THE UNIVERSITY OF TOLEDO **College of Natural Sciences and Mathematics**

physics.utoledo.edu *DEPARTMENT OF PHYSICS AND ASTRONOMY*

WAVES

Number 15 Summer 2012

DEPARTMENT CHAIR'S COMMENTS

Anderson-Huang

Greetings to all of our alumni, friends and supporters of the department! I hope this newsletter finds you well. The College of Natural Sciences and Mathematics is now more than one year old and growing well under the leadership of our founding dean, Dr. Karen Bjorkman. Among other interesting developments, together with the College of Engineering, our college has founded a School for Green Chemistry and Engineering. The new school will focus on the need for sustainability with the design of products and processes from origin through end of life that use renewable raw materials and environmentally safe processes. You can follow more college news on the Web site at *utoledo.edu/nsm*. At the University level, the Faculty Senate approved a complete revision of the University Core Curriculum, starting with the general education requirements. Courses used by non-scientists to satisfy a science requirement (and all other such courses in the social sciences and the humanities) must now have a "competency assessment" component that addresses progress in five core competencies, one of which is "scientific and quantitative reasoning and literacy."

In other news, Provost William McMillan announced his retirement to be effective in June 2012. Our next edition will introduce his replacement. As immediate past president of the Faculty Senate, I am now serving on the search committee. Dr. John Feldmeier, whom some of you may know, is also retiring as chair of the Department of Radiation Oncology on the UT Health Science Campus. The Department of Physics and Astronomy administers the Ph.D. in physics with a concentration in medical physics in cooperation with that department, and I am also serving on the search committee for Feldmeier's replacement.

As we announced in the last edition of Waves, we had three new tenure-tenure track appointments in 2011. In order of appointment, we are very happy to welcome Dr. Nikolas Podraza as an assistant professor of physics in the area of photovoltaics, Dr. Michael Cushing as an assistant professor of astronomy and the new director of the Ritter Planetarium and Observatory, and Dr. Yanfa Yan, awarded an Ohio Research Scholar Endowed Chair in Photovoltaics as a full professor. We are very pleased to have these well-recognized scholars join us. Podraza comes from the Materials Research Laboratory at Penn State and has an accomplished record in ellipsometry and other characterization methods of thin film materials. Cushing comes from the NASA Jet Propulsion Laboratory and has an accomplished record in the analysis of brown dwarfs—objects at the boundary between stars and planets. Yan comes from the National Renewable Energy Laboratory and has an accomplished record in current, emerging and future generation materials and device architectures for energy and related applications, electron microscopy techniques and density functional theory of electronic structure modeling. All three scientists complement and add to our existing research efforts, and promise significant contributions to enhancing our profile. You will find more complete descriptions of these individuals later in this edition.

In addition to these new appointments, we are happy to report that Dr. J.D. Smith, an astrophysicist working on star formation, active galactic nuclei and dust in the nearby universe, has been promoted to the rank of associate professor and awarded tenure. You can find his profile at *tir.astro.utoledo.edu/jdsmith*. As the articles in this edition of Waves attest, our programs continue to attract interest locally, nationally, and internationally.

Also as we mentioned in the last issue, both Willie Brown, our chair's secretary, and Stephany Mikols, our business services officer, retired at the end of June 2011. The department was able to hire replacements, with an upgrade to administrative assistant for what used to be the chair's secretary. This upgrade was granted in compensation for losing the secretarial position held by Nadine Hoffman. Fortunately, we have hired two very experienced replacements. Our new administrative assistant, Sherry Cox, had previously served as an administrative assistant in a dean's office. Our new business services officer, Kim Dusseau, had previously worked on graduate student contracts in the College of Graduate Studies. If you are in town, please drop by to meet these very effective staff members.

Ritter Planetarium and Observatory continues its excellent outreach efforts to the community, especially now with its new all-digital all-sky projector. Cushing has settled into his role as director with a very rapid learning curve and is providing very professional and engaging programming with the help of

Associate Director Alex Mak. Please find further details later in this edition. We were very saddened by the death of the first director of the planetarium, our good friend and benefactor Helen Brooks. Her obituary is also later in this edition.

We are proud of all the efforts reported on in this edition of Waves and hope to develop even more in future years. If you'd like to help us grow and improve, including adding to the planetarium projector upgrade, there is information elsewhere in this newsletter about how you can contribute — there are several funds established to support various efforts within the department. The department is very fortunate to have strong supporters in the community and beyond, and we are grateful to all of you.

In closing, let me just say that we value all our supporters, friends, former students and colleagues. We'd love to hear from you, so please do drop us a line sometime and tell us what you're doing these days. If you happen to be in the area, do stop in and visit us.

Lawrence Anderson-Huang

NOTABLE FACULTY NEWS

Professor Yanfa Yan

Assistant Professor Nikolas Podraza

Two new faculty members, Dr. Yanfa Yan and Dr. Nikolas Podraza, have joined UT's hub of the Wright Center for Photovoltaic Innovation and Commercialization (PVIC). The two faculty positions were created in the Department of Physics and Astronomy with funds competitively awarded to UT via the Ohio Research Scholars Program (ORSP). Yan joins UT as a professor of physics and as the ORSP Endowed Chair in Photovoltaics, while Podraza comes to UT as an assistant professor of physics. Yan and Podraza bring unique and complementary experience to the existing UT PVIC team, broadening and strengthening UT's already world-renowned expertise in the area of thin-film PV.

"UT's Wright Center for PV Innovation and Commercialization attracted me to UT," said Yan. "The large and growing number of solar cell companies in the Toledo area help to drive UT's strong PV research and education program. My interests lie at the intersection between academia and industry, where we can combine the industry's needs for rapid advances and problem solving with the PVIC's creative and innovative research ideas and solutions."

Yan joins UT following 12 years as a thin-film solar cell scientist on the staff of the National Center for Photovoltaics, part of the National Renewable Energy Laboratory (NREL) in Colorado. Yan has received numerous awards for outstanding research, holding research positions at Oak Ridge National Laboratory (Tennessee), Tohoku University in Japan and the French National Center for Scientific Research (CNRS) in Paris. Yan aims to combine his expertise in theoretical and experimental research to improve existing PV technology and to develop new materials with the potential to further lower the cost of solar electricity.

"UT's perspective on photovoltaic research is what brought me here," said Podraza. "Specifically, important opportunities arise from the direct connection formed between UT's PV research program and regional and national companies. It helps us to affect real-world problems." Podraza received his Ph.D. in 2008 from UT under the supervision of distinguished University Professor of Physics Dr. Robert Collins. Podraza spent three years at Penn State University's Materials Research Institute, where he developed his extensive expertise in applying optical measurements to thin-film materials — a process critical to the understanding, design and manufacture of high-efficiency solar cells. Podraza has taught classes in physics and engineering since 2003, and at Penn State, he mentored students en route to their Ph.D.s in these subjects. "Working in a place like Toledo, which has a history in manufacturing products essential to the PV industry, is incredibly useful. Toledo's PV community understands what is needed to support the development of a new manufacturing base within this challenging economic climate."

Both Yan and Podraza believe that the world will increasingly use sunlight to generate electricity and eventually fuels. "We're in an energy crisis right now," said Podraza, "and PV, along with other renewable energy sources are what are going to get us through this as a society." Yan adds, "It is forecast that over 30 terrawatts (10^{12} watts) of power will be needed globally by 2050. To maintain atmospheric CO_2 concentrations near their current level and avoid further harm to environment and human health, the majority of the new power must come from renewable energies that do not rely on fossil fuels such as coal. Photovoltaic solar electric technology is considered the top choice of renewable energies. Once the solar cell module is produced, the 'fuel' to run it is free from the Sun." Thin-film solar cells will continue to lead the way as an affordable and effective way of harnessing this energy needed for the present day as well as the future. "Thin film holds the greatest potential for achieving large scale deployment at low cost," said Yan. "Not only are thin-film solar cells cheap," adds Podraza, "but they point the way to new, important scientific problems that we can solve to make even cheaper PV technologies. We have numerous new areas in which to study." Both faculty members will teach within UT's new School for Solar and Advanced Renewable Energy (SSARE) and have research laboratories within the PVIC home location — the Research and Technology Complex 1 — which boasts 20 kilowatts of cadmium telluride solar cells in front of the building along Dorr Street. The Department of Physics and Astronomy and SSARE offer programs to train students at the undergraduate and graduate levels, providing the essential educational component of UT's PV program.

NOTABLE STAFF NEWS

Dusseau

APPOINTMENT OF KIM DUSSEAU AS BUSINESS SERVICES OFFICER

After the retirement of Stephany Mikols in June, Kim Dusseau has been hired as the departmental business manager. Dusseau comes to the department with extensive experience at The University of Toledo. As Dusseau notes, "I have been here 22 years starting in the Bursar's Office and have worn a few hats on my way here to "Physics & Astronomy."

Cox

APPOINTMENT OF SHERRY COX AS ADMINISTRATIVE ASSISTANT

After the retirement of Willie Brown in June, the secretary 1 position held by Nadine Hoffman was eliminated, though Nadine was able to move to another position in engineering. Sherry Cox joined the Department as an administrative assistant in September. She manages the office and assists with student walk-ins and faculty needs. Some of her duties include assisting with the REU program, course scheduling, organizing department functions and serving as a liaison between administrators and the department chair. Previously, Sherry worked for University College for 10 years and in the dean's office at Wright State University. She spent many years volunteering for the American Red Cross and Ohio Reads program, and was a supporting service member for families in the USAF and Army. Her upcoming endeavors include volunteering at a local hospital and pursuing some med-tech courses.

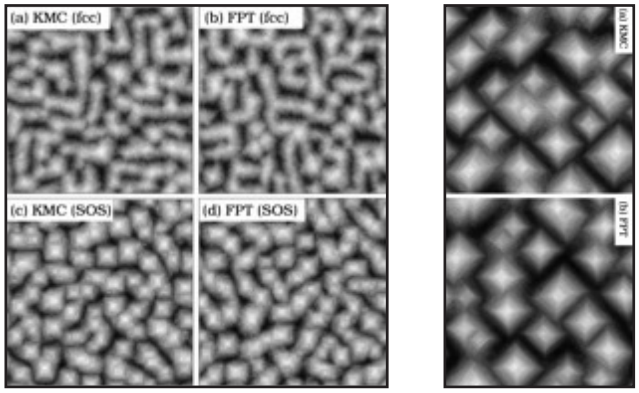
UT WELCOMES ASSISTANT PROFESSOR MICHAEL CUSHING

Assistant Professor Michael Cushing

A new faculty member in astronomy, Dr. Michael Cushing, joined the Department of Physics and Astronomy in fall 2011, where he will also serve as director of the Ritter Planetarium and Observatory. Cushing comes to us from the Jet Propulsion Laboratory. His research interests include low-mass stars and brown dwarfs, extra-solar giant planets, infrared astronomy and instrumentation. Welcome Dr. Cushing!

PROFESSOR AMAR'S RESEARCH ON ACCELERATING SIMULATIONS OF THIN-FILM GROWTH HIGHLIGHTED BY OHIO SUPERCOMPUTER CENTER

(Adapted from Ohio Supercomputer Center News, May 2011)



Thin-film morphologies obtained in epitaxial thin-film growth simulations using both regular KMC and first-passage-time (FPT) simulations.

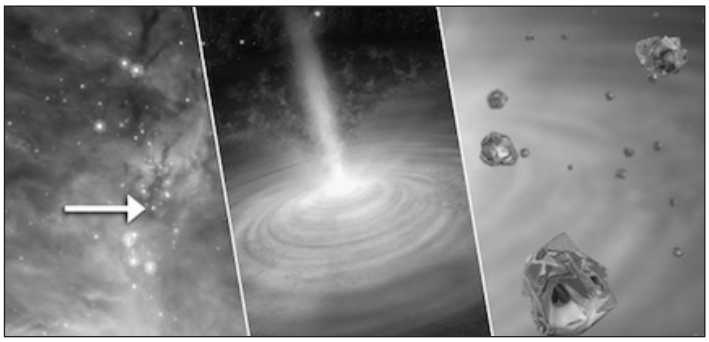
The Ohio Supercomputer Center recently highlighted a new mathematical approach, developed by UT Physics & Astronomy professor Dr. Jacques G. Amar and co-workers, which accelerates some complex computer calculations used to simulate the formation of micro-thin materials. Amar studies the modeling and growth of materials at the atomic level. He uses Ohio Supercomputer Center (OSC) resources as well as a variety of atomistic methods including quantum (ab initio) calculations, molecular dynamics, accelerated molecular dynamics and kinetic Monte Carlo (KMC) to simulate thin-film growth. Thin films are used in industry to create a variety of products, such as semiconductors, optical coatings, pharmaceuticals and solar cells.

"Ohio's status as a worldwide manufacturing leader has led OSC to focus on the field of advanced materials as one of our areas of primary support," noted Ashok Krishnamurthy, co-interim co-executive director of the center. "As a result, numerous respected physicists, chemists and engineers, such as Amar, have accessed OSC computation and storage resources to advance their vital materials science research." Recently, Amar leveraged the center's powerful supercomputers to implement a "first-passage time approach" to speed up KMC simulations of the creation of materials just a few atoms thick. "The KMC method has been successfully used to carry out simulations of a wide variety of dynamical processes over experimentally relevant time and length scales," Amar noted. "However, in some cases, much of the simulation time can be 'wasted' on rapid, repetitive, low-barrier events." While a variety of approaches to dealing with the inefficiencies have been suggested, Amar settled on using a first-passage-time (FPT) approach to improve KMC processing speeds. "In this approach, one avoids simulating the numerous diffusive hops of atoms, and instead replaces them with the first-passage time to make a transition from one location to another," Amar said. Additionally, he employed two different methods for calculating the FPT for these events:

the mean FPT (MFPT), as well as the full FPT distribution. Both methods provided "very good agreement" between the FPT-KMC approach and regular KMC simulations," Amar concluded. "In addition, we find that our FPT approach can lead to a significant speed-up, compared to regular KMC simulations." Amar's research was supported through multiple grants from the National Science Foundation, as well as by a grant of computer time from OSC. A paper co-authored by Amar and UT colleagues, Giridhar Nandipati and Yunsic Shim, "First-passage time approach to kinetic Monte Carlo simulations of metal (100) growth," appeared in a recent issue of the journal Physical Review B.

SPITZER SEES CRYSTAL 'RAIN' IN OUTER CLOUDS OF INFANT STAR

(Adapted from JPL News, May 26, 2011)



Tiny crystals of a green mineral called olivine are falling down like rain on a burgeoning star, according to observations from NASA's Spitzer Space Telescope. This is the first time such crystals have been observed in the dusty clouds of gas that collapse around forming stars. Astronomers are still debating how the crystals got there, but the most likely culprits are jets of gas blasting away from the embryonic star. "You need temperatures as hot as lava to make these crystals," said Dr. Thomas Megeath of the UT Department of Physics & Astronomy. He is the principal investigator of the research and the second author of a new study appearing in Astrophysical Journal Letters. "We propose that the crystals were cooked up near the surface of the forming star, then carried up into the surrounding cloud where temperatures are much colder, and ultimately fell down again like glitter."

Spitzer's infrared detectors spotted the crystal rain around a distant, sun-like embryonic star, or protostar, referred to as HOPS-68, in the constellation Orion. The crystals are in the form of forsterite. They belong to the olivine family of silicate minerals and can be found everywhere from a periodot gemstone to the green sand beaches of Hawaii to remote galaxies. NASA's Stardust and Deep Impact missions both detected the crystals in their close-up studies of comets.

"If you could somehow transport yourself inside this protostar's collapsing gas cloud, it would be very dark," said UT Department of Physics & Astronomy graduate student, Charles Poteet, lead author of the new study. "But the tiny crystals might catch whatever light is present, resulting in a green sparkle against a black, dusty backdrop." Forsterite crystals were spotted before in the swirling, planet-forming disks that surround young stars. The discovery of the crystals in the outer collapsing cloud of a proto-star is surprising because of the cloud's colder temperatures, about minus 280 degrees Fahrenheit (minus 170 degrees Celsius). This led the team of astronomers to speculate the jets may in fact be transporting the cooked-up crystals to the chilly outer cloud.

The findings might also explain why comets, which form in the frigid outskirts of our solar system, contain the same type of crystals. Comets are born in regions where water is frozen, much colder than the searing temperatures needed to form the crystals, approximately 1,300 degrees Fahrenheit (700 degrees Celsius). The leading theory on how comets acquired the crystals is that materials in our young solar system mingled together in a planet-forming disk. In this scenario, materials that formed near the sun, such as the crystals, eventually migrated out to the outer, cooler regions of the solar system. Poteet and his colleagues say this scenario could still be true but speculate that jets might have lifted crystals into the collapsing cloud of gas surrounding our early sun before raining onto the outer regions of our forming solar system. Eventually, the crystals would have been frozen into comets. The Herschel Space Observatory, a European Space Agency-led mission with important NASA contributions, also participated in the study by characterizing the forming star. "Infrared telescopes such as Spitzer and now Herschel are providing an exciting picture of how all the ingredients of the cosmic stew that makes planetary systems are blended together," said Bill Danchi, senior astrophysicist and program scientist at NASA Headquarters in Washington.

"SOLAR CELL OPPORTUNITIES: LOOKING TO A BRIGHT SUNNY FUTURE"

(Adapted from NIST Tech Beat, April 2011)

What are the major technology challenges to future growth in the solar-cell industry? Where are the big bang-for-the-buck R&D investment opportunities? These and other questions were put to a group of 72 internationally recognized experts in the field at a special workshop in 2010. Their conclusions have now been summarized in a new National Institute of Standards and Technology (NIST) publication on Photovoltaic Technologies for the 21st Century. The workshop was led by a steering committee chaired by Roger G. Little, CEO, Spire Corporation, and Robert W. Collins, Professor of Physics & Astronomy and NEG Endowed Chair of Silicate and Materials Science, and co-sponsored by NIST. Photovoltaics — the generation of electric power by direct conversion of sunlight using "solar cells" — is a rapidly growing field. Conservative estimates predict a worldwide annual photovoltaic manufacturing capacity of 200 gigawatts (GW) by 2020. For comparison, the current global generating capacity for commercial nuclear power plants is estimated to be 377 GW. The United States currently has eight percent of the manufacturing share of this market, but there are opportunities to double that or better, particularly through technological advances, according to the workshop report.

Workshop participants from industry, academia and government discussed the "Priority Challenges" for the four dominant photovoltaic technologies — crystalline silicon-based wafers, amorphous silicon and polycrystalline thin films, III-V multijunctions (a presently expensive but highly efficient technology that was first used in space applications), and more experimental excitonic and quantum-structured based technologies — and defined critical milestones on the path to solutions. Challenges range from reaching a better scientific understanding of the devices themselves to developing practical engineering data for determining optimal use of photovoltaics. Key questions include how can we simultaneously increase manufacturing yields, quality and performance of photovoltaic products; how can we better predict a solar cell's expected useful life and what are the connections between the properties of specific components and the performance of a final device; and how can we exploit this understanding to produce cheaper, more reliable and higher energy efficiency devices.

Recognizing that it's not all up to the researchers, the workshop also noted several institutional or policy-related issues for solar power, including increased availability of raw materials; better understanding and control of environmental impacts for the entire life-cycle of a photovoltaic installation; regulatory and tax policies that may needlessly hamper the growth of the market; and the need for better consumer information. The new publication, "Foundations for Innovation: Photovoltaic Technologies for the 21st Century," is now available online. The 32-page document summarizes for policy makers a considerably more detailed workshop report issued last year, "Workshop Report: Grand Challenges for Advanced Photovoltaic Technologies and Measurements."

PROFESSIONAL SCIENCE MASTER'S DEGREE PROGRAM IN PHOTOVOLTAICS CONTINUES TO ATTRACT STUDENTS

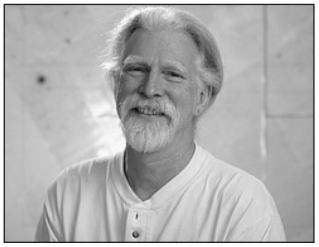
Associate Professor Sanjay Khare

The Professional Science master's degree program in Photovoltaics continues to gain much attention. The program is hosted by the Department of Physics and Astronomy, the College of Business and Innovation and the College of Graduate Studies and is directed by Associate Professor of Physics and Astronomy Sanjay Khare. The program, now in its second year, has eight students enrolled. The primary focus is training the students in the fundamentals of PV science and technology, as well as in management and the business aspects of manufacturing. The degree brings together essential science and business knowledge that is necessary for those interested in alternative energy careers. In the two-year program, which began fall 2010, students conduct a research project with UT faculty and participate in practical training in a local photovoltaic manufacturing company, rather than completing a traditional master's degree thesis.

The State of Ohio has recognized this program by awarding three full scholarships starting in 2012 and three additional scholarships starting in 2013 from a "Choose Ohio First" grant proposal submitted by Chair Anderson-Huang. The "Choose Ohio First" program is administered by the Ohio Board of Regents and is designed to train both undergraduate and graduate students for successful careers in Ohio industry and administration, particularly in areas of sustainability and renewable energy.

UT PHYSICS & ASTRONOMY ALUMNUS RECEIVES TURIN AWARD

(Adapted from UT News, March 2012)



Steve Howell, UT alumnus

The University of Toledo alumnus Dr. Steve Howell received the John J. Turin Award for Outstanding Career Accomplishments. The Turin Award is named after former Physics and Astronomy Chair John J. Turin and is presented each year by the UT Department of Physics and Astronomy to a former undergraduate or graduate student for his or her outstanding career accomplishments. Howell received a master's degree in physics at UT after receiving a master's degree in astronomy from the University of Pennsylvania. He later received a Ph.D. in astrophysics at the University of Amsterdam. He is the project scientist for the Kepler space telescope, working at the NASA Ames Research Center in northern California, where he searches for exoplanets. He previously worked at the Kitt Peak National Observatory, where he helped develop digital cameras for use on the telescopes. "The Turin Award honors former students in our program who have become established and used their physics degrees to excel in the fields they entered," said Dr. Steve Federman, UT professor of astronomy. "We've had a number of our graduates work for NASA. The astronomical community and NASA chose Howell as the principal scientist for the Kepler mission, which indicates his stature within the community." Howell presented a free, public lecture on the Kepler mission on March 20.

RESEARCH EXPERIENCES FOR UNDERGRADUATES (REU)

The summer 2011 NSF-REU program in Physics and Astronomy, directed by Dr. Richard Irving and professor Tom Kvale, gave enhanced research opportunities to 20 undergraduate students from 10 colleges and universities in seven states. Student participants were chosen competitively from more than 140 applications from students in 35 different states in all regions of the U.S. Strong faculty support for the REU research program is evidenced by four students receiving support from faculty members' external grants and two students volunteering to participate in our REU program. One student received funding from the internal Undergraduate Summer Research and Creative Activity Program (UT USRCAP) and from the NSF-REU grant — at the level of support of fully NSF-REU funded participants. Josiah Aultman and Philip McDonald were among the cohort of participants in our program from the UT-Itasca Community College collaboration. All the participants were serious and talented young scientists, who tackled substantial problems, participating in all stages of a project, from formulation to conclusion, including oral and written presentations of their results.

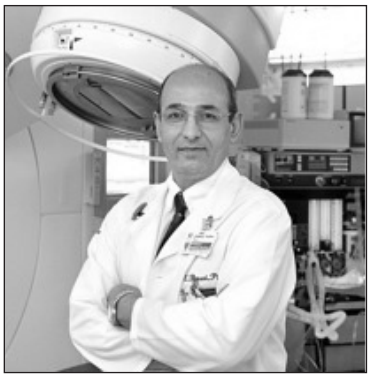
We are pleased to report that summer 2011 was a success from both the students' and faculty mentors' perspectives. At least two abstracts by this year's undergraduate researchers have been accepted for presentations at national, professional conferences and at least two manuscripts have been submitted to archival journals based on research this past summer. And a previous REU student published an additional paper this year and additional manuscript(s) are in preparation to be submitted shortly to refereed journals.

Social activities were coordinated with the help of the following local participants: Tyler Fronk, Luke Kwiatkowski, Marina Kounkel and Dhruv Sengar. Weekly activities included movie night, bowling, sand volleyball, ultimate Frisbee, board games and various ventures to local restaurants. One of the notable establishments people found fun to visit was Pizza Papalis. The perennial favorite is a windsurfing adventure, courtesy of Professor Alvin D. Compaan, at his pond. He also has a solar hybrid home and is proud to give tours to the students. Some of the other special events included: frisbee golf, several BBQ's, a trip to Cedar Point Amusement Park, a Toledo Zoo visit and swimming at Centennial Quarry. During the REU, we also had fun attending a program at the University of Michigan's Angel Hall Planetarium. Again this year, the students visited the First Energy Bay Shore coal burning power plant in Oregon, Ohio.

DR. ISHMAEL PARSAI SELECTED FELLOW OF AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE

(Adapted from UT News, August 2011)

Dr. Ishmael Parsai, professor of radiation oncology, chief of Medical Physics Division, director of the Graduate Medical Physics Program and adjunct professor of Physics and Astronomy, has been elected a Fellow of the American Association of Physicists in Medicine (AAPM). "I am extremely honored and grateful to have been selected for this award and honorable distinction," said Parsai, who traveled to a presentation banquet in Vancouver, British Columbia, to receive the award. AAPM fellowships are awarded to "senior members of the medical physics community" chosen through a peer-review process, according to Parsai. Fellows must be full members of the association for at least 10 years and be nominated by a chapter or by two Fellows of the association. Nominations are offered to those who have made significant contributions of service to the organization, advancement of knowledge related to medical physics through original research, leadership in the practice of medical physics, and educational pursuits in the field — particularly in the training of medical students, medical physicists, allied health personnel, as well as medical residents.

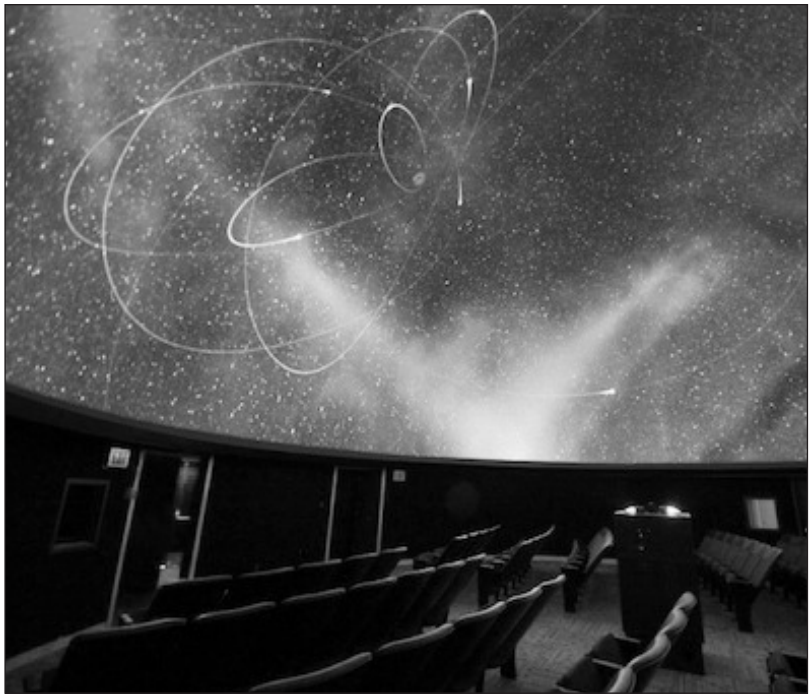


Professor Ishmael Parsai

Dr. Don Frey, professor of radiology at the Medical University of South Carolina and chair of the AAPM Awards and Honors Committee, said Parsai excelled in all of these areas. "Dr. Parsai is well-known for his contributions to medical physics on a global scale," Frey said. "He has served as editor of the Medical Physics World newsletter and has spearheaded many educational projects, helping medical physicists in developing nations understand what they need to know to be well-functioning practitioners in the field."

"I've been very fortunate to be here at UT with really brilliant radiation oncologists like Dr. Ralph Dobelbower, our previous chair, and Dr. John Feldmeier, our current chair, with whom I have a number of patents and publications together," Parsai said. "I am humbled by the honor and take it to heart as an added responsibility to further refine my professional skills in clinical medical physics, teaching and research, and to strive harder to make our graduate program maintain the course of excellence and live up to our reputation to better position our graduates in the field," Parsai said.

NEWS FROM RITTER PLANETARIUM AND OBSERVATORY



One of the new full-dome programs available at the Ritter Planetarium and Observatory includes "Black Holes: The Other Side of Infinity". Narrated by Academy-Award nominated actor Liam Neeson, this stunning program takes the audience on a trip into the super-massive black hole at the center of our Milky Way Galaxy.

During 2011, The University of Toledo's Ritter Planetarium and Observatory had an exciting year. In June, we shut down for major renovations, which included a complete overhaul of the theatre and lobby and the installation of the world's first Spitz SciDome XD system. This fully digital system projects more than 6.5 million pixels onto our 40 foot dome and is capable of displaying stunning astronomical landscapes. In August, our new director, Professor Michael Cushing, arrived and took the reins from the interim director Professor Rupali Chandar. Beginning in late October, we unveiled the new planetarium at three grand re-opening events, which drew more than 1,500 people from the surrounding community. We have since restarted our K-12 programs, Friday and Saturday public events and Astronomy 1010 classes. We have also begun new collaborative efforts with UT entities including the Art Department and the Center for Creative Instruction.

Another full-dome program includes "One Sky, One World: Big Bird's Adventure" which takes the younger members of the family on a trip with Big Bird, Elmo and Hu Hu Zhu as they explore the night sky from Sesame Street, the Moon and China. We are also very excited to be presenting "Dynamic Earth", the latest Spitz production that explores the inner workings of Earth's climate engine. Using advanced computer simulations, the audience will float along ocean and wind currents, fly into a hurricane and explore the deep sea in this exciting new program. Ritter Planetarium and Observatory is well on its way to becoming a cutting-edge educational tool for the entire UT community.

IN MEMORIAM

Helen Brooks, the first director of UT's Ritter Planetarium and the namesake with her husband, Elgin, of an observatory on campus, passed away in September 2011 at the age of 94.

Brooks retired in 1972, but until spring 2011 was a regular participant at the weekly Tuesday bag lunches — in which faculty and post-doctoral and graduate students present papers. "She was always there in the front row," said Adolf Witt, UT distinguished professor of astronomy emeritus. She kept track of developments in astronomy online and each week contributed what she learned. "She was a very great inspiration to our graduate students." In 2008, Brooks established a $1 million trust gift to create upon her death — the Helen Luedtke Brooks endowed professorship of astronomy. In honor of her husband, an enthusiastic supporter of her pursuits, she established the Elgin C. Brooks undergraduate scholarship in astronomy in 1999 after his death. The couple's contribution in 1987 established the Brooks Observatory atop McMaster Hall on the UT campus. She received a bachelor and masters degree from UT, but her interest in astronomy began in grade school. In adulthood, she traveled the world to view total solar eclipses. "If you stayed in one position on the Earth, you'd have a chance of one total eclipse in 350 years. That's why you have to chase them," she told The Blade in 2002.

In the mid-1950s, she became a part-time UT mathematics instructor who taught a noncredit course in popular astronomy. As the Space Age sparked interest in the cosmos, Brooks began to teach astronomy courses exclusively. "In the 1960s, she introduced George Ritter, a lawyer interested in supporting education, to the UT president at the time William Carlson and physics Chairman John Turin," Witt said. With Ritter's financial gift, the result was a planetarium — the Ritter Planetarium and Observatory — which she and her husband helped plan. Armand Delsemme and Witt were hired to the faculty and helped develop an astronomy graduate program. "If it hadn't been for her instrumental role, we wouldn't be here nor would the other subsequent astronomers who came," Witt said. "Toledo wouldn't be a place where astrophysics is being done and is recognized around the world." The University granted her an honorary doctorate in 2003.

PHYSICS AND ASTRONOMY SUMMER CAMP 2011

Mentors and participants in 2011 Summer REU: Left to Right (Front row): Frances Schmidt, Kristen Garofali, Olivia Eggenberger, Ammaarah El-Amin, Anthony Passero, Marina Kounkel, Rupali Chandar, Joe Converse, Nathan Callahan, Luke Kwiatkowski, Left to Right (Second Row): Lawrenzo Moses, Pattlyn McLaughlin , Logan Stagg, Will Fischer, Dhruv Sengar, Jacques Amar, Tyler Fronk, Tyler Kinner, Brandon Saner Left to Right (Back Row): Al Compaan, E. Ishmael Parsai, Tom Kvale, Jacob Buenger, Adolf Witt, Steve Federman, Josiah Aultman, Rick Irving, Jakub Prchlik, Chad McElvany, Kris Wieland.,

As part of this NSF program our REU students hosted the physics and astronomy summer camp as an outreach activity for high school students from July 14 to July 15, 2011. The summer camp activities were developed and supervised with the help of our REU team. Again this year Jackie Kane, a St. Ursula high school science teacher, was extremely helpful in promoting the camp. We had in attendance 24 high school students composed of one student who was home-schooled and students from the following local high schools: Emmanuel Christian, Ottawa Hills, St. Francis, St. Ursula, Sylvania Northview, Sylvania Southview, Toledo Early College and Woodward.

The first day of the summer camp dealt with alternatives for energy generation. To start this journey the group did a tour of UT's own Scott Park Campus of Energy and Innovation, led by Michael Green, UT's director of energy management. During this tour, the students were able to visit a 1.2 MW solar and wind system. The project utilizes thin-film-on-glass photovoltaic solar technology and a 132-foot wind turbine. Both the wind and the solar system are expected to generate power equal to the amount of electricity used by 140 homes annually. Next, the students experienced similar technology at the homeowner level. This consisted of a tour of the home of Professor Alvin Compaan, along with a discussion regarding his 4.3 kW CdTe rooftop PV system and his homemade electric truck. After a barbeque, the afternoon provided the students with hands-on activities to explore the concepts of the day. One student activity involved building and testing a dye-sensitized solar cell using fruit such as blackberries, raspberries and pomegranate seeds. The students also really enjoyed testing their endurance to power up to four incandescent light bulbs at 60 Watts each with a homemade bicycle generator. While grunting (and laughing) during this physically challenging activity, the students expressed the need for conservation by at least avoiding a phantom energy wasting lifestyle.

The second day featured nighttime activities related to astronomy including a presentation with public viewing on a six-inch refractor telescope at Ritter Planetarium and Observatory by Alex Mak, the associate director. Brad Rush, a graduate student in our department, gave a tour of the Ritter Planetarium and Observatory facility, which has a one-meter telescope. Kathy Shan, a doctoral student in curriculum and instruction with a focus in science education, helped develop activities for this part of the camp as well. Shan and the REU students had the students explore the size and scale of the solar system through an interactive demonstration using toilet paper as our unit of measurement. Shan also introduced the high school students to astronomy research through participation in a Galaxy Zoo project, using real images from the Hubble Space Telescope archive to classify galaxies.

RECOGNIZING OUR DONORS

The Department of Physics & Astronomy recognizes and thanks all donors who generously made gifts during the past calendar year from January 1, 2011 to December 31, 2011. Donors are listed alphabetically.

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UNDERGRADUATE STUDENT NEWS

Undergraduate student Kathryn Hoepfl was lead author on a paper entitled "Solar and Wind Energy Portfolios and Real-Time Pricing," which appeared in the Journal of Technology Policy and Management. Co-authors were professor Alvin D. Compaan of the Physics and Astronomy Department and professor Andrew Solocha of the College of Business and Innovation.

GRADUATE STUDENT NEWS

Congratulations to Physics and Astronomy graduate student Sean Tanny for winning the second place award at the Ohio River Valley Chapter meeting held at the Ohio State University. Tanny's paper was co-authored with David Pearson, George Hancock and E.I. Parsai. The paper was titled "Small Field Electron Beam Dosimetry Using Solid State Detectors on the Surface and in the Build-Up Region."

CONGRATULATIONS!

The following graduate students successfully defended their Ph.D. dissertations or received a master of science based on a thesis or major peer-reviewed publication in 2011:

Dr. Amruta Nawarange, Ph.D.

Dr. Naba Raj Paudel, Ph.D.

Dr. Scott Little, Ph.D.

Dr. Erin Kryukova, Ph.D.

Dr. Yevgen Kryukov, Ph.D.

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Dr. Xiance Jin, Ph.D.

Craig Koontz, M.S.

Bradley Rush, M.S.

GRADUATE AND UNDERGRADUATE AWARDS CEREMONY

The Department of Physics and Astronomy's Eleventh Annual Recognition Ceremony and Sigma Pi Sigma induction were both held on April 25, 2011. The following awards were presented:

UNDERGRADUATE AWARDS

- Physics & Astronomy Outstanding Graduating Undergraduate Student: **Nathan Reaver**
- *Elgin Brooks Memorial Astronomy Scholarship:* **Dayna Boes**
- *A. Jackson and Sally K. Smith Scholarship:* **Julia Deitz**
- *Chad Tabory Memorial Award for Outstanding Undergraduate Research in Physics and Astronomy*: FIRST PLACE: **Tiffany Pewett** ; SECOND PLACE: **Kathryn Hoepfl**
- *Robert and Noreen Stollberg Award:* **Anthony Passero**
- *Edwin Jayamaha Scholarship Award:* **Julia Deitz**
- *John J. Turin Memorial Fund:* **Abril Galang**
- *C.V. Wolfe Scholarship in the Natural Sciences:* **Corbin Taylor**

GRADUATE AWARDS

David Turnbull Scholarship in Materials Science: **Puruswottam Aryal** and **Zhaoning Song**

2011 SIGMA PI SIGMA INDUCTEES

Amaarah El-Amin

Nichole Hill

Kathryn Hoepfl

Anthony Passero

Tiffany Pewett

Nathan Reaver

Brandon Saner

Naresh Sen

ALUMNI NEWS

John Kohl (Ph.D. 1969). Kohl is the principal investigator on the Coronal Physics Investigator (CPI), a solar telescope that will be mounted on the international space station to investigate the processes that produce the sun's fast and slow solar wind. The proposal is one of 11 Explorer science proposals which have been selected for future evaluation as potential science missions. Kohl is at the Smithsonian Astrophysical Observatory in Cambridge.

Bruce Wisniewski (Ph.D. 2005). Wisniewski works as part of a research group called SEEDS at the University of Washington in Seattle. The group is carrying out a five-year-long near-infrared study of young stars and their surrounding dust disks, and found evidence for planets in circumstellar disks. "What we're finding is that once these systems reach ages of a few million years, their disks begin to show a wealth of structure — rings, divots, gaps and now spiral features," said Wisniewski. "Many of these structures could be caused by planets within the disks."

Dr. John Teufel (B.S. 1999). Teufel's recent work on getting to the ground state of a micromechanical oscillator was featured in the September issue of Physics Today. He was the first author on a recent article in Nature, which reported this result. Teufel received his B.S. from our department in May 1999. He then obtained his Ph.D. from Yale University and is now at NIST.

Craig Maloney (B.S. 1998). Maloney is now on the faculty at Carnegie Mellon University. He has just been awarded an NSF career grant as well as a separate NSF grant.

Gregory Madsen (B.S. 1998). Madsen is now a Senior Research Fellow at the Sydney Institute for Astronomy in the School of Physics at The University of Sydney.

OTHER NOTABLE NEWS

Lawrence Anderson-Huang, Physics & Astronomy Chair: Professor Anderson-Huang was elected president of the UT Faculty Senate.

Robert Collins, NEG Endowed Chair and Professor: Robert Collins was awarded, along with co-PIs at Old Dominion University and the University of Illinois, a Department of Energy/National Science Foundation award for their project "High-throughput CIGS solar cell fabrication via ultra-thin absorber layer w/optical confinement". This is a collaborative project supported through the F-PACE program. The goal of the project is to develop processes for higher production line throughput of copper indium-gallium diselenide (CIGS) solar cell structures in part by reducing the thickness of the CIGS absorber layer.

Also, he was awarded, along with co-PIs at Old Dominion University and the University of Illinois, a Department of Energy/National Science Foundation award for their project "Novel contact materials for improved performance CdTe solar cells." This is a collaborative project supported through the F-PACE program. The goal of the project is to develop improved back contacts that increase the voltage of CdTe solar cells and modules.

Collins also received an award (from Nippon Electric Glass Corporation) for his project titled, "Deposition of CIGS solar cells" as well as an award from Techneglas Corporation awarded Collins for his project titled, "Deposition of CIGS solar cells."

During the period from January 1, 2011 to December 31, 2011, faculty members based at the Center for Photovoltaics Innovation and Commercialization (PVIC) received approximately $100,000 for research services performed primarily in support of Ohio PV companies, an important mission of PVIC.

PROFESSOR YANFA YAN ELECTED AS FELLOW OF THE AMERICAN PHYSICAL SOCIETY

Professor Yanfa Yan has been elected as a Fellow of the American Physical Society (APS) "for contributions to the understanding of defect physics and structure and electronic property relationship of energy materials, quasicrystals and wide-band gap metal oxides, through electron microscopy and first-principles electronic structure calculations." Yan joins two other faculty members in the department, Bo Gao and Steven Federman, who are also APS Fellows.

UT ASTRONOMER DISCOVERS ROOM-TEMPERATURE STARS

(Adapted from UT NEWS, September 2011)

There have been hotter days in Toledo this summer than in the atmosphere of a new class of stars discovered right in our galactic neighborhood by a UT researcher. While stars with searing temperatures as high as 50,000 degrees Fahrenheit are not uncommon, Dr. Michael Cushing, assistant professor of astronomy, is part of a team of scientists that has discovered brown dwarf stars, called Y dwarfs, with atmospheric temperatures as low as 80 degrees Fahrenheit. "Brown dwarfs have the mass of very small stars, but never got hot enough to ignite the thermonuclear fires that keep stars like our sun shining for billions of years. Instead they've just gradually cooled down over time," Cushing said. In a statement released by NASA, Cushing told the space agency, "Finding brown dwarfs near our sun is like discovering there's a hidden house on your block that you didn't know about. It's thrilling to me to know we've got neighbors out there yet to be discovered. With WISE [NASA's Wide-field Infrared Survey Explorer], we may even find a brown dwarf closer to us than our closest known star." Cushing, who was the lead author of a paper on Y dwarfs published in the Astrophysical Journal, recently joined UT from NASA's Jet Propulsion Laboratory. "Because these stars are so cold, they emit almost no visible light," Cushing said. "By using WISE, we were able to detect what are essentially failed stars using infrared light." The team also used the Hubble Space Telescope to hone in on candidates once WISE identified them. Cushing said they have discovered six Y dwarfs so far, all within 40 light years of Earth, but believe there could be many more out there. We're looking for more Y dwarfs and we're also looking to see if there are still colder stars out there somewhere," he said. "Just how cold can a star get?"

Dr. Michael Cushing, assistant professor of astronomy and director of the Ritter Planetarium and Observatory, shown here in the Brooks Observatory, is part of a team that discovered a new type of star, the Y Dwarf.

CONGRATULATIONS TO J.D. SMITH

Associate Professor J.D. Smith

Congratulations to J.D. Smith, who has been promoted to associate professor.

GIVE A GIFT, MAKE A DIFFERENCE

The support of our alumni and friends is paramount to the success of our educational programs. Your generous financial support will impact the lives of current and future students in the Department of Physics and Astronomy at The University of Toledo.

For more information about giving, including setting up scholarships or additional gift funds, please contact Mary Galvin, principal gifts officer for the College of Natural Sciences and Mathematics, at **419.530.4134** or at: mary.galvin@utoledo.edu

PHYSICS AND ASTRONOMY FUNDS FOR EXCELLENCE

The Funds for Excellence supports scholarships and fellowships, acquisition of research equipment, special colloquia, etc. which are so essential for departmental excellence.

JOHN J. TURIN MEMORIAL FUND

Established to honor former department chair and dean of the Graduate School, John J. Turin. He was integral in building UT's first Ph.D. program in the 1960s. This endowment funds annual awards to physics students, based on merit (3.5 GPA or higher).

CHAD TABORY OUTSTANDING UNDERGRADUATE RESEARCH FUND

This account, founded in memory of Chad Tabory, a UT physics graduate and research lab technician, funds the outstanding undergraduate research award.

THE PLANETARIUM PROGRESS FUND

The purpose of the Planetarium Progress Fund is to hold the subscription donations of the friends of Ritter Planetarium and Observatory and all other gifts in support of our astronomy outreach programming. All funds are used for large capital expenses and the growth of an endowment portfolio, the interest from which will help cover operating expenses.

COLLEGE OF NATURAL SCIENCES AND MATHEMATICS PROGRESS FUND

This fund supports the areas of greatest need for the college.

The UT ALUMNI ASSOCIATION wants to hear from you. Check out their Web site at *toledoalumni.org*. Please join the movement.

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