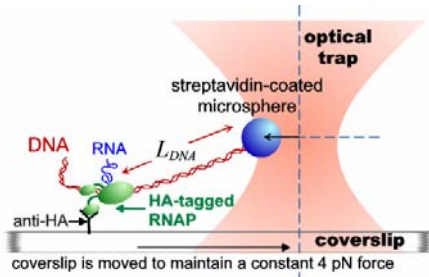


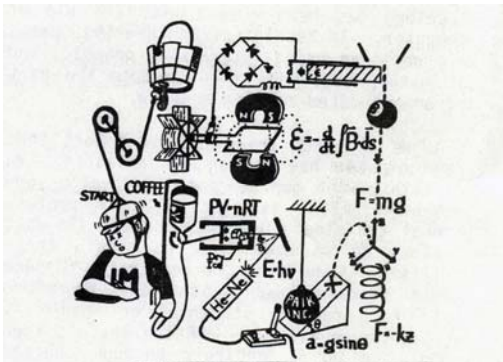


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November 2006– Issue 51



Arthur Laporta wrote this month's Research Spotlight regarding his research on real world nano-bots with optical tweezers.



### Physics Phun Phacts:

Old issues of The Photon (previously called PHAST Facts) were found in the Physics storage room, dating back to 1979. To show how times have changed, take a look at the November 1982 edition, where they featured the design for the physics t-shirt (only \$5.50 per shirt).

\*Send us your Physics Phun Phacts to [moulding@umd.edu](mailto:moulding@umd.edu). If your submission is chosen for the next issue, you will win a physics t-shirt with the 1979 logo!!

Alumnus Philip Land attributes the success of his undergraduate education to the guidance he received from Physics' faculty, staff and students. Read all about his educational journey in this month's Alumni Spotlight.

John C. Mather was awarded the 2006 Nobel Prize in Physics. For more information or to read about more department awards visit the News section.

Michael Fisher spent a week in Beijing, from September 23-October 2, at a Bio-Systems Summer School. He delivered a course of three lectures on "Motor Proteins: Single molecular transport, observations and theory." Visit the Recent Events section for more information about past events.

An article co-written by James Drake, appears in the October 6, 2006 edition of Nature magazine. To view the article or to read about other faculty in the news, visit the News section.

Elizabeth Lockner wrote this month's Graduate Blog about the dreaded, "what do you do?" question. Elizabeth Lockner was the recent recipient of the Ruth Davis scholarship.

The November Colloquium Speakers include Leo Kadanoff (University of Chicago), John Thomas (Duke University), Negriz Malvala (Massachusetts Institute of Technology), Douglas Hamilton (University of Maryland) and David Spergel (Duke University). To view other upcoming events, visit the Up Next Section.



DEPARTMENT OF  
**PHYSICS**  
UNIVERSITY OF MARYLAND



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## RESEARCH SPOTLIGHT

### Studying Real World Nano-bots with Optical Tweezers - By Arthur LaPorta

Anyone who follows the news or is a fan of Star Trek is familiar with the notion that sometime in the distant future mankind will make frequent use of ‘nano-probes.’ When introduced to the body these tiny robots, which are usually depicted as tiny metallic gadgets, will perform incredibly sophisticated tasks, tugging on cellular structures, manipulating DNA, destroying invading viruses, etc. The only thing that makes this notion science fiction rather than science fact is the strange appearance of the nano-probes and the assumption that they will be relegated to the distant future. In fact, nature is replete with nano-probes and nano-bots that perform functions no less astonishing than what is depicted in any science fiction movie. However, these nano-bots are not metallic gadgets, but single molecule molecular motors, that hydrolyze ATP (or other nucleotide tri-phosphates) and convert the energy released to mechanical work.

These single molecule biological motors perform a variety of functions, such as transporting cargo throughout the cell, helping to pull pairs of chromosomes apart during cell division, or copying and editing genomic information stored in our DNA. The specific molecular motor that I am most interested in is RNA polymerase. This molecule crawls along a DNA molecule, prying the two strands apart so that one strand can be used as a template for creating a complementary RNA molecule. It moves on the DNA in discrete 1 nucleotide steps, ligating an additional RNA nucleotide to the chain at each position. The ‘messenger’ RNA molecule is subsequently sent to the ribosome, which uses it to synthesize a protein needed in the cell.

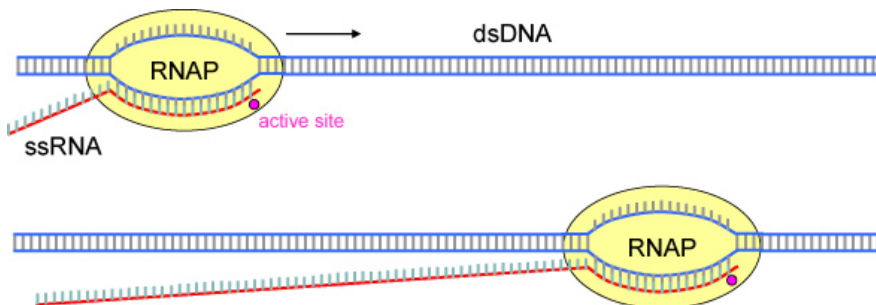


Figure 1. Schematic representation of RNA polymerase (RNAP) transcribing a double stranded DNA molecule, creating a single stranded RNA chain.

RNA polymerase has been extensively studied using a technique called “optical tweezers.” In these experiments a tiny latex sphere is attached to the RNA polymerase molecule transcribing DNA in solution and the piece of DNA being copied is tacked down to the bottom of the sample chamber. The latex sphere is captured by an optical trap, which exerts a constant tension on the DNA tether. By observing the motion of the sphere, the position of RNA polymerase on the DNA molecule is measured as a function of time. In this way, we can observe a gene being transcribed in real time. As a result of such studies, we can observe the kinetics of RNA polymerase as it moves down the template and see how individual molecules react to signals that are encoded in the DNA sequence.

Continued on next page

These signals might cause RNA polymerase to halt, or to become unstable and dissociate from the template. This information is critical to understanding the role of RNA Polymerase in regulating the production of proteins in a cell. Future work at the University of Maryland may involve determining how RNA Polymerase reacts to torque as well as force, and determining how other proteins may interact with RNA Polymerase to change its behavior.

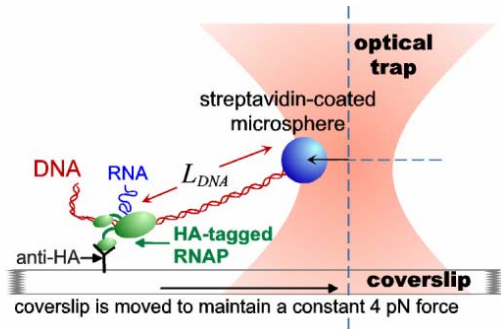


Figure 2 Schematic representation of the use of optical tweezers to study RNA polymerase.

*Dr. La Porta is an assistant professor of Physics for the University of Maryland . He is a member of the Biophysics research group. Feel free to contact him at, [alaporta@umd.edu](mailto:alaporta@umd.edu) .*



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## ALUMNI SPOTLIGHT

### **Land: Professors, classmates and graduate students were my lifeboats, life vest and Ships**

The positive guidance provided by universities is often overseen, but never forgotten. Faculty and staff are among the people that lead students to succeed and long after graduation, remain some of their closest friends. For Alumnus, Phillip Land, that list is long.

“I try to keep in contact with most of my professors,” said Land. “Some of my favorite professors include Drs. Wendell Hill, Tom Cohen, Justin Wyss-Galifent, Richard Greene, James Drake, Christopher Lobb, Steve Rolston, Deborah Bryant, David Levermore, James Anderson, Elizabeth Beise and Mr. Tom Gleason....to name a few.”

Land was born and raised in Baltimore, Maryland. He obtained his bachelor’s degree from the University of Maryland in 2005.

“UMD was an in state school and had the best physics department,” said Land. “I liked Maryland a lot. There were times when I hated it, but overall, I loved it.”

Currently, he is a Graduate Research Assistant at Alabama A&M University. This spring he will receive his master’s degree in physics, with a concentration in optics. His research details the study of photo refractive and semi-conducting crystals specifically for usage of a dual interferometer which has applications for biomedical imaging, optical communication and DoD applications. As a Center for Subsurface Sensing and Imaging Scholar, Land has a joint research at Boston University. In addition, he is working towards tenure for the United States Navy S.M.A.R.T. scholarship and fellowship program.

As Land continues on his educational journey, he remains grateful for the support he received here and offers current students advice.

“Keep your eyes on the ‘prize,’ don’t get discouraged when the waters get rough and though you may feel like you are about to drown, keep your head above the water,” said Land. “We cannot go through life alone...be sure to network and keep in contact with all of your professors and classmates.

Study! Study! Study! Physics is like a sport. You must practice for perfection.

Get into research ASAP. When you’re a freshman find a professor to work for. Think of the research areas you are interested in and what you want to do with your life. And as I mentioned before, keep you eyes on the prize and never give up!

I would never have been able to make it through Maryland’s undergraduate program if it wasn't for certain professors, classmates and graduate students/ Hill Lab researchers, If it wasn’t for their guidance and tutelage, I would not have made it through. In my eyes, they are the lifeboats, life vest and ships that helped me cross the rough and steady waters from freshman year to graduation. I am forever in dept and thankful for there ongoing support and friendship.”



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**GRADUATE BLOG**

**So, What Do You Do?---By : Elizabeth Lockner**

“So, what will that be useful for?”

The sequence of questions is so predictable I sometimes feel we should write out answers and exchange them on note cards when we meet new people – just to save time.

“What do you do?” I’m a graduate student in physics at the University of Maryland.

“Physics, huh?” (Sometimes with the added “Wow, I HATED that in high school!!!”)

“What sort of physics are you studying?” High Energy Particle Physics, a VERY exciting field with the upcoming opening of the LHC, the new super high power accelerator at CERN in Geneva!

“I see. So, what will this be useful for?” Perhaps absolutely nothing – in the terms they are thinking. I read into that question a search for some practical application that will make our daily lives better, that will boost our economy or make us less dependent on fossil fuels or lead to a technological advance that could help us go where no man (or woman) has gone before. This stranger is asking me to justify my efforts, to prove that the way I spend my days and many nights is somehow equally valid as the heart surgeon who saves lives every few hours.

The only answer I can give is that I never grew up. I never outgrew that stage of childhood that stretches every parents patience with a need for fundamental, beginning of everything, no “just because” answers. Why do we care what makes up the Universe? Sure, that understanding may help us make cars fly, but that’s not why we do it. We do it because it’s there, because it taunts us with little bits of insight every once in a while.

As I step back and survey the “worth” of my work I consider my brother in the Army fighting for our country, my best friend teaching 4th graders the morals that will make the future generation great, my previous housemate doing physical therapy for head trauma patients so they can put their lives back together. My efforts seem selfish and moderately juvenile. I just want to know. I want to know if these complex theories of matter interactions are right – or just thicker versions of Dr. Suess. I want to know why things seem to fit together in such a beautiful pattern. The answers are waiting for us to find them, waiting for us to ask the right questions. I want to be there when we do. What will this be useful for? “Probably not much. So what do you do?”



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**UP NEXT**

November Colloquia:

November 07 - Leo Kadanoff

November 14 - John Thomas

November 21 - Negriz Mavalvala

November 28 - Douglas Hamilton

[Click here to view the entire colloquia schedule.](#)

November 02, 2006- Physics is Phun “Good Vibrations”

7:30- 8:45 PM Physics Lecture Halls

November 14, 2006- “From the Big Bang to the Nobel Prize”

7:00 - 8:00PM, Room 1412

Public Lecture by Nobel Laureate, John Mather

A memorial service, in remembrance of Dr. William Hornyak, will be held on Monday, November 20, 2006, at 1:00PM. Dr. Hornyak was a Physics Emeritus professor. Please join us in remembering his life and career.



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## NEWS

### Awards and Honors

John C. Mather and George F. Smoot of Lawrence Berkeley National Laboratory have won the Nobel Prize in Physics. Dr. Mather has been an adjunct professor in the department since 1992. The prize was awarded for their work that helped cement the big-bang theory of the universe which gave a deeper understanding of the origin of galaxies and stars.

The prize includes a \$1.4 million check, gold medal and a diploma which will be presented on December 10. Dr. Mather is a researcher at the NASA Goddard Space Flight Center at Greenbelt, MD.

William Phillips was awarded the Service to America Medal for conducting cutting-edge research to improve the quality of lives for US citizens. All of the civil servants were honored in early October.

The following Banneker-Key students were awarded a \$5000 summer research scholarship:

Matthew Barr  
Matthew Graves  
Paul Lamber  
Andrew Marsh  
Chetan Mehta  
Richard O'Steen  
Travis Weyforth  
Benjamin Crist

\*The summer research scholarship funds are donated by the family of the late Professor Angelo Bardasis. The money for the laptops are donated by department faculty.

### In the News

James Drake co-wrote an article that appeared in the October 6, 2006 edition of Nature. The report covers the new model for electron acceleration during magnetic reconnection.

To view the article, visit:

<http://www.nature.com/nature/journal>

On September 19th, Ronald Sagdeev was quoted in the Orange County Register on a story regarding the return of the space shuttle, Atlantis.

Keith Schwab was featured in an article in Nature on September 14th. Along with his team, Schwab completed an experiment titled "Cooling a Nanomechanical Resonator with Quantum Back-Action."





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## RECENT EVENTS

The 2006 Staff Retirement Reception was held on October 26, 2006. The reception honored staff members, Kari Aldridge (Business and Finance), Larry Bleau (Space Physics) and Brenda Dunn (High Energy Research) and Joyce Robinson (Copy Center) for their years of excellent service.

On October 2, 2006, Hassan Jawahery officially began work as the spokesperson for BaBar. For more information, visit: <http://today.slac.stanford.edu/a/2006/10-02.htm>

Michael Fisher spent a week in Beijing, from September 23-October 2, at a Bio-Systems Summer School. He delivered a course of three lectures on "Motor Proteins: Single molecular transport, observations and theory."

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### **In Memoriam**

Our deepest condolences go out to the friends and family of Mr. Sol Haberman, one of our Slawsky Clinic tutors. Haberman passed away on September 1, 2006 at the age of 84. He joined APL in 1962 as a mathematician and spent the next two decades working as a statistician and analyst. His work supported anti-air warfare, anti-submarine warfare, command control & communications and transportation projects. In 1984, Haberman retired. He came to UMD and volunteered three days a week as a physics tutor.

Mr. Haberman is survived by his wife, Malca, son, Daniel and three grandchildren.





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**LETTER FROM THE CHAIR**

Dear Colleagues,

We have reached the half-way mark of the semester and I can sense the excitement in the department. Thank you, again, for all of your hard work!

I would like to take this opportunity to congratulate John Mather, Adjunct Professor of Physics, who has been awarded the 2006 Nobel Prize in Physics. He has been an adjunct professor for us since 1992 and has brought international recognition to the department and university through his research. This honor is well deserved and I, along with my colleagues, congratulate John on his recent accomplishment. Dr. Mather is a Senior Astrophysicist in the Observational Cosmology Laboratory at NASA's Goddard Space Flight Center. His research centers on infrared astronomy and cosmology.

Dr. Mather will be giving his first public lecture since receiving the 2006 Nobel Prize in Physics on November 14, 2006. Please plan to attend this intriguing lecture hosted jointly by NASA Goddard Space Flight Center and the University of Maryland. The talk entitled, From the Big Bang to the Nobel Prize, will be followed by a Q&A and small reception. For more information, visit the Up Next section.

I hope to see all of you there!

Regards,  
Drew





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**EDITOR'S NOTE**

Dear Readers,

As the leaves change colors and the temperature drops, I am shocked at how fast this semester is coming to an end. None-the-less, let's celebrate in the department's latest accomplishments.

Our students and faculty continue to bring positive recognition to the University and Physics Department. This past month, many of our students were awarded with summer research scholarships. John C. Mather was honored with the 2006 Nobel Prize in Physics and Nobel Laureate, Bill Phillips was awarded the Service to American Medal. In addition to awards and honors, our faculty remain hard at work. James Drake recently co-wrote an article that appeared in the October issue of Nature magazine. Also, Arthur LaPorta wrote this month's Research Spotlight, regarding his research on *Real World Nano-bots with Optical Tweezers*.



And the excitement does not end there! We still have a long list of things to look forward to before the end of the semester. Visit the Up Next section to plan for all of our upcoming events, including the November colloquia, John Mather's Public Lecture and the start of this semester's Physics is Phun series.

Best,  
Carole



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**CONTACT US**

The Photon Online is the official University of Maryland-Physics online newsletter. We release an issue monthly to highlight researches, alumni, awards, honors and events. The views and opinions of our readers are valued; please contact us with any questions, ideas or comments.

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