

## LETTER FROM THE DEPARTMENT HEAD

Hello to our alumni and friends,



It has been awhile since our last newsletter and a lot has changed. For example, my name is Dave McIlroy and I am the new Head of the department. I came to OSU last year after 20+ years at the University of Idaho, where I served as Chair for four years. I am an experimental condensed physicist, where I study materials and phenomena at the nanoscale. What condensed matter physicist doesn't, right? I have really enjoyed my first year at OSU and working with my colleagues in the department. We have a fantastic group of faculty and staff. Enough about me.

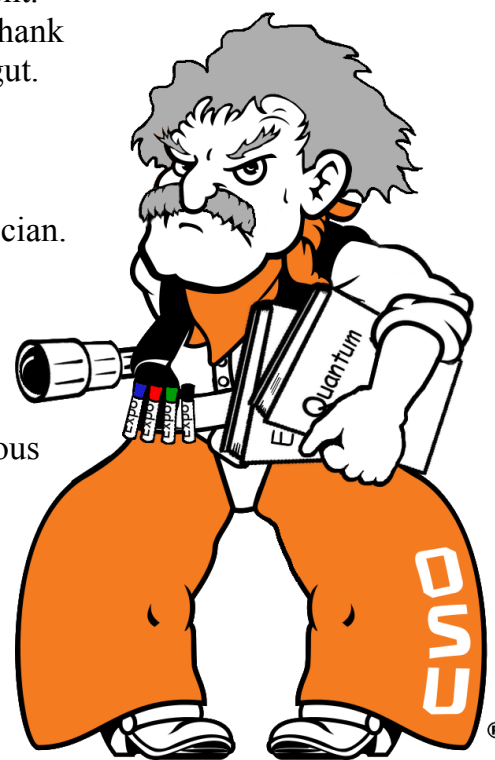
There have and continue to be many changes to the face of the department. In particular, Bruce Ackerson is retiring after four decades of service! Thank you, Bruce! We have a new faculty member by the name of Emrah Turgut. Emrah is a condensed matter experimentalist who comes our way via Cornell University (postdoc) and the University of Colorado-Boulder. Welcome, Emrah! In addition, we have the green light to hire two new faculty during the upcoming year – one experimentalist and one theoretician.

As for our students, we have approximately 50 physics majors, which I believe is the largest in the history of the department. I can't take any credit for this. The faculty have been working hard to recruit and create an inclusive atmosphere for all of our students. We are growing our efforts to get our physics majors into the lab and reflected by the numerous scholarships and awards garnered. Our graduate program is also doing well. If you know any great physics majors, send them our way.

The department's goal is to continue to grow our footprint across campus and the community. We have excellent support from the college and plan to continue to demonstrate the value of a high quality physics program. We hope you will stop by the department for a visit next time you are in town.

### In this issue:

- New Faces
- Faculty Honored
- Degrees Granted
- Student Projects & Awards
- Alumni News
- Undergrad Opportunities
- Grants Awarded
- Faculty Retiring
- New Faculty
- Society of Physics Students
- Astronomy and Observatory
- Department Highlights
- Featured Publication



## NEW FACES

### New Additions to Our Staff

We have had a few new faces join us in our department over the last year. In the office, Beth Bridenstine joins Susan Cantrell and Alisha Leach as Administrative Support Assistant II. Alisha has moved to Financial Assistant II and Susan is as amazing as ever in her role as Administrative Associate. Along with our new Department Head, Dr. McIlroy came two post-docs, Elena Echeverria and Lyndon Bastatas. And while Dr. Shaikh Saad and Dr. Saki Khan are not new faces, they have joined us as Visiting Assistant Professors. In the Instrument Shop, Megan Wick has joined Larry Vaughn's crew.



## FACULTY HONORED

### Dr. Flera Rizatdinova Receives 2017 Regents Distinguished Research Award



**Dr. Flera Rizatdinova** was one of six faculty honored on Dec. 6 at the annual University Awards Convocation. Recipients are selected based on evidence of outstanding and meritorious research achievements and are recognized nationally and internationally in their fields of study.

Dr. Rizatdinova investigates high-energy physics to understand properties of fundamental elements in the universe. She came to OSU in 2005 to start a high-energy physics research group, which led OSU scientists to join two international research collaborations, the ATLAS Detector experiment at CERN in Switzerland and a study of the interaction of elements at the Fermi National Accelerator Laboratory in Illinois.

### Dr. Donghua Zhou Receives 2018 OSU President's Fellows Faculty Research Award

**Dr. Donghua Zhou** received the 2018 President's Fellows Faculty Research Award to study the structure of protein mortalin in complex with cancer drug SHetA2. This study is expected to provide accurate information for structure-guided design of compounds with the best cancer inhibition power and the least toxicity. Dr. Zhou was one of the three faculty honored at the 2018 Researcher's Reception on March 28.



## DEGREES GRANTED

### PhD Degrees

|               |             |
|---------------|-------------|
| Shaikh Saad   | Summer 2017 |
| Shuo Dai      | Fall 2017   |
| Hem Moktan    | Fall 2017   |
| Oliver Causey | Spring 2018 |
| Adam Coleman  | Spring 2018 |
| Siamak Dadras | Spring 2018 |
| Rajesh Panthi | Spring 2018 |

### Master's Degrees

|                     |             |
|---------------------|-------------|
| Percy Nebah         | Fall 2017   |
| Nishan Shrestha     | Fall 2017   |
| Amruthaa Sundararaj | Spring 2018 |

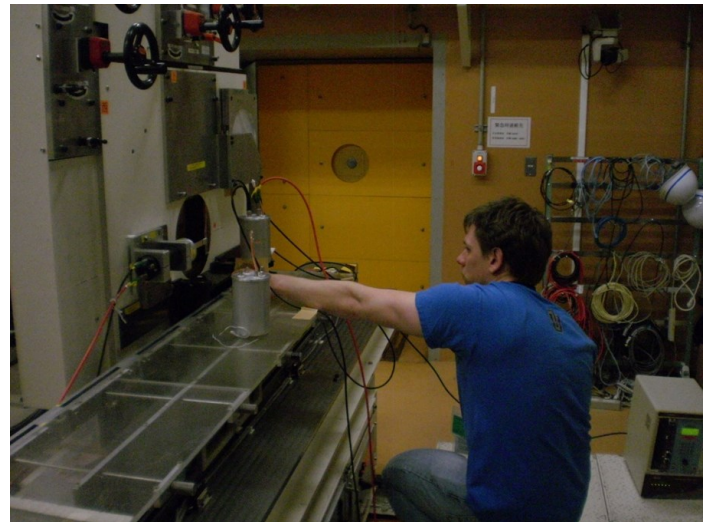
### Bachelor's Degrees

|                 |             |
|-----------------|-------------|
| Cameron Racz    | Fall 2017   |
| Charith DeSilva | Spring 2018 |
| Tristen Lee     | Spring 2018 |
| Brian Ragsdale  | Spring 2018 |
| Cosmo Binigar   | Spring 2018 |

## STUDENT PROJECTS AND AWARDS

### OSU Physics goes to space

The Active Tissue Equivalent Dosimeter (ATED), developed by OSU physics Ph.D. students Oliver Causey and Bryan Hayes of the Radiation Physics Laboratory, was sent to the International Space Station (ISS) aboard the OA9 Antares resupply mission on May 21, 2018. ATED is a compact, portable, low cost ionizing radiation detector designed for use on a range of different platforms including manned spacecraft, unmanned satellites and space probes, high altitude balloon flights and on commercial, civil (business) and military aircraft. The instrument is based on a gas-filled tissue equivalent proportional counter designed to simulate a  $\sim 3 \text{ mm}^3$  biological cell such that the sensitivity of the detector to ionizing radiation is similar to that of human tissue. ATED, developed with support of a NASA



**OSU Graduate Student, Oliver Causey adjusting the ATED detector head during calibration exposures at the HIMAC heavy ion accelerator in Chiba, Japan**



**Active Tissue Equivalent Dosimeter flight unit prior to delivery to NASA**

EPSCoR grant, is scheduled to operate for six months, after which it will either be returned to OSU or be handed over to the Space Radiation Analysis Group at NASA Johnson Space Center for further operation on ISS.

Exposure of astronauts to elevated levels of ionizing radiation is one of the major hazards of spaceflight—especially long duration space missions such as the human exploration of Mars or the establishment of human habitats on the Moon. Real time monitoring of the radiation levels that space crews are exposed to will be essential on human exploration missions. ATED will measure the radiation dose received by crew during spaceflight as functions of time and the orbital location of the ISS.

## STUDENT PROJECTS AND AWARDS

### Solmaz Bastani and her teammates win Pitch & Poster Competition

It is our pleasure to announce that **Solmaz Bastani**, a Physics PhD candidate in Dr. Jongmin Cho's Medical Physics Laboratory, along with her teammates, MBA student Imran Salim and MSE student Misti Quirling, won first prize with their business idea in the Spears School of Business Pitch and Poster Competition. They presented "Self-illuminating Quantum Dots to Image Cancerous Cells" in a 90-second talk as if they were in an elevator with a potential customer to see whether he was interested in investing in their start-up company. This year, 25 teams participated with 2 rounds of serious competition and Solmaz's team won first place in the STEM field. The team received a cash prize of \$1500 and free admission to Startup Weekend.



### OSU doctoral student wins research fellowship at Argonne National Lab

**Wasikul Islam**, a graduate student in physics at Oklahoma State University, has been selected for a prized research fellowship at the Argonne National Laboratory (ANL) in Chicago, one of the largest science and energy laboratories in the U.S. The laboratory usually hosts only two interns a year in its high energy physics division, and Islam, who is already familiar with the facility, will work there for one year thanks to the research fellowship.

"Last summer I worked at Argonne National Lab as a research aide in the HEP Center for Computational Excellence Summer Internship program. I am very happy to get this expanded opportunity to go back to Argonne and work there again for a much longer period of time," Islam said. "I'm especially grateful to my adviser, Dr. Alexander Khanov, and other professors in our research group at OSU for their guidance and support."

The fellowship, which includes a \$20,000 stipend, is provided by the ATLAS research group at ANL to graduate students whose universities participate in the ATLAS experiment at the Large Hadron Collider at the CERN laboratory near Geneva, Switzerland. OSU's Experimental High Energy Physics research group has been a member of the ATLAS collaboration since 2010. The ATLAS experiment involves the search for new discoveries based on the collision of high energy protons.

Islam will be participating in work toward upgrading the pixel tracker, which is the innermost part of the ATLAS detector for the High Luminosity Large Hadron Collider and essential for allowing scientists to better analyze the products of proton collisions and draw insights. The objective of the project is to ensure that the upgraded detector is able to cope with increased collider luminosity and make the rare processes the collider can generate observable in more detail. The upgraded version of the collider is expected to become operational in the year 2025.



### Gil M. Repa from Dr. Zhou's Lab Receives Wentz Research



Congratulations to **Gil M. Repa**, a Biochemistry major working in Dr. Zhou's Biological Physics group, on his reception of a Wentz Research Grant. Recently, Gil also won 2nd place in OSU College of Arts and Sciences Undergraduate Three Minute Thesis (3MT) Competition on February 23, 2018. In the event, undergraduates presented their own research in 3 minutes with the assistance of only one power point slide. Scholarships ranging from \$500 to \$1,250 were awarded to the 1st through 5th place winners. The title of his presentation was Structure-based Drug Design for Cancer. His presentation can be viewed on ostate.tv, starting at about 33 min. On April 14, Gil presented again at an OSU Heritage Foundation Celebration fundraising event.

## ALUMNI NEWS

### Michelle Shinn Doing Well at Department of Energy



**Michelle Shinn** was born and raised in Oklahoma, and received her Physics degrees at Oklahoma State University. After receiving her PhD, she joined Lawrence Livermore National Lab in 1984, working in the Laser (Y) Division, until 1990, when she left to join the faculty at Bryn Mawr College as an Associate Professor of Physics. In 1995, she started at Jefferson Lab as a staff scientist. From 1996-1999, she led the design, procurement, and installation activities for the IR Demo free-electron laser (FEL) optical cavity, transport and diagnostics, and from 1999 to 2006 performed the same duties on the Upgrade FEL, which is still the world's highest power tunable ultrafast laser. For her work at Jefferson Lab and earlier work on the use of lasers in society, in 2012 she was elected a

Fellow of the American Physical Society. In August of 2013 she started a 1 year assignment at the DOE Office of Nuclear Physics Facilities and Project Management Division, and finding she liked the environment, joined the Office in Jan. 2016. She is the Program Manager for Industrial Concepts, responsible for the NP Small Business Innovative Research program and is working to strengthen ties with industry in order to foster the development of commercial applications from nuclear physics research.

## UNDERGRAD OPPORTUNITIES

### Dr. Mario Borunda and Dr. Alexander Khanov host REU Summer 2018



**National Science Foundation Supported Physics REU Site:**  
Multidisciplinary Research Experience for Undergraduates at  
Oklahoma State University, Department of Physics



This summer, undergraduate students were supported per year for ten weeks of summer research. The primary objective was to immerse students in a stimulating multidisciplinary research atmosphere that would allow the participants to pursue a personalized research project in physics. This REU program develops human resources that enhance the nation's technology base and are critical for the well-being of society at-large.

There were research projects available in several research areas including Atomic Physics, Computational Physics, Experimental and Theoretical High Energy Physics, Optical Physics, Optoelectronics, and Quantum Information Sciences. Participants also attended seminars on a variety of topics including both professional development and careers in physics, received ethics and safety training, and engaged in cohort activities with the other students. This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

## GRANTS AWARDED

### OSU physicists land \$1.27 million grant from Department of Energy

(STILLWATER, Okla., Oct. 6, 2017) – Five high energy physicists from the Oklahoma State University Department of Physics have secured a major grant from the U.S. Department of Energy worth \$1.27 million to conduct fundamental research in elementary particle physics. The grant, which is spread over three years, will support research in experimental particle physics led by Drs. Flera Rizatdinova, Alexander Khanov and Joseph Haley as well as theoretical physics research led by Drs. Satya Nandi and Kaladi Babu.



Rizatdinova is a professor of physics and the leader of the high energy experimental physics program at OSU, Khanov is an associate professor of physics and Haley is an assistant professor of physics at OSU. All three are involved in the international ATLAS experiment at the Large Hadron Collider in Geneva, Switzerland, and have contributed to the discovery of a new fundamental particle, the Higgs boson. Their current research focuses on searching for new fundamental particles associated with supersymmetry as well as very heavy, yet-to-be-seen particles known as vector-like quarks. The OSU team is also involved in the upgrade of the ATLAS detector scheduled for the near future.

Nandi, the principal investigator of this grant, and Babu are Regents Professors in the physics department. Their research focuses on new theories leading to new particles and phenomena that may be discovered at the Large Hadron Collider. Such theories include new types of Higgs bosons, new dimensions beyond the known three, supersymmetry and unification of particles and forces.

This Department of Energy grant will also support theoretical explorations in neutrino physics, in particular, new phenomena that may be revealed in the Deep Underground Neutrino Experiment (DUNE) which is under construction in the US. This experiment involves neutrino beams - beams of elusive particles that rarely interact - shot from the Fermi National Accelerator Laboratory (Fermilab) near Chicago and detected in a deep underground mine in South Dakota some 1,300 km away, and looks for quantum entanglements of different species of neutrinos. Babu is currently a Distinguished Fermilab Scholar and spends time there in the summer for research collaboration, along with his students.

This grant will enhance the participation of the OSU high energy physics group in research at the world's highest energy particle accelerator, and will support students and postdoctoral fellows, with some stationed at the CERN laboratory. It will also enhance OSU participation in research at the "intensity frontier" associated with neutrino oscillations, and will enhance collaborations with Fermilab and will provide opportunities for OSU students to participate in research at the national lab.

Brian Petrotta | Arts and Sciences

## FACULTY RETIRING

### **Professor Girish Saran Agarwal, FRS, DSC. (H.C.) retires after a long and distinguished career at Oklahoma State University.**

After many years at Oklahoma State, Dr. Agarwal has retired.

He currently has taken a position with Texas A&M University.

Best known for his pioneering contributions to quantum optics, quantum statistics and coherent control of quantum systems, Dr. Agarwal also made major contributions to the fields of nonlinear optics, nano photonics and plasmonics. He contributed more than 650 reviewed papers to a wide range of topics in the fields of optics and quantum optics. In 2013, he published his textbook - Quantum Optics (Cambridge University Press), covering a wide variety of recent developments.

Girish S. Agarwal has received numerous awards for his achievements in the field of optics and quantum optics. This includes the Einstein Prize for Laser Science (1994), the TWAS Prize in Physics (1994), and the Shanti Swaroop Bhatnagar Award in Physical Sciences by the Government of India (1982). He was invited to the Sir JC Bose Chair at the Indian Institute of Science Education and Research (IISER), Pune, India, and the JRD Tata Chair at The Tata Institute of Fundamental Research, Mumbai, India. In 2012, he was recognized by Oklahoma State University with the “Eminent Faculty Award”.



### **Professor Bruce Ackerson retiring next September.**



After forty-plus years, Dr. Bruce Ackerson will be retiring this September.

“I will hang up my spurs on September 5, 2018. That's right, I'm done, finished, quitting, going out to pasture, retiring. Mind you, it's been a great run at OSU. Lanie and I didn't think we would be here more than a few years, but a department where people get along is hard to leave. While I continue to publish, I'm not taking students nor seeking external funding. At age 70, I must take retirement distributions. So, it's time to clean out the dead wood. But I'll still be around in my office and ready to show off my demonstrations.”

## NEW FACULTY

### **Emrah Turgut, Ph.D. joins us in the Fall as our newest Assistant Professor**

We would like to welcome our newest Assistant Professor, Emrah Turgut, Ph.D. Turgut received his Ph.D. from the University of Colorado Boulder in 2014. From there he moved to Ithaca, New York to be a Postdoctoral Associate at Cornell University. We are excited to have him this Fall.

“We study materials because we are curious how materials show countless different properties. High energy physicists call the family of elementary particles as a zoo. Because they trap them in LHC and study them in a controlled way. We also study elementary and sometimes quasi-particles, but in a condensed matter environment, which is like a jungle, unlike a zoo. Our typical 10<sup>21</sup> electrons can behave violently in this jungle and result in magnetism, superconductors, topological insulators ...”



# SOCIETY OF PHYSICS STUDENTS

## Message from SPS



The OSU Chapter of the Society of Physics has been busy this year! We had a blast at our annual fall picnic, and we are already planning for the spring picnic too. In February, we set up a table at Will Rogers Elementary for the STEM fair, where we demonstrated some neat physics with the generous assistance of a Van de Graff generator. Back in December, we had a physics department Secret Santa where many undergraduates and Dr. Haley exchanged gifts. We've also been working hard at our two projects: a telescope, and a trebuchet. Lastly, we have hosted several speaker lunches with the various colloquium speakers to provide the undergraduates a place to learn about the various research being done by professors outside of our school. Stay tuned for all the neat things the SPS will be doing in the coming year!



# ASTRONOMY AND OBSERVATORY

## Eclipse

August 21st, 2017 was a spectacular day for seeing a total solar eclipse. If one took a little drive, they could see the eclipse in totality. The moon's shadow crossed 14 states, from Oregon to South Carolina.



## Work at the Observatory

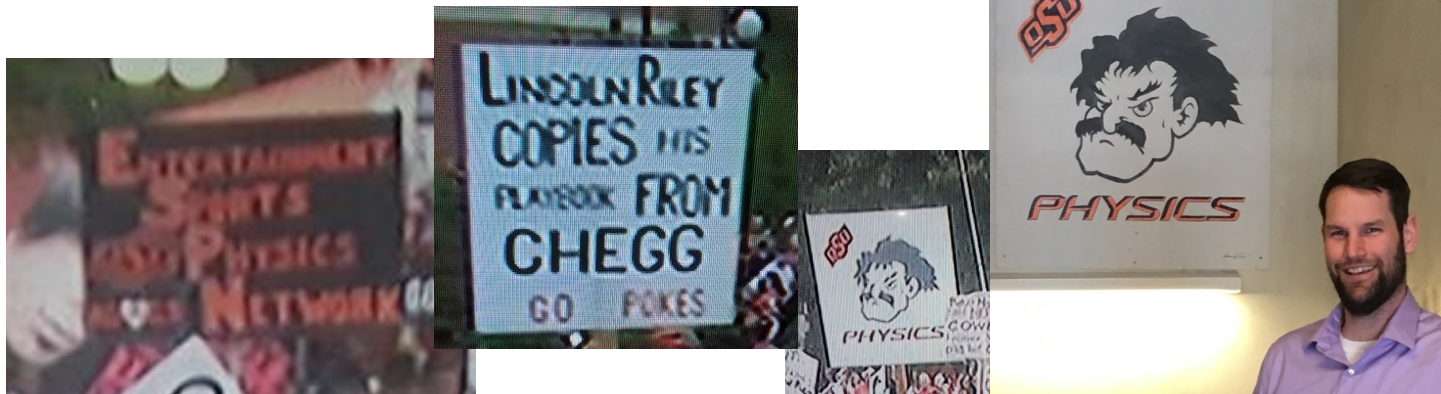


Dylan Chapman and Mingzheng Yang uncovering the water line at the Observatory.

# DEPARTMENT HIGHLIGHTS

## OSU Physics Crashes ESPN College Game Day

Did you happen to catch College Game Day on ESPN? Thanks to the creative insight, artistic ability, and early morning motivation of Dr. Joseph Haley and Dr. David McIlroy, OSU Physics was front and center for the entire ESPN viewing audience. Dr. Haley's now famous Pistol Einstein Pete currently hangs in the stairwell of Physical Sciences II.





## FEATURED PUBLICATION

### Unexpected Patterns in Snow and Dirt

**Bruce J. Ackerson, Oklahoma State University, Stillwater, OK**

For more than 30 years, Albert A. Bartlett published “Thermal patterns in the snow” in this journal.<sup>1-12</sup>

These are patterns produced by heat sources underneath the snow. Bartlett’s articles encouraged me to pay attention to patterns in snow and to understanding them. At winter’s end the last snow becomes dirty and is heaped into piles. This snow comes from the final clearing of sidewalks and driveways. The patterns observed in these piles defied my intuition. This melting snow develops edges where dirt accumulates, in contrast to ice cubes, which lose sharp edges and become more spherical upon melting. Furthermore, dirt absorbs more radiation than snow and yet doesn’t melt and round the sharp edges of snow, where dirt accumulates.



Fig. 1. Note the dirt decorating the sharp edges of this melting three-dimensional structure.



Fig. 2. Here dirt decorates edges, and large concave pockets appear free of detritus.

Figures 1 and 2 give representative examples of melting snow that had been cleared from sidewalks. Note the sharp edges where dirt accumulates. At the valley bottoms little dirt is observed.

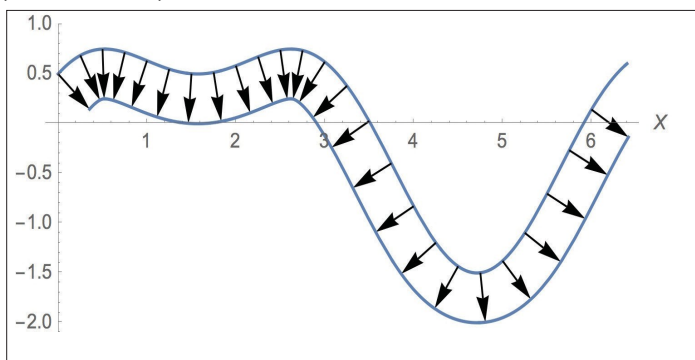


Fig. 3. The upper curve is a plot of  $[x(s,0), z(s,0)] = [s, h(s)]$ . The lower curve is a plot of  $[x(s,t), z(s,t)]$  for  $\alpha t = 0.5$ . Here  $h(s) = \sin(s) + \frac{\cos(2s)}{2}$ . The arrows are lines of constant  $s$ , are perpendicular to both curves, and represent the direction of melting. All the arrows are the same length and connect the one-dimensional snow surfaces at two different times.

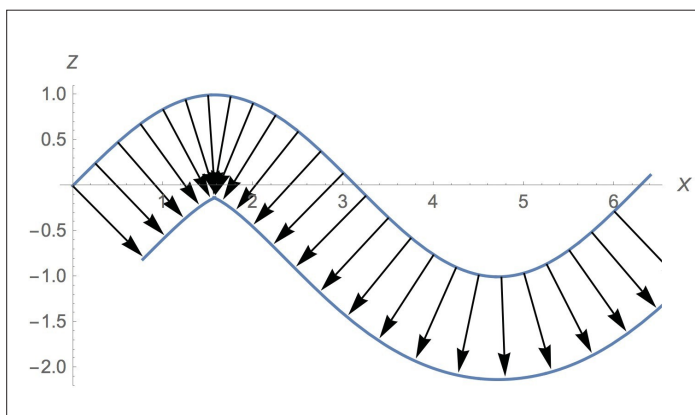


Fig. 4. The upper curve is a plot of  $[x(s,0), z(s,0)] = [s, h(s)]$ . The lower curve is a plot of  $[x(s,t), z(s,t)]$  for  $t = 1.1$ . Here  $h(s) = \sin(s)$ . The arrows are lines of constant  $s$ , are perpendicular to both curves, and represent the direction of melting. All the arrows are the same length and connect the one-dimensional snow surfaces at two different times. A kink or discontinuity in slope occurs at the maximum of the lower curve.

A hint for an explanation comes from Rhodes et al.<sup>13</sup> They find that dirt particles move perpendicular to the snow surface on which they sit. If the snow surface is not horizontal, the dirt will move both vertically and horizontally. Let’s assume the dirt and snow surface move together in a direction perpen-

Consider the upper curve in Fig. 3. This represents a one-dimensional snow surface. Spaced nearly evenly along this curve are arrows directed normal to the curve. All arrows are the same length, indicating the same rate of melting everywhere. The resulting surface is defined along the arrow tips. A piece of dirt, starting at an arrow tail on the original surface, ends at the arrow tip of the new surface. Interestingly, the ar-