue until positions are filled. For more information, please see www.bioocomplexity.indiana.edu and www.compucell3d.org or contact Prof. Glazier by e-mail.

Indiana University is an EOAAE.

Job Advertisement

Language Development Specialist

The Biocomplexity Institute
Indiana University, Bloomington

The Biocomplexity Institute at Indiana University, Bloomington, is seeking to hire research associates to fulfill the following roles as part of recent initiatives funded by the Environmental Protection Agency and the National Institute of General Medical Sciences:

A research associate level **language development specialist** to lead development of the Cell Behavior Ontology, Cell Behavior Model Specification Language and Cell Type Repository. The candidate will develop tools for the implementation –independent specification and sharing of multi-cell models and for the annotation of time-lapse imaging data sets; organize and lead language specification workshops; write language specifications for publication and discussion; maintain the developing language standard on a web portal; conduct community outreach and work closely with the developers of other ontologies and languages (particularly GO and SBML) to ensure interoperability. The applicant should be highly independent, have extensive experience in ontology or domain-specific language development, open-source community organization and workshop design. In addition, the applicant should have at least B.S. (M.S. or Ph.D. preferred) experience in developmental or cell biology and have shown a significant understanding of cell behavior phenomenology or time-lapse microscopy, as well as M.S. or Ph.D.-level expertise in language development. Experience in web and database design helpful.

All applicants will work in an interdisciplinary team including toxicologists, geneticists, developmental biologists, computer-scientists, physicists and mathematicians to develop large-scale approaches to understanding the principles of development underlying teratogenicity, normal development and developmental diseases like cancer. Interest in regenerative biology and tissue engineering appreciated. Starting salary range will be between $30,000 and $70,000 dependant on experience and qualifications. Appointments may be at the level of staff scientist, postdoctoral fellow or research assistant professor depending on qualifications. Initial appointment for one year, renewable for up to three years depending on performance and funding availability.

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Job Advertisement

Computational/Developmental Biology Scientist

The Biocomplexity Institute
Indiana University, Bloomington

The Biocomplexity Institute at Indiana University, Bloomington, is seeking to hire research associates to fulfill the following roles as part of recent initiatives funded by the Environmental Protection Agency and the National Institute of General Medical Sciences:

A research associate level **Computational/Developmental Biology Scientist** to develop predictive quantitative simulations of developmental defects induced by toxicological exposure using the CompuCell3D package. The applicant will develop multi-cell simulations of environmental perturbations of early development integrating reaction-kinetic models of regulation and GGH models of cell behaviors. The applicant should have at least an M.S. (Ph.D. preferred) level of expertise in cell or developmental biology, biophysics, or biochemistry and experience developing simulations of at least one sophisticated biological phenomenon (e.g. regulatory networks, biomechanics, organogenesis, etc…). The position requires the ability to independently digest literature related to cell regulation, cell signaling and cell behavior to extract the underlying biological models; to translate these biological models into mathematically rigorous form; to identify and recognize missing information in the literature and to interact with experimental biologists to design experiments to explore regulatory pathways; to study/model the physiological consequences of toxicological perturbations and to validate simulations. Expertise in angiogenesis, somitogenesis or gastrulation particularly helpful in either zebrafish or chick. Microscopy experience helpful. Experience in image analysis also helpful. Scripting Language programming experience required (Python preferred). Experience with SBW or CellML/Physiome helpful.

All applicants will work in an interdisciplinary team including toxicologists, geneticists, developmental biologists, computer-scientists, physicists and mathematicians to develop large-scale approaches to understanding the principles of development underlying teratogenicity, normal development and developmental diseases like cancer. Interest in regenerative biology and tissue engineering appreciated. Starting salary range will be between $30,000 and $70,000 dependant on experience and qualifications. Appointments may be at the level of staff scientist, postdoctoral fellow or research assistant professor depending on qualifications. Initial appointment for one year, renewable for up to three years depending on performance and funding availability.

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Job Advertisement

Developmental Biology-Cell Biology-Biochemistry Experimentalist

Development and Developmental Defects induced by Toxicological Exposure

The Biocomplexity Institute
Indiana University, Bloomington

The Biocomplexity Institute at Indiana University, Bloomington, is seeking to hire research associates to fulfill the following roles as part of recent initiatives funded by the Environmental Protection Agency and the National Institute of General Medical Sciences:

A research associate level **Computational/Developmental Biology Scientist** to develop predictive quantitative simulations of developmental defects induced by toxicological exposure using the CompuCell3D package. The applicant will develop multi-cell simulations of environmental perturbations of early development integrating reaction-kinetic models of regulation and GGH models of cell behaviors. The applicant should have at least an M.S. (Ph.D. preferred) level of expertise in cell or developmental biology, biophysics, or biochemistry and experience developing simulations of at least one sophisticated biological phenomenon (e.g. regulatory networks, biomechanics, organogenesis, etc…). The position requires the ability to independently digest literature related to cell regulation, cell signaling and cell behavior to extract the underlying biological models; to translate these biological models into mathematically rigorous form; to identify and recognize missing information in the literature and to interact with experimental biologists to design experiments to explore regulatory pathways; to study/model the physiological consequences of toxicological perturbations and to validate simulations. Expertise in angiogenesis, somitogenesis or gastrulation particularly helpful in either zebrafish or chick. Microscopy experience helpful. Experience in image analysis also helpful. Scripting Language programming experience required (Python preferred). Experience with SBW or CellML/Physiome helpful.

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Job Advertisement

The Bruno H. Zimm
Biological Physics Postdoctoral Fellowship

The Center for Theoretical Biological Physics (CTBP) at the University of California, San Diego invites applications for the Bruno H. Zimm Postdoctoral Fellowship

Applications are due November 15, 2010

For additional information and application instructions, visit:

http://ctbp.ucsd.edu/zimm_fellowship.html

CTBP is a consortium of researchers from UCSD, the Salk Institute for Biological Studies, and the University of Michigan, involved in research on fundamental problems at the interface between physics and biology. Research encompasses three synergy themes – ***Cellular Tectonics***, the dynamic mesoscale structure of the intracellular milieu; ***Computational Approaches to Intracellular and Intercellular Communication,*** chemical-based reaction-diffusion governed communication across complex spaces; and ***Gene Regulatory Networks***, genetic/signaling networks that exhibit specificity and robustness in the face of intrinsic stochasticity, and yet retain evolvability. The Zimm fellowship is for recent graduates who have demonstrated exceptional research aptitude and are interested in pursuing more independent, semi-autonomous research than is available in a traditional postdoctoral position. Zimm fellows will be expected to pursue intensive research in any area of biological physics related to the CTBP research synergies.

CTBP Faculty include:

Henry Abarbanel, Physics, UCSD
Olga Dudko, Physics, UCSD
Terence Hwa, Physics, UCSD
Bo Li, Mathematics, UCSD
José Onuchic, Physics, UCSD
Terence Sejnowski, Salk Institute
Wei Wang, Chemistry, UCSD
Charles L. Brooks, III, U Michigan
Michael Holst, Mathematics, UCSD
Herbert Levine, Physics, UCSD
J. Andrew McCammon, Chemistry, UCSD
Wouter-Jan Rappel, Physics, UCSD
Tatyana Sharpee, Salk Institute

For more information contact Christopher Smith, PhD., CTBP, Department of Physics, 9500 Gilman Drive, MC0374, University of California, San Diego, CA 92093, csmith@ctbp.ucsd.edu (858) 534-8370

CTBP is a Physics Frontiers Center of the ***National Science Foundation***

2010 Biological Physics Meetings, Conferences and Workshops

A representative listing of various events for TBP Newsletter readers

February 13-17 April Meeting Am Phys Soc / Am Assoc of Physics Teachers
Washington, DC
http://www.aps.org/meetings/april/index.cfm

February 20-24 54th Ann Meeting of the Biophysical Society
San Francisco, CA
http://www.biophysics.org/2010meeting

March 15-19 Am Physical Society March Meeting
Portland, OR
http://www.aps.org/meetings/march/index.cfm

April 24-28 2010 Ann Meeting Am Soc for Biochemistry & Molecular Biology
Anaheim, CA
http://www.asbmb.org/meetings_01/2010mtg/2010mtghome.aspx

May 23 –27 Physics 2 Life
Rehovot, Israel
http://www.weizmann.ac.il/conferences/Physics2Life/

June 7-11 Orflow10 - Living organisms in flows
Palma de Mallorca, Spain
http://ifisc.uib-csic.es/orflow10/

August 9-27 ISSP International Workshops on Soft Matter Physics
Tokyo, Japan
http://www.issp.u-tokyo.ac.jp/public/soft2010/

Sept 1-3 IOP Physics Meets Biology
Oxford, UK
http://pmb10.iopconfs.org/index.html

Sept 5-10 Biointerface Science (Gordon Research Conference)
Les Diablerets, Switzerland
http://www.grc.org/programs.aspx?year=2010&program=biointerf

If you know of any meetings that you feel would be of interest to TBP Newsletter readers, please forward them to the Newsletter editors.