Annual symposium celebrates fourth year

Event showcases ASU student research efforts in physics

ASU graduate student receives fellowship to partner with K-12 class

ASU Physics' grad student, Samuel Tobler, has been awarded the GK-12 "Down to Earth" fellowship. Granted by the National Science Foundation, the fellowship is designed to bring scientists and engineers into K-12 classrooms.

Tobler, who works with ASU Professor Peter Bennett, will receive a $30,000 stipend for the year-long program which will cover his tuition and insurance.

During the first phase of the program, Tobler will attend a summer workshop with ASU faculty and K-12 teachers from across the Valley.

After the workshop, he will be teamed up with a K-12 teacher. The teacher will come to ASU and work with Tobler in the lab to better understand Tobler's research.

Tobler, in turn, will visit the K-12 classroom two days a week where he will teach at least two lessons concerning his research and help improve science education in the classroom through inquiry-based teaching.

For more information on the GK-12 program, please visit http://gk12.asu.edu/.

On Friday, April 25, ASU Physics hosted the Fourth Annual Undergraduate Research Symposium. Eight physics undergraduate students shared presentations highlighting their ongoing research with faculty, REU summer experiences, and other research topics in their respective areas of interest within physics.

Participants gave 15 minute presentations to an audience of faculty, graduate students, and other physics undergraduates. The event was organized by Professor Michael Treacy, Director of Undergraduate Programs, and Sabrina Mathues, Academic Advisor and Undergraduate Program Coordinator.

"This is an opportunity for undergraduates to get a taste of what the future holds for them," says Mathues "Many will go on to graduate school and postdoc positions where presentations are common and a critical part of a job search."

Although the event was successful in terms of the quality of presentations, it also underscored the enthusiasm undergraduates hold for research and discovery. ASU Physics congratulations to all symposium participants on their presentations and looks forward to their future success in research.
BOOK REVIEW

It Must be Beautiful: Great Equations of Modern Science

My own college (Ormond College) was an imposing Victorian castle complete with battlements, towers, lawns and sculpture. Formal dinners were held each day in a great hall and attendees come in full academic gown. Oil paintings of past College Masters going back a hundred years surrounded us at dinner. But it was Bryn Newton-John whose portrait held our gaze. Centered above High Table for all to see, physics students knew that he was married to the eldest daughter of the great physicist and Nobel laureate Max Born and that he had worked with Allan Turing on the Enigma project at Bletchley Park – the site of code-breaking efforts in the United Kingdom during World War II. Turing helped design arguably the first electronic computer used to crack the Nazi U-boat codes.

We at Ormond College were delighted when the Newton-John's daughter, Olivia, became a popular singer in the 1960s and 70s, leading to her movie role with John Travolta in immensely popular movie "Grease".

The memory I have of her grandfather Born's disapproval of her singing style in her early career and the memories of my studies at Ormond came flooding back to me when, on a trip to London, I picked up It Must Be Beautiful: Great Equations of Modern Science, a wonderful book edited by Graham Farmelo.

This is a superb read for any

The editor begins with Einstein, Planck, and the quantized energy of the photon. The chapter follows the path from Clausius through the ultraviolet catastrophe to Planck's uncomfortable quantization.

Max Planck, like Hemmingway, worked standing up at a lectern, and first wrote down his distribution on Sunday evening October 7, 1900. He presented his quantum modification of Ludwig Boltzman's statistics at a talk in Berlin in December after “the most exhausting few weeks of work in my life”. For Planck, the importance of his work lay not in quantization at all, but in the prospect it held for a new system of natural units.

Everyone else saw the quantization as a mere mathematical formality without physical significance. Only Einstein saw the flaw in Planck's theory (normalization) and took an additional leap. Einstein wrote that "it is as if radiation consisted of quanta" in his photoelectric effect

accompanied the great violinist Josef Joachim, and possibly Johannes Brahms. Einstein was an avid and accomplished violinist frequently performing Mozart with everyone and anyone who expressed an interest, including the Queen of Belgium.

In another chapter, Robert May writes about the fascinating and deceptively simple Logistic Map equation which describes the chaotic behavior of everything in ecology - from spawning salmon to grouse populations. He traces this back to Henri Poincare's work on the stability of the planetary orbits.

May reviews modern chaos theory in meteorology (think "butterfly effect"). He also discusses the discovery that even phenomena described by differential equations can be chaotic ("deterministic chaos"), so that sensitivity to initial conditions can lead to an unpredictability; an unpredictability which some may call "free will". He also makes connection with unpredictable (individual) quantum jumps.

May strongly recommends James Gleick's popular book Chaos (1988). It was Gleick’s book that caused Al Gore to hire a mathematician specifically to teach him the essentials of the theory.

Further in the book, we find a chapter on the Drake equation. The Drake equation was new to me. It was written down in 1961 at the first "SETI" workshop in Green Bank, West Virginia. Frank Drake had estimated the number N of
physical scientist. The book consists of eleven chapters, each authored by a contemporary scientist or science writer and focused on one of the great equations of science and how it came about. These essays rarely contain more than one equation. Yet, every chapter is full of fascinating anecdotes, history and insight into how these great equations arose. The book concludes with an afterword by Steven Weinberg.

As we heard in a recent excellent ASU Physics’ colloquium, this was arguably the greatest of his 1905 papers. The next year, Einstein quantized photons and explained the specific heat anomaly in one of only three papers he would ever publish which compare theory and experiment.

Interestingly, the chapter also illustrates Planck and Einstein’s common musical interests. Planck

(Continued on Page Four)

From the Chair

Student Researchers Advance the Forefront of Knowledge

Our physics textbooks develop the known fundamental concepts of the relation of matter and energy and of space and time and provide mathematics that describe physical phenomena. Indeed students of physics at all levels are able to apply these concepts to solve amazingly complex problems and provide precise and quantitative answers.

At ASU, many of our students of physics (both undergraduate and graduate) are actively involved in advancing the forefront of knowledge through their research projects. In these projects, students are challenged to understand new phenomena that are not described in their textbooks. They must organize the concepts, develop quantitative measurements and/or mathematical descriptions, and use the scientific method to bring forth new knowledge that may well impact our society.

The excitement of discovery and innovation, and the advancement of science knowledge were certainly evident at the Fourth Annual Undergraduate Research Symposium. It was a pleasure to listen as our students describe concepts that ranged from quantum interference and information transfer, to nanoscale properties of materials for electronics, to understanding the interactions of the fundamental particles of matter.

ASU Physics has an exceedingly dynamic research program that is driven by the enthusiasm, intellect and creativity of our undergraduate and graduate students.

In the News...

ASU Physics is delighted to welcome Professor Sara Vaiana to the faculty. Dr. Vaiana will join the faculty as Assistant Professor in January 2009. Vaiana comes to ASU from the National Institutes of Health (NIH) where she has worked as a postdoctoral fellow since 2004. Vaiana research in experimental biological physics focuses on studies aimed at obtaining a quantitative physical understanding of biologically relevant processes occurring in protein and polypeptide solutions on two spatiotemporal scales.

Professor Arjan van der Vaart of the Center for Biological Physics has been offered a visiting professorship at the University of Reims Champagne-Ardenne in France starting in May 2008. He will work with a team of theoretical and organic chemists on the rational design of new $\alpha$-galactosylceramides, glycolipids, that elicit a strong anti-tumor response from natural killer T cells. Professor van der Vaart will perform computer simulations to direct the design and his collaborators will synthesize and test the resulting drug leads.

Congratulations to Dr. Dong Su, Assistant Research Scientist in Professor John Spence's lab. Dr. Su has accepted a position at Brookhaven National Laboratory as a staff scientist.

More congratulations are in order for ASU Physics’ Kong Thon “Frank” Tsen and Otto Sankey. Their research on fighting viruses with lasers continues to attract national and international attention. The Journal of Physics: Condensed Matter recently recognized Tsen and Sankey’s paper...
Our students are urged to push forward, to discover, to innovate, and to advance our knowledge. In walking through the Research Symposium and the halls of the Physical Sciences Building, it is evident that our students have accepted every challenge.

Robert J. Nemanich, Professor & Chair
ASU Physics

"Selective Inactivation of micro-organisms with near-infrared femtosecond laser pulses" and another Tsen paper “Inactivation of viruses with a very low power visible femtosecond laser” as among the top papers of the year. The former paper was also recognized as the most downloaded paper of 2007. Papers on the JoP’s Top Papers 2007 Showcase were chosen for their excellent science. Tsen and Sankey, along with their graduate students Daryn Benson and Erik Dykeman, have collaborated on a number of papers and projects through ASU Physics. You can view the Top Papers of 2007 at http://www.iop.org/EJ/news/-topic=1290.

Congratulations to ASU Physics graduate student Amber Straughn who has been selected by NASA Headquarters Office of Education to engage in a session with current NANA Administrator, Mike Griffin. The session is designed "to allow stellar graduate students from NASA Education Programs the opportunity to engage in an informal, question and answer session/dialogue" with NASA officials. In addition, Straughn will meet with NASA official and Nobel laureate in Physics, John Mather. She will begin work with Mather at NASA as a postdoctoral fellow in Fall 2009. Straughn current works in Professor Rogier Windhorst's research group.

The Department’s Particle Physics & Astrophysics Group has just completed the first Particle Physics & Astrophysics Seminar Series. The inaugural series hosted eight exciting talks at the cutting edge of research in topics such as dark matter, quantum gravity, and exotic particle physics beyond the Standard Model. Thanks to Department support, series organizer Professor Cecilia Lunardini, with help from Professors Andrei Belitsky and Rich Lebed, were able to attract speakers from as far afield as Fermi National Laboratory and the University of Miami to discuss current research.

To view Spring 2008 speakers’ presentation slides from each talk, visit http://physics.asu.edu/seminars/index.php?type=Series&ID=142 and click on the title of each talk.

HAPPY BIRTHDAY!

Congratulations to ASU Physics grad student, Sampriti Bagchi who welcomed daughter Anusha - which means "first rays of the morning sun" - on April 17th.

Physics Cares!
Team participates in ASU Review: It Must be Beautiful...

human-dolphin communication analogous to the larger-scale interstellar communication effort. The 1971 follow-up workshop included such luminaries as Francis Crick, Thomas Gold, Marvin...
community service project

Over 200 ASU staff, faculty, students, and community members gathered on Saturday, March 29th to participate in ASU Cares, an annual volunteer community service event organized by the ASU Public Events Office.

This year's event was organized as a one-day project to help revitalize Thunderbird Park by trimming overgrown vegetation, removing trash from the adjacent creek, and cleaning park common areas.

Teams donned their ASU Cares t-shirts and dove into the task of trimming brush and removing trash from the Cave Creek Wash. ASU Physics participated with a five member team organized by ASU Physics Academic Advisor Sabrina Mathues. The team included ASU Physics undergrads Patrick Varvel and Karin Dethloff, Mathues and her fiancé Josh Ezell, and ASU Physics Office Assistant Sharon Puzio.

"The project served not only as an outreach opportunity," stated Mathues, "but also as an occasion to share stories and laughs – strengthening community in every sense of the word. Thank you to all who participated!"

Keep in touch and

MAKE A DIFFERENCE

Minsky, Carl Sagan, Boris Shklovskii and later Freeman Dyson, Ronald Bracewell and Frank Tipler.

To some extent all this work derives from the question Fermi posed to Teller at lunch one day at Los Alamos in 1950 when he asked "Where is everybody?" - to which everyone laughed, guessing his meaning. This is one chapter in the book which could do with some serious updating in view of the very recent planetary discoveries which must greatly reduce N.

Peter Galison uses John Wheeler's famous 1945 Survey of Science to launch an essay on the history of $E=mc^2$, with lively quotes from letters between Otto Hahn and Lise Meitner following Meitner's dramatic escape from Nazi Germany to Sweden on July 13, 1938. In the letters, Hahn discussed his work with uranium which prompted Meitner and Otto Frisch to take a step further. The rest is familiar history leading to the Manhattan Project. Wheeler was travelling by ship with Niels Bohr to the USA at the time. Having heard of the Hahn-Meitner letter, Wheeler and Bohr worked out a comprehensive theory of fission.

Arthur Miller provides a spirited account of Erwin Schrödinger and his wave equation. Miller states that Schrödinger "did his great work during a late erotic outburst in his married life" at a ski resort with his girlfriend in 1925.

Schrödinger was notorious for his womanizing and, at one point in his life, actually had two wives – one of which was married to another man. "It would be easier to live with a canary than a racehorse" said Schrödinger's wife, "but I prefer the racehorse". The Byronic Schrödinger was an impeccably dressed Weimar dandy and scholar of Hindu. Interestingly Schrödinger was, like Werner Heisenberg and a handful of scientists of the day, a pianist of near-concert standard.

Whereas Schrödinger’s method triumphed, it was Heisenberg's interpretation that we use today. Einstein thought that Schrödinger was correct and Heisenberg "off the track". Heisenberg thought Schrödinger's theory "disgusting". Max Born proposed a probabilistic interpretation of Schrödinger's wave function, causing Heisenberg "acute psychological distress".

Schrödinger never accepted Born's interpretation or quantum jumps - to Schrödinger his wave function was the real de-Broglie matter-wave. But significantly Schrödinger gave up on trying to interpret many-particle wave functions. As Richard Feynman later famously stated, "I think I can safely say that no one understands quantum mechanics."

This will give you some sense of the book. The other chapters are equally good – Wilczek’s chapter on the Dirac equation, Roger Penrose on General Relativity, John Maynard Smith on rate equations to model evolution, Aisling Irwin on the Nobel-prize winning rate equations describing ozone reactions with chlorofluorocarbons in the atmosphere, Igor Aleksander on Claude Shannon's equation, and Christine Sutton on the Yang-Mills equation.

My only quibble with the book is that so many great equations are not included, among them Navier-Stokes, Poisson, Newton's Gravity, Fourier on heat, and or course Maxwell who needs an entire
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book to himself; a fact that was realized in the remarkable *The Maxwellians* by B.J.Hunt, which I reviewed in an earlier issue of the Physics Flash (see HERE).

All these omissions certainly don’t diminish the book, but only beg the question “Where is Volume II?”

John Spence is Regents’ Professor of Physics at Arizona State University. For more information about Professor Spence and his research, please visit [http://physics2.asu.edu/people/jspence](http://physics2.asu.edu/people/jspence)