

Physics Newsletter

2023 - 2024

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Dear Friend

Greetings from the Physics Department at McMurry University! As we are finishing yet another academic year full of interesting and exciting events, we want to share our latest news with you.

We have three graduates this year. One graduated in December, another one in May and the last one will be finishing in August.



Senior Student Showcase

Chloe Gatch

HOMETOWN: ALEDO, TX

Chloe Gatch, working with Dr. Keith, completed her senior research project on the design and study of an autonomous Vehicle. The focus of this project was to understand how the external sensor system of an autonomous vehicle contributes to the features of auto-stopping and collision avoidance. It is important to understand how autonomous vehicles operate, since this technology has been proposed as a viable solution to address greenhouse gas emissions, a way to improve the quality of life for the disabled and elderly, and to help reduce the number of lives lost to motor vehicle-related accidents. To study an external sensor system, a robot prototype was created and programmed using an ultrasonic sensor for data collection. An ultrasonic sensor uses sound pulse emissions to gather information related to proxemics. The project verified how an ultrasonic sensor worked and gave insight into how an autonomous vehicle would operate. We are grateful to the Science and Math Advisory Board for supporting Chloe's project with one of the 2023-2024 Charles and Lisa Bloomer Student Research Stipends. At the academic year's end, Chloe was recognized as an Outstanding Physics Senior and received the Piper-Bottom Award for Excellence in Physics. Her name is now engraved on a plaque outside of the Physics Department. After graduating in December, Chloe is still thinking if she wants to continue her academic career with a graduate degree in medical physics, electrical engineering or to attend a medical school. To gain additional experience in one of these fields, she is currently working as a medical scribe in a hospital in Wichita Falls, TX.





Jake Woodward

HOMETOWN: NORTHLAKE, TX

Jake Woodward, working with Dr. Keith, completed his senior research project on Concept Deer Feeder. The goal of the project was to design and build a technologically advanced deer feeder. The design can be adapted into several different styles of deer feeders with little modifications, depending on the situation of how one would want to provide deer feed for their animals. It uses a 55-gallon barrel, an Arduino, and stepper motor to control when and how the feeder opens and closes. During his presentation in May, Jake walked the audience through how he built and designed his feeder as well as what challenges he faced along the way. Since graduating in May, Jake has been looking for different types of engineering positions in industry. His overall career goal is to work as an engineer in construction management.

Isaiah Alvarez

HOMETOWN: ABILENE, TX

Our last graduate this year is Isaiah Alvarez. He will be graduating in August and will become our first graduate for the new Engineering Physics degree. He was also working under the supervision of Dr. Keith and will finish his senior research project on Shredding for Sustainability: The Designing and Implementation of a Plastic Shredder over the summer. Isaiah's goal for this project is to create an efficient process of plastic bottle shredding. The shredder will incorporate three stages with compression, shredding, and dumping. The goal for the final product is for the machine to dump 1.5"- 2" plastic strips to be sold to different recycling companies. We are grateful to the Science and Math Advisory Board for awarding Isaiah's project with the second of the 2023-2024 Charles and Lisa Bloomer Student Research Stipends. We are looking forward to the public presentation of his project in August.



Congratulations to our Graduating Seniors!

Left photo: December graduation ceremony, from left to right – Dr. Keith, Mr. Jake Woodward, Ms. Chloe Gatch, and Dr. Bykov.

Right photo: May graduation ceremony, from left to right – Dr. Bykov, Dr. Renfro, Mr. Isaiah Alvarez, and Dr. Keith.



Junior Research Proposals



Matthew Pyle

HOMETOWN: BEDFORD, TX

Matthew Pyle, working with Dr. Keith and Dr. Joseph Atchison from Abilene Christian University, is planning to learn more about Gravity: The Mystery of the Simplest, Yet Most Complicated Thing in The Universe. He wants to do a literature review over a recent CERN experiment on how antiparticles behave under the influence of gravity and study explanations of gravity at different academic levels. He will also study the historic development of theories of gravitation. He will study inconsistencies between the most successful gravitational theories with the goal of producing a concise overview of the subject accessible to an undergraduate student.

Kane Strohman

HOMETOWN: KATY, TX

Kane Strohman, working with Dr. Keith and Mr. Upshaw, will be developing a project on a residential rainwater purification system. In his presentation, Kane stated that high quality water is a human necessity that cannot be taken for granted. Aging infrastructure, climate change, and underfunded water systems have caused millions of Americans to not have tap water they can trust. His project will address this problem by detailing the design of a system for residential areas that collects and purifies rainwater effectively and affordably.



Elijah Gregory

HOMETOWN: BILLINGS, MT

We are expecting that another physics junior, Mr. Elijah Gregory, will present his senior research proposal in August. Elijah is working with Dr. Renfro on the design of a 3D printed jet engine.

Thermodynamics II

As part of the Thermodynamics II course offered by Dr. Bykov, Chloe Gatch and Elijah Gregory worked on the project Computer Generated Art using Density Functional Theory in a 2D Lattice Gas Model. The project's objective was to produce computer-generated artistic effects, based on the wetting behavior and phase transitions of a modeled inhomogeneous fluid. A MATLAB code was developed that was meant to mimic the condition of traditional art medium where a flat surface is covered by a liquid substance like paint. The parameters, such as temperature, saturation, and strength of the surface attraction could be varied. Depending on these parameters, the surface will exhibit

different wetting behavior with the substance being absorbed or not absorbed. The next step in this project is to modify the code by modulating the strength of the surface attractive potential with the RGB values from an existing photo image file to produce painting like effects for these images. Both Chloe and Elijah will continue working with Dr. Bykov through the summer to take this project to the next level, where it can be presented at a conference or published in a peer-reviewed journal. Dr. Bykov is grateful to the Virgil E. Bottom Endowed Professorship Fund for supporting this work.

Classical Mechanics

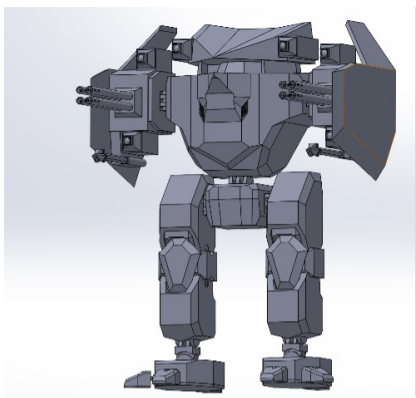
Another student project was completed as part of the Classical Mechanics II course that was also offered by Dr. Bykov. The class project was focused on MATLAB programming applications. In the project, nonlinear effects in vibrating strings were studied with the Runge-Kutta (RK45) numerical method. In this study, the students modeled and analyzed the behavior of freely vibrating strings and vibrations under the influence of an external driving force. The results were then compared to approximate analytical models. The results of that project were presented at the McMurry University Undergraduate Research Symposium at the end of April. An oral presentation on nonlinear effects in vibrating strings observed through numerical analysis was given by Isaiah Alvarez and Matthew Pyle.

Automated Experimental Measurements

Another student project was completed as part of the Automated Experimental Measurements course offered by Dr. Renfro in the fall. For this project, a group of students including Marie Ange Uwituze, Zarius Garcia, Victor Huerta, and Matthew Pyle created several designs and built prototypes for storm detectors that use electric potential and charge distribution variations to locate nearby thunderstorms. The device is quite sensitive and may serve as a detector to observe potential storms and electric discharges in the environment. Matthew Pyle presented the project at the spring meeting of the Texas Section of the American Physical Society at Tarleton State University in Stephenville, TX, and at McMurry University's Symposium for Student Research, Scholarship, and Creative Works in April.

CAD

In the CAD course offered by Mr. Upshaw, each student worked on their own small engineering project, where the project parts were designed and assembled in the SolidWorks engineering CAD



software. Prototypes for some of these projects were later 3D printed. The projects ranged from a sci-fi fighting robot to a wind turbine and a surfboard. Most of these projects were presented as posters at the McMurry University's Symposium for Student Research, Scholarship, and Creative Works. The picture on the left is a mechanized fighting robot designed by engineering physics student Alex Smith. A working prototype has been printed and is on display in the engineering physics laboratory.

Electronics

In the Electronics course offered by Dr. Keith this spring, students Marie Ange Uwituze and Matthew Pyle undertook a project to document and build a production version of the digital dice project prototype designed by previous Electronics student Kris Valdez in 2016. The students carefully documented and learned about the dice circuit with its multicolor LEDs and control circuits and transferred the components of one of two existing dice onto a permanent project board from the prototype breadboard. The documentation was completed, and the circuit was finished except for a few connections. Matthew plans to complete and troubleshoot the circuit over the summer.

Advanced Physics Lab

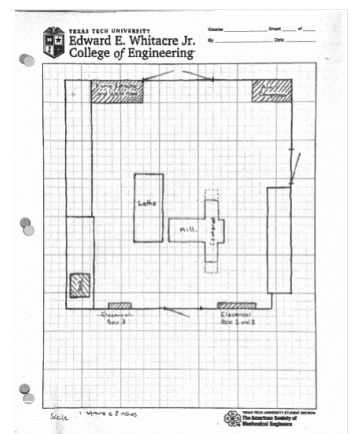
In the Advanced Physics Lab, a group of students, including Elijah Gregory, Zarius Garcia, Victor Huerta, and Jaumarian Barnett, built and tested mini rockets with "candy" (sugar-based) fuel. They designed and 3D printed rocket motor casings and "cooked" the fuel mixture for these rockets. The students had a lot of fun working on this project.

Another Advanced Physics Lab project, Detecting Radioactive Uranium Traces in Oil Drilling Equipment, was performed by the same group of students. A spectrum of gamma radiation measured from a drilling pipe collected at a west Texas oil field was studied. This spectrum was compared to one produced by uranium ore to show that there are substantial traces of that ore in the material of that pipe. The results of this project were also presented at the McMurry University's Symposium for Student Research, Scholarship, and Creative Works. The Physics Department is also grateful to the Title V Department of Education funding for supporting the purchase of new nuclear radiation spectrometers.

Manufacturing Engineering

In the new Manufacturing Engineering course, also offered by Mr. Upshaw, Isaiah Alvarez and Kane Strohman worked on a project to build a quality work environment, both physically and mentally, in our machine shop, using the lean production philosophy and 5S methodology. The five S's of lean are: sort, set in order, shine, standardize, and sustain. The project introduced the class to implementation of visual control and lean production

tools to improve safety, decrease equipment downtime, lower defect rates, reduce costs, increase production agility and flexibility, improve morale, increase asset utilization, and enhance enterprise image to students, employees, and management. The accompanying picture shows a current shop layout created by the team at the start of the project.



The Rise of Engineering at McMurry

Our new Engineering Physics degree is becoming more popular with students. This year Mr. Upshaw offered courses Mechanics of Materials and Fluid Mechanics in the fall and Heat Transfer and Manufacturing Engineering in the spring. Dr. Bykov also offered a revised version of the Classical Mechanics II course. The summer bridge program Lift Off has entered its second year with students already on campus taking classes. Another great program that some incoming STEM students can participate in is the STEM-Scholars Program, sponsored by the National Science Foundation. This program provides scholarships to outstanding STEM students that, in combination with other McMurry scholarships, results in free tuition. These scholars will also get the benefit

of having official student mentors selected from upper classmen who will help them throughout their student career at McMurry. This year, two first-year Engineering Physics students were selected to participate in the STEM-Scholars program and four more physics students received the Ward-Bottom Science Scholarship. Both programs are unique opportunities to make McMurry University education more affordable and accessible to students in need. As our program continues to redevelop and grow, if you know of any prospective students who might be interested in both the physics and engineering aspects of our offerings, please direct those students' attention towards the McMurry Physics Program.

SPS Chapter News 2023–2024

This year, our Society of Physics Students (SPS) chapter was as busy as always. We have continued with our project of building a go-kart vehicle thanks to the generous support from the McMurry Student Government. The building of the frame was finished this year, and the assembly of the vehicle will be continued next year. We are grateful to Mr. Upshaw and the SPS members who have spent several weekends working on parts of this project.

Once again, the SPS National Office recognized the McMurry University Chapter of the Society of Physics Students as an Outstanding Chapter for the 2022–2023 academic year. This is the fifth time in a row that our students were recognized. Elijah Gregory, who served as our chapter president this year and will continue serving in the same capacity next year, was recognized with the McMurry Wally Outstanding Junior award for his role as the chapter president. He and Marie Ange Uwituze will also be participating in the McMurry Student Leadership Intensive program for students interested in practicing their leadership skills. The program will involve leadership training workshops and conferences at McMurry and outside campus.

Throughout the academic year, our SPS chapter hosted several invited speakers.

Our science Christmas tree went up as usual just before Thanksgiving break. In the picture, SPS students

Samantha Ford, Elijah Gregory, Marie Ange Uwituze, Hailie Brown, Christopher Monterroso, and Matthew Pyle are finishing putting decorations on the tree.

This year, the induction ceremony for the Sigma Pi Sigma National Physics Honor Society took place on April 19. We inducted two of our best SPS students: Matthew Pyle and Marie Ange Uwituze. Our induction speaker was Mr. Watson. We are grateful to our SPS Zone Councilor and good friend, ACU physics professor Dr. Larry Isenhower, and former McMurry University Vice President for Academic Affairs Dr. Matt Draud for attending our ceremony and supporting our students.



Marie Ange Uwituze at NREMST

Last summer, Marie Ange Uwituze participated in the Nuclear Research Experiences for Minority Students in Texas (NREMST) program at the University of Texas in Arlington. She worked in their laboratory for neutrino and rare events searches. The project that she completed was to run simulations and study the behavior and occurrence of neutrinoless double beta decays at atmospheric temperature using a DUNE volume-sized

detector. In the fall, she presented an overview of her internship experience to encourage other students to participate in similar programs in the future. This summer, Marie returned to NREMST to work on a similar project again.

Centennial Homecoming and Alumni Presentations

During Homecoming this year, the University finished celebrating its centennial anniversary. It was a very special event with many alumni, friends, and former colleagues in attendance. We had a large group of our recent graduates who visited with the current students. Our Homecoming speaker for this year was Dr. Rick Nason '83, an associate professor of finance at Dalhousie University. He is the author/co-author of seven books, including *It's Not Complicated: The Art and Science of Complexity in Business*. In his talk on AI, Complexity and the Arts, he introduced complexity science, talked about how it complements AI, and how the study of the liberal arts is more necessary than ever to succeed in our increasingly informational technology driven society. We are deeply grateful to all our alumni and friends who were able to attend our Centennial Homecoming last year. We are looking forward to seeing many more at Homecoming 2024 which will take place October 31 to November 3, 2024. Please mark your calendars and watch your mail for additional details on the Science and Math Homecoming Reunion.

We had some other alumni who were able to visit us during the year and gave interesting and engaging talks to our students about the career paths they took after graduating from McMurry.

In April, we hosted a physics, math, and computer science alumna Ms. Jeanette Schofield '11 who recently finished her MS degree in data science and machine learning at Georgia Tech University. She is currently working as a senior software developer on the Intelligence team at PakEnergy Solutions in Abilene. Her presentation, *A Brief Overview of Machine Learning and Its Applications*, provided an introduction on what machine learning is, how it can be applied to various fields, and current

opportunities in the field. Ongoing research was presented demonstrating how machine learning can be leveraged to estimate the orientation of a spacecraft in outer space.

Another talk by a physics alumnus Mr. Joseph Watson '21 was devoted to the research, internship, and job opportunities at the NASA Space Center in Maryland. He is currently working as a mechanical engineer at the NASA Goddard Space Flight Center. His talk, *My Journey from McMurry to NASA*, was a reflection on his career path from studying physics at McMurry, working as an intern at NASA and as a jr. mechanical engineer at a perforating gun supplier for the oil industry, to becoming a lead engineer at NASA. Currently, he is working on the NASA EXCLAIM team. EXCLAIM's mission is to use a cryogenic balloon-borne telescope to record a three-dimensional intensity map in the microwave electromagnetic range corresponding to carbon monoxide and carbon ion emission to study galaxy evolution and star formation. Mr. Watson encouraged students to apply for NASA internships and answered many questions from the audience.

Next year, we would like to continue our presentation series, "What I Did With My Physics Degree." If you are interested in giving a talk, please let us know, and we will be happy to schedule your presentation, virtual or face-to-face, during one of our SPS meetings.

Physics Year in Review 2023–2024

In October, a group of physics students, including Aaron Brokovich, Elijah Gregory, and Matthew Pyle, accompanied by Dr. Bykov, Dr. Keith, and Dr. Renfro, traveled to the fall meeting of the Texas Section of the American Physical Society at



Angelo State University in San Angelo, TX. Students attended professional talks and learned about graduate

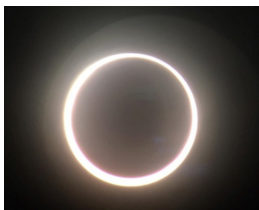
school opportunities at several institutions in Texas. The

group also participated in the public outreach event to observe an annular solar eclipse on October 14. There were not that many solar telescopes available to the public at the Angelo State University parking lot on that day, so our telescope received a lot of attention.

In the first picture (from left to right): Dr. Bykov, Dr. Renfro, Matthew Pyle, Dr. Keith, Elijah Gregory, and Aaron Brokovich stand in front of the Angelo



State University Planetarium. In the second picture, McMurry students are getting ready for the eclipse. The third picture is a photo of the eclipse taken by Dr. Keith with the McMurry solar telescope.



In December, we welcomed back a group of local middle school and high school students. Last year they were so impressed with our facilities that for the second year in a row, they decided to use the Physics Department at McMurry as a site for an engineering competition on building cardboard boats. The boats were then tested in the University swimming pool. .

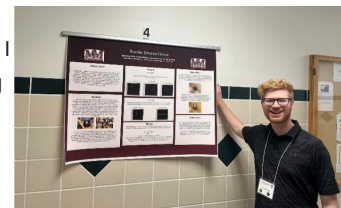
In March, a group of physics students including Matthew Pyle, Aaron Brokovich, and Hailie Brown, accompanied by Dr. Keith and Dr. Renfro, participated in the Texas Section of the American Physical Society spring meeting at Tarleton State University in Stephenville, TX. In the first picture (from left to right): Dr. Renfro, Dr.

Keith, Matthew Pyle, Aaron Brokovich, and Hailie Brown on the Tarleton campus. In the second picture, Matthew is standing next to his poster on Weather Detector Device



that he presented at the conference. "I absolutely loved this conference," Aaron Brokovich said. "Extra events outside of school always tend to remind me why I love what I am doing, and each meeting I go to I feel like I understand a little bit more about higher level physics and current research. I was inspired to start exploring my own ideas for research."

In January, a group of our female students, including Marie Ange Uwituze, Hailie Brown, and Samantha Ford traveled to one of the national sites for the Undergraduate Women in Physics conference at Tulane University in New Orleans, LA. During the conference, our students had a unique opportunity to meet with physics students from all over the United States as well as some well-recognized national experts on the subjects of teaching and learning,



like Dr. Sandra McGuire (in the picture from left to right: Hailie Brown, Marie Ange Uwituze, Dr. Sandra McGuire, Samantha Ford). They also learned how to build a resume, their next career steps, how to find internships and research positions, and, of course, they had a lot of fun in the great city of New

Orleans. We are grateful to the McMurry University Leadership Intensive Program and to the Ward-Bottom Science Fund for making this trip possible.

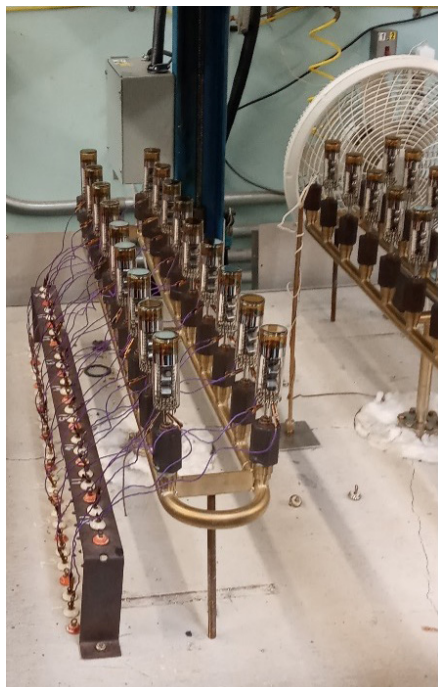
In February, a large group of physics and computer science students attended a tour of the Lockheed Martin Aerospace company in Fort Worth. The tour was conducted by McMurry physics alumni working at the plant. We are very grateful



to Taylor Freehauf, Kent Grimes, and Taryn Fambrough for hosting us on that day. The students were able to see the main production line for the F-35 Lightning II fighter jet and learned about many aspects of aircraft design and manufacturing. They also learned about the work culture and job opportunities at Lockheed. Engineering physics student Dustin Volk said, "What interested me most was how they manufactured different components of the aircraft and the manufacturing process as a whole. Everything from layering

panels of composite to filling holes after the wings were drilled. I feel like this little bit of exposure opened up my mind to the manufacturing process as it applies to engineering. I would absolutely recommend other students to participate in a discovery trip.” In the picture, our group is standing at the shore of Lake Worth right after we finished the tour. We are grateful to the McMurry University Discovery Trip program for supporting our travel for this tour.

On February 23, a group of physics students attended a tour of the ADIT Electron Tubes and Ludlum Measurements companies in Sweetwater, TX. ADIT Electron Tubes is a major electron tube manufacturer in the United States. It is a joint venture with Ludlum Measurements and Eljen Technology. Together they also own an international conglomerate of companies operating in several locations within the United States, United Kingdom, and Germany. Even though electron tubes are not as widely used in modern electronic devices as they once were, they are still the main component for radiation detectors. The tubes are being used in various kinds of radiation detectors, including those in airports, border crossings, and major highways. In addition, detectors of radiation are being used in many research and educational institutions all over the world. The tour was conducted by the company’s general manager, Mr. John Spaulding. During the first part of the tour, students saw the production line for different types of electron tubes. They looked at the glass blowing process and an assembly line for inserting pins into the bases of the tubes. They also saw the process of depositing metals on various tube parts (shown in the picture),



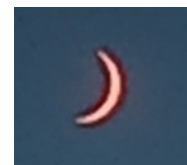
and learned about the challenges of electron tube manufacturing, quality control and assurance, and final product acceptance testing. During the second part of that tour, students were able to visit several machine shops and learned about machining various parts that are used in the process of tube manufacturing as well as additive manufacturing

techniques used in production. Finally, they were able to attend a production line where different types of radiation detectors are assembled and tested. Mr. Spaulding finished the tour by inviting our students to apply for open positions at the company or reach out to him to talk about

opportunities for summer internships. Due to that networking opportunity, Elijah Gregory is participating in a summer internship with ADIT Electron Tubes through this summer.



This year will always be remembered for two great American solar eclipses. Earlier in this letter, we told you about our public outreach effort during the October eclipse. For the April eclipse, we stayed on McMurry University campus to allow the university community to use our solar telescopes to observe the eclipse. Our SPS chapter was also instrumental in distributing solar glasses to everybody who wanted to see the eclipse on that day. We are especially grateful to Matthew Pyle, Elijah Gregory, Mr. Upshaw, and Dr. Renfro for their service to the McMurry community. In the pictures: A crowd of people gathering in front of the Finch Gray Science Building to watch the eclipse, and the partially eclipsed sun over the McMurry University campus.



In April, a group of CAD students attended a tour of the facilities of Hartmann’s Inc. in Abilene. This is the second time our students have had an opportunity to visit Hartmann’s machine shop. Students were able to see CNC lathes and mills producing parts, component inspections in quality control, and also received a tutorial on tool path creation.



In May, Mr. Upshaw and Dr. Renfro both served as judges for the inaugural Big Country Additive Manufacturing Challenge competition that was also held at Hartmann’s. Competing teams from local high schools were given engineering drawings for a component and asked to design a clamping fixture to secure it into a CNC mill for machining.



SCAN ME

Keep track of our current events by visiting us on Facebook at the McMurry Society of Physics Students or online at <https://sites.google.com/site/mcmurryphysicsdepartment/home>.

To update your communication preferences, email tbykov@mcm.edu.

Thank you for your support,

The McMurry Physics Department

Our Thanks

Many of the above trips and student experiences would not have been possible without the support from the Ward-Bottom Science Fund. We are deeply grateful to Dr. Ward for making this fund available for our use. Because of this funding, last year we were able to purchase new ultrasonic testing equipment. This year, this equipment was used for the first time in the Advanced Physics lab. Students used ultrasound techniques for nondestructive evaluation (NDE), such as finding defects in a plastic slab. They also learned about medical physics applications of ultrasound. This year, the Ward-Bottom Science Fund allowed us to purchase new software for 3D scanning. We are looking forward to using this product in our engineering courses and for student projects.

If you have been recently added to our database and/or 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 email tbykov@mcm.edu.

Tikhon Bykov – Wayne Keith – Timothy Renfro – David Upshaw
The McMurry Physics Department