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

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

WAVES

Number 16 June 2013

DEPARTMENT CHAIR'S COMMENTS

Anderson-Huang

Greetings to all! I hope this newsletter finds you well. The College of Natural Sciences and Mathematics is now another year old, and still successful under the leadership of our founding dean, Dr. Karen Bjorkman. Dr. Bjorkman's two-year contract has been renewed. The University Women's Commission recently honored Dr. Bjorkman with a Dr. Alice Skeens Outstanding Woman Award. College enrollments are remaining stable and even increasing slightly despite a slow decline in University enrollments as a whole. The University is facing a serious budget shortfall. As a result, our college has had its annual budget reduced by $1.4 million or approximately half of its funds not reserved for tenure/tenure track salaries. The dean and the college are being very creative in trying to preserve staff positions, but some retirees will not be replaced. Provost McMillan announced his retirement effective June 2012. Our new provost is Dr. Scott Scarborough. Prior to assuming this position, Dr. Scarborough was senior vice president and executive director of The University of Toledo Medical Center. As mentioned in the last edition of Waves, Dr. John Feldmeier, whom some of you may know, retired 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. We are pleased to welcome Dr. Changdu Chen as the new chair, and look forward to a continuing rapport with that department and campus.

We are happy to announce that in summer 2012 the administration authorized the conversion of one of our visiting assistant professors into the department's first full-time lecturer. Lecturers typically have five-year appointments with annual review and indefinite renewal assuming satisfactory performance. We welcome Kathy Shan onto our teaching staff in this position. Kathy will be receiving her Ph.D. in science education from the Judith Herb College of Education in December 2013. She is presently working with the new Jesup Scott Honors College to redesign pedagogy and presentation of the honors sections of PHYS-2130 and 2140 (Physics for Science and Engineering Majors, I and II). This spring, the administration also approved the conversion of one more VAP to lecturer, and we are conducting a national search for that position.

As noted below under Notable Staff News, both our Business Officer Kim Dusseau and our Administrative Assistant Sherry Cox have moved on to other positions in the University. As we go to press, the administration has approved the filling of both positions. Maintaining these positions is part of the creative financing worked out by our dean and chairs in the college, for which we are most grateful. Unfortunately, a position that will not be replaced immediately is that of our stalwart and capable machinist, Robert Lingohr, who will have retired at the end of May 2013. We hope to manage by sharing a machinist with the Department of Environmental Sciences, and calling Bob in on a part-time basis as necessary.

We are proud of all the efforts reported on in this edition of Waves, and hope to develop even more in future years. Of particular note are: our partnership in the Discovery Channel Telescope, Professor Yan's Sustainable Energy Pathways project, Assistant Professor Podraza's acquisition of a THz range spectroscopic ellipsometer, and our continued success with undergraduate research. 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.

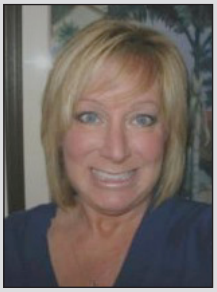
Lawrence Anderson-Huang

NOTABLE STAFF NEWS

Dusseau

DEPARTURE OF KIM DUSSEAU AS BUSINESS SERVICES OFFICER

Kim Dusseau, our business services manager, has left our department for another position within the University. We thank Kim for her dedication to the department and wish her well!



Cox

DEPARTURE OF SHERRY COX AS ADMINISTRATIVE ASSISTANT

Sherry Cox, our departmental administrative assistant, has left our department for another position within the University. We also thank Sherry for her dedication to the department and wish her well!

NOTABLE FACULTY NEWS

UT PARTNERS ON DISCOVERY CHANNEL TELESCOPE, A GAME-CHANGER FOR DEPARTMENT OF PHYSICS AND ASTRONOMY

(adapted from UT News, August 2012)

The University of Toledo has joined the 4.3 meter Discovery Channel Telescope (DCT), which is operated by Lowell Observatory south of Flagstaff, AZ, as a full partner. Perched high on the Mogollon Rim overlooking the Verde Valley, the DCT is the 5th largest telescope in the continental U.S. and one of the most technologically advanced. After 10 years of planning and building, the DCT was completed with First Light celebrated on July 21, 2012 with a gala featuring the image below at right, speeches from dignitaries, and an unforgettable talk by special guest speaker, former astronaut and first human on the Moon, Neil Armstrong. "We are playing in the major leagues," observed University of Toledo Trustee Joseph Zerbey during the July 21 visit to the Lowell Observatory in Flagstaff, Ariz. Zerbey was part of a delegation of 10 UT faculty, students and administrators who headed out West to sign an agreement making the University a partner in the Discovery Channel Telescope. Described by Dr. Michael Cushing, assistant professor of astronomy and director of the Ritter Planetarium, as the "Swiss Army knife" of telescopes, the Discovery Channel Telescope poses tremendous opportunities for UT researchers. "The beauty of the Discovery Channel Telescope is that the instrument bay on the back has a little flip mirror that you can turn to any instrument you want in 30 seconds," Cushing said. "We have a lot of flexibility in the ability to change instruments." "It's a huge step forward for the group," said Dr. Karen Bjorkman, dean of the College of Natural Sciences and Mathematics, and Distinguished University Professor of Astronomy. "As astronomers, we typically have to apply for time. We have to compete with other astronomers. With access to the Discovery Channel Telescope as a science partner, we'll be able to know that we'll have access to this telescope over a longer period. People can plan long-term science projects that will be much more interesting and much larger in scope than what they've been able to do."

Aerial view of 4.3-meter Discovery telescope, at an elevation of 7,760 feet (2,370 meters) atop a cinder cone in Happy Jack, 40 miles southeast of Flagstaff, Ariz.

DCT first light: galaxy M109

Testing and commissioning of the Discovery Channel Telescope, which is located 45 miles southeast of Flagstaff near Happy Jack, Ariz., will continue for at least another 18 months, as is typical with four- meter class telescopes. Structured scientific research is expected to begin in 2013 or 2014.

UT WELCOMES KATHY SHAN AS LECTURER IN THE DEPARTMENT OF PHYSICS AND ASTRONOMY

Kathy Shan

Kathy Shan, who was previously a visiting assistant professor, has been appointed as a Lecturer in the Department of Physics and Astronomy. Kathy received her bachelor of science degree in physics from Marshall University in Huntington, W.Va., her master of science degree in physics from The University of Toledo with Dr. Philip James, and is currently earning her Ph.D. in physics education. Welcome Kathy Shan!

PHYSICS & ASTRONOMY DEPARTMENTAL REU (RESEARCH EXPERIENCE FOR UNDERGRADUATES) PROGRAM

Rick Irving and Thomas Kvale are pleased to report that our NSF-REU (Research Experiences for Undergraduates) grant has been renewed for another three years. At the conclusion of this grant, this will make 24 years our department has enjoyed continuous NSF-REU funding and more than 250 students that have participated in research. Starting this year, we have funding for students to conduct their research at both UT and a national facility such as the Nevada Terawatt Facility.

PROF. VICTOR KARPOV'S RESEARCH ON MEMORY STORAGE TECHNOLOGY HIGHLIGHTED BY AMERICAN INSTITUTE OF PHYSICS

(adapted from UT News, January 2013)

A focused review of the electrical conduction in phase change memory materials by Prof. Victor Karpov in collaboration with former UT Ph.D. students Marco Nardone and Mark Simon as well as Dr. I.V. Karpov of Intel Corporation, was the most read article published in the October 2012 issue of the Journal of Applied Physics. Dr. Victor Karpov co-authored the article about the recent technology called "phase change memory" to describe not only the physics behind the process, but also to chronicle the history of the discovery and efforts to better understand and perfect its underlying materials of chalcogenide glasses. Most existing technology for computer and cell phone memory uses silicon or magnetic storage while the novel approach of phase change memory is just penetrating the market. Phase change memory is unique in that it has a higher endurance with the ability to rerecord millions of times more than other technologies and it also is very robust. Using electric pulses rather than light, it can record information by switching nano-size particles of chalcogenide alloys between their insulating and conductive phases. "Even though phase change memory has been researched and improved, so too has silicon and other technology by leaps and bounds," Karpov said. The article discusses the science behind the transport phenomena in glassy materials along with the history of its understanding by English physicist Neville Mott and American physicist Phillip Anderson, who shared the 1977 Nobel Prize in Physics for their work on non-crystalline materials. Karpov himself has made contributions to this field and has been recognized by Intel based on his results. "The goal of the paper was to explain the physics, but also to put everything into perspective and appreciate where the mechanisms came from and how they evolved," Karpov said. Karpov's current research in solar cell physics is supported by the National Science Foundation. He also continues his work on phase transformations in solid-state memory and other device physics.

Prof. Victor Karpov

ASTRONOMY RESEARCHER RECEIVES PRESTIGIOUS AWARD FOR INVESTIGATION, EDUCATION

(adapted from UT News, July 2012)

A University of Toledo faculty member has been selected as a 2012 Cottrell Scholar in recognition of his passion for both research and education. The prestigious award, which includes a $75,000 grant, was given by the Research Corporation for Science Advancement to Dr. J.D. Smith, UT associate professor in the Department of Physics and Astronomy.

The Research Corporation for Science Advancement, which is celebrating its 100th anniversary this year, awards only professors in their third year of a tenure-track appointment. It recognizes outstanding young faculty in the fields of astronomy, biochemistry, biophysics, chemistry or physics who excel in both research and teaching, and who show exceptional potential in both areas. Smith was the only recipient in astronomy this year, and one of only 11 awardees, who hailed from institutions that included Cornell, Yale, CalTech and UCLA. He will use the award to support two projects, one research-based and one educational, that he proposed to the Research Corporation for Science Advancement. Smith is one of three Cottrell Scholars from UT since the program's inception in 1994. Dr. Karen Bjorkman, dean of the College of Natural Sciences and Mathematics, won the award in 1999 in the field of astronomy, and Dr. Ale Lukaszew, UT assistant professor in the Department of Physics and Astronomy, won in 2004 in the field of physics. "In the end, research is about people — people curious about or even driven by a fundamental desire to understand the universe around them," Smith said.

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For his research project, Smith plans to study "How Galaxies Die and Why," investigating when and how galaxies stop producing stars or "die." Smith explained that galaxies normally are forming new stars from reservoirs of gas and dust, but can stop quite abruptly and for very poorly understood reasons. In order to conduct his research, Smith plans to utilize the Herschel and Spitzer space observatories, along with ground-based telescopes, to follow the gas and dust in galaxies transitioning from a star-forming state to "red and dead," a term used by astronomers because of the red appearance of old stars. With an international group of collaborators, Smith has helped discover a new population of such rare but important galaxies. "We've found a new way to identify galaxies undergoing this transition, and now we're trying to study in particular not what's happening to the aging stars within them, but what becomes of all this raw material, the stellar fuel itself," Smith said. By following the fuel for the first time, Smith hopes to gain insight into the processes that control the life and death of all galaxies in the universe, including our own. For his educational project, Smith wants to improve the impact of elementary astronomy labs, both at UT and beyond. "We've taught introductory labs in astronomy very much the same way for probably 25 years," Smith said. "The techniques used are often quite outdated, so that in many ways students are not fully engaged by the material." Smith said he hopes to move a number of the labs into UT's Ritter Planetarium to utilize the unique capabilities of the new SciDome XD full-dome digital projector, a major renovation completed last year. He plans to share these lab modules with other institutions equipped with similar full-dome projectors.

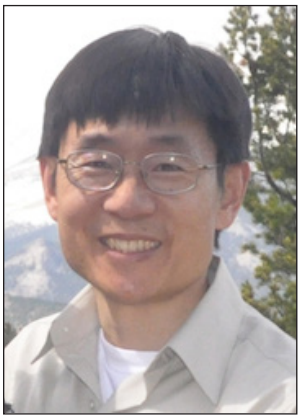
Professor J.D. Smith

PROF. SANJAY KHARE RECEIVES AWARD FROM NSF DMREF PROGRAM

Associate Professor Sanjay Khare

In collaboration with another researcher, Prof. Daniel Gall, at Rensselaer Polytechnic University, Prof. Sanjay Khare has received one of the first 14 awards to the NSF program "Designing Materials to Engineer our Future". NSF officials say the funded projects combine both new science discoveries and the development of new algorithms and software to speed materials and applications development and are expected to foster discoveries that lead to effective tools and methods for materials scientists and engineers to utilize in design and practice — as well as for further research endeavors. Professors Khare and Gall received funding for their project entitled "Nitride Discovery — Creating the Knowledge Base for Hard Coating Design." In this project these researchers will develop a systematic method to determine the intrinsic physical properties of transition metal nitrides, which are of importance for the development of hard coatings, using a combination of experiments and density functional calculations. The knowledge from binary nitrides will be used to develop a quantitative model that relates composition of ternary and off-stoichiometric nitrides to mechanical properties. This project is expected to provide a systematic understanding of the fundamental properties of all transition metal nitrides, based on their electronic structure. This understanding represents the knowledge base that has the potential to transform the multi-billion-dollar hard coating industry with a new coatings design approach. Thus, it provides the basis to accelerate discovery of hard, wear and corrosion resistant coatings and transform the evolutionary trial-and-error development of protective coatings into a coatings-by-design approach, resulting in rapid deployment of new coating materials for emerging applications including fuel-efficient jet engines and gas turbines, environmentally-friendly lubricant-free cutting tools, high-temperature concentrating solar power plants, and wind turbines.

PROF. YANFA YAN LEADS $1.9 MILLION COLLABORATIVE SUSTAINABLE ENERGY PATHWAYS (SEP) PROJECT



Professor Yanfa Yan

Led by Professor Yanfa Yan, a highly interdisciplinary research team including physics and astronomy faculty J.G. Amar, R. Ellingson, M. Heben, N. Podraza, and Yanfa Yan along with additional faculty in environmental sciences, civil engineering, chemistry, finance, and electrical engineering and computer science, have received the National Science Foundation award "Earth-abundant thin-film solar cells as a sustainable solar energy pathway." One of the main goals of this project is the development of the concepts, materials, and processes necessary to economically produce environmentally friendly thin-film solar cells from earth-abundant, environmentally benign materials including FeS_2, Cu_2S, CuO, Zn_3P_2 and Cu_2ZnSnS_4 (CZTS). The research team will concomitantly also develop and analyze the sustainability of new solar cell systems in order to create a comprehensive life cycle sustainability assessment (LCSA). The research team will also employ an integrative approach wherein students from widely varying backgrounds and fields of expertise will work together to solve complex real world problems.

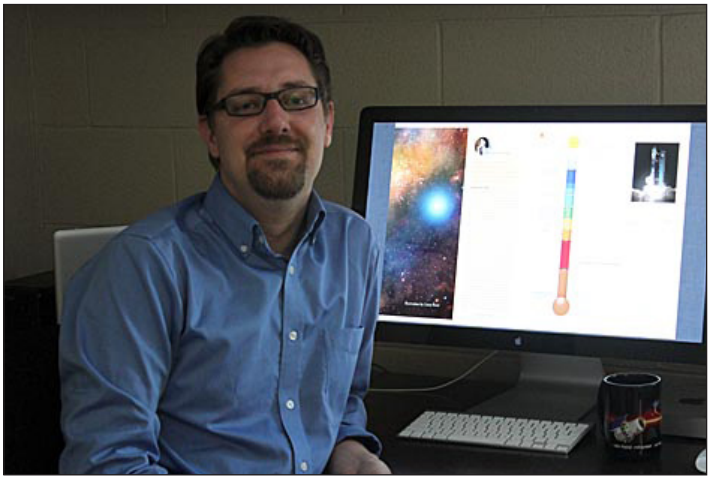
ASSISTANT PROFESSOR NIK PODRAZA LEADS ACQUISITION OF MAJOR RESEARCH INSTRUMENTATION

Assistant Professor Nik Podraza

Led by Assistant Professor Nik Podraza, a research team including Physics & Astronomy faculty Rob Collins, Mike Heben, Randy Ellingson, and Yanfa Yan have received the National Science Foundation, Major Research Instrumentation Award: "Acquisition of a THz Range Spectroscopic Ellipsometer". When it arrives at UT in summer 2013, this tool will be one of only a handful in the world with its capabilities and spectral range. With this instrument, it will be possible to obtain ellipsometric spectra over the 200-2700 μm wavelength range for bulk materials, thin films, and layered structures of multiple thin films in opto-electronic device configurations (solar cells, sensors, etc.). Ellipsometric data is sensitive to thicknesses of layers in multilayer stacks, spectroscopic optical properties of each material in the form of the complex and wavelength-dependent dielectric function ε , and gradients in ε resulting from structural and compositional variations. Information contained within ε over this spectral range pertains to film resistivity, carrier concentration, mobility, and effective carrier mass for semiconductor materials. This technique will also serve as a non-contacting probe allowing for extraction of electrical properties of materials in final, operating device structures such as thin film solar cells.

PROF. MICHAEL CUSHING'S WORK DISCUSSED IN ASTRONOMY MAGAZINE

(adapted from UT News, August 2012)



Professor Michael Cushing

When looking at the night sky, it's clear that there are a multitude of stars. But invisible to the naked eye are stars that never reached their full potential — brown dwarfs doomed to burn out completely, unable to sustain nuclear fusion the way stars like our sun do. Dr. Michael Cushing, UT assistant professor of astronomy, is mentioned in the July issue of Sky and Telescope magazine because of his study of brown dwarfs. He was the lead author of a paper published in the Astrophysical Journal in December on the discovery of Y dwarfs — an entirely new class of brown dwarfs. "To have Sky and Telescope, which is a very popular amateur astronomy magazine, discuss our work is pretty exciting," Cushing said. "I was pretty happy when the article came out." Cushing was a part of a team of astronomers who discovered the Y dwarfs, which are the coldest type of brown dwarfs known. Cushing helped find six using data from NASA's Wide-field Infrared Survey Explorer (WISE). One of these stars burned at only around 80 degrees Fahrenheit, the temperature of a summer day on Earth.

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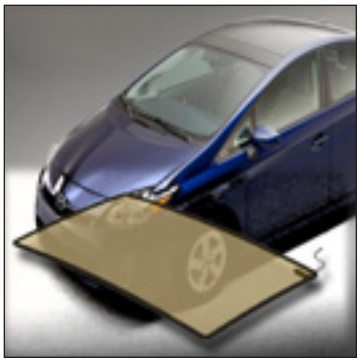
The discovery and analysis of brown dwarfs are important because, by looking at these failed stars and how they form, it is easier to understand far away planets that orbit other stars in the galaxy, Cushing said. Brown dwarfs share features of both low-mass stars and gas giant planets like Jupiter, earning them the nickname of "misfit stars," being in some ways half planet and half star. Although nearly as faint, brown dwarfs are easier to study because they typically live in isolation. "It's much easier to study a faint brown dwarf — even if you have to use the Hubble Space Telescope — to make sure that you understand how very cold atmospheres work," Cushing said.

Another goal of the astronomers, according to Cushing, is to obtain a complete census of all brown dwarfs in the solar neighborhood, which is the region of space around the sun out to a distance of roughly 20 light-years. The data obtained by WISE is still being analyzed and likely will be for years to come. As Cushing told Sky and Telescope: "Right now we have 1,600 candidates in our list, and we're not done searching the WISE data."

TECHNOLOGY INITIALLY DEVELOPED IN THE DEPARTMENT OF PHYSICS AND ASTRONOMY IS THE BASIS FOR NEW PHOTOVOLTAICS COMPANY

Lucintech Inc, is the new name for Xunlight 26 Solar, LLC, a technology spin-off from UT and the Department of Physics and Astronomy. The photovoltaics (PV) company was co-founded in 2008 by Professor Emeritus Alvin Compaan and Professor Xunming Deng, as a subsidiary of Xunlight Corp. and originally named Xunlight 26 Solar ("26" for the II-VI compound CdTe which is the active PV layer). The new name was chosen in 2012 as the company obtained its first venture capital investment and financially separated from Xunlight.

Lucintech licensed sputter deposition technology from UT that was developed by Compaan and his students under more than 20 years of research in McMaster Hall. Since 2008, Lucintech's development activities have been supported by more than $2 million of seed capital, and grants from the Ohio Third Frontier, NSF-SBIR, and DOE-STTR. Lucintech is currently developing next-generation products in collaboration with UT's PVIC on a $1 million award from the DOE-STTR program. Lucintech has developed a see-through, photovoltaic (PV) coating for glass or polymers that efficiently generates electricity and simultaneously reduces solar heat gain. The company has demonstrated the technology by fabricating small prototype PV windows with imperceptible laser-scribed interconnects and with various color tints. Compaan says that Lucintech technology can provide the best cost/watt of any PV window system and is based on materials that are well established, bankable, and stable for more than 20 plus years.

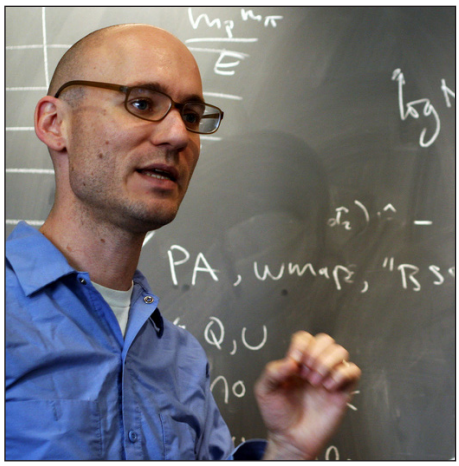


Lucintech is targeting the building-integrated photovoltaic (BIPV) window market and the automotive PV sunroof market as sketched in the figure. With six hours of summer sun, a panoramic sunroof of about 1 m^2 could provide power for an electric vehicle for about 30 km of driving. Alternatively, a PV sunroof can power a circulating fan to keep the interior 20 degrees Farenheit cooler on hot summer days providing more comfort at the start of driving and allowing the air conditioning system to be downsized by as much as 30 percent, saving fuel and weight. Besides Professor Compaan, Lucintech currently has five full-time employees including two UT graduates and two Professional Master's of Science in Photovoltaics interns, and is currently raising capital to develop a pilot production line.

MCMASTER COSMOLOGY LECTURE

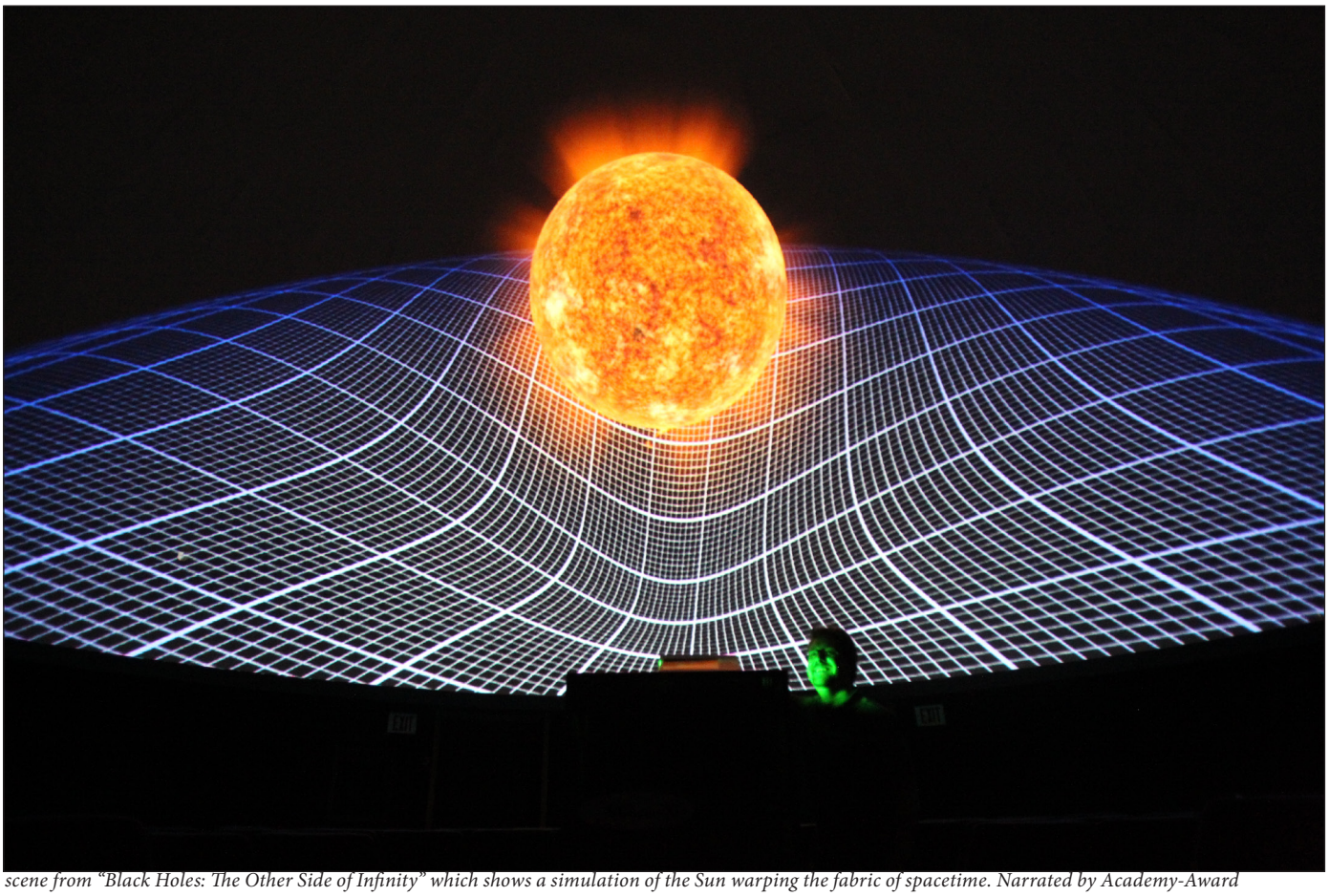
(adapted from UT News, April 2013)

A large fraction of the universe is invisible to the naked eye — and to every other scientific instrument ever invented. Dr. David Hogg, associate professor of physics at New York University, presented the 2013 McMaster Cosmology Lecture titled "Where and What is Dark Matter?" on April 4. "Dark matter gets its name because it does not emit, reflect or absorb light; it is truly invisible," Hogg said. Dr. Michael Cushing, UT assistant professor of astronomy and director of the Ritter Planetarium, said dark matter is one of the biggest unsolved mysteries in astrophysics. "The debate about whether dark matter really exists is effectively over, so the focus among astronomers is shifting to detecting dark matter directly," he said.



Prof. David Hogg

NEWS FROM RITTER PLANETARIUM-BROOKS OBSERVATORY

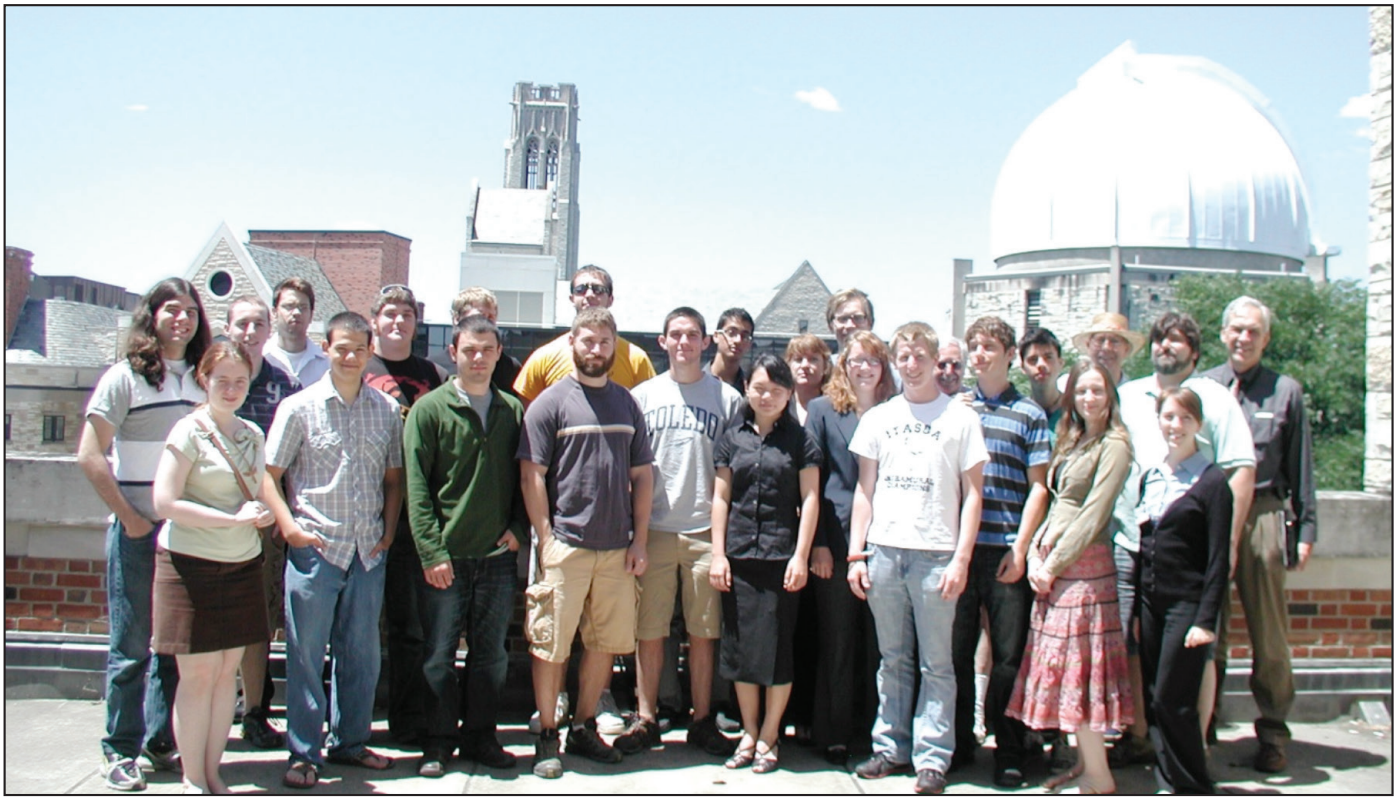


A scene from "Black Holes: The Other Side of Infinity" which shows a simulation of the Sun warping the fabric of spacetime. Narrated by Academy-Award nominated actor Liam Neeson, this stunning program takes the audience on a trip into the super-massive black hole at the center of our Milky Way galaxy. The director of the Ritter Planetarium Michael Cushing is illuminated by the projector in the foreground.

Ritter Planetarium had another exciting year in 2012. We increased attendance, expanded our repertoire of full-dome shows and increased our impact on the greater UT community. Much of this success can be directly attributed to the major renovation, which was undertaken in summer 2011 and included the installation of a fully digital projection system. In April 2012, we hosted The Ohio Great Lakes Planetarium Association yearly meeting where we demonstrated our system to upwards of thirty colleagues from across the state. Then in June, we welcomed over five hundred members of the general public to experience the final transit of Venus in our lifetime. During the event, a number of small solar telescopes were set up outside of the planetarium and we used the solar telescope atop McMaster Hall to project the transit on to a large screen. The event was so popular people had to wait patiently in line to get a peak through the telescopes. Overall, we have experienced an increase in planetarium attendance of ten percent over 2010 levels, a trend we hope continues for years to come.

We also acquired two new full-dome shows: "Tales of the Maya Skies" and "The Case of the Disappearing Planet" both of which have proved very popular during our public and school programs. "The Case of the Disappearing Planet" documents the events that led to Pluto being demoted from planetary status while "Tales of the Maya Skies" immerses the audience in Mayan science, art, and mythology and explores the deep connection the Mayan people have with the sky. "Maya Skies" also comes with a Spanish language audio track so some introductory and intermediate level Spanish classes now view this program during their class time. We have also welcomed some introductory geology classes to the planetarium to watch the program "Dynamic Earth," which explores the inner workings of Earth's climate engine. We look forward to expanding the impact the Ritter Planetarium has on departments across UT. Finally, we have continued and expanded our collaboration with Dr. Seder Burns and his students from the College of Communication and the Arts. Working with us they have begun creating full-dome content using the open source software Blender. Our long-term goal is to produce professional quality full-dome programs that will be shown in planetariums across the world.

RESEARCH EXPERIENCES FOR UNDERGRADUATES (REU)



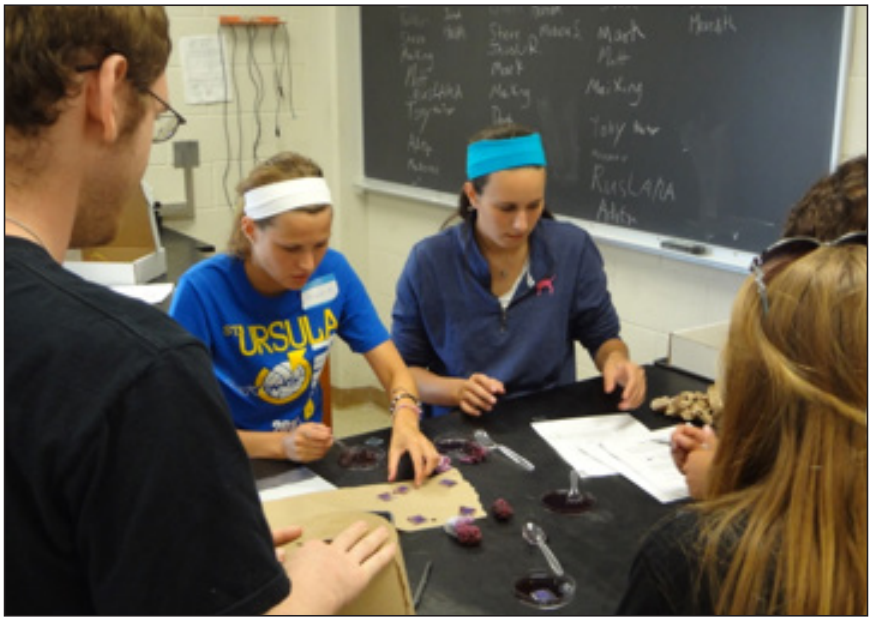
Mentors and participants (boldface) in 2012 Summer REU: *Left to Right. Front row: Marina Kounkel, Michael Huebner, Tyler Kinner, Steven Cloutier, MeiXing Dong, Derek Brinkman, Meredith McLinn, Kathleen Connolly/ Second Row: Anthony Passero, Nathan Diemler, Morgan Vasilakes, Adam Smercina, Mackenzie Endres, Peter Jones, Rick Irving. Back Row: Joseph Ozbolt, Jakub Prchlik, Steven Solomon, Adnan Choudhary, Ruslina Sistryak, Matthew Kurth, Steven Federman, Antonio Porras, Adolf Witt, Michael Dennis*

The Summer 2012 NSF-REU program in physics and astronomy, directed by Dr. Richard Irving and Professor Thomas Kvale, gave enhanced research opportunities to 15 undergraduate students from 12 colleges and universities in nine states. Student participants were chosen competitively out of 141 applications from students in 36 different states in all regions of the U.S. The strong support of our faculty for the REU research program is evidenced by five additional students receiving support from faculty members' external grants and/or participating through the Office Undergraduate Research programs. We had three students participate in our program from community colleges. 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.

As has been the case for several years now, social activities were coordinated by the students themselves with the help of the local REU and UT participants. Activities included movie nights, 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: a UT Planetarium show, Frisbee golf, several BBQ's, a trip to Cedar Point, a Toledo Zoo visit, sky-diving, swimming at Centennial Quarry and camping.

PHYSICS AND ASTRONOMY SUMMER CAMP 2012

As part of our NSF program the REU students hosted the Physics and Astronomy Summer Camp. This is an outreach activity for high school students, which took place on July 18 and 19. 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. Twenty two high school students attended, including one home schooled student, from the following six area high schools: Emmanuel Christian, St. Francis de Sales, St. Ursula, Sylvania Southview, Toledo Early College and Woodward.



REU and Summer Camp students building organic solar cells.

The first day of the summer camp dealt with alternatives for energy generation. Our exploration of the topic included a tour of UT's own Scott Park Campus of Energy and Innovation: led by Michael Green, director of energy management for The University of Toledo. During this tour the students were able to visit a 1.2 MW solar and wind system at this campus. The facility 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. Off campus, the students were exposed to similar "green" technology implemented at a smaller scale of the homeowner. This consisted of a tour and discussion by Professor Alvin Compaan concerning 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 dye-sensitized solar cells using fruit such as blackberries, raspberries and pomegranate fruit. During this lab activity, students enjoyed testing their endurance on the homemade bicycle generator to power various household items. This activity really helped to spark a lively conversation about avoiding a phantom energy wasting lifestyle. The second day featured nighttime activities related to astronomy. Alex Mak, associate director of Ritter Planetarium, along with the help of Cody Gerhartz, an astronomy graduate student, gave informative tours of both the Brooks Observatory and the Ritter Observatory facilities. This included a great planetarium show with the world's first Spitz SciDome XD projection system. Kathy Shan, a doctoral student in curriculum and instruction with a focus in science education, helped develop activities for this part of the camp too. Kathy and the REU students involved the students with an exploration of the size and scale of the solar system through an interactive demonstration using a toilet paper sheet as our unit of measurement. Also, Kathy 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.

OTHER NOTABLE NEWS

MICHAEL CUSHING

Professor Cushing was awarded two grants during the past year: "Completing the Census of Ultracool Brown Dwarfs in the Solar Neighborhood using HST/WFC3" Hubble Space Telescope, Cycle 20 and "Brown Dwarf and Exoplanet Weather Forecasts: Are Y Dwarfs Partly Cloudy?" Spitzer Space Telescope, Cycle 9.

UNDERGRADUATE RESEARCH EXPERIENCE

As part of its continual evaluation and assessment, the Department of Physics and Astronomy carried out a survey in fall 2012 of undergraduate students who have been involved in research in the department. In general, it was found that the opportunity to participate in research as an undergraduate greatly enhanced their undergraduate experience and also allowed them to prepare themselves for future career opportunities. Below are some of the comments provided by current and former undergraduate students:

CURRENT UT STUDENTS

"Without the possibility for undergraduate research, I would not have chosen to come to UT [...]" — Julia Deitz

"There is however a stark difference between the knowledge gained in the classroom to that in research in my experience." — Jakub Prchlik

"I feel far more confident in my abilities to find career opportunities based on the experience gained as an undergraduate researcher [...]" — Jonathan DeWitt

"I am very thankful to have this research experience because I feel it has helped me become a better student and a better future employee." — David Nicholas

"The possibility of getting involved in research was critical in my choice to come to UT. I did apply and even obtain acceptance to other universities, and I inquired extensively about the research opportunities in each place before making the decision." — Emily Safron

"The skills that I have learned from [my research with] PVIC have greatly improved my resume, especially in the career field that I am working towards." — Jon M. Stone

"The research experience takes the abstract concepts from the classroom and finds an application for them." — Trevin Flickinger

"My undergraduate research experience has had a great impact on my education." — David Kinder

"As a high school senior, one of the most important deciding factors of which university to attend was the opportunity to participate in undergraduate research." — Adam Smercina

"Research provides a platform for tangible application of knowledge, providing the mortar by which the bricks of education can stand." — Ryan Zeller

"I feel that my research experience has been the cornerstone of my education, and I would recommend such involvement to any incoming freshmen." — Corbin Taylor

FORMER UT STUDENTS

"I know that undergraduate research was one of the main factors that led to my acceptance into graduate school [...]" — Marina Kounkel

"Much of my own success is due to the beginning of my career and research opportunities at UT [...]" — Noel Richardson

"I learned how to communicate on a scientific level which I think you miss in regular classes [...]" — Katie Hoepfl

"[...] my research experience was perhaps the most important experience that I had at UT." — Paul Sell

"At this point I have been a high school teacher of calculus and physics for over 15 years [...]. My research experience and depth of understanding gained from rigorous coursework sets me apart from other teachers and the preparation they received." — Tim Adkins

"As a high school senior, I was offered admission by Carnegie Mellon University, the University of Chicago, Case Western Reserve University, and The University of Toledo. One reason I chose the University of Toledo was that its physics and astronomy faculty described to me specific opportunities for research that I could undertake as soon as I arrived on campus." — Will Fischer

"The messy nature of research — dead-ends, misdirections, and the like — is in sharp contrast to the sanitized view of the world presented in the classroom and in homework problems. We need students who can creatively handle the messiness of the real world." — Rich Ghrist

"I feel that my undergraduate research at UT was invaluable to my education. I do not think I would be where I am today with out it." — Josh Thomas

"For me, it's hard to overstate the value of undergrad research programs." — Greg Madsen

"[...] the most important thing that doing undergraduate research helps accomplish is instilling a sense of intellectual curiosity in the student." — Michelle Ghrist

GRADUATE STUDENT NEWS

Congratulations to physics and astronomy graduate student Puruswottam Aryal for winning the best presentation award in June 2012 at the 38th Photovoltaics Specialists Conference in Topic Area 8: Photovoltaics Characterization Methods. The title of Puruswottam's paper was "Large Area Compositional Mapping of $Cu(In_{1-x}Ga_x)Se_2$ Materials and Devices with Spectroscopic Ellipsometry " with co-authors Dinesh Attygalle, Puja Pradhan, N. J. Podraza, S. Marsillac and R. W. Collins.

Puruswottam Aryal of UT with B.J. Stanbery, Conference General Chair

CONGRATULATIONS!

The following graduate students successfully defended their Ph.D. dissertations or received master of science degree based on a thesis or major peer-reviewed publication in 2012 or early 2013:

Dr. Joshua Thomas, Ph.D.

Dr. Bhoj Gautam, Ph.D.

Dr. James Davidson, Ph.D.

Dr. Lila Raj, Ph.D.

Joshua Orndorff, M.S.

James Truxon, M.S.

RECOGNIZING OUR DONORS

The Department of Physics and Astronomy recognizes and thanks all donors who generously made gifts during the past calendar year from January 1, 2012 to December 31, 2012. Donors are listed alphabetically.

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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 23, 2012. The following awards were presented:

UNDERGRADUATE AWARDS

Physics and Astronomy Outstanding Graduating Undergraduate Student: Marina Kounkel

Elgin Brooks Memorial Astronomy Scholarship: Nathan J. Lewis

A. Jackson and Sally K. Smith Scholarship: Abril Galang

Chad Tabory Memorial Award for Outstanding Undergraduate Research in Physics and Astronomy:
First Place: Marina Kounkel
Second Place: Tyler Kinner

Robert and Noreen Stollberg Award: Brandon Saner

Edwin Jayamaha Scholarship Award: Julia Deitz

C.V. Wolfe Scholarship in the Natural Sciences: Corbin Taylor

Elmer R. and Gertrude M. Brigham Scholarship: Luke Kwiatkowski

GRADUATE AWARDS

David Turnbull Scholarship in Materials Science: Jason Roehl

Robert and Noreen Stollberg Graduate Award for Teaching Achievement: Mark Siebert

Robert and Noreen Stollberg Graduate Award for Leadership & Service to department: Lesley Simanton

The 2012 Sigma Pi Sigma Inductees *(Professor Scott Lee, faculty adviser)* were:

Kevin Belcik

Julia Deitz

Bhargava Kanchibotla

Luke Kwiatkowski

Lesley Simanton

ALUMNI NEWS

JOSEPH CONVERSE. The work of Joseph Converse, who is a postdoctoral research associate with Professor Rupali Chandar, and The University of Toledo was mentioned in the March 2013 issue of Scientific American in an article entitled "The Inner Life of Star Clusters" by Steven Stahler.

GREG MADSEN (B.S., 1998). Madsen has recently been appointed to a two-year position at the Institute of Astronomy at the University of Cambridge in the U.K. The new role is working with the 'Cambridge Astronomy Survey Unit' team that handles most of the data coming off the optical/IR ESO telescopes in Chile. Madsen received his bachelor of science degree in astrophysics from our department in 1998. He then received a Ph.D. from the University of Wisconsin at Madison. Most recently, Madsen has been Senior Research Fellow at the Sydney Institute for Astronomy in the School of Physics at the University of Sydney.

GIRIDHAR NANDIPATI (Ph.D., 2009). Nandipati reports that he has recently accepted a position as a postdoctoral research associate at the Pacific National Northwest Laboratory. He and his wife, Usha, have also recently welcomed a baby boy, Geet, born on March 28, 2013.

JOHN WISNIEWSKI (Ph.D., 2005). Wisniewski recently joined the University of Oklahoma faculty as an assistant professor of astronomy. Wisniewski also recently contributed to the discovery of a massive exoplanet with a mass about 13 times that of Jupiter and an orbit somewhat larger than Neptune's, which orbits the massive star Kappa Andromedae as a member of the international team Strategic Explorations of Exoplanets and Disks with Subaru, or SEEDS project.

CONGRATULATIONS!

Graduate student **Bradley Hubartt** and his wife Dana, recently welcomed a new baby, Oliver Hubartt, on July 20, 2012.

IN MEMORIAM

Willie Mae Brown, administrative secretary in the Department of Physics and Astronomy from 2003 - 2011, passed away October 25, 2012. She was preceded in death by her husband, Rev. Frederick Brown. She is survived by two sisters, Diane Beavers and Mary Carr Davis (Charlie Alexander); a host of nieces, among them a devoted Monica Williams; nephews and cousins and other relatives and friends.

Stephany Cichy-Mikolajczyk Mikols, departmental business manager in the Department of Physics & Astronomy from 2005 - 2011, passed away peacefully August 9, 2012, at Ebeid Hospice in Sylvania, after a brief but valiant fight with cancer. A graduate of The University of Toledo, Stephany worked for her alma mater for 22 years, retiring in 2011 from the Department of Physics and Astronomy. Prior to that, Stephany worked for the former Toledo Trust Corp. for 17 years. Stephany was the proud mother of twin sons, Andrew (Cynthia) Mikolajczyk, and Brian (Marilyn) Mikolajczyk, and daughter, Nicole (John) Pupos, who survive to honor her memory. Stephany is also survived by her best friend and life partner, David Mikolajczyk. Stephany also leaves behind nine loving grandchildren, Andrew, Anthony, Brian, Ian, Lily, Madison, Michael, Nicholas, and Sarah, and siblings, Christine Brooks, Donna Sautter-Flack, Mary Irene Padmanabhan, Elizabeth Schings, and Ed Cichy.

Faculty and classmates are interested in you and your career. Please update information on this form and return to the Department.

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THE UT ENDOWMENT FUND CAMPAIGN

Alumni and friends of the Department of Physics and Astronomy are urged to remember our department and college as they consider giving and pledging. The department has several established funds; some of which are endowed and others may not yet be endowed. Other funds may have dipped below the threshold required by the UT Foundation for returning spendable earnings that can be used, for example, for scholarships, honoraria for speakers, etc.

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.

RITTER OBSERVATORY PUBLICATION FUND

This fund helps to support the cost of publishing the Ritter Observatory annual report, as well as student papers when possible.

REACH FOR THE STARS FUND

This account has recently been established to begin an endowment that will be used to support the buy-in to an international telescope consortium and ancillary activities. This is a major goal of the department.

PLANETARIUM PROGRESS FUND

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

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.

SIGMA XI DION D RAFTOPOULOS OUTSTANDING FACULTY RESEARCH AWARD

This is a perpetual memorial in honor of Dion D. Raftopoulos for support of the Sigma Xi Award for Outstanding Research at UT. This award remains one of few awarded by the faculty to peers in recognition of their outstanding contributions to the research enterprise at the UT. We are proud to note that 12 of the total 30 winners of this award through 2005 have been from the Department of Physics and Astronomy.

The UT Alumni Association wants to hear from you. Check out their website at *toledoalumni.org*. Please join the movement!

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

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