Department of Physics

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Friend

19-Jul-17

Dear Friend :

With the current academic year being over, we are eager to bring you the latest news from the McMurry Physics Department.

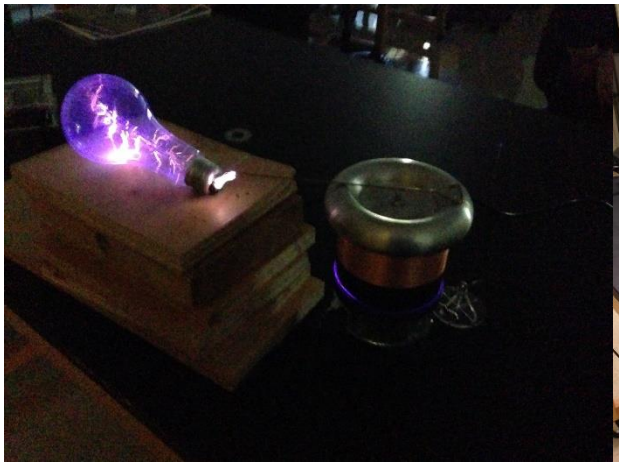
This year the department had three graduating seniors: Kirk Hodel, Ryan Pittman and Robert Schmidt. All of them have been working hard to complete their senior research projects on time.

Kirk Hodel, working under the supervision of Dr. Bykov, completed his project on "Feasibility of Wind Energy Production on a Small Scale". The goal of the project was to determine the feasibility of the construction of a small-scale wind turbine and using supplemental wind energy from that turbine to assist in providing power to a building. Feasibility was determined by three factors: cost-effectiveness, estimated ease of mass production, and minimum required wind speed. Upon construction of the prototype, wind speeds as low as 2 mph were able to move the turbine; however, as an effective gear system was not yet designed for the turbine axel no power was produced rendering a decision on the cost-effectiveness of the turbine inconclusive. As for the third factor that of ease of mass production, given the time and difficulties faced in the blade construction it does not seem to fill this point. Therefore, with only one factor being confirmed and a second inconclusive the overall conclusion will require more testing in the form of power generation. With this being said, it is clear that the project was a little too ambitious to be completed by a single student. However, this gives us an opportunity to use the prototype built by Kirk as a starting point for a future project by another student. The picture above depicts the turbine as it was tested in mid-April.

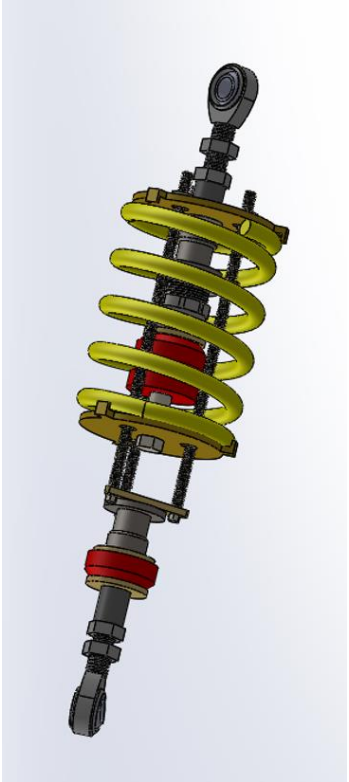
Some of you may recognize that the base of the turbine is built of recycled wood that many years ago was part of the first incarnation of McMurry Physics Trebuchet. So, the old trebuchet continues to live through this project, while the new trebuchet has received another facelift this year. The last wooden part, the arm, has been replaced with a metal piece. The testing of this new metal arm is left until the fall semester. Stay tuned for more news about that.

The "Wind Turbine" project also served as Kirk's honors thesis. It was presented to the public during the McMurry Academic Conference in April and during a formal thesis defense in May. Kirk graduated with a double degree in Physics with honors and in Math. He has been accepted to the Nuclear Program of the US Navy. After completing a series of interviews in the spring, Kirk will start his Navy training during the summer and will be deployed in September. Kirk is the second McMurry Physics graduate in recent history (after John Garza) who joined the Navy program. Congratulations to Kirk!

Ryan Pittman, working under the supervision of Dr. Keith, completed a project to build a musical Tesla coil. This work was inspired by another project started by physics graduate Tyler McCracken several years ago. The objective was to develop a working circuit for a musical Tesla coil. Musical Tesla coils create electrical arcs that discharge at different frequencies that correspond to musical notes. By varying this frequency, music may be created. At the first stage of the project (presented in the pictures), a kit was



assembled to better understand the inner workings of the digital circuitry. The circuit consists of three major parts: the interrupter, the logic portion, and the driver portion. For this project, a rather advanced interrupter kit was purchased to further the coil's capabilities. In the second stage of the project, a circuit for a full size Tesla coil was built. The logic and driver portion were laid out on separate boards due to different sized leads from components, as well as convenience for future troubleshooting. The coil was tested and presented to the public in early May. You can see a video of the small Tesla coil working on our Facebook page. Ryan graduated in May with double degree in Physics and in Math. In the fall, he will continue his education at Baylor University to purse a PhD in Physics. Ryan was also recognized as an outstanding physics senior this year. Congratulations!



Robert Schmidt, working under the supervision of Dr. Keith, has completed his project to study a torque link for a racecar. Being used in over 10,000 racecars all over the United States, the torque link is a vital part of the racecar's suspension in transferring weight from the front tires to the rear tires during the state of acceleration. The torque link is available in two different designs (presented in the pictures): having polyurethane bushings or a coil spring that may be linear or progressive as a means transferring mechanical energy. For this project, the two different types of torque links were tested and compared both numerically and experimentally. It was found that the polyurethane bushing torque link is stiffer than the coil spring torque link. Treating the torque link as a lever, it was discovered that the polyurethane bushing torque link with two "red" bushings transferred the most

weight to the rear tires, as it was the "stiffest" torque link. Likewise, the 800 lbs. coil spring torque link transferred the least amount of weight to the rear tires, as it was the "softest" torque link. Therefore, for sufficient amount of friction between the tire of the racecar and the track surface, the polyurethane torque link would be the optimal choice. If grip between the racetrack and the tire is lacking, a coil spring torque link would be the best choice to use. Robert presented his project to the public in early May. After graduation, he will applying to graduate programs in Mechanical Engineering. His overarching career goal is to get a job in the automotive industry.

This year one physics junior, Rody Johnson, presented his proposal for the project that he will start in the fall. Rody will be working under the supervision of Dr. Keith. Since Rody is actively involved with the University Baseball team, his proposal is to study how to maximize the force when hitting a baseball. He will determine whether the mass of the player hitting a baseball is an overall determinate of how much force he can exert on the baseball. If not, Rody will also analyze other variables that could result in the batter maximizing force when hitting. He will use various pieces of equipment along with a variety of hitters in order to determine what variables play the biggest role in hitting a baseball harder. Using the data acquired along with the laws of classical mechanics, he will be able to gain a better understanding of how to hit a baseball with maximum force.

There are several other student projects that were performed as parts of regular courses that are worthy of mentioning.

In the Electricity and Magnetism II course, which was offered by Dr. Bykov in the spring, Ryan Pittman and Kirk Hodel completed computational projects on "Numerical study of electrostatic potentials with cylindrical symmetry in two dimensions". Determining the electrostatic field and potential for different configurations of electric charge is time consuming, and depending upon the configuration difficult to experimentally measure. In such cases, taking an analytical or numerical approach is beneficial as it can allow for a faster approximation of the electrostatic field. When taking an analytical approach, the Laplace equation is solved using an appropriate set of boundary conditions and for a numerical approach, the Gauss-Seidel or Successive Over-Relaxation methods can be used through an iterative procedure to provide an accurate approximation. Ryan focused on a boundary problem corresponding to a cylindrical pipe with varying cross section and a cylindrically symmetrical top for a Tesla coil. Solutions to Laplace's equation in two dimensions were found with the help of different iteration techniques using numerical methods. The resulting distributions of electric potential and electric field were obtained. Kirk studied the electric potential and electric field next to a lightning rod that could be placed on the top of a large structure like a windmill. The results of both projects were presented to the public during the McMurry Academic Conference in April.

The McMurry Academic Conference has been growing through the last several years. This year not just current students, but two physics alumni participated. Taylor Freehauf, who is currently pursuing his Master's degree in Mechanical Engineering at Texas A&M University and Kent Grimes who is working on his Master's degree in Civil Engineering at Texas Tech came back to present the projects they completed last year when taking Classical Mechanics II with Dr. Bykov. Taylor talked about planetary orbits and the chaotic tumbling of Hyperion. Kent presented his study of precession of the perihelion of Mercury.

Another numerical project that was finally finished by Robert Schmidt this year was "Numerical study of Kirkwood Gaps". The purpose of this project was to simulate the Kirkwood Gaps in the Solar System, under the influence of Jupiter. The Kirkwood Gaps are orbital radii where few asteroids are observed because the orbital radius of the asteroid causes it to be in resonance with Jupiter. This problem could be resolved using the RK4 numerical method used for solving ordinary differential equations. The three-body problem of the Sun, Jupiter, and an asteroid could be simulated. The median of the 2/1 and 7/3 Kirkwood Gaps were used for the simulation. Both asteroids were unstable and flew off their orbits. It was found that an asteroid must be within .01 AU for it to be effectively "in" the Kirkwood Gap. Robert presented his findings to the public in late April.

The final project this year for "Automated Experiments" course was to make a device that read photo intensity from a photometer then translate this information into the audible spectrum for a human. This project was inspired by the singing tree trunk that is shown on YouTube. As part of a normal grade, students already learn how to read and translate photometer voltage into irradiance. Students also learn how to use

LabVIEW nodes to produce notes on their computers using the waveform constructs. Students made a piece of paper with varying lines of darkness. They then would move the photometer over the paper, which then generated the sound that related to that light intensity. The end result was something that sounded like a dialup modem but interesting. Students were also encouraged to try this with other objects.

In Advanced Physics Lab this spring, there were several projects for the final exam. Students were allowed to pick one of the experiments that was completed during the semester and modify how it was done, or allowed to pick something of interest to develop an experiment around. Students were given advice on how to perform the experiment and what data they would need to perform an analysis based on physical laws. Here is a list of what students did for their class project. Millikan Oil Drop using video tracker and a GoPro. Effect of angle of a dive on restitution of a body entering water. Specific heat of coffee and different creamers. Addition of another coil to the coil gun and the video analysis of a projectile fired from it. Frank-Hertz Experiment and a rewrite of a new lab.

In the Electronics course in the spring three different projects were completed with the common theme of revisiting past senior projects. Ryan Pitman's electronics project consisted of repairing and completing the coil gun previously build by Jordan Nix. The multiple coils were mounted with their common glass "barrel", and power distribution rails added for the two supply voltages needed to operate the device and the temporary jumper wires removed. This will make the coil gun more usable for classroom demonstrations. The induction furnace previously built by Heath Koop was revisited by Alexandria Mendoza, Jordan Speck, and Juan Valadez. The electrical circuit was redesigned and rebuilt, improving the energy transferred to a nail placed inside the coil enough to make it red hot, but not yet enough to melt the metal. A bigger power supply will probably be necessary for further improvements. Aaron Ramos' Battlebot was the subject of the project performed by Tyler Sanchez and David Winski. The plan was to replace the H-bridge built on a breadboard of multiple MOSFETs with a single integrated circuit chip. The new chip worked, but other problems and degradation from age with the remainder of the circuit prevented the robot from successfully running with the new H-bridge. However, it was demonstrated that the motors still work when run at full speed directly from the batteries.

We had another large freshman class this year. Fourteen students will continue to sophomore year. Our Modern Physics and Automated Experiments courses in the coming fall are completely full. Even the upper division Classical Mechanics has a record high ten students. However, we do not know yet how large our incoming freshman class is going to be, even though some seats in University Physics are already taken by some of last year's freshmen who did not have a sufficient math background last year. So, if you know of any prospective students who might be interested in a physics or engineering degree, please direct those students' attention towards McMurry Physics Program.

Last fall we were very glad to see many of you during the Homecoming reception. This year's Homecoming will take place during the weekend of October 6th-8th. You will be receiving a separate invitation for this event, but please mark your calendars.

We also hope that some of you will be able to participate in the "What did I do with my physics degree?" talk series. If you happen to be in Abilene for any reason, please do come see us, talk to our students, and learn about the latest news in the Physics Department. We are very grateful to Taylor Freehauf and Kent Grimes who were able to come this April and talk to our students about their experience in graduate school and about the transition from undergraduate to graduate education.

Some other student news from the past academic year are the following:

In January, first year physics student Chandi Chandler attended the national conference for undergraduate women in physics at Rice University, Houston TX. It was an unforgettable experience for Chandi. She has shared her impressions from the conference during several SPS meetings in the spring. In April, Chandi was also recognized as one of two recipients of the Dr. Sandra S. Harper Women's Leadership scholarship. She is active in the Society of Physics Students and will serve as treasurer during the next academic year.

The department is starting to put more emphasis on promoting summer research and internship opportunities among our students. We want to congratulate physics sophomores Tyler Sanchez and Patrik Morrison. Tyler has been accepted to participate in the Florida State University's RETREAT summer

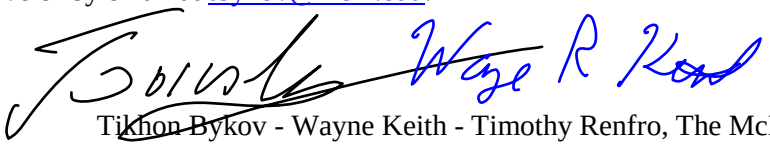
research program. He will be working as part of a research team to study Magneto-Additive Manufacturing of Tailored Composites. Patrik will be working with a summer program of the Air Force Research Laboratory at Kirkland Air Force Base, NM. He will be part of the research team working on Dynamic Plasma Coupling. Both students will be paid full-time salary for their summer work. First year physics student Casey Walters will complete a summer internship with a local engineering company in Abilene.

On Monday, August 21, 2017, a total solar eclipse will cross the entire United States, coast-to-coast, for the first time since 1918. The entire continent will have the opportunity to view a partial eclipse as the Moon passes in front of the Sun, but some areas of the continental United States will experience a full eclipse. The McMurry chapter of the Society of Physics Students is currently organizing a student trip just before classes start in the fall, to allow our students an opportunity to observe this unique event. Students will be traveling with Dr. Renfro to Kansas City, KS on August the 18th to tour the area. On the 21st, they will travel just north of Kansas City to make observations of the Eclipse and its effects on the environment. Dr. Keith will be traveling separately to Nashville, TN where he has been invited by Dr. Matthew Huddleston of Trevecca Nazarene University to participate in their eclipse activities as a visiting space physicist. Analyses of the observational data collected in Kansas City and in Nashville will be made in a report to the Texas Region of the Society of Physics Students in the next academic year.

At the end of the spring semester, Dr. Bykov was named the 2017 Gordon L. and Lola Bennett Award Recipient for his continuing contributions to outstanding teaching, scholarship, and service at McMurry University.

These were just some of the many events we had during the past academic year. You can always keep track of our current news by visiting us on Facebook (look for McMurry Society of Physics Students) or online at our web site is located at https://sites.google.com/site/mcmurryphysicsdepartment/home.

If you have been recently added to our database and never received this letter before and/or by some reason want to be removed from the list and/or prefer to update your contact information and/or prefer to receive an electronic instead of a paper copy of this letter, please do not hesitate to contact me at the address above or by email at tbykov@mcm.edu.



Tikhon Bykov - Wayne Keith - Timothy Renfro, The McMurry Physics Department