THE BIOLOGICAL PHYSICIST

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

Vol 10 № 1 February 2011

In this Issue

It appears we are back on track (6 TBP issues/year). This issue features a summary of a think-tank meeting on approaches to evaluating cancer metastases using quantitative methods (i.e., physics). PRL/PRE highlights for December through February are included. And we also are introducing a new section on research funding opportunities. If you have a particular subject you would like to see in our feature article section, please forward suggestions to the Editor.

– CS

FEATURE ARTICLE

The Physics of Cancer Metastasis

Summary of an NSF-sponsored mini-conference (November 1-2, 2010) on Cancer and how Physics approaches may contribute to advancing discoveries in understanding the Biology of Cancer Metastasis

by Herbert Levine, PhD

Approximately thirty scientists, equally divided between cancer biologists and scientists, met in Arlington, VA for a day and a half at a meeting sponsored by the NSF Physics of Living System Program. The scientific focus of this meeting was the subject of cancer metastasis, as it is the spread of cancer cells from a primary tumor to secondary sites, and their subsequent growth at those sites that results in a high probability for patient's death. The overall goal of the workshop was to begin a dialogue on possible contributions to understanding metastasis that can be made by taking advantage of advances in both experimental physics and in the theory of live processes, and to discuss possible organizational strategies for enabling those advances.

The program of the meeting was divided into three parts: presentations by cancer biologists, presentations by physical scientists, and open discussion of the issues at hand. The attached program lists the specific speakers. The formal presentations by the cancer researchers established various concepts regarding metastasis that set the stage for future progress. These included:

- Metastasis is a multi-stage process, requiring the intravasation of cells from the primary tumor into the vasculature (or the lymphatic system), having these cells (either singly or in clumps) circulating through the body, eventually extravasating into target tissue and finally growing to form secondary tumors. The majority of the biologic processes involved in each of these steps remain poorly understood.
- The initiation of metastatic spread (from solid tumors) requires that cells become motile either on their own (perhaps by undergoing a transformation in cell phenotype from epithelial-like to mesenchymal-like) or by being part of a collective cell migration (perhaps similar to what occurs in wound healing). These cells must then enter the circulatory system, aided by the leaky vasculature that is characteristic of tumors.
- Most evidence points to the colonization of the secondary site as the most difficult step for the cancer cells to accomplish. This notion is often referred to as metastatic inefficiency. In fact, the patterns of secondary tumors are quite specifically dependent on initial cancer cell type. Prostate cancer, for example, almost always metastasizes to the bone, not due to any obvious transport limitations but rather due to the hospitable nature of the bone marrow as a site for extravasation and growth or because colonization barriers are higher elsewhere. While colonizing, cells remain identifiable as to their origin even amidst multiple subsequent complex genetic and epigenetic changes. Thus, even when two different cell types metastasize to the same tissue, they can have differing effects. It would be useful to have an understanding of the key elements that must match in the target tissue versus the primary tumor type for growth to occur.
- It is unclear as to the extent to which specific genetic and/or epigenetic changes are needed to enable these different parts of the metastatic cascade. Also unclear is the extent to which cells act more or less independently versus cells being guided by complex intercellular signals (from co-opted stromal cells, e.g.) or by details of the mechanical microenvironment. A conceptual picture of the extent to which a tumor is acting like a multi-cellular entity as opposed to a collection of rogue individuals each of which might turn out to be the

founder of secondary tumors is needed but lacking.

Given the need for progress along multiple lines, there appear to be several avenues along which physical science can play an important role. These break down into possible advances in local sensors, advanced imaging modalities (and model systems), and theoretical studies. Local sensors could detect elements that are beginning to play a prominent role in various conceptual frameworks concerning tumor progression. For example, mechanical stresses on individual cells (to be distinguished from hydrostatic pressure in the tumor) could be directly coupled to gene expression, growth rate and apoptotic probability. A recent example (see Grashoff, C. *et al. Nature* 466, 263–266 (2010) of a force sensor that has yet to be applied in the cancer context is based on vinculin, a cytoskeletal-associated protein involved in cell-matrix adhesion. This particular example may turn out not to be suitable, but the principle that one can design clever molecular probes to report on and eventually actively modulate cell states is one that could be applied fruitfully to the problem of metastasis. Note though that measurements are much more useful if they can be interpreted in the light of a useful theoretical model.

A significant part of the physics presentations dealt with advances in light microscopy and in MRI measurements. It is clear that these approaches have differing roles; light microscopy can only reach superficially into organisms and need to be used in either mouse models (for example with skin flaps) or with in vitro analogues. There was some discussion of the extent to which the “slice” idea in neuroscience in which one compromises between fully in vivo measurements on the one hand and in vitro culture experiments on the other; some details of the organ structure and connectivity can be maintained. It might be possible to create bone slices, for example, in which one could monitor growth of prostate cancer cells. One major difficulty is the time scale, however. There is evidence that cancer cells can lie dormant for many years before beginning to grow into a secondary tumors and focusing on protocols in which the colonization happens immediately (so as to facilitate experimental study) may be less informative. Again, there is a role for theory development here, to extrapolate obtainable experimental data to cases of more direct clinical relevance.

If one hopes to directly image parts of the metastatic process in human subjects, advances in biomedical imaging are necessary. A critical issue is the resolution necessary to see small numbers of seeded cancer cells long before they grow to macroscopic size. This will require advances in either technology to enhance visualization, e.g., MRI, or technology that specifically identifies tumor cells because of unique cellular characteristics, i.e, unique cell surface proteins. Exactly what sets final detection limits is certainly an area worthy of investigation. It seems reasonable to assume that one will have to use mouse models to calibrate MRI responses in cases where one also has optical access and then proceed to totally non-invasive measurements.

Quite a bit of the discussion dealt with the role of theory and modeling, as this was clearly a missing component in many of the methods that were being pursued in this field. It is perhaps useful to consider different types of theoretical treatments and methodologies. The systems biology approach aims to create bottom-up models of extremely intricate signaling pathways and intercellular interactions. For cases in which this can be reliably accomplished (we heard for example about successes in using this level of modeling for bacterial chemotaxis), this is obviously the most quantitatively useful approach. It is fair to say, though, that we are very far from this regime for any cancer problem. Of more use here are conceptual theories such as the one described by Geoff West on scaling related to transport needs and the one briefly alluded to earlier about the role of homeostatic stress on the competition between normal and neoplastic tissue. Other questions that could be investigated in this manner include the epithelial-mesenchymal transition (and the reverse mesenchymal to epithelial transition in the secondary tumor), the formation and structure of the tumor vasculature (coupled to experimental measurements of the same), the effects of blood flow shear on cancer cell survival and the role of stochasticity in overcoming metastatic inefficiency. This type of theory can be very useful in conjunction with a coupled experimental program, since it offers guidance as to most informative things that one can measure as predictors of future progression and possibly even response to treatment. In this regard, there was some debate about whether ecological paradigms (dispersal theory as a way of understanding selection for motile mutants, for example) could serve a useful purpose here. It is reasonable to hypothesize that we will not really be able to learn much from the vast amounts of genomic data becoming available

without sophisticated evolutionary theories; some of this work is already beginning.

Cancer touches on some of the most basic questions underlying biology, related to the plasticity of genetic degrees of freedom, the nature of cell differentiation, the constraints that multi-cellularity places on the proliferation and selfish behavior of individual cells, the role of environment in both genotypic selection and phenotypic behavior etc. Clearly, the community will be grappling with these overarching issues for many decades to come. However, this should not preclude the possibility that many smaller scale issues can be addressed with modern methods and that one could imagine projects with 3-5 year lifetimes that could positively impact both our understanding and our clinical practice.

So, where do we go from here? This was a definitively enunciated need for ongoing dialogue, as it was only on the last morning that the inevitable barriers to scientific inter-disciplinary communication began to be breached. In terms of the basic question that the NSF (possibly in partnership with other funding bodies) needs to address, there was a feeling that a program aimed at creating small mixed teams of researchers to tackle some of the most direct challenges would be a very worthwhile investment.

For additional information on the Physics of Cancer Metastasis meeting, point your web browser to: http://physicsofcancer.blogspot.com/

This meeting was sponsored by the NSF Physics of Living Systems program (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=6673), Dr. Krastan Blagoev (kblagoev@nsf.gov), program director.

DBP Announcement

2010 Award for an Outstanding Doctoral Thesis Research in Biological Physics

Erez Lieberman-Aiden

Harvard University

"Evolution and the emergence of structure"

Erez Lieberman-Aiden studied Mathematics, Physics, and Philosophy at Princeton University, and received an Master's degree in Applied Physics from Harvard. He recieved a PhD in Applied Mathematics and Health Science and Technology from Harvard and MIT, where he was supported by fellowships from the NSF, the NDSEG, and the Hertz Foundation. His work integrates mathematical and physical theory with the invention of new technologies. As a graduate student in the laboratory of Eric Lander, Erez devised the Hi-C method for reconstructing the 3D structure of the human genome. Together with Nynke van Berkum, a postdoc in the lab of Job Dekker, he led the team that implemented Hi-C in practice. They discovered the existence of a new type of genetic regulation, in which genes move from one compartment to another as they are turned on and off. They also observed a never-before-seen polymer configuration, the fractal globule, which enables the genome to pack extremely densely without forming knots.

In 2009, Technology Review named him as one of the "TR35: Top 35 Innovators Under the Age of 35". He was also recognized with the Lemelson-MIT student Prize for the best student inventor at MIT, as well as the Hertz Foundation's Doctoral Thesis Prize. His work has appeared on the covers of both Nature and Science. Erez is currently a fellow at the Harvard Society of Fellows, and is a member of the American Physical Society.

DBP Announcement

2011 March Meeting Travel Award Recipients

Aidan Brown (Andrew Rutenberg), Dalhousie University,
Developmental and Metabolite Transport Strategies to Optimize Growth of Filamentous Cyanobacteria

Jie-Pan Shen (Chia-Fu Chou), Academica Sinica, Nanking, Taipei
Pattern Transitions in Bacterial Oscillating System under Nanofluidic Confinement

Nir Friedman (Karin Dahmen), UIUC
Beyond Critical Exponents in Neuronal Avalanches

Shuo Huang (Stuart Lindsay), ASU,
Nucleic Acids -- Structure, Function, and the Genome

Clare Armstrong (Maikel Rheinstadter), McMaster
Diffusion in Single Supported Lipid Bilayers

Tatiana Artemova (Jeff Gore), MIT
Cooperative Bacterial Growth Dynamics Predict the Evolution of Antiobiotic Resistance

(Faculty advisor name appears in the parentheses)

2011 March Meeting DBP Session Highlights

DBP Members have all surely been combing the online Epitome to make up their schedules for next week. But suppose you've missed something? Here's a list of all the DBP-sponsored sessions this year. For an updated list visit:
http://meetings.aps.org/Meeting/MAR11/sessionindex2?SponsorID=DBP

Session A

A7. Prize Session: Single Molecule Biophysics I: Recent Advancements in Technology and Applications
A39. Focus Session: Energy Future: Biological and Biometric Systems

Session B

B39. Focus Session: Single Molecule Biophysics II: Novel Single Molecule Approaches to Biology
B40. Lipid Bilayers and Biological Membranes: Dynamics and Thermodynamics
B41. Focus Session: Supramolecular Self-Assembly--Controlling Network and Gel Formation I

Session D

D6. Physics of Proteins I: Unifying Principles and Concepts
D39. Physics of Physiological Systems
D40. Lipid Bilayers and Biological Membranes: Peptide Interactions

Session H

H7. Physics of Proteins II: Dynamics and Functions
H38. Focus Session: Quantum Coherence in Biology I
H39. Focus Session: Physics of Cancer
H40. Multi-cellular Processes and Development

Session J

J4. Interactions Between Pore Forming Peptides and Membranes
J39. Physics of Proteins III: Folding, Structure and Stability

Session L

L7. System Biology I: The Physics of Development
L38. Focus Session: Quantum Coherence in Biology II
L39. Focus Session: Single Molecule Biophysics III: Novel Single Molecule Approaches to Biology
L40. Focus Session: Noisy Dynamics as Survival Strategies and Nanopores

Session M

M38. DBP Business Meeting

Session P

P7. System Biology II: The Physics of Morphogenesis
P38. Focus Session: Quantum Coherence in Biology III
P39. Physics of Proteins IV: Folding, Dynamics and Function

Session Q

Q4. Macromolecular Crowding Effects in the Cytoplasm
Q7. System Biology III: The Physics of Evolution
Q39. Information Processing in Biological Systems
Q43. Focus Session: Translocation through Nanopores I

PRL HIGHLIGHTS

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

3 December 2010
Volume 105, Issue 23 (Articles 23xxxx)

http://prl.aps.org/toc/PRL/v105/i23

Homogeneous Bulk, Surface, and Edge Nucleation in Crystalline Nanodroplets
Jessica L. Carvalho and Kari Dalnoki-Veress
Published 1 December 2010 // 237801

Adaptive Multiscale Molecular Dynamics of Macromolecular Fluids
Steven O. Nielsen, Preston B. Moore, and Bernd Ensing
Published 3 December 2010 // 237802

Negative Normal Restitution Coefficient Found in Simulation of Nanocluster Collisions
Kuniyasu Saitoh, Anna Bodrova, Hisao Hayakawa, and Nikolai V. Brilliantov
Published 30 November 2010 // *238001*

Cross-Link-Governed Dynamics of Biopolymer Networks
Chase P. Broedersz, Martin Depken, Norman Y. Yao, Martin R. Pollak, David A. Weitz, and Frederick C. MacKintosh
Published 30 November 2010 // 238101

Swimmers in Thin Films: From Swarming to Hydrodynamic Instabilities
Marco Leoni and Tanniemola B. Liverpool
Published 2 December 2010 // 238102

Polarity Patterns of Stress Fibers
N. Yoshinaga, J.-F. Joanny, J. Prost, and P. Marcq
Published 2 December 2010 // 238103

Elasticity of Globular Proteins Measured from the ac Susceptibility
Yong Wang and Giovanni Zocchi
Published 3 December 2010 // 238104

10 December 2010
Volume 105, Issue 24

http://prl.aps.org/toc/PRL/v105/i24

Reentrant Behavior of Divalent-Counterion-Mediated DNA-DNA Electrostatic Interaction
Sell Lee, Tung T. Le, and Toan T. Nguyen
Published 6 December 2010 // 248101

Two-Dimensional X-Ray Grating Interferometer
Irene Zanette, Timm Weitkamp, Tilman Donath, Simon Rutishauser, and Christian David
Published 7 December 2010 // 248102

4D Traction Force Microscopy Reveals Asymmetric Cortical Forces in Migrating *Dictyostelium* Cells
H. Delanoë-Ayari, J. P. Rieu, and M. Sano
Published 7 December 2010 // 248103

Sources and Sinks: A Stochastic Model of Evolution in Heterogeneous Environments
Rutger Hermsen and Terence Hwa
Published 8 December 2010 // 248104

Off-Lattice Monte Carlo Simulation of Supramolecular Polymer Architectures
H. E. Amuasi and C. Storm
Published 9 December 2010 // 248105

First-Principles Simulations of Chemical Reactions in an HCl Molecule Embedded inside a C or BN Nanotube Induced by Ultrafast Laser Pulses
Yoshiyuki Miyamoto, Hong Zhang, and Angel Rubio
Published 7 December 2010 // 248301

17 December 2010
Volume 105, Issue 25

http://prl.aps.org/toc/PRL/v105/i25

Azimuthal Instability of the Interface in a Shear Banded Flow by Direct Visual Observation
J. P. Decruppe, L. Bécu, O. Greffier, and N. Fazel
Published 14 December 2010 // 258301

Direct Detection of the Ultrafast Response of Charges and Molecules in the Photoinduced Neutral-to-Ionic Transition of the Organic Tetrathiafulvalene-*p*-Chloranil Solid
H. Uemura and H. Okamoto
Published 16 December 2010 // 258302

Nuclear-Magnetic-Resonance Measurements Reveal the Origin of the Debye Process in Monohydroxy Alcohols
C. Gainaru, R. Meier, S. Schildmann, C. Lederle, W. Hiller, E. A. Rössler, and R. Böhmer
Published 16 December 2010 // 258303

31 December 2010
Volume 105, Issue 26
http://prl.aps.org/toc/PRL/v105/i26

Dynamical Phase Transition in a Model for Evolution with Migration
Bartłomiej Waclaw, Rosalind J. Allen, and Martin R. Evans
Published 22 December 2010 // 268101

Tubulin Bistability and Polymorphic Dynamics of Microtubules
Hervé Mohrbach, Albert Johner, and Igor M. Kulić
Published 28 December 2010 // 268102

Reproduction of a Protocell by Replication of a Minority Molecule in a Catalytic Reaction Network
Atsushi Kamimura and Kunihiko Kaneko
Published 29 December 2010 // 268103

Dynamical Entropy Production in Spiking Neuron Networks in the Balanced State
Michael Monteforte and Fred Wolf
Published 30 December 2010 // 268104

Shear Banding and Flow-Concentration Coupling in Colloidal Glasses
R. Besseling, L. Isa, P. Ballesta, G. Petekidis, M. E. Cates, and W. C. K. Poon
Published 20 December 2010 // 268301

Active Motion of a Janus Particle by Self-Thermophoresis in a Defocused Laser Beam
Hong-Ren Jiang, Natsuhiko Yoshinaga, and Masaki Sano
Published 20 December 2010 // 268302

Shear Thickening and Migration in Granular Suspensions
Abdoulaye Fall, Anaël Lemaître, François Bertrand, Daniel Bonn, and Guillaume Ovarlez
Published 22 December 2010 // 268303

Crossover between 2D and 3D Fluid Dynamics in the Diffusion of Islands in Ultrathin Freely Suspended Smectic Films
Zoom Hoang Nguyen, Markus Atkinson, Cheol Soo Park, Joseph Maclennan, Matthew Glaser, and Noel Clark
Published 30 December 2010 // 268304

7 January 2011
Volume 106, Issue 1
http://prl.aps.org/toc/PRL/v106/i1

Detection of Phase Biaxiality in Liquid Crystals by Use of the Quadrupole Shift in ^{131}Xe NMR Spectra
Jukka P. Jokisaari, Anu M. Kantola, Juhani A. Lounila, and L. Petri Ingman
Published 4 January 2011 // 017801

Differential Dynamic Microscopy of Bacterial Motility
L. G. Wilson, V. A. Martinez, J. Schwarz-Linek, J. Tailleur, G. Bryant, P. N. Pusey, and W. C. K. Poon
Published 5 January 2011 // 018101

Relativity and the Lead-Acid Battery
Rajeev Ahuja, Andreas Blomqvist, Peter Larsson, Pekka Pyykkö, and Patryk Zaleski-Ejgierd
Published 5 January 2011 // 018301

Electron-Catalyzed Mutual Neutralization of Various Anions with Ar^+: Evidence of a New Plasma Process
Nicholas S. Shuman, Thomas M. Miller, Raymond J. Bemish, and A. A. Viggiano
Published 6 January 2011 // 018302

Terrestrial Gamma-Ray Flashes as Powerful Particle Accelerators
M. Tavani *et al.* (AGILE Team)
Published 3 January 2011
018501

14 January 2011
Volume 106, Issue 2

http://prl.aps.org/toc/PRL/v106/i2

Drag Induced Lift in Granular Media
Yang Ding, Nick Gravish, and Daniel I. Goldman
Published 13 January 2011 // 028001

Vesicle Migration and Spatial Organization Driven by Flow Line Curvature
Giovanni Ghigliotti, Abtin Rahimian, George Biros, and Chaouqi Misbah
Published 10 January 2011 // 028101

Salt-Dependent DNA-DNA Spacings in Intact Bacteriophage λ Reflect Relative Importance of DNA Self-Repulsion and Bending Energies
Xiangyun Qiu, Donald C. Rau, V. Adrian Parsegian, Li Tai Fang, Charles M. Knobler, and William M. Gelbart
Published 12 January 2011 // 028102

Pattern Formation in Active Fluids
Justin S. Bois, Frank Jülicher, and Stephan W. Grill
Published 13 January 2011 // 028103

Struggle for Space: Viral Extinction through Competition for Cells
José A. Cuesta, Jacobo Aguirre, José A. Capitán, and Susanna C. Manrubia
Published 14 January 2011
028104

Engineering the Electronic Band Structure for Multiband Solar Cells
N. López, L. A. Reichertz, K. M. Yu, K. Campman, and W. Walukiewicz
Published 10 January 2011
028701

Emergent Hierarchical Structures in Multiadaptive Games
Sungmin Lee, Petter Holme, and Zhi-Xi Wu
Published 14 January 2011
028702

21 January 2011
Volume 106, Issue 3

http://prl.aps.org/toc/PRL/v106/i3

Density Fluctuations in Liquid Water
Niall J. English and John S. Tse
Published 18 January 2011 // 037801

Swimming with an Image
R. Di Leonardo, D. Dell'Arciprete, L. Angelani, and V. Iebba
Published 19 January 2011 // 038101

Facilitated Diffusion of Proteins on Chromatin
O. Bénichou, C. Chevalier, B. Meyer, and R. Voituriez
Published 20 January 2011 // 038102

Crossover from Normal to Anomalous Diffusion in Systems of Field-Aligned Dipolar Particles
Jelena Jordanovic, Sebastian Jäger, and Sabine H. L. Klapp
Published 18 January 2011 // 038301

Prediction of Long and Short Time Rheological Behavior in Soft Glassy Materials
A. Shahin and Yogesh M. Joshi
Published 20 January 2011 // 038302

Precision Measurement of Gravity with Cold Atoms in an Optical Lattice and Comparison with a Classical Gravimeter
N. Poli, F.-Y. Wang, M. G. Tarallo, A. Alberti, M. Prevedelli, and G. M. Tino
Published 18 January 2011 // 038501

28 January 2011
Volume 106, Issue 4

http://prl.aps.org/toc/PRL/v106/i4

Inelastic Collisions and Anisotropic Aggregation of Particles in a Nematic Collider Driven by Backflow
Oleg P. Pishnyak, Sergij V. Shiyanovskii, and Oleg D. Lavrentovich
Published 24 January 2011 // 047801

PRE HIGHLIGHTS

Biological Physics Articles from
Physical Review E

December 2010
Volume 82, Issue 6, Articles (06xxxx)
http://pre.aps.org/toc/PRE/v82/i6

ARTICLES

Resistance to antitumor chemotherapy due to bounded-noise-induced transitions
Alberto d'Onofrio and Alberto Gandolfi
Published 2 December 2010 // 061901

Frequency-dependent stiffening of semiflexible networks: A dynamical nonaffine to affine transition
E. M. Huisman, C. Storm, and G. T. Barkema
Published 6 December 2010 // 061902

Cooperativity of self-organized Brownian motors pulling on soft cargoes
Javier G. Orlandi, Carles Blanch-Mercader, Jan Brugués, and Jaume Casademunt
Published 7 December 2010 // 061903

Separation of time scales in one-dimensional directed nucleation-growth processes
Paolo Pierobon, Judith Miné-Hattab, Giovanni Cappello, Jean-Louis Viovy, and Marco Cosentino Lagomarsino
Published 9 December 2010 // 061904

Virus infection speeds: Theory versus experiment
Daniel R. Amor and Joaquim Fort
Published 14 December 2010 // 061905

Cooperative deformation of hydrogen bonds in beta-strands and beta-sheet nanocrystals
Zhao Qin and Markus J. Buehler
Published 14 December 2010 // 061906

Spontaneous spiking in an autaptic Hodgkin-Huxley setup
Yunyun Li, Gerhard Schmid, Peter Hänggi, and Lutz Schimansky-Geier
Published 15 December 2010 // 061907

January 2011
Volume 83, Issue 1, Articles (01xxxx)
http://pre.aps.org/toc/PRE/v83/i1

ARTICLES

Locomotion by tangential deformation in a polymeric fluid
Lailai Zhu, Minh Do-Quang, Eric Lauga, and Luca Brandt
Published 6 January 2011 // 011901

Sequence dependence of the binding energy in chaperone-driven polymer translocation through a nanopore
Rouhollah Haji Abdolvahab, Mohammad Reza Ejtehadi, and Ralf Metzler
Published 10 January 2011 // 011902

Correlation times in stochastic equations with delayed feedback and multiplicative noise
Mathieu Gaudreault, Juliana Militão Berbert, and Jorge Viñals
Published 11 January 2011 // 011903

Feigenbaum cascade of discrete breathers in a model of DNA
P. Maniadis, B. S. Alexandrov, A. R. Bishop, and K. Ø. Rasmussen
Published 11 January 2011 // 011904

Stretching and relaxation of vesicles
Hernan Zhou, Beatriz Burrola Gabilondo, Wolfgang Losert, and Willem van de Water
Published 18 January 2011 // 011905

Environmental correlation effects on excitation energy transfer in photosynthetic light harvesting
Mohan Sarovar, Yuan-Chung Cheng, and K. Birgitta Whaley
Published 18 January 2011 // 011906

Employment Opportunities

American Physical Society Career Center

Employers and employment opportunities are available through our APS Career Center by visiting:

http://www.aps.org/careers/employment/index.cfm

Biophysical Society Job Board

Finding a job in this tough economy can be hard. That is why you should take advantage of the Biophysical Society Job Board whose focus is on jobs specifically related to the field of biophysics. Currently, employers are looking for postdoctoral, faculty and research candidates. Visit the Job Board today by going to:

http://www.jobtarget.com/home/index.cfm?site_id=652

PhD Studentship

"Novel computational methods for drug discovery"

University of Southhampton, UK

This PhD studentship will involve developing and evaluating novel approaches for the more accurate and realistic simulation of biomolecular association, and applying these to predict the interaction of putative drugs with biomolecular systems. A combination of simulation techniques will be used, including classical molecular dynamics, structure optimisation, statistical mechanics approaches for calculating free energies, and ab initio quantum mechanical calculations with Density Functional Theory (DFT). Most importantly, the DFT calculations will be performed at unprecedented large scales, on entire protein assemblies consisting of thousands of atoms by using the ONETEP linear-scaling DFT program. The use of full quantum mechanical models is essential for quantitative (and sometimes even qualitative) understanding of electronic polarization which is ubiquitous and controls drug binding affinity. This project will not only give access to new methods for assessing the likely affinity of proposed drugs with the biological target of interest, but will also aim to address aspects of drug optimisation and will be directed at rationalizing the fundamental mechanisms and modes of action in biomolecular association. The wider implications of this research will be in reducing our dependence on laboratory experimentation for stages of the drug development process.

This is a prestigious BBSRC CASE PhD studentship which is supported by Boehringer Ingelheim who will enhance its tax-free stipend (approximately £16,000 p.a. and subject to annual increase) and will provide periods of placement within the company's research laboratories in Germany. Academic supervision will be provided by Dr Chris-Kriton Skylaris and further details regarding research themes and projects within the group can be found at http://www.soton.ac.uk/chemistry/research/skylaris/skylaris.html.The successful applicant will join a well-established Research Group in the area of computational chemistry with a keen focus on the development of methods for large-scale quantum mechanical calculations and their applications to biomolecular problems and will have access to state-of-the-art supercomputing facilities and the latest developments in the ONETEP package (www.onetep.org). He/She will also be a member of the Computational Systems Chemistry section and will support the ongoing theme of multiscale biomolecular simulation.

Applicants should have a good (preferably first or 2:1) degree in Chemistry, Physics or related subject and a keen interest in computational chemistry and biochemistry. For further details please contact **Dr Chris-Kriton Skylaris** (c.skylaris@soton.ac.uk), School of Chemistry, University of Southhampton. The studentship is open to UK students and also to EU students who fulfil the eligibility criteria set by BBSRC:
http://www.bbsrc.ac.uk/web/FILES/Guidelines/studentship_eligibility.pdf

Postdoctoral Position in

Machine Learning Approaches to Predict Enzyme Function

University of Saint Andrews, Scotland

This project is being undertaken by Dr John Mitchell's research group in the modern Biomedical Sciences Research Complex. This computational project is sponsored by the Biotechnology and Biological Sciences Research Council (BBSRC). In this work, we will use machine learning methods to predict the catalytic functions and chemical mechanisms of enzymes. The key idea in our work is to identify the reaction mechanism, if any, catalysed enzymatically by a protein structure. The possible reaction mechanisms considered are the 300 or so distinct entries in our database MACiE. Our principal machine learning method is Random Forest, simply a forest made out of many different randomly created decision trees. After predicting the reaction mechanisms, we will apply chemoinformatics, docking and virtual screening to suggest substrates for the enzyme reactions identified.

We seek to appoint a highly computer literate postdoctoral scientist with a PhD in the Life, Chemical, Physical, Computer or Mathematical Sciences. Knowledge of, and experience in, at least one of the following areas is required for this position: bioinformatics, chemoinformatics, machine learning, computational chemistry, biological or pharmaceutical chemistry. A high level of computer literacy is expected and experience of scientific computing, preferably including some programming skills, would be an advantage. The position is available for three years from 1 June 2011, or as soon as possible thereafter.

Informal enquiries to Dr John Mitchell, jbom@st-andrews.ac.uk
Closing Date: 11 April 2011
Interview Date: Week commencing 25 April 2011
Please apply online at https://www.vacancies.st-andrews.ac.uk/welcome.aspx
Please quote ref: JC7960

Postdoctoral Position in Singapore

A 2 year postdoctoral position is available in singapore, starting from april-june 2011. The candidate should have experience of computational methods in studying protein-ligand interactions and experience with free energy methods will be an advantage. The project is aimed at fragment screening, small molecule screening, peptide design against a protein of therapeutic interest. We have recently designed and patented a peptide against this target for oncology and it is hoped that this will inspire further developments in this project. The work is in close collaboration with experimental labs (biophysical/cell & molecular biology & zebrafish/mouse models) and with the oncology division of the local hospital, with a rapid turnaround time that helps guide design. It is hoped that it will result in a molecule that will be be taken over by a small local biotech after 2 years.

For further details please contact chandra@bii.a-star.edu.sg

Post-doctoral and Ph.D. Positions in Single Molecule Microscopy

University of Texas at Dallas

Post-doc and Ph.D. positions are available to work on the development of methodology for fluorescence microscopy related projects. The projects aim to develop novel imaging modalities, image processing and data analysis methods for superresolution single molecule approaches. Different projects are available and they include continued development of multifocal plane microscopy, superresolution approaches, QD tracking, point spread function modeling.

The positions will provide the opportunity to not only work on projects of significant technical interest but also to become familiar with the fundamental biological questions that are being addressed in the laboratory. Specifically the laboratory investigates the trafficking of antibodies in live cell environment. A main emphasis of the research is the investigation of the effects of the engineering of the antibody binding to Fc receptors on the cellular trafficking behavior and in vivo properties. These studies have direct relevance to the rapidly expanding use of antibodies in the biopharma industry as therapeutics in autoimmunity, infectious diseases and cancer. Funding is provided by the NIH and biopharma companies.

For more information on the research carried out in the laboratory see www4.utsouthwestern.edu/wardlab, or publications such as *Optics Express*, **17**, 6881-6898, 2009; *Biophys J.*, **95**, 6025-6043, 2008; *Proc. Natl. Acad. Sci. USA*, **104**, 5889-5894, 2007; *Proc. Natl. Acad. Sci. USA*, **103**, 4457-4462, 2006; *Nature Biotechnol.,* **23**, 1283-1288, 2005; *Proc. Natl. Acad. Sci. USA*, **101**, 11076-11081, 2004; *IEEE Transactions Nanobioscience*, **3**, 237-242, 2004; *J. Immunol*., **172**, 2021-2029, 2004; *Biophys. J*., **86**, 1185-1200, 2004.

Highly motivated individuals with a background in any biological area, (bio)engineering, biotechnology, chemistry, physics, mathematics or any other physical science will be considered. Direct experience is not necessary. These positions provide the opportunity for the successful candidate to gain experience in advanced microscopic techniques applied to important problems in biotechnology.

Please send inquiries (resume, names of referees etc.) to

Prof. Raimund J. Ober
University of Texas at Dallas
email: ober@utdallas.edu

Research Funding Opportunities Related to Biological Physics

Transforming Biomedicine at the Interface of the Life and Physical Sciences (NIH / R01)
http://grants.nih.gov/grants/guide/pa-files/PAR-10-141.html

New Biomedical Frontiers at the Interface of the Life and Physical Sciences (NIH / R01)
http://grants.nih.gov/grants/guide/pa-files/PAR-10-141.html

Chemical Approaches to Target Validation for Drug Resistant Pathogens (R01)
http://grants.nih.gov/grants/guide/rfa-files/RFA-AI-11-004.html

Functional Genetics, Epigenetics, and Non-coding RNAs in Drug Addiction (R01)
http://grants.nih.gov/grants/guide/pa-files/PA-11-033.html

Advancing Theory in Biology (NSF)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501066

Collaborative Research in Computational Neuroscience (NSF)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5147&org=MPS&sel_org=MPS&from=fund

Chemical Theory, Models and Computational Methods (NSF)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503420

Macromolecular, Supramolecular and Nanochemistry (NSF)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503422&org=CHE&from=home

Networks and Regulation (NSF)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503611&org=BIO&sel_org=BIO&from=fund

Biological Dynamics, Structure and Function (NSF)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503609&org=BIO&sel_org=BIO&from=fund

Conferences, Meetings, Workshops, And Summer Schools Announcements

If you would like to post an announcement for a workshop or conference in this Newsletter, send your notice (text) or a PDF document (resized to a maximum size of 7 inches x 10 inches) to the editors.

17th International Biophysics Conference (IUPAB)

October 30 – November 3, 2011
Beijing, China

http://www.17ibc.org

Sponsored by
International Union for Pure and Applied Biophysics (IUPAB)
Biophysical Society of China(BSC)

Organized by
Biophysical Society of China(BSC)
Institute of Biophysics, Chinese Academy of Sciences (IBP)

Dynamics and Thermodynamics of Biomolecular Recognition)

May 5-7, 2011
Ecole Polytechnique, Palaiseau, France

http://www.cecam.org/workshop-596.html

Joint User-Training Workshop

Developing Multi-Scale, Multi-Cell Developmental and Biomedical Simulations with CompuCell3D and SBW

Indiana University, Bloomington
August 8th - 19th, 2011

We are pleased to announce the **Joint User-Training Workshop "Developing Multi-Scale, Multi-Cell Developmental and Biomedical Simulations with CompuCell3D and SBW "**. It will focus on teaching the basics of multi-cell, multi-scale modeling using the open-source packages CompuCell3D and SBW. The workshop will be taught by many of the CompuCell3D and SBW developers. In addition to participating in lectures and hands-on exercises, each participant should prepare a 30 minute presentation covering her/his area of research. Based on our previous experience, such presentations lead to many future collaborations as well as make the workshop a more scientifically stimulating event.

The workshop will be held on the **Indiana University, Bloomington** campus from **August 8th - 19th, 2011** and is appropriate for Experimental Biologists, Medical Scientists, Biophysicists, Mathematical Biologists and Computational Biologists of experience from advanced undergraduates to senior researchers.

By the completion of the workshop, participants will have implemented a basic simulation of the particular biological problem involved in their research.

There is no registration fee, and partial support for travel and hotel costs may be available. Priority will be given to student and postdoctoral participants. We will also provide lunches and all workshop materials.

Post-course support and collaboration to continue simulation development is available. If seeking support, please include a statement with your application that documents your need and the amount you request.

Enrollment is by application only, and early enrollment is encouraged as the number of workshop spaces is limited. To apply, please send a C.V. and brief statement of your current research interests and specific modeling problem(s). Students and postdocs should include a letter of support from their current adviser.

Deadline for applications is June 1st, 2011. All submissions must be by email to Dr. Maciej Swat (mswat@indiana.edu).

For additional information, see the attached poster, contact Maciej Swat (mswat@indiana.edu), or visit http://www.compucell3d.org. (Please forward this e-mail to any of your colleagues who might be interested.)

The 5th International Conference on Bioinformatics and Biomedical Engineering
(iCBBE 2011)

Wuhan, China May 10-12, 2011

www.icbbe.org/2011

Technical Areas to be covered at this conference include:

Bioinformatics & Computational Biology:

Protein structure, function and sequence analysis
Protein interactions, docking and function
Computational proteomics
DNA and RNA structure, function and sequence analysis
Gene regulation, expression, identification and network
Structural, functional and comparative genomics
Computational evolutionary biology
Data acquisition, normalization, analysis and visualization
Algorithms, models, software, and tools in Bioinformatics
Any novel approaches to bioinformatics problem

Bioinformatics & Computational Biology:

Biomedical imaging, image processing & visualization
Bioelectrical and neural engineering
Biomaterials and biomedical optics
Methods and biology effects of NMR/CT/ECG technology
Biomedical devices, sensors, and artificial organs
Biochemical, cellular, molecular and tissue engineering
Biomedical robotics and mechanics
Rehabilitation engineering and clinical engineering
Health monitoring systems and wearable system
Bio-signal processing and analysis
Biometric and bio-measurement
Biomaterial and biomedical optics
Other topics related to biomedical engineering

Special Sessions:

Biomedical imaging
Biostatistics and biometry
The information technology in bioinformatics
Environmental pollution & public health

For more information about this conference, please contact: submit@icbbe.org