

## A Note from the Chair

By Ravindra Pandey

A new research grant marks 30-plus years of continuous support by National Science Foundation (NSF) to **Alex Kostinski**, who is well-known as a “scientist for all seasons” due to his somewhat nomadic interests in diverse areas of physics. Alex has also received the Michigan Tech Research Award and helped the department to establish a well-funded research program in Atmospheric Physics, which is now celebrating the 10th anniversary of its PhD program.

In photonics, non-Hermitian degeneracies, also known as exceptional points, have recently emerged as a new way to engineer the response of physical systems to external perturbation. **Ramy El-Ganainy** and his colleagues have considered a system of three coupled cavities possessing third order exceptional points and found that the frequency response associated with this system follows a cube-root dependence on induced perturbations in the refractive index. These findings are applicable to improve thermal and bio-sensing capabilities of devices ([nature.com/articles/nature23280](http://nature.com/articles/nature23280)). We also congratulate El-Ganainy in receiving tenure and promotion to associate professor in the department.

**Ben Manning**, a recent graduate (BA with secondary education), has received the Woodrow Wilson Teaching Fellowship, which prepares recent graduates to teach in high-need secondary schools. According to Ben, the best way he can help in the progress of science and technology in society is by pursuing the teaching profession in his chosen field, physics.

**Yoke Khin Yap** and **Dongyan Zhang** have been leading efforts to develop the entrepreneurial culture through their startup company, StabiLux Biosciences. They have received substantial support from NSF under the Small Business Technology Transfer Program to support commercialization of high-brightness fluorophores. StabiLux won the “Up and Comer Award” at this year’s Accelerate Michigan Innovation Competition, receiving more than \$30,000 in cash and services.

Congratulations to **Jesse Nordeng** for receiving the “Creative Solutions” award at this year’s Michigan Tech Staff Making a Difference Awards reception. All of us who have worked with Jesse over the years know how well deserved this recognition is.

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.*

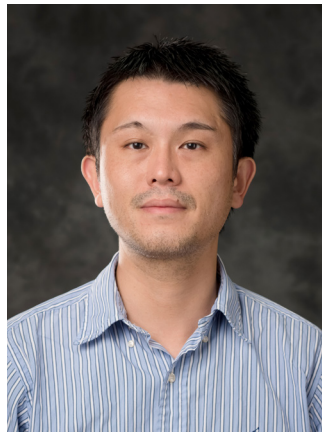
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Content editors: Katrina Black and Andrea Lappi

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## Current Research

Issei Nakamura



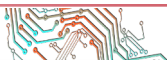
Soft materials are ubiquitous in our daily lives. Recently developed smartphones have high-resolution displays, but this feature can now be achieved with liquid crystal technology. Rubber-made and sticky substances mostly contain polymers, chain-like macromolecules formed by reacting monomer molecules together in chemical reactions. As such, our understanding of the molecular function of DNA molecules is driven by an ever-

growing interest in various biological reactions. Among other concepts, energy storage consisting of ion-containing liquids (electrolytes) is of particular concern in soft-condensed matter physics. This concern is in response to the recent technological improvement of sustainable devices such as the lithium-polymer rechargeable battery and fuel cell.

Our questions range from fundamental interest to more industrial purposes related to electrolytes. Either way, the key concept is to recognize that the delicate balance between entropy and enthalpy commonly leads to the quite rich thermodynamic and mechanical behaviors of electrolytes. Perhaps a good example of polymer liquids involving this issue is that they indeed exhibit various crystal symmetries such as bcc and hexagonal close-packed structures as the temperature cools down. These structures are not solid and can dynamically flow, but show such symmetries on a time average as a statistical ensemble. However, the addition of just a small amount of ions causes drastic morphological transitions through electrostatic interactions, which significantly alter ionic and electronic conductivity and mechanical strength. Our theoretical and computational methods, such as statistical field theory, Monte Carlo simulation, and molecular dynamics simulation, can track these phase transitions. We are largely motivated by experimental findings, so our group has also been strengthening collaborative studies with experimental groups to spark synergistic activity.

In the meantime, we have also embarked on the computational modeling of lithium dendrite formation in electrolytes (i.e. the accumulation of lithium on the surface of metal electrodes). For safety issues, this study includes the science behind exploding cell phone batteries because lithium dendrite growth often causes a Li-ion battery to short out and catch fire. Recent experimental studies suggest that ionic liquids (“room-temperature molten salts”) and polymers

*continued on page 4*



## Awards and Achievements

Three department members were recognized this year for their long service to the University: **Ravi Pandey** (25 years), **John Jaszc-zak** (25 years), and **Andrea Lappi** (35 years). Thank you for your dedicated service!

Congratulations to **Bryan Suits**, who ran the 2017 Boston Marathon in April!

**Ben Manning** and **Kelci Mohrman** were the 2017 recipients of the Ian Shepherd Award, presented by alumna **Carly Robinson**. The award recognizes our outstanding undergraduate seniors. Ben has also been named a Georgia Teaching Fellow by the Woodrow Wilson National Fellowship Foundation and is pursuing graduate work in education at Piedmont College. Kelci received honorable mention from the NSF's Graduate Research Fellowship Program and is a PhD student in physics at Notre Dame.

**Crystal Massoglia** is the 2017 Department Scholar.

Department alumna **Carly Robinson** was awarded the first Henes Center for Quantum Phenomena Distinguished Alumna Award. Robinson graduated with a BS in Physics from Michigan Tech in 2007, received her PhD from the University of Colorado, and is currently a senior product strategist/science advisor with the US Department of Energy.

**Goaxue Wang** was awarded the prestigious Director's Fellowship at Los Alamos National Lab, New Mexico, where he spent the 2017 spring semester.

**Mingxiao Ye**, PhD candidate, published a review article entitled "Recent Advances in Electronic and Optoelectronic Devices Based on Two-Dimensional Transition Metal Dichalcogenides," in *Electronics* as a feature paper. An image of the 2-D crystals synthesized by Ye appeared as the cover image of the printed version. ([mdpi.com/2079-9292/6/2/43](http://mdpi.com/2079-9292/6/2/43)).

Several graduate students received university awards. **Shiva Bhanderi** received the Graduate School Dean's Award for Outstanding Scholarship, **Tyler Capek** received the Summer 2016 DeVlieg Fel-

lowship, and **Teresa Wilson** received the Graduate School's Outstanding Teaching Award. **Hugo Ayala Solares**, **Bishnu Tiwari**, and **Gaoxue Wang** were supported during Fall 2016 with Finishing Fellowships.

The graduate research oral and poster presentations were given in February and April 2017, respectively. The oral presentation award went to **Kevin Waters**; **Kamal Chandrakar** received the poster presentation award.

**Jesse Nordeng**, master machinist, received the Michigan Tech Making a Difference Award in the Creative Solutions category. He was recognized for his collaborative nature and ability to find ingenious solutions to tough problems.

**Gary Shiflet**, Physics alum (MS '74) and William G. Reynolds Professor at the University of Virginia, will be the new NSF Program Director for the MPS/DMR Metals and Metallic Nanostructures (MMN) Program. Gary earned his BS and MS in Physics and his PhD in Metallurgical Engineering from Michigan Tech. Congratulations to him on attaining this important position of service to the research community.

The Michigan Tech chapter of the **Society of Physics Students** (SPS) was named a Distinguished Chapter. Our chapter has been named either Outstanding or Distinguished Chapter every year since 2009.

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## Department Updates

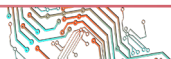
Three faculty members were involved with the search for signals from the neutron star merger detected on Aug. 17. **Petra Huente-meyer** is a member of the HAWC collaboration, which searched for high-energy gamma rays associated with the merger. The results were published in the journal *Science* (<http://science.sciencemag.org/content/358/6365/911>). **David Nitz** and **Brian Fick** are members of the Pierre Auger collaboration, which looked for high-energy neutrino emissions. The results of these observations (and many others) were published in *Astrophysical Journal Letters* (<http://iopscience.iop.org/article/10.3847/2041-8213/aa91c9>).

Physics office assistant positions were upgraded to reflect duties and responsibilities consistent with other academic departments across campus. **Claire Wiitanen**, administrative aide 7, provides financial support and assists with research accounting. **Rachel Griffin** joined physics as an office assistant 6 to assist with graduate programs, colloquia, and research proposal form processes.

Outreach activity in the department continues. **Teresa Wilson**, PhD candidate, gave seventh graders from Houghton Middle School a short presentation on astronomy and astrophysics. Students used telescopes fitted with solar filters to view sunspots. Teresa presented a similar event to the fourth grade class at the Barkell Elementary School in Hancock. The **Society of Physics Students** presented Family Physics Night at Chassell Elementary and participated in the Western UP Science Fair and Festival.



*Carly Robinson (center), named the first Henes Center for Quantum Phenomena Distinguished Alumna, presents the Ian W. Shepherd Award to seniors Kelci Mohrman (right) and Ben Manning (left).*



## Recent Funding

**Alex Kostinski** is the principal investigator on “Correlated Random Processes in Physical and Radar Meteorology,” a project that has received a \$156,119 research and development grant from NSF. This is the first year of a potential three-year project totaling \$477,948.

**Raymond Shaw** is the principal investigator on a project that has received a \$98,855 research and development contract from the Pacific Northwest National Laboratory. The project is titled “HOLODEC Participation in the ARM Campaign Aerosol and Cloud Experiments in the Eastern North Atlantic (ACE-ENA).” He is also the PI on a research and development project that has received a \$150,931 grant from the US Department of Defense, Air Force Research Laboratory (AFRL).

**Will Cantrell** and **Claudio Mazzoleni** are co-PIs on the project, “An Investigation of the Suitability of a Laboratory Cloud Chamber for Optical Radiative Transfer Measurements.” This is the first year of a two-year project potentially totaling \$316,374.

**Claudio Mazzoleni** is the principal investigator on a research and development project that has received \$400,321 from NSF.

**Jacek Borysow, Raymond Shaw, Will Cantrell,** and **David Ciochetto** are co-PIs of the project, “MRI: Development of a Water Vapor and Temperature Mapping System to Study Cloud-Turbulence Interactions in the MTU Pi-Chamber.” This is the first year of a two-year project potentially totaling \$316,374.

**Ravi Pandey** is a co-PI on an interdepartmental project that has received a \$1 million research and development grant from NASA. Greg Odegard from Mechanical Engineering is the principal investigator, along with co-PIs Julia King and Trisha Sain.

The project, “Institute for Ultra-Strong Composites by Computational Design (US-COMP),” is potentially extendable to five years and \$14,999,995.

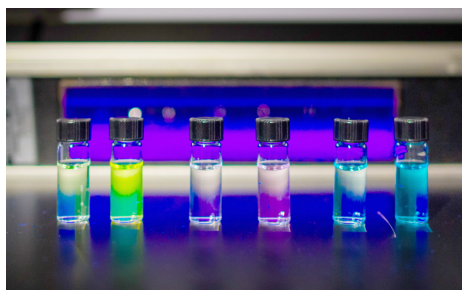
**Chad Brisbois** is one of only 53 graduate students nationwide to receive funding through the US Department of Energy’s Office of Science Graduate Student Research Program. He is currently spending the Fall 2017 semester at Los Alamos National Laboratory.

**Kamal Kant Chandrakar** received a NASA Earth and Space Science Fellowship. Kamal is a PhD student in atmospheric science working with Raymond Shaw.

**Illiya Chibirev** and **Owen Cruikshank** received Summer Undergraduate Research Fellowships.

## In the News

**John Jaszczak**, professor and adjunct curator of the A.E. Seaman Mineral Museum, has been in the news due to two mineral discoveries. Along with an international team of scientists, he was responsible for proving the uniqueness of a new mineral, now named merelaniite, which so far has only been found in one mine in Tanzania. In June, merelaniite was selected as the 2016 Mineral of the Year by the International Mineralogical Association. Additionally, Jaszczak was honored in November 2016 when new bismuth and gold sulfide discovered in the Börzsöny mountain range in Hungary was named jaszczakite.



*High brightness fluorophores, produced by Stabilux Biosciences, are used to detect diseased cells in blood.*

This year, StabiLux Biosciences, a startup founded by professor **Yoke Khin Yap**, received funding through NSF’s Small Business Technology Transfer Program, the Michigan Economic Development Corporation’s Small Company

Innovation Program, and Michigan Tech’s Superior Innovations.

The company is a spin-off of Yap’s research in high-brightness fluorophores. It produces dyes that fluoresce in different colors and brightnesses for use in flow cytometers to detect diseased cells in blood. The tunable nature of the dyes allows for better detection of cells than current methods.

One million miles from Earth, a NASA camera is capturing unexpected flashes of light reflecting off our planet, and **Alex Kostinski** has helped identify them as ice particles high in the atmosphere. The story was widely reported, including news articles by *Scientific American*, *Nature*, NASA, Health Medicine Net, and Astrobiology Web.

## Recent Degree Recipients

### 2017

	Destination
Hugo Ayala Solares, PhD	Penn State
Jie Li, PhD	Ventura College
Bishnu Tiwari, PhD	—
Gaoxue Wang, PhD	Los Alamos National Laboratory
Lokesh Gona, MS	—
Mehdi Sadatgoltabarestani, MS	—
Teresa Wilson, MS	Michigan Tech
Michael Foetish, BS	Michigan Tech
Tyler Harp, BA	—
Austin Hermann, BS	Northrup Grumman
Ben Manning, BA	Piedmont College
Kelci Mohrman, BS	University of Notre Dame
Kevin Rocheleau, BS	—
David Russell, BS	Montana State University
Parker Schimler, BA	Detroit Public Schools
Colin Sheidler, BS	Michigan Tech
Cameron Shock, BS	Michigan Tech
Raven Stone, BS	—
Nick Videtich, BS	Michigan Tech

**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](mailto:physics@mtu.edu). As always, we appreciate your continued interest in the Department of Physics at Michigan Technological University.

Gary P. Agin  
Anonymous  
Edward Augustyniak '94 & Monika  
Sujczynska  
BAE Systems  
Robert & Dorene Bauer  
Theodore L. Bedore '72  
Benevity Community Impact Fund  
John '69 & Louise Bretney  
Ziyong Cai '88 & Ping Zhou  
Russell '63 & Joan Compton  
John '50 & Eugenia Evans  
Fidelity Charitable Gift Fund  
Walter '48 & Edith Gabriel  
James '68 & Lynne Gekas  
Kenneth '79 & Lynn Genutis  
Kyle J. Gorkowski '11  
Joel H. Graber '87  
Daniel F. Hammang  
Frank '58 & Shirley (dec.) Hastedt  
Heidelberg Inst for Theoretical Studies  
John & Sherry Jaszczak  
Stanley '70 & Christine Jefferson

Joe '60 & Ann Jenney  
David R. Kalliainen  
Anil '02 & Uma Kandalam  
Paul '76 & Peggy Kaptur  
James '59 & Carole Kauppila  
Walter '64 & Margaret Kauppila  
Esther & Rolland (dec.) Keeling  
Peter A. Kiefer '02  
James M. Kilpela '59  
Gregory M. Kinney '16  
Joyce & Arne '52 (dec.) Koskela  
Thomas '84 & Renee Kugler  
Jack '62 & Kaethe Labo  
Samuel C. Lambert '62  
Robert '61 & Eugenia '64 Lind  
Gerald & Delphine Mc Master  
Ronald '56 & Judith (dec.) McKee  
Ronald '64 & Hermine Meyer  
Paul '71 & Joanne Michaels  
Jeffrey '84 & Suzanne Morris  
Dale '68 & Lauren Mukavetz  
Richard & Marion Nienhaus  
David Nitz & Mary Marchaterre

Brenda & Samuel '63 (dec.) Ochodnický  
Harold W. Paul '75  
Thomas '69 & Sharon Plutchak  
Steven J. Puro '11  
William '66 & Dorothy Roth  
Joseph Roti Roti '65 & Stephanie Pagano  
(dec.)  
Suresh K. Sampath '98  
Thomas & Sharon Silvis  
James '63 & Janice Strahl  
Donald '73 & Carolyn Szenina  
T Rowe Price Program for Charitable  
Giving  
Glen J. Tauke '72  
Alfred '69 & Deborah Trapanese  
C. John '64 & Kathryn Umbarger  
SriramaSwaminat Venkataraman '98 &  
Kalpana Chandrasekharan  
Werner '66 & Tamara Vogt  
David E. Woon '84  
Charles '66 & Mary Zeigler  
Gary '72 & L. Lynn Zulauf

## Postdoc Spotlight

*Nabanita Saikia*



**Nabanita Saikia** received her PhD in Theoretical and Computational Chemistry at Tezpur University, India, in 2014. She was a postdoctoral research fellow at Indian Institute of Technology (IIT) Bombay, University of Akron, Ohio, and University of Colorado Boulder, prior to joining Michigan Tech in April 2016. Her research areas include Biomolecular Recognition at the Solid/Liquid Interface, Molecular Self-Assembly and Computational

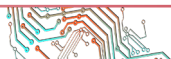
Drug Delivery. She has several publications in peer-reviewed journals and is a reviewer in journals such as *Scientific Reports*, *2D Materials*, *Applied Surface Science*, and *J. Physics: Condensed Matter*. She received three best poster awards and chaired a technical session in the COMP-Materials Science Division at the American Chemical Society Spring 2017 meeting. She had been an invited speaker at various research forums including a Tech Talk in Fall 2016. She has mentored undergraduate, graduate, and exchange students on their projects, which have been published in peer-reviewed journals and presented at national meetings.

Apart from being an avid researcher, she is also passionate about teaching. She taught courses at IIT Bombay, University of Colorado Boulder, and is presently an instructor at the Department of Chemistry at Michigan Tech. She likes to integrate advanced teaching techniques with conventional teaching and makes learning fulfilling for students.

Nabanita intends to pursue her career in academics and explore solutions to challenging fundamental research problems using high-computing computational techniques in the field of nanoscience and nanotechnology.

## Current Research *continued from page 1*

could ameliorate this technical problem, but the complete mechanism of the observed phenomena largely remains elusive. Thus, to address this challenge, our computational algorithm has been developing through the significant effort of graduate students in our group. The dendrite grows in response to the local electrostatic potential and exhibits fractal structures. We suspect that the growth mechanism should be significantly affected by various molecular parameters, such as the dielectric response of liquids, polymer architecture, and meta-liquid interfacial structure. We have aspirations that the theoretical study of this field would provide a new paradigm in soft-condensed matter physics.



## Graduate Spotlight

*Kamal Kant Chandrakar*



**Kamal Kant Chandrakar** is a PhD candidate working with Raymond Shaw. He joined Michigan Tech in fall 2014, after finishing his master's degree in Mechanical Engineering (fluid dynamics) at Indian Institute of Science, Bangalore. His research interests include cloud microphysics, cloud-aerosol-turbulence interaction, and turbulent convection. Kamal's PhD work focuses on understanding the turbulence-induced aerosol effects on cloud microphysics using analytical tools and experiments in

the Michigan Tech Pi-chamber facility, and he has published in *Proceedings of the National Academy of Sciences*, *Geophysical Research Letters*, and *Bulletin of the American Meteorological Society*. In 2017, he received a NASA Earth and Space Science Fellowship. Kamal's long-term goal is to pursue a research career in cloud physics and academia.

Kamal is grateful for the guidance and encouragement of Raymond Shaw and Will Cantrell, and thankful to the Pi-chamber group. He also acknowledges all support from the chair, Ravindra Pandey and the physics department.

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## Staff Spotlight

*Claire Wiitanen*



**Claire Wiitanen** is one of the department's new office assistants. She provides and maintains a high level of financial and administrative support for faculty, staff, and students.

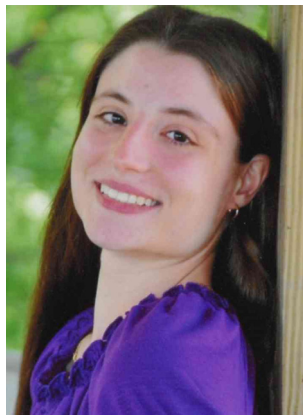
Claire graduated from Michigan Tech in 2010 with a BS in business administration. Before joining the physics department, she worked at Zimmer Spine in Minneapolis as a document control coordinator, spent a season in Anchorage, Alaska, working for Salmon Berry Tours,

and was the office manager at Discover Chiropractic in Hancock.

When she's not at her desk, Claire enjoys spending time with her family, traveling, and getting outdoors to ski, run, mountain bike, and camp.

## Senior Spotlight

*Crystal Massaglia*



**Crystal Massaglia** is a fifth year physics and applied/computational mathematics double major with an astrophysics minor. She says, "My time at Michigan Tech has been filled with many opportunities to learn, both in academics and in research. These opportunities have encouraged me to go further with my educational goals."

In her time at Tech, she has participated in two research projects. The first was under Will Cantrell in the physics department, where she used her engineering background to design a stage to be cooled and a holder for a small vacuum chamber. Using the stage, she studied heterogeneous ice nucleation rates. Her second project is with Cecile Piret in the math department. She is using a finite difference method to simulate the initial conditions of the orbits for the outer four giant planets in our solar system.

Crystal has received a certificate of excellence in nine of her math classes, won the Women of Promise Award from the math department, the Departmental Scholar Award from the physics department, and was nominated for the Goldwater Scholarship. After graduation, Crystal plans to attend graduate school and earn a PhD in astronomy, then conduct research either at a university or a national laboratory.

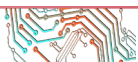
*Illiya Chibirev*



**Illiya Chibirev** is a fourth-year student at Michigan Tech pursuing a degree in physics and applied/computational mathematics. He has also been a student athlete, competing for the men's varsity tennis team.

During his time in the physics department, he received a Summer Undergraduate Research Fellowship, which allowed him to work on a project under the guidance of Jacek Borysow. They used laser spectroscopy to determine changes in temperature and composition of the atmosphere by studying the roto-vibrational states of molecules from Raman scattered photons. The work continues as part of Illiya's senior research, where he will be using a more powerful laser to resolve the rotational lines of oxygen and nitrogen. By analyzing the ratios of the upper and lower rotational states, they will be able to precisely measure changes in temperature.

After graduation, Illiya intends to pursue a degree in medical physics, where he plans to study radiation oncology and its application to the treatment of cancer. He is excited to have the incredible opportunity of using his education in physics in order to help others in need.





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## Physics News

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*Merelaniite, first discovered in 2011, was confirmed to be a new mineral by a team led by John Jaszczak. The mineral was named the 2016 Mineral of the Year by the International Mineralogical Association.*