*Department of Physics*

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Friend

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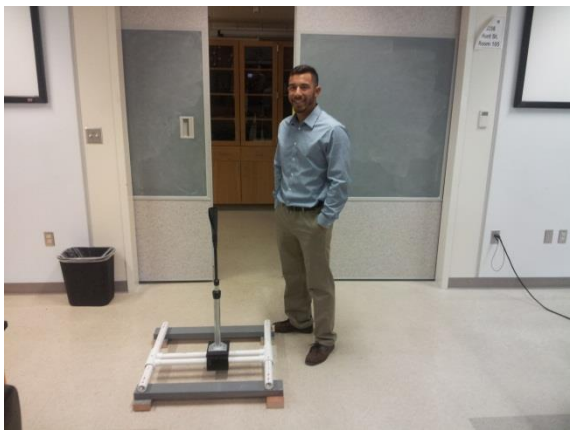
Dear Friend :

As this academic year came to an end, we would like to bring you the latest news from the McMurry Physics Department.

Throughout this academic year our seniors, Richard Garcia and Jacob Howdeshell, have been working on their senior research projects.

Ricky was working on his project under the supervision of Drs. Bykov and Renfro. The project entitled **"**Characterization and development of the ideal baseball batting tee" has been devoted to the study of how to improve baseball batting tee to make fundamental batting practice easier and more productive for baseball players. Baseball batting tees are known to be vital in the development of a hitter's swing, but also unstable and inconvenient. Current tees on the market are incapable of addressing two main concerns: 1) The tendency for the tee to fall over after contact with the bat, and 2) The extra work that hitters must perform to change the pitch location while using the tee. In this project design and analysis of a mechanical system capable of withstanding the force of the bat and moving to each location of the plate with ease have been undertaken, resulting in the construction of a final prototype. The prototype has taken advantage of an x-y table which allows the shaft of the tee to slide to any location in the hitting zone. Video analysis has been performed on the motion of the prototype, showing that the system successfully absorbs the force acted upon it by the bat, remaining upright at all times. Three designs were implemented and tested in the batting cage by the McMurry Baseball team. The study resulted in the successful construction and analysis of a final, working prototype ready for the batting cage. Ricky presented his project to the public in late April. The picture shows Ricky with the final prototype of his tee.



In the fall Ricky was elected to become a member of the McMurry Chapter of Sigma Pi Sigma, National Physics Honor Society. In May he graduated from McMurry as has been recognized as one of the two outstanding physics seniors this year.

We would also like to congratulate Ricky Garcia on being accepted to the MS program in Mechanical Engineering at Texas A&M University in College Station. He will be moving to College Station in the fall to continue his education there. After finishing his Master's degree Ricky ultimately hopes to find work in the field of research and development of athletic equipment and products.

Texas A&M School of Engineering is not completely new for Ricky. Last summer he was working there as part of a Summer Research Experience for Undergrads (REU) program. In the course of that

experience he was able to apply his knowledge of CAD SolidWorks he gained in the McMurry Engineering Drafting class towards the real engineering project of "Development and characterization of irrigation runoff sensor". The project was addressing the issue of water being lost during the irrigation process as runoff. It is known that current irrigation system technologies are incapable of managing water-loss in a time effective manner. The research group in which Ricky was working performed design and analysis of mechanical devices capable of detecting excessive runoff resulting in the construction of three different prototypes including a conductivity design, a float design, and a paddle-wheel design. Prototypes were calibrated to determine their working flow rates by measuring the flow rate at which the sensors were activated and remained stable. This study resulted in the successful construction and calibration of three runoff sensor prototypes ready for field testing. Ricky was able to present this work as a poster at a special REU symposium in Texas A&M at the end of the summer. He has also given a talk on the same subject to a group of science faculty and students at McMurry last fall.

Yet another poster presentation Ricky made under the supervision of Dr. Bykov at the McMurry Academic Conference this April was based on the project he completed as part of the Classical Mechanics II course last spring. In this work knowledge of classical mechanics was applied to analyze the behavior of a baseball in flight. More specifically, the projectile motion of a baseball in flight was analyzed to determine which external forces effect the trajectory of the baseball. While the force of the bat and initial angle are important, there are several different factors which also contribute throughout the flight path, such as drag forces. Through the analysis of the drag forces, a Fortran programming language code was written, using the RK4 numerical method, capable of predicting the trajectory of a baseball in flight for given initial conditions. Trajectories produced by this numerical model were then compared to those produced through video analysis to confirm the codes' reliability.

Another senior research project this year has been completed by Jacob Howdeshell, who was working under the supervision of Dr. Keith. Jacob's project is entitled "Conversion of combustion engine generator from gasoline to syngas". The goal achieved through this project is running a gasoline generator off of an alternative fuel, in this case syngas produced from wood chips, using low cost readily accessible parts. The original gasifier made in one of the previous senior research projects by Alistair Adams has been used, but unfortunately it has not been able to produce a large enough volume of syngas to power the generator for long periods, so natural gas has been substituted for load testing because of its similar molecular makeup. While running on natural gas, the generator's voltage was measured at different resistances and a load line has been created and compared to a load line for gasoline. The low cost of materials encourages the use of this process by the general public allowing for a practical conversion of biomass into energy. Jacob presented his project to the public in late April.

Jacob was also elected to become a member of the McMurry Chapter of Sigma Pi Sigma, National Physics Honor Society in the fall. This year he was serving as president of the McMurry Chapter of the Society of Physics Students. In May he graduated from McMurry and he has also been recognized as one of the two outstanding physics seniors this year. Jacob is planning to go directly into the job market after leaving McMurry.

A record high number of six junior physics students have started working on their senior research proposals this year.

Taylor Freehauf working under the supervision of Dr. Bykov has made a proposal for an Honors Thesis entitled "Dual Axis Solar Tracking System". It is known that with the growing concern of fossil fuels depleting and alternative energy interest increasing, solar panels have become progressively more utilized in not only residential instances but in commercial applications as well. Often these panels are not being used to their maximum potential if the sun is not directly angled at the solar panel. By incorporating a dual axis solar tracking system into these panels, rather than a fixed or single axis system, the panels become more efficient and in turn, produce more energy. Many solar panels do not utilized this more efficient method, as they are expensive to produce and require more difficult and more frequent maintenance than fixed or single axis solar panels. The purpose of this project will be to design and build a working apparatus, at a small and individual scale, in order to prove such a concept is possible. The final

product proposed to be delivered is a functioning prototype addressing the issues of the larger scale models.

We would like to congratulate Taylor and we are grateful to the Science and Math Advisory Board for awarding one of the two 2015-2016 Bloomer's Student Research Stipends to this project. Taylor was also elected to become a member of the McMurry Chapter of Sigma Pi Sigma, National Physics Honor Society in the fall and an Outstanding Physics Junior in the spring. He served as a vice-president this academic year and will be serving as the new president of the McMurry Chapter of the Society of Physics Students next year.

Kent Grimes working under the supervision of Dr. Bykov has made a proposal for a senior research project entitled "Hydroelectric Generator". It is known that alternative energy sources have increased greatly in importance in recent years. One such alternative energy source is hydropower. Hydro energy has been known and used by humans from ancient times, but in the age of the industrial revolution mega scale hydroelectric power plants have become dominant. The purpose of this project is to build a hydroelectric generator that could be used in a common household. Questions arise, such as, how much energy can such generator produce; can it be used to meet energy needs of the household? This hydroelectric generator will be constructed using the principle of electromagnetic induction known to any undergraduate physics student. Strong permanent magnets will be attached to a hydro wheel, while copper wire coils will be housed on a stationary frame. The project will start with the drafts of the hydro wheel, magnet and coil housings. These parts will be printed on a 3D printer, then a frame will be constructed to be sturdy and hold various parts aloft. Once the construction process is completed, the generator's electric output will be studied.

We would also like to congratulate Kent and we are grateful to the Science and Math Advisory Board for awarding the second of the two 2015-2016 Bloomer's Student Research Stipends to this project. Kent was also elected to become a member of the McMurry Chapter of Sigma Pi Sigma, National Physics Honor Society in the fall. He served as secretary this academic year and will be serving as the new vice-president of the McMurry Chapter of the Society of Physics Students next year.

Kristopher Valdez working under the supervision of Dr. Bykov has made a proposal for an Honors Thesis in physics and math entitled "Study of the Electro-magnetic Generator Pickup". The goal of this project is to create a numerical model of the magnetic field created by the "Electro-Magnetic Generator" active pickup for electric guitars, as well as to examine the electronics involved with the sound processing of the pickup. This everyday application of Faraday's Law will be studied to find a mathematical model of the field produced by the magnetic configuration specific to the EMG-85 active pickup. The model can then be used to predict inputs to the circuitry of the pickup, and by testing the circuit for voltage inputs and outputs, the model can be checked for accuracy. Once this accuracy is achieved, a detailed examination of how the circuit affects the final sound we hear will take place.

Another project that Kris was involved with this year was a numerical project of finding the electric potential and electric field of a two-dimensional cylindrically-symmetrical boundary problem as part of the Electricity and Magnetism II course taught by Dr. Bykov. In this project electric potential was first measured experimentally, but then a series of numerical finite difference methods for solving Laplace's equation for electric potential were used. Both numeric and experimental results were found to be in very good agreement. The practical experience with programming in Fortran gained by Kris while working on this project will be essential when he starts the numerical modeling of the magnetic field for his senior research project next year.

We would also like to congratulate Kris on the birth of his first child in the fall and on being named an Outstanding Second Year Physics Student in the spring.

D. Jordan Nix working under the supervision of Dr. Keith has made a proposal for a senior research project entitled "Coil Gun (Gauss rifle)". A coil gun is a device that uses an electromagnetic coil to create a magnetic field to attract ferromagnetic objects. The goal of the project is to build and working prototype of such a coil gun. With this apparatus, it is not creating the magnetic field attracting to the metal object that's difficult, but getting multiple coils to work in series to achieve maximum velocity. In order to achieve that, one has to address the circuitry of the coils, and have them turn on and off at certain times. To

reach maximum velocity of the coil gun, Jordan will have to study the bullet to coil ratio, meaning the length of the bullet in comparison to the length of the coils; and how long the wire is able to hold the specific amount of current being used.

Jordan will also be serving as the new treasurer for the McMurry Chapter of the Society of Physics Students next year.

Robert Schmidt working under the supervision of Dr. Keith has made a proposal for a senior research project entitled "A Study of the Torque Link". This project grew out of Robbie's passion for stock car racing. In the project he will be creating two different types of torque links for race cars and comparing the two against one another. A torque link connects the rear end to the chassis above the driveshaft; under acceleration the torque link pushes down on the rear end, and under deceleration, the torque link tries to lift up the rear end. The two types of torque links, also known as pull bars, being used are a progressive coil spring torque link and a urethane bushing torque link. By comparing the force vs. displacement exerted at each end of the pull bar, one can see which pull bar would be more effective creating force pushing down on the rear end of the race car so that it can load the rear tires, ultimately helping produce better acceleration.

Marco Flores working under the supervision of Dr. Keith has made a proposal for a senior research project entitled "Theory of the Evolution of Baseball Bats". The purpose of the project is to compare the efficiency and dynamics of several different types of baseball bats (Wood bat non composite one piece, BESR one piece aluminum bat, and BBCOR one piece aluminum bat). Experimental data collected from the study of the bats will be compared to the analytical data found in literature. The three different ways that the bats will be tested are: Stationary Ball vs. Bat swing (Batting Tee), Stationary Bat vs. Pitched Ball (Pitching Machine), and Bat Swing vs. Pitched ball (Live Pitching). The goal for this project is to see if experimental data are consistent with the known information for these types of bats.

This year Marco served as the treasurer for our chapter of the Society of Physics Students and next academic year Marco will be serving as the treasurer of McMurry Student Government.

There are several other student projects being performed by our students as parts of their regular courses that are worthy of mention here.

In the Automated Experiments course in the fall the project was to conduct an experiment using National Instruments LabVIEW, Elvis, and an Arduino Uno in conjunction with an automated x-y table, built by a previous class. The x-y table was used to move a photo sensor across a sheet of paper with a design drawn on the paper. The outcome of the experiment was to produce a digital image of the paper using the contrast between light and dark spots on the paper. This technique is heavily used in academia and industry for collecting spatial data.

In the Engineering Statics course in the fall all students were required to design a "spaghetti bridge" as a final project for the course. The tasks in this project were to design a bridge made of spaghetti that had a road bed wide enough for two hot wheels to pass on the roadbed, span a gap of two feet, hold a weight of at least twice the bridges weight, and write an engineering report giving geometric details of the design using Solid Works 3D CAD software as well as a calculation as to how much the bridge could actually hold. The model bridges were tested with a toy car.

In the Engineering Dynamics course in the spring the students were to design a lifting engine that would be able to lift a weight of 5 kg for a distance of 0.50 m off its resting surface using a small 3V electric motor with the torque of 15 gcm. Students also had to write an engineering report giving the geometric specifics of their engine using Solid Works 3D CAD as well as show the calculations as to how much their engine should be able to lift. All of the students in this class used the department's 3D printer to produce parts for their engines.

In the Advanced Physics Lab in the spring the project this year was to conduct video analysis of the Millikan Oil Drop Experiment instead of using a manual approach of measuring time while observing droplets moving across a grid. In the course of the project a student group was able to attach a video camera to the Millikan Oil Drop apparatus and analyze the motion of droplets using the "Tracker" video analysis software. To succeed with this task students had to design an adapter for a GoPro 3 camera in

Solid Works 3D CAD and print it on the department's 3D printer. With this adapter, the students mounted the camera on to a microscope.

In the Electronics course in the spring the project was to repair an old non-working microwave oven donated by a student. The problem was determined to be with a control chip and the challenge was successfully resolved by converting the microwave to manual control.

Our freshman class was not as strong this year as it was last year. Three physics majors and two minors should continue to the next year, but as usual at this time of the year we are asking for your help to direct any prospective students who might be interested in physics or engineering degrees towards the McMurry Physics Program.

As usual in the fall, we were very glad to see some of our recent graduates; including Austin Wegner and Jeanette Schofield, as well as a somewhat older generation of physics alumni, represented by Adam Davidson during the Science Homecoming Reception. Adam, who is currently working with oil and gas facility development in Midland, has graciously agreed to become the Homecoming speaker for the 2015 Homecoming Reception. You will be receiving a separate invitation for this event which will take place during the weekend of October $9^{th}$-$11^{th}$ 2015. Please mark your calendars.

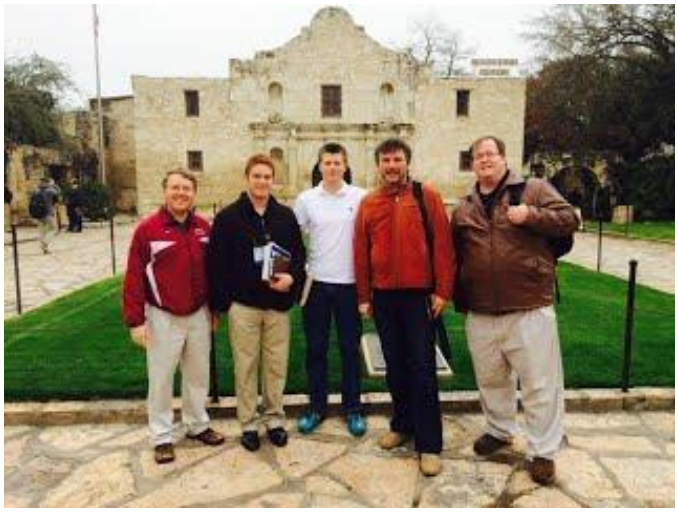
We hope to see even more of you as speakers in the "What did I do with my physics degree?" series as well as our visitors during homecoming in future years. If you happen to be in Abilene for any reason, please do come to see us and our students and learn about the latest news in the Physics Department.

One of the biggest news last fall was that in November the Physics and Chemistry Departments were able to sign an articulation agreement with the University of North Dakota (UND) to deliver full scope engineering degrees in Mechanical and Chemical Engineering to students on the McMurry Campus. University of North Dakota is the only school in the country that has a complete ABET accredited engineering program delivered online. Therefore, through this collaboration McMurry students will have a unique opportunity to combine the solid foundation of a small liberal-arts school education with professional preparation at a large university. McMurry will deliver foundational courses in physics, chemistry, math and even some introductory level engineering courses, while UND will provide upper division engineering courses online. Moreover, even when students are taking online courses from UND during their junior and senior years they will still receive assistance from McMurry faculty and will not be left completely on their own. This program is designed as a five year program. At the end of the program students will receive two BS degrees. Mechanical Engineering track will lead to a BS degree in Physics with minor in Mathematics from McMurry and an ABET accredited BS degree in Mechanical Engineering from UND. Chemical Engineering track will lead to a BS degree in Chemistry with minors in Physics and Mathematics from McMurry and an ABET accredited BS degree in Chemical Engineering from UND. Students will therefore be getting a much broader education compared to one they would have gotten by completing a standard engineering program. This will open up more career paths to these students including the possibilities of going to graduate programs in physics or engineering as well as employment in technical fields and teaching. Typical engineering preparation is very much focused on a single engineering branch, while having additional physics background would allow for easier transition from one engineering field to another in case a student's future career path requires such a transition. This program may be especially attractive to the local Abilene population, since currently it is the only way to obtain an ABET-accredited engineering degree almost without leaving Abilene. (This program would require students to travel to UND for a several week period during one summer (ME program) or two summers (ChE program,) to complete laboratory portions of some courses). This coming fall will be the first time when incoming students will be able to take full advantage of this dual degree program. We are looking forward to this recruitment opportunity, but as usual we are also asking you, our alumni and friends, to spread information about this new program to people who might be interested in engineering preparation at McMurry.

Some other news from the past academic year include the following.

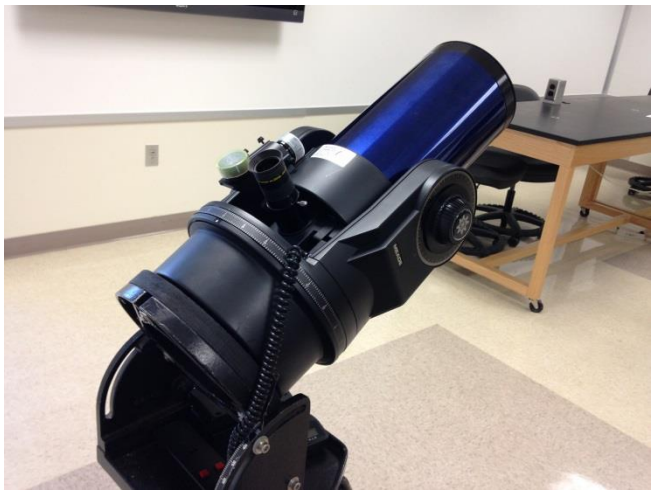
In October all physics faculty traveled to the Texas Section of the American Physical Society (APS), American Association of Physics Teachers (AAPT) and Society of Physics Students (SPS) joint meeting at Texas A&M University in College Station. The meeting included several interesting talks in the areas of high energy physics and physics education.

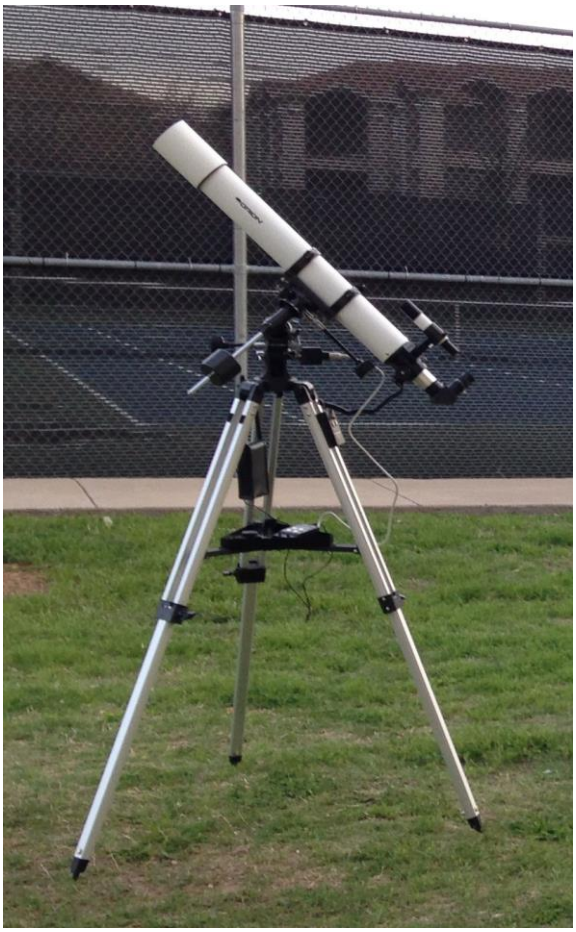
In October all physics faculty and a group of physics students took a tour of the Wind Farm near Snyder TX. During that tour we were able to learn about basic operations of a wind farm. We are grateful to Dr. Renfro for organizing this tour.



In March all physics faculty and two physics students Kent Grimes and Kirk Hodel attended the National Meeting of the American Physical Society in San Antonio. It is not very often that our students have a chance to attend such a big professional meeting and it was a unique experience for them to be able to interact with physics professionals as well as other physics students from all over the United States and abroad. Several talks at that meeting were especially interesting. In particular, one devoted to the History of Physics and common misrepresentations about the scientific contributions of famous physicists such as Galileo and Einstein. There was also a surprisingly interesting set of talks on biomechanics which included a good deal of mechanical engineering. While visiting San Antonio, we were also able to take a tour of the Southwest Research Institute main campus. During that tour we had a chance to attend several research facilities including the lab which works on designing the future generation of cars that will be able to drive automatically without significant input from human drivers. We also visited the Space Science Division working on various sensors to be placed on satellites. Finally, we attended the nondestructive testing laboratory headed by McMurry Physics alumnus Dr. Glenn Light. We are grateful to Dr. Keith for organizing this tour as well as to Dr. Light for hosting our group while at Southwest Research Institute.

Several physics students were able to visit with the Science and Math Advisory Board members during the spring SMAB meeting and talk about their future career plans. We are grateful to the SMAB for providing this opportunity for students.





In the spring semester, the department received a donation of two new high quality telescopes (a Meade ETX-125EC Astro, an Orion Astroview 90mm EQ, and associated accessories). Dr. Keith has already begun to use these telescopes to conduct observations with his Astronomy students and for other local groups such as the Boy Scouts, Girl Scouts, and the Cisco Science Club. We are grateful to Rebecca DeVore (in memory of her late husband Larry DeVore) for this generous gift.

This May also marks the last semester that Dr. Alicia Wyatt served as the Dean of the School of Natural and Computational Sciences. As a result of the academic reorganization at McMurry this Dean's position will be eliminated starting this summer. We are very grateful to Dr. Wyatt for her leadership guiding the McMurry science programs through the difficult time of change and moving many of our programs to new levels of success. In particular, we would like to thank her for the many contributions to the well-being of our Physics program. We are looking forward to the new opportunities that this academic reorganization can bring and want to support Dr. Wyatt's enthusiasm and devotion to her work as she returns to full time teaching in the fall.

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