

A Note from the Chair

By Professor Ravindra Pandey

Greetings! Star Trek's holodeck comes to clouds! A new way of seeing clouds by an airborne laboratory using a holographic imaging technique was recently proposed by Prof. Shaw and his collaborative groups. Their results, published in *Science*, will improve models predicting weather and climate by showing distinct mixing patterns in cloud droplets.

Bionanotechnology is a new research frontier at the nanoscale. Dr. Dongyan Zhang has been working to develop high brightness fluorophores for bioscience applications. This NSF-supported research will facilitate detection and sorting of low abundance cells by cell imaging techniques. Additionally, Michigan Tech received a \$1.2M NSF grant to acquire a transmission electron microscope. This sensitive instrument will enable researchers like Prof. Yap to image and identify atomic structure with resolution close to a single atom.

Astronomy Picture of the Day (APOD) is still growing with an average of one million hits per day. Public understanding and appreciation of astronomy via APOD were recently recognized; Prof. Nemiroff and his NASA colleague Dr. Bonnell received the Klumpke-Roberts Award. Congratulations to Will Cantrell and Pete Moran for becoming Professors. Dr. Cantrell is a key member of the atmospheric science group and has made a substantial contribution to its research and teaching activities. Dr. Moran established a well-funded research group which developed specialized material functionalities for several industrial applications. Ms. Andrea Lappi also received a promotion this year, going above and beyond to facilitate a smooth relationship among the faculty, staff and students. Congratulations to Profs. Jacek Borysow and Alex Kostinski for 25 years of service at Michigan Tech.

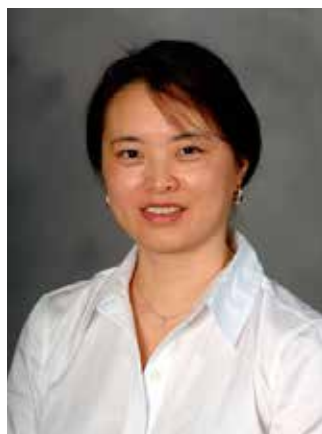
A generous gift of \$2M will help us to establish The Elizabeth and Richard Henes Center for Quantum Phenomena in the department. The Center's vision is to bring the academic community together to address problems which cannot be explained by means of classical physics. Prof. Borysow will serve as the director of the Center. Future proposals include activities ranging from understanding the fate of the universe to making use of quantum physics in addressing human health. Previously, a Henes gift of \$700K was used to upgrade facilities in the physics research laboratories.

Many of these achievements have been possible only with your encouragement and support of the department. As you decide on end-of-the-year donations, please consider a contribution to the department's endowment. Your continued support is deeply appreciated.

Best wishes for a joyous holiday season and a happy and prosperous New Year.

Current Research

Dongyan Zhang



Dr. Dongyan Zhang is currently an Adjunct Assistant Professor and Senior Research Scientist in the department. She has been working in the area of bionanotechnology in collaboration with Professor Yoke Khin Yap.

Dr. Zhang received her academic training in microbiology, biochemistry, immunology, molecular biology, nanotechnology, and entrepreneurship (NSF Innovation Corps team 2014). She earned her PhD in Pharmaceutical Sciences from Osaka University, Japan. Her PhD work focused on the mechanisms of enterobacterial infection and the development of a simple, rapid, and relatively inexpensive diagnostic test to detect enterotoxins of *Vibrio cholerae* and enterotoxigenic *Escherichia coli* from clinical and environmental samples. In 2007, Dr. Zhang developed and taught a new course "Molecular Biology for Physicists." It was followed by the establishment of the new Chemical and Biological Physics Laboratory in the Department of Physics. She served as principal investigator (PI) and co-PI on several research projects funded by the National Science Foundation (NSF), the University of Michigan, Nano Innovations, LLC, and Stabilux Biosciences, Inc.

Dr. Zhang has expanded research areas in the department, focusing on functionalization of novel nanomaterials, their biological compatibility, cell internalization mechanisms, drug delivery capability, and potential as nano-devices for biological and chemical sensing. Her research provides an unconventional interface between basic sciences (physics, chemistry, and biomedicine) and nanomaterial engineering. This interdisciplinary approach will not only further our insight into biomedicine, but it will also uncover new biological properties of functionalized nanomaterials. All these will have significant impact on the emerging areas of nanobiotechnology and nanomedicine, such as specific single cell therapy and diagnosis.

Fisher Hall is 50 Years Old
1964—Fisher Hall Dedicated
2006—Classroom Technology Upgrades
2012—Henes Improvements to Physics Labs

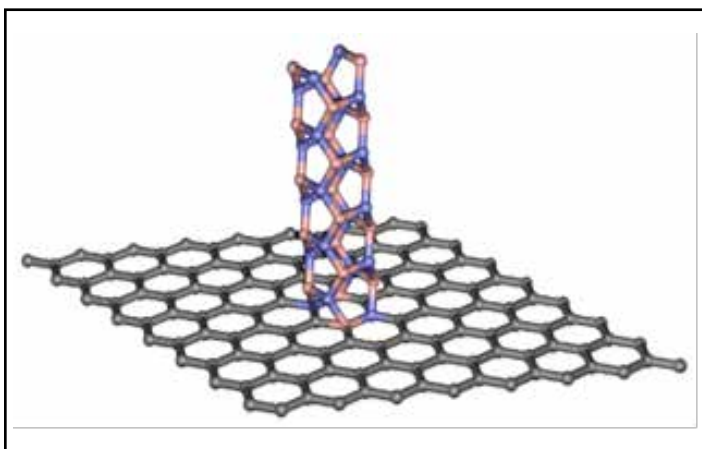
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Research with Impact

Faculty members have presented the most surprising findings in scientific publications including digital switches, cloud holography, and atmospheric particles.

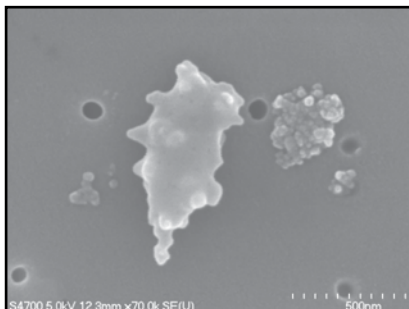
Nanotechnology: **Yoke Khin Yap** combined graphene and nitride nanotubes to create a more efficient digital switch. Receiving widespread coverage in *World News and Electronics Weekly*, this work constituted a follow-up to Yap's goal of designing transistors without semiconductors.



Atmospheric Science: The use of holography to study mixing behavior in clouds by **Raymond Shaw's** group appeared in *Science* and in several national media outlets. The 3-D imaging takes place aboard a flying H O L O D E C — the Holographic Detector for Clouds. The detector is attached to a military transport-style aircraft and the data are processed using high-end graphics cards.



Climate Change: **Claudio Mazzoleni** studies the soot that enters the atmosphere from wildfires, industrial plants, and other kinds of burning. The global impact of black carbon particles becomes evident when understanding how the particles heat up from sunlight. The work was published in *Nature Communications* and appeared as a headline in the NSF news site *Science360*.



Department Updates

Michigan Tech's Board of Control promoted **Will Cantrell** and **Pete Moran** to Professor with tenure at their May 2015 meeting.

Copper Country native **Debra Linn** joined the department as a new office assistant in February 2015. She is married to Bruce Linn, and they have three daughters. Debra enjoys spending time with family and friends. When she is not basking in a warmer climate for winter vacation, Debra likes helping the physics department to run smoothly.

New office assistant Taana Kalliainen, hired August 2014, was recently replaced by **Kimberly Oldt**. Kimberly has volunteered with organizations such as Michigan Tech Preschool, Houghton Elementary school, Girl Scouts, Portage Lake Little League, and the Chassell VFW. She is a cosmetologist and former beauty salon owner. Most recently she worked at Houghton Elementary School as a Title 1 paraprofessional. Kimberly also enjoys the company of family and friends, as well as the physics department environment.

Professor Emeritus **Edward Nadgorny**, along with his wife Nina, established an endowment fund to support physics related research and career development opportunities for undergraduate students at Michigan Tech.

Taylor Kaminski and **Jeanine Chmielewski** attended the American Physical Society Conference for Undergraduate Women in Physics (CUWiP), January 16–18. The CUWiP is a three-day regional conference providing undergraduates with a professional networking opportunity.

Members of the physics department met up with alumni at the 2015 March Meeting of the American Physical Society in San Antonio, Texas.

Raymond Shaw, **Will Cantrell**, and **Claudio Mazzoleni** held a Cloud Chamber open house last spring, introducing the research facility to the campus community. The instrument is fully operational, with the capability of generating clouds under a variety of conditions. Steady-state turbulent cloud conditions can be sustained for more than a day in this innovative chamber.

Petra Huentemeyer, **Brian Fick**, and PhD candidate **Hugo Ayala Solares** attended the HAWC inauguration March 2015 at the high-altitude site of the HAWC gamma-ray observatory near Pico de Orizaba in Mexico to mark the official start of science operation of the instrument. The head of CONACyT, the Mexican science foundation, Dr. Enrique Cabrero Mendoza, and the director of NSF, Dr. France A. Córdova, officiated the inauguration ceremony. The Michigan Tech team led by Petra is in charge of the calibration of the observatory, and instrumental in the acquisition, reconstruction, and analysis of cosmic gamma-ray data.



Awards and Achievements

Ravi Pandey was elected a Fellow of the American Physical Society (Computational Physics), November 2014. His citation reads, “For creative use of advanced computational techniques from materials physics and quantum chemistry to gain insights into nanostructure behaviors, especially for his prescient recognition of the looming importance of such calculations for predicting bio-nano hybrid material properties.”

Yoke Khin Yap was awarded the title of Global Alumni Fellow by Osaka University in Japan. The newly established award is granted to alumni who are academically active overseas.

Robert Nemiroff and Astronomy Picture of the Day (APOD) co-author Jerry Bonnell received the Klumpke-Roberts Award for outstanding contributions to public understanding and appreciation of astronomy. It was presented recently at the 127th Annual Meeting of the Astronomical Society of the Pacific. The APOD awardees join the likes of Carl Sagan, Isaac Asimov, and Timothy Ferris for this recognition.

Jacek Borysow and **Alex Kostinski** were recognized for 25 years of service last May.

Andrea Lappi was nominated for the Making a Difference Staff Award in the category of Above and Beyond, coordinated by Staff Council.

Kamal Dhungana, **Niraj Dhital**, and **Swarup China** received the Graduate School Outstanding Scholarship Awards.

Joseph Niehaus was a 2015 spring semester recipient of the DeVlieg Foundation Fellowship, which supports graduate students pursuing research in engineering, wildlife, and biology at Michigan Tech.

M. A. “Mandy” Shaw was selected as Michigan Tech’s representative for the Midwestern Association of Graduate Schools Excellence in Teaching Award for her innovative work in online education and revamping the lab experience for two courses.

The graduate research poster and oral presentations were given on April 14, 2015. **Kiley Spirito**, MS physics, was recipient of the top poster presentation award, while **Gaoxue Wang**, PhD candidate, received the top oral presentation award. Spirito also received an Outstanding Teaching Award from the Graduate School.

Outstanding undergraduate senior **Mick Small** received the 2015 Ian Shepherd Award. The award was presented by physics alumnus Joseph Kuehl.

The Michigan Tech chapter of the Society of Physics Students (SPS) has been selected as one of the Distinguished SPS Chapters.

Recent Degree Recipients

2015

Douglas R. Banyai, PhD
Ashim Chakravarty, PhD
Niraj Dhital, PhD
Kamal B. Dhungana, PhD
Colin Gurganus, PhD
Anindya Majumdar, MS
Tolga Yapici, PhD
Kiley Spirito, MS
Cody Bell, BS
Christopher Bush, BS
Jeanine Chmielewski, BS
Adam Laxo, BS
Eric Morris, BS
Cody Salmon, BS
Luke Schroeder, BS
Michael Small, BS

Destination

ThermoAnalytics
Michigan Tech
Michigan Tech
University of Iowa
SPEC Inc., Boulder, CO
Michigan Tech (Biomedical)
Michigan State University
University of Utah
Nexteer Automotive
—
New Mexico Tech
Law school
Wayne State
—
—
Maine

Physics Outreach

National Geographic quoted graduate student **Teresa Wilson** on Fata Morgana. This type of atmospheric mirage was made famous by a recent image of a floating city in China.

Many people were in attendance for a lunar eclipse viewing event on campus, organized by graduate student **Amanda Shaw**.

Astronomy Picture of the Day (APOD) co-founder **Robert Nemiroff** was interviewed by *MUSEUM* about the origins of the popular, online image repository. Nemiroff traced the 20-year-old phenomenon back to the earliest days of the internet. He noted, “I think we consider APOD’s design a bit like the Volkswagen Beetle. It is simple, serves its purpose, and people now expect it to look the way it does.”

Lab associate **Scott Rutterbush** pioneered Nerd Night as part of the inaugural Keweenaw Science Engineering Festival last summer. Local teens got hands-on experience with physics demos in a casual club setting in downtown Houghton.

Postdoctoral research fellow **Chiumun Michelle Hui** and physics lab assistant **Dustin Winslow** taught “The Physics of Skiing” last winter, emphasizing how science impacts performance.

Yoke Khin Yap taught a workshop on nanotechnology to local high school girls as part of Michigan Tech’s GEAR UP, a Pre-College Innovative Outreach Institute.

Raymond Shaw spoke about lake-effect snow at the local Carnegie Museum, as part of a monthly series on geoheritage and natural history of the Keweenaw.

Undergraduates in the Optics Lab course held a poster session in Fall 2014 about their experiments and projects.



Thanks! We extend our deepest appreciation to friends and alumni who have made recent gifts or pledges to Michigan Tech. Did we miss your contribution? If so, contact physics@mtu.edu. We appreciate your continued interest in the Department of Physics at Michigan Technological University.

Wilma & Keith (dec) Baldwin
Theodore L. Bedore '72
James '67 & Janet Bohren
John '69 & Louise Bretney
Konstantin '95 & Dessy Dinov
Eric '83 & Kari Duffin
Cornelis P. Dullemond
Thomas '63 & Judith Essig
John '50 & Eugenia Evans
Fidelity Charitable Gift Fund
Walter '48 & Edith Gabriel
Thomas '63 & Dona Gould
Daniel F. Hammang
Steven M. Handlovits '89
Frank '58 & Shirley Hastedt
Louis '66 & Diane Hein
Richard '48 & Elizabeth (dec) Henes
David Ingram
Stanley '70 & Christine Jefferson
Joe '60 & Ann Jenney

Philip Kaldon '88 & Deborah Morrow
Russell W. Karry '50 (dec)
Walter '64 & Margaret Kauppila
James '59 & Carole Kauppila
Joyce & Arne '52 (dec) Koskela
Thomas '84 & Renee Kugler
Jack '62 & Kaethe Labo
Lam Research Corp
Samuel C. Lambert '62
Kah C. Lau '07
Edward M. Leonard '12
Miguel & Anita Levy
Robert '61 & Eugenia '64 Lind
Robert '70 & Nancy '73 Martin
Paul '71 & Joanne Michaels
Charles Morris
Edward & Nina Nadgorny
David Nitz & Mary Marchaterre
Samuel '63 & Brenda Ochodnicky
Aparna '92 & Ravindra Pandey

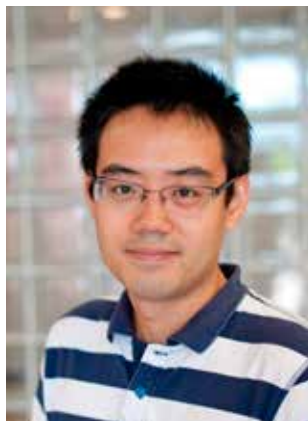
Thomas '69 & Sharon Plutchak
James R. Quinsey
William '66 & Dorothy Roth
Joseph Roti Roti '65 & Stephanie Pagano
(dec)
Suresh K. Sampath '98
Maximilian & Mary Ann Seel
Silicon Valley Community Foundation
Thomas & Sharon Silvis
Bradford '77 & Roseann Smith
James '63 & Janice Strahl
Donald '73 & Carolyn Szenina
Steven L. Tomsovic '80
Alfred '69 & Deborah Trapanese
C. John '64 & Kathryn Umbarger
SriramaSwaminat Venkataraman '98 &
Kalpana Chandrasekharan
David E. Woon '84
William E. Wuerthele '66
Charles '66 & Mary Zeigler



The Physics Graduate Poster Session, held on April 16 in the Fisher Atrium.

Graduate Spotlight

Boyi Hao



Boyi Hao is a PhD candidate in the engineering physics program at Michigan Tech, working under the supervision of **Professor Yoke Khin Yap**. Boyi joined Michigan Tech in fall 2009, after finishing his master's degree in materials sciences at Queen Mary University of London, UK. His research interests lie in condensed matter physics, focusing on the growth, characterization, functionalization, and application of boron nitride based nanomaterials. He has co-authored papers

appearing in several top journals, such as *Advanced Materials*, *Nature Communications*, and *Scientific Reports*. Boyi just finished a summer internship with Lam Research Corporation, a top provider of semiconductor processing equipment. In fall 2015 he was awarded a finishing fellowship from the Michigan Tech Graduate School to support the completion of his degree.

Boyi considers himself really blessed in joining the Michigan Tech physics department, as well as being given the opportunity to work with Professor Yap during his graduate study. He acknowledges all the support from the physics department; in particular, from **Professor Ravi Pandey** as the department chair. Boyi plans to finish his degree in fall 2015. He wants to join the semiconductor industry to make smaller, lighter, faster, and cheaper electronic devices.

Senior Research Projects

Cody Bell (Advisor: **L. B. King**, ME-EM)

Construction of a Retarding Potential Analyzer (RPA) for an Ion Thruster

Jeanine Chmielewski (Advisor: **Aleksey Smirnov**, GMES)

Investigation of the Effect of the Verwey Transition on Remnant Magnetization in Magnetite

Adam Laxo (Advisor: **Raymond Shaw**)

Effect of Charge on Heterogeneous Ice Nucleation

Eric Morris (Advisor: **Sean J. Kirkpatrick**, Biomedical Engineering)

Analysis of Reperfusion in a Hand Using Laser Speckle Contrast Imaging

Luke Schroeder (Advisor: **Ramy El-Ganainy**)

Supersymmetric Single Mode Lasing Arrays

Senior Spotlight

Angela Small

Angela Small is a fourth-year physics major with a minor in mathematics. Throughout her time at Michigan Tech, she has sought out a variety of research experiences in the field of physics. She was first exposed to research in 2012 when she began studying Raman spectroscopy with **Dr. Jacek Borysow**, later working in his lab as a Summer Undergraduate Research Fellow. Her second year, in addition to being a teaching assistant for Introduction to Experimental Physics, Angela pursued research with **Dr. Will Cantrell** on ice nucleation in the contact mode.

These combined experiences led to a summer internship at MIT Lincoln Laboratory within the Chemical, Microsystem, and Nanoscale Technologies group. This involved conducting and improving data analysis for a novel spectroscopy system built to detect chemical coatings on liquid surfaces. Angela streamlined the data analysis system, speeding up the main script's runtime by a factor of 200.

During her third year, Angela worked with **Dr. Ramy El-Ganainy** on computational testing of a potential biosensor. Her summer 2015 research took place at the NOAA facility through the Hollings Scholarship program, working for the Atmospheric Remote Sensing group in Boulder, Colorado. While there, she tested the impact of different pressure and temperature profile sources on tropospheric ozone lidar (light and radar) analysis, specifically working with data from NOAA's TOPAZ lidar system.

Additionally, during this internship, Angela had the opportunity to attend the annual workshop for the Tropospheric Ozone Lidar Network (TOLNet), a collaboration of lidar groups across the country. Angela presented her summer research at the Boulder Labs Student Symposium, winning the Outstanding Presentation award in the undergraduate category. This year Angela will be working with **Dr. Loredana Valenzano**, chemistry, on the quantum chemical description of the physicochemical interaction of drinking water drug contaminants with metal oxide-based materials.

After graduation, she plans to pursue a PhD in Chemical Physics and aims to study the mechanics of solar fuel generation with various spectroscopy systems. Angela's other accomplishments include the Michigan Tech National Scholar of Excellence award, the Milton Olsson Scholarship for musical accomplishment, and maintaining an active membership in the Pavlis Honors College Scholars and Leaders Program.

Michael Small (Advisor: **Yoke Khin Yap**)

Towards the Fabrication and Construction of Quantum-dot Sensitized Nanowire-based Photovoltaic Devices

Raven Stone (Advisor: **Claudio Mazzoleni**)

Quartz-Enhanced Photoacoustic Spectroscopy of Light Absorbing Aerosols



Michigan Tech

Physics News

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From left to right: Andrea Lappi, John Jaszczak, Ranjit Pati, Don Beck, Bob Weidman, Wil Slough, Rami El-Ganainy, Brian Fick, Claudio Mazzoleni, Bryan Suits, Miguel Levy, Alex Kostinski, Debbie Linn, Kimberly Oldt, Ravi Pandey, Will Cantrell, Yoke Khin Yap, Raymond Shaw, Petra Huentemeyer, Bob Nemiroff, Jacek Borysow, and Max Seel.