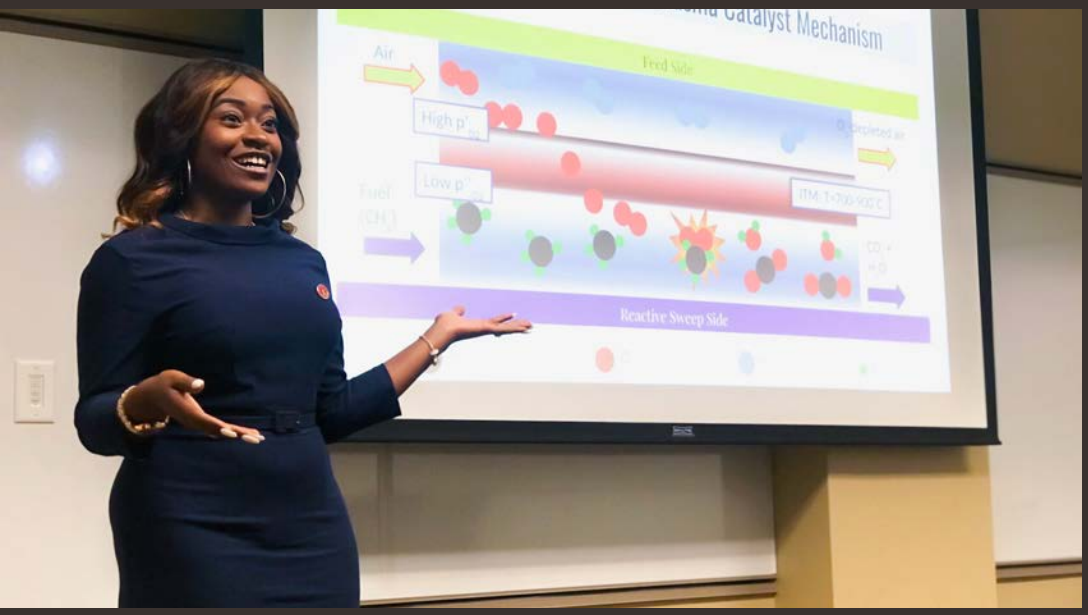

WITHIN THE PLASMA UNIVERSE

ISSUE NO. 02 | SPRING 2019

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DIRECTOR'S MESSAGE

Dear Friends & Colleagues,

Our second annual Newsletter from the NSF EPSCoR RII-Track-1 project, Connecting the Plasma Universe to Plasma Technology in AL: The Science and Technology of Low-Temperature Plasma, also known by the acronym CPU2AL, describes a busy year that has been packed with accomplishments by our students, post docs, researchers, and faculty, some of which are described in the newsletter. We completed an excellent STEM outreach event that was tied to the NSF Regional Outreach Meeting and Annual Meeting. All to be followed by a successful Reverse Site Visit in April.

However, the wonderful achievements were tempered by our sadness in having to say good-bye to two wonderful colleagues and friends. Over the summer, our outstanding Project Manager Dr. Carlos Reinhold retired but we were fortunate in obtaining an excellent replacement in Mr. Patrick Hambloch shortly thereafter. Sadly, our wonderful EPSCoR Program Manager Dr. Uma Venkateswaran retired at the end of September. The CPU2AL Program and I personally owe an enormous debt of gratitude to both Uma and Carlos in helping us to successfully launch CPU2AL and put the project onto a sound footing. I know that I speak for all of the management team in saying that they are both missed and we thank them for their help and guidance over the past three years.

Like the first newsletter, several important themes run through this newsletter. Part of the CPU2AL mission is to educate the broader community about a discipline that impacts our lives everyday in profound and sometimes life-changing ways. This is the subject of low temperature plasma (LTP), which has a pervasive influence on almost every aspect of our lives today. We have chosen to illustrate this theme through articles that describe the work that our students and industrial interns (through CIPPTA, our Corporate Internship Program on Plasma Technology Applications) are undertaking, whether in an academic setting as part of a post-graduate degree, as part of a summer program, or interning with one of our industrial partners.

Our CIPPTA program is unique in that CPU2AL provides the funding to support the internship, seeks out internship opportunities and invites a company to provide a set of projects for interns. In this way, CPU2AL brings our academic plasma expertise to the workplace in a concrete way. The program is open to undergraduates and graduates alike across the State of Alabama. We are always looking for new industrial partners for the CIPPTA program, so if anyone reading this newsletter wishes to become part of the program, I encourage you to contact Ms. Dana Waller, Mr. Patrick Hambloch, or me.

The range of plasma science being explored by our graduate students is quite breathtaking. We illustrate this in part with articles describing how Ms. Lori Scott at AU is studying dusty plasma using a laboratory on board the International Space Station, while Mr. Rajagopalan Ranganathan is exploring novel ways to improve the efficiency and make "greener" the construction of reactors.

Besides graduate students, we initiated the first of our summer Alabama Plasma Internship Program (ALPIP) programs. This was a great success. Students initially spent a week learning about plasma physics from members of the Princeton Plasma Physics Laboratory (PPPL) before spending the remaining 9 weeks working across the CPU2AL universities on plasma projects. Students chose the projects on which they wished to work and by all accounts had an outstanding and stimulating experience. The overwhelming demand to attend the ALPIP program has encouraged us to now offer the program annually rather than every two years as originally planned. This together with our other summer programs has resulted in broad exposure of Alabama students to the world of plasma physics and its applications.

Finally, I invite you to peruse the news about some of our outstanding scientists described in the newsletter.

None of the programs and activities would be possible without the excellent support, engagement, and enthusiasm of the management team, the project manager, the outreach coordinator, the assistants across all institutions, and of course the researchers and students. I should particularly like to thank Ms. Dana Waller and her team for generating an excellent newsletter. A huge thank you to everyone! I trust that after reading the newsletter, you will share my excitement and enthusiasm for CPU2AL!

All the best,

THE SCIENCE

DR. GARY ZANK AND DR. EDWARD THOMAS, JR. SELECTED BY NAS TO PARTICIPATE IN DECADAL ASSESSMENT OF PLASMA SCIENCE

WRITTEN BY EMILY MCGUIRE

Dr. Gary Zank, director of the Center for Space Plasma and Aeronomic Research (CSPAR) at The University of Alabama in Huntsville (UAH) and CPU2AL, and Dr. Edward Thomas, Jr., Professor and Associate Dean for Research and Graduate Studies at Auburn University as well as CPU2AL co-PI, were selected by the National Academies of Sciences, Engineering and Medicine (NAS) to participate in the Decadal Assessment of Plasma Science.

Dr. Zank was named to co-chair the Decadal Survey committee performing the survey along with Dr. Mark Kushner, director of the Michigan Institute for Plasma Science and Engineering (MIPSE) and of the DOE Plasma Science Center at the University of Michigan. “Our responsibility as co-chairs is to ensure that the broad spectrum of plasma science is evaluated, emerging new plasma science assessed, and future directions anticipated for the coming decade. The committee’s responsibility is to help put all of that together,” says Dr. Zank.

Dr. Ed Thomas serves as a committee member and is helping to contribute to the report in the areas of basic plasmas, low temperature plasmas and fusion plasmas. “At this stage, we've now gathered a lot of information from the plasma physics community and are beginning the process of reviewing that material and beginning to write the first draft of the report,” says Dr. Thomas.

THE SCIENCE

“The decadal is very high-level and something that's obviously very important to the community, and so the people that are typically asked to serve on that committee are very well known in the research community and the plasma physics community,” says Dr. Zank. “The fact that we've got two members from CPU2AL is, I think, an indication of the level at which the EPSCoR program CPU2AL is operating, so it's nice recognition in terms of our status as a plasma program and puts Alabama a little bit on the map.”

This comprehensive survey is conducted by the NAS every ten years and is intended “to synthesize the progress that has been made in the past decade and then look forward to what you anticipate happening in the next decade,” says Dr. Zank. It will be used by Congress as well as the Department of Energy, the National Science Foundation, the Air Force Office of Scientific Research, and the Office of Naval Research to determine funding priorities for the next decade.

The turnaround time for the assessment is short, requiring the co-chairs and committee to remain focused on the synthesis of the white papers received and writing the report, which is due in February of 2020. Dr. Zank and Dr. Thomas expressed that between the community engagement, attending meetings, and writing the report, it has been a time-consuming task, but that doesn’t influence their excitement to be involved in it. Working on the decadal “gives you an opportunity to take a step back and look at an entire scientific field so to speak. There's really fascinating work that's going on broadly across many different areas, and that has been educational and eye-opening, and it has been fun to hear other plasma scientists get excited about the work that they're doing!” says Dr. Thomas.

For Dr. Zank, the future of space and astrophysical plasma and the computational aspect of plasma physics are interesting areas to be examined in the assessment. Both areas are likely to provide some fascinating insights in the next 10 years as technologies are developed to allow for space exploration and significant computing capabilities to study plasma previously unavailable.

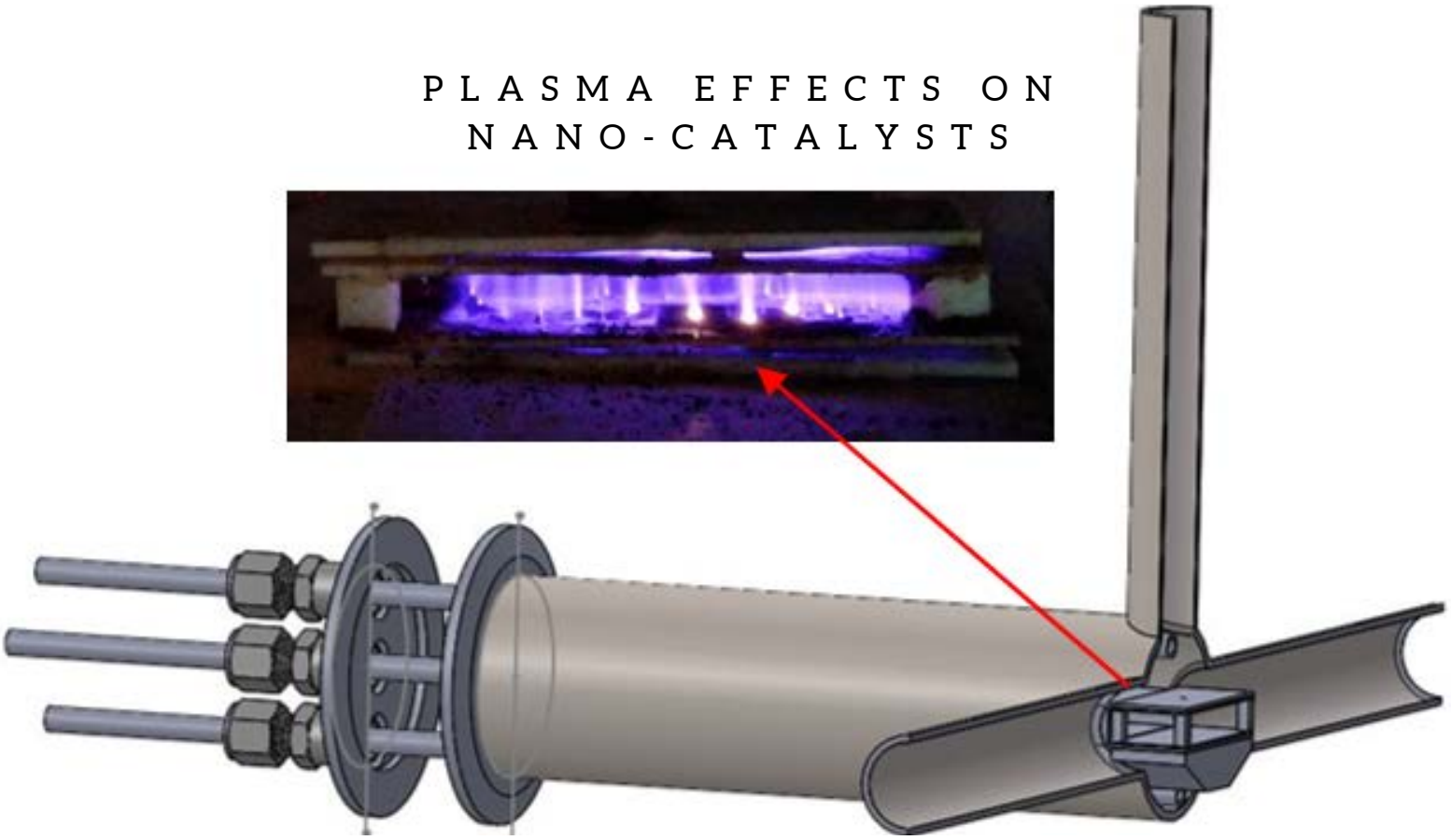
Dr. Thomas identified two ways that their involvement in the decadal survey has complemented the work being done through CPU2AL:

- “It puts the work that we're doing within the CPU2AL project in context; because this project has a research focus on low temperature plasmas that includes laboratory space, industrial applications, etc., and you can see how the work that we're doing here in Alabama is broadly connected to this larger community of work that is going on in the rest of the country and around the rest of the world.
- It's providing an opportunity to see the very high-level questions that people in different areas of plasma physics research are asking, and it gives us the opportunity to be able (when the report comes out) to see how we can eventually align ourselves to some of those directions.”

Following the release of the decadal assessment, Dr. Zank and co-chair Dr. Mark Kushner will be presenting it to the sponsors, Congress, and the plasma research community, i.e., “stakeholders in government, the plasma sciences communities, and industry … sharing perspectives on the major achievements and challenges of the past decade and the most exciting and promising areas of plasma research anticipated for the next 10 years, as well as how plasma research impacts and is impacted by adjacent areas of science and technology,” as stated on the NAS website. Dr. Zank noted that the survey is used as a blueprint for the next decade and will help shape the future of plasma science in the nation.

THE SCIENCE

PLASMA EFFECTS ON NANO-CATALYSTS



Picture of nanomaterials placed in the plasma region for laser diagnostics.
Nano shaped catalysts are placed in the non-equilibrium plasma region to study the fundamentals of plasma-surface interaction related to chemical looping reactions using laser diagnostics.

RESEARCH DEVELOPMENT AT THE UNIVERSITY OF ALABAMA

WRITTEN BY KATHERINE MACGILVRAY

Rajagopalan Varadarajan Ranganathan has had a busy year, publishing an article in the Journal of CO2 Utilization, presenting at the 11th U.S. National Combustion Meeting in Pasadena and the IEEE Pulsed Power and Plasma Science Conference in Orlando, as well as submitting two posters at the NSF EPSCoR CPU2AL Annual Meeting's Science and Technology Open House last April in Mobile. It's clear he's passionate about what he does and his dedication has brought him a long way.

Ranganathan earned a bachelor's degree in mechanical engineering from the College of Engineering, Guindy, India's oldest technical institution (founded in 1794), and went on to work as a research and development engineer at TVS Motor Company, a multinational motorcycle company based in Chennai, India. At TVS he worked on product development, specifically research centered on understanding the complex combustion process and testing and evaluating the latest developments in reducing environmental hazards. His efforts led the company to sponsor his pursuit of a master's degree in automotive technology at the Indian Institute of Technology, Madras.

In 2016, he became a doctoral candidate at the University of Alabama's College of Mechanical Engineering where, under the mentorship of Dr. Mruthunjaya "Jay" Uddi, Assistant Professor of Mechanical Engineering, he is currently working on a project that focuses on low-temperature plasma-enhanced nano-catalysis.

THE SCIENCE

“Catalysts are known to enhance reactions and non-equilibrium electric discharge plasma is also known to enhance low-temperature reactions,” Dr. Uddi explains. “Here, we combine the beneficial effects of both the catalysts and plasma synergistically to gain multiple factor (greater than four) enhancement of reactions at low temperature (150-400 ^{0}C) in an energetically efficient manner.”

The result: The duo conducted plasma-assisted chemical looping reforming with water splitting experiments using a button cell reactor and found they were able to perform dry reforming of methane (DRM) and water splitting at those lower temperatures.

“Thus, plasma catalysis can enhance reactions at lower temperatures efficiently, while maintaining the integrity of materials over long hours,” says Ranganathan. “We find better advantages of plasma catalysis at lower temperatures, reaching an optimum value at approximately 400 degrees celsius.” He continues to explain that the same amount of H2 produced at 300 degrees celsius with plasma catalysis water splitting would require more than double the temperature - around 750 degrees - without plasma.

“These plasma catalysis results show substantial advantages for reactor construction and efficiency, using solar energy and waste heat,” says Ranganathan. “Therefore, this leads to carbon capture utilization reducing greenhouse gases in the environment.”

Ranganathan, who will complete his Ph.D. program in 2020 plans to continue to present his research at conferences. He and Dr. Uddi have also recently submitted an article, “Plasma Assisted Chemical Looping Reforming with Water Splitting using Ru-based Nanocatalyst and Ni-based Perovskite – A Comparison Study,” for publication

THE STUDENTS

THE STUDENTS

MEET LORI SCOTT, AUBURN UNIVERSITY PH.D. PHYSICS STUDENT

WRITTEN BY KATHERINE MACGILVRAY

Lori Scott, a third-year graduate student pursuing her Ph.D. in physics at Auburn University, has travelled a lot this year, making trips to Germany and France as part of her doctoral research based on the Plasma Kristall-4 (PK-4) laboratory on the International Space Station.

The PK-series are a scientific collaboration between the European Space Agency (ESA) and the Russian Federal Space Agency (Roscosmos) and are operated by the German Aerospace Center (DLR) and the Russian Academy of Sciences. The PK-4 laboratory is the fourth microgravity complex plasma experiment that has been operated in space and is open to an international research community and overseen by an international advisory board with researchers from the U.S., Europe, and Japan.

Scott is part of a multi-institutional U.S. collaboration with scientists at Auburn University, Baylor University in Texas, and Wittenberg University in Ohio using PK-4 to study the evolution of thermal properties of a complex (dusty) plasma.

"In complex (dusty) plasma research, the key feature is to suspend small, charged particles -- the "dust" particles -- in a background plasma," explains Dr. Edward Thomas, Charles W. Barkley Endowed Professor of Physics and Associate Dean for Research and Graduate Studies in the College of Sciences and Mathematics at Auburn University. Thomas has been part of the PK-4 external scientific advisory team since the initial stages of its design in 2008-2009. "This allows us to use laboratory experiments to simulate processes in naturally-occurring dusty plasma systems such as planetary rings or nebula."

But when dusty plasma experiments are performed on the ground, gravity compresses the dust particles and limits the size of the dusty plasma "clouds" that can be formed. Researchers determined that if dusty plasma experiments were performed without gravity it would be possible to form very large dusty plasma systems, allowing them to study additional processes that would otherwise be hard to measure due to gravity restrictions.

"By putting the experiment in microgravity, other forces that are usually masked by the magnitude of gravity become the main forces of the dusty plasma system which creates a unique experimental environment," says Scott. "I'm specifically investigating how kinetic energy from the dust particles flowing at high speed is redistributed upon an application of an electric field which stops the particles within a few high-speed frames."

Her team was also able to compare the data from microgravity to data taken on a ground PK-4 module. Scott made three trips to the location of the project's ground module at a DLR office in Oberpfaffenhofen, near Munich, Germany, first to get acquainted with the experiment, then to finalize the collaboration's proposal for the experiment, and finally to test the computer scripts that run the experiment and ensure that the conditions requested in the team's proposal were correct.

Then, in July, Scott traveled to France's National Center for Space Studies in Toulouse where she worked with Russian cosmonauts on the International Space Station to verify the information captured by the experiments in space. Working with the astronauts is critical. "Since our data is all video, there's a large time delay if PK-4 were to be run solely by the ground science team," Scott explains. "We have the astronauts/cosmonauts capture the particle cloud and then we execute the rest of the experiment on the ground using the scripts."

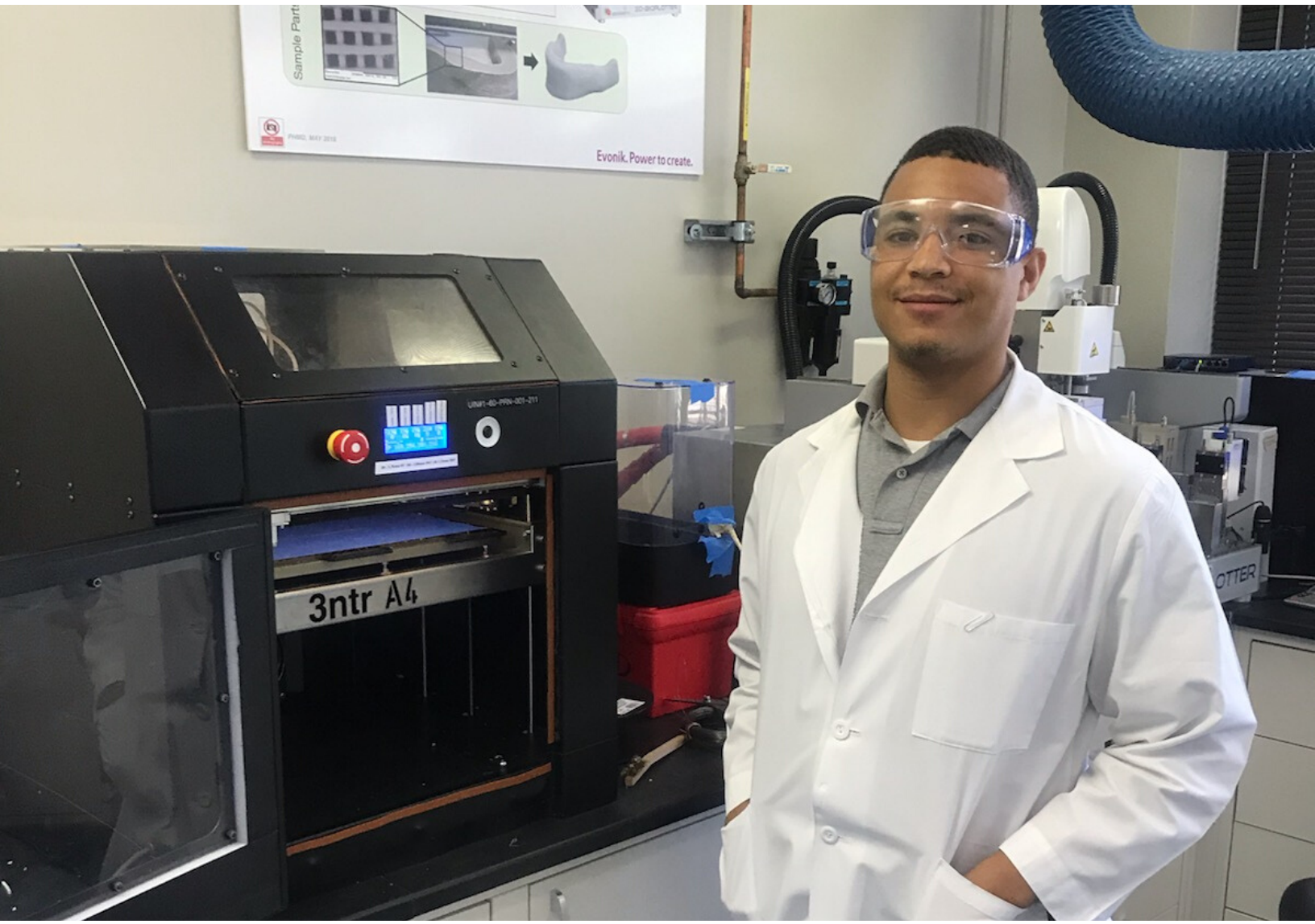
Scott and her team received a screen recording of their entire experiment a few weeks after it was conducted. "But it is very low resolution," she says. Now they're waiting on the data to be sent from the space station on a return flight.

Since 2013, the dusty plasma group at Auburn has been supported by NASA, the National Science Foundation, and EPSCoR programs to develop diagnostic tools and experiment designs for PK-4. Ms. Scott is the first full-time Ph.D. student at Auburn whose research will be fully-based on PK-4.

THE STUDENTS

MEET VINCENT HEMBRICK-HOLLOMAN, CIPPTA INTERN

WRITTEN BY KATHERINE MACGILVRAY



The Corporate Internship Program on Plasma Technology Applications (CIPPTA), open to undergraduate and graduate students pursuing degrees in science, technology, engineering, and mathematics, focuses on offering its participants a unique opportunity to develop plasma technology applications while networking with industry and academic professionals. Sponsored by the Alabama NSF EPSCoR CPU2AL project, CIPPTA caught the eye of Vincent Hembrick-Holloman who is earning his Ph.D. in Materials Science and Engineering at Tuskegee University.

"NSF EPSCoR has been funding my research for the last two to three years," he explains. "They host annual meetings and at one they were giving out information on CIPPTA. I was very interested in the program and the companies involved so I applied online."

Hembrick-Holloman spent his 10-week internship based at Evonik Industries, a pharmaceutical company in Birmingham, Alabama, where he studied the effect of plasma treatment on interlayer bonding of 3D printed fused deposition modeling (FDM) parts.

THE STUDENTS

In recent years, 3D printing technology has revolutionized the medical and pharmaceutical fields, allowing the production of patient-specific implants from a variety of biomaterials, including metals, ceramics, polymers, and composites. These custom devices can then be incorporated with bioactive drugs, cells, and proteins, thus changing the conventional ways engineers design and manufacture medical devices. 3D printing has showed enormous promise in further developing prostheses, drug-delivery devices, tissue engineering, and regenerative medicine. FDM has proved a cost-effective and timely means of producing these customized parts. The problem? FDM printed parts are weak due to insufficient interlayer bonding.

Under the mentorship of Dr. Andrew Wood and Dr. Jian-Feng Zhang, and with an industrial advisor, Balaji Prabhu, all with the Evonik Medical Device Competence Center, Hembrick-Holloman worked on incorporating plasma technology to help increase the mechanical strength of 3D printed parts.

"Plasma surface modification is a technique used to functionalize surfaces, improve surface energy, and reduce the contact angle by introduction of plasma on the surface," Hembrick-Holloman explains. "This process can be used as a potential treatment to enhance the interlayer bonding by altering the surface properties and chemical make-up of filament surfaces for 3D printing without changing the bulk properties of the overall material."

In addition to revealing the potential of continued research on plasma treatment, Hembrick-Holloman's experience at Evonik enabled him to develop his engineering skills and biomaterials research experience in a fast-paced, industrial research setting. "When I started, I was very eager and intrigued to learn which helped me naturally become more knowledgeable in many key areas of studying polymers and biomaterials for medical devices."

He also spent the first two weeks of his internship undergoing safety training, learning how to operate the equipment he would be using, and was introduced to Good Manufacturing Practices (GMP) and Good Documentation Practices (GDP).

"I had a wonderful experience with the internship and everyone at Evonik. I was able to work in a very engaging and innovative environment where I made connections with some industry leaders in the field of biomaterials. Being able to simply talk and pick their brains really helped me understand how to go about being a professional at my craft. Also, the ability to apply hands-on research in a field that I plan on going into after my Ph.D. was very helpful for my professional career."

His advice for future applicants? "I would definitely encourage them to apply." And if they're accepted? "Make connections and network. Go there with a plan so that you aren't simply reacting to requests. Be proactive about the opportunity and nothing but good things will come from the internship."

THE STUDENTS

2019 CIPPTA Interns

Dakotah Sauerwald

The University of Alabama in Huntsville

Evonik Industries

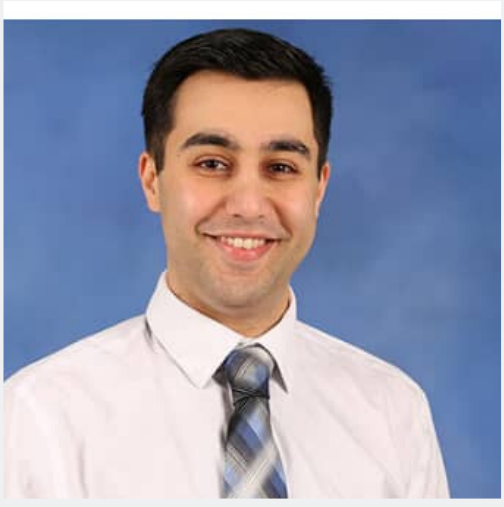
"During my internship, I have learned a significant amount about the electrospinning technique as well as plasma applications for electrospun materials. One thing I found interesting was the use of different gases with the plasma treatment process and the vastness of that. The best part of this program is having the opportunity to work alongside professionals in a company. I would tell other students thinking about applying to the internship program to consider reading up on literature about the topic, which would prove beneficial in research that may be done."

Jason Zhang

The University of Alabama at Birmingham

SiO2 Medical Products

"I learned how to use Radio Frequency powered vacuum technology to coat plastic medical vials and enhance their performance to that of glasses'. It's a great experience to see what real industry is like."



Amirahmad Ramezani

The University of Alabama in Huntsville

CFD Research Corporation

"As a computer engineer, I have been responsible for parallelising our computations and simulations on GPUs. With the help of my mentors, Dr. Vladmir Kolobov and Dr. Robert Arslanbekov, I have been introduced to various new softwares and applications including basilisk, COOLFluiD, Kokkos, etc. This has been an amazing experience so far and I have learned so much. I would definitely recommend other students to apply to this program so that they can see how they can use their knowledge in real world research and industry projects."

THE STUDENTS

2019 CIPPTA Interns

Ehsan Zolghadr

The University of Alabama

SiO2 Medical Products Inc.

"This internship is a great opportunity to experience the industrial working environment, and fill the gap between academic research and industrial R&D. During this internship, I have learned working with different machines, quality processes, policies, and some marketing procedures. Moreover, I improved my problem solving, communications, and teamwork skills. SiO2 is a very diverse and friendly atmosphere, and I'm so grateful that I had the opportunity to work here."

Thanh Dang

The University of South Alabama

CFD Research Corporation

“I've learned about methods to compute fluid simulations and how to visualize them. The best part is that there are various community events happening consistently in and around the company and sometimes there are free lessons on software and software development. I would tell other students participating that they should attend the community events if they are free. It's a great way to improve yourself and meet others.”

Ashley Romans

Auburn University

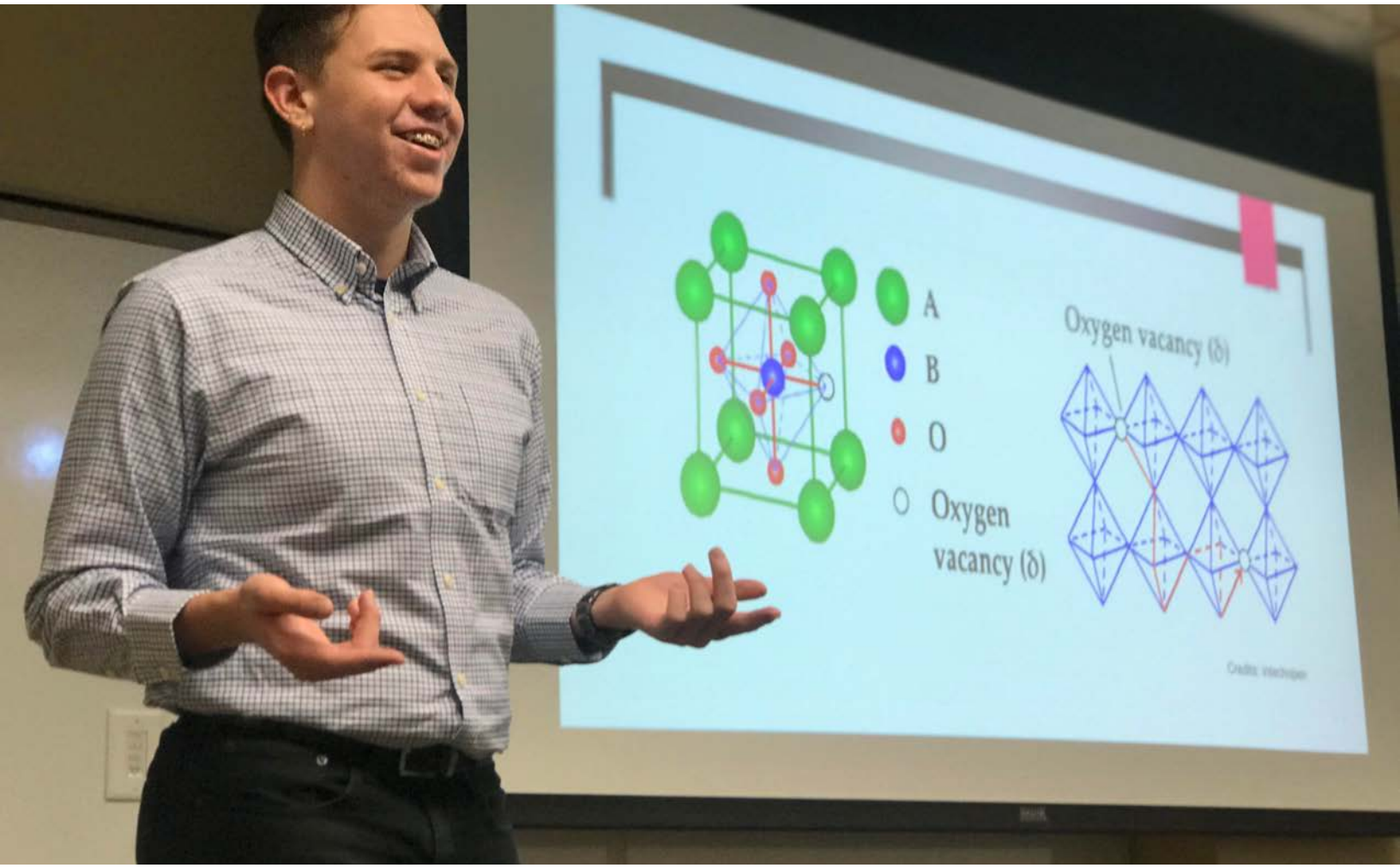
Plasma Processes, LLC

"The best advice I can give someone interested in applying is to not be afraid of things unknown. As an engineer and a scientist, we deal with unknown every day. You will adapt to your situation, research it, and conquer any and all challenges you are faced with if you chose to go outside your comfort zone. Trust your brain to learn and grow.'

THE STUDENTS

MEET JULIO OCANA-ORTIZ, ALPIP INTERN

WRITTEN BY KATHERINE MACGILVRAY



When Julio E. Ocana-Ortiz decided to look for summer internship opportunities last November he came upon a Facebook ad for the Alabama Plasma Internship Program (ALPIP). Ocana-Ortiz, pursuing a chemical engineering degree with a minor in pharmaceutical sciences at the University of Puerto Rico at Mayagüez, didn't think his chances of being admitted into the program were very high. "But I decided to give it a try," he says, "and to my surprise, I was accepted!"

The 10-week program solicits undergraduate students from across the southeast, the U.S. Virgin Islands, and Puerto Rico, and immerses them in a nine-week research project at a CPU2AL partner institution. ALPIP students then participate in an intensive one-week training that includes lectures, laboratory experiments, and courses led by Princeton Plasma Physics Laboratory (PPPL), a U.S. Department of Energy national laboratory for plasma physics and nuclear fusion science.

"It was a truly amazing experience," Ocana-Ortiz recalls. Under the mentorship of Dr. Mruthunjaya "Jay" Uddi, Assistant Professor of Mechanical Engineering at The University of Alabama, Ocana-Ortiz and two other interns, Chigozie Chinakwe from Tuskegee University and Reece Frederic from the University of Louisiana, worked on carbon sequestration, a process of capturing and storing atmospheric carbon emissions with the goal of reducing their impact on the environment.

THE STUDENTS

"I worked on a perovskite Ion Transport Membrane (ITM) reactor catalyzed by low-temperature plasma in order to selectively permeate oxygen with the purpose of enhancing oxy-combustion reactions with methane," Ocana-Ortiz explains. "It was fun and easier than it sounds."

While Ocana-Ortiz describes his work with ITMs as fun, it also has a lot of potential for the future of generating cost-effective clean energy and decreasing dependence on the combustion of fossil fuels. "Basically, it allows you to extract the energy produced by the reaction without freeing the emission, making it possible to recycle the products."

Ocana-Ortiz and his teammates designed and cast two furnace reactors, one for laser diagnostics of plasma-assisted chemical looping, and the other for their ITM experiments. They also tested the configuration of electrodes to ensure the formation of the plasma field.

"Julio is a very diligent and smart student who got down to work from day one," says Dr. Uddi. He adds that Ocana-Ortiz tackled several other hands-on projects, including using Python software to communicate with Arduino for detonation tube testing, testing spark ignition and solenoid valve control for the detonation tube, using Matlab programming to control gas flow into the ITM reactor, testing flow control for the reactor experiment, and testing various configurations of plasma to find the best one for the ITM experiment.

Through its partnership with PPPL, the ALPIP program offers its students an opportunity to take part in plasma science on a national level. "Such firsthand hands-on experience on applied advanced projects will go a long way in training undergraduate students for research and entrepreneurship," says Dr. Uddi.

For Ocana-Ortiz the experience has bolstered his academic goals. He plans to obtain a master's degree in either pharmaceutical or biomedical engineering and hopes to go on to obtain a Ph.D. in one of those fields. "It was a truly amazing experience and I would encourage every undergraduate to take the chance and go for it. It really helped me interpersonally and it brought some amazing people into my life."

THE STUDENTS

2019 ALPIP Interns

Demetrius McAtee

Southern University and A&M College

"Under the guidance of my esteemed mentor Dr. Komal Vig I have been incorporating Low-Temperature Plasma in vascular tissue regeneration. I am growing Human Umbilical Vein Endothelial Cells (HUVEC) on a low-temperature plasma engineered scaffold and analyzing for cellular proliferation and cellular attachment. I would like to thank Alabama EPSCoR, ALPIP, Alabama State University and the Center for NanoBiotechnology Research, and Dr. Komal Vig for this awesome experience this summer. I highly recommend any undergraduate STEM major to apply for this internship."

Jacob Paiste

The University of Alabama at Birmingham

"The Alabama Plasma Internship Program (ALPIP) has been tremendously beneficial for me. It has allowed me the opportunity to improve my knowledge in programming and in physics by developing a 1D Particle-In-Cell (PIC) simulation code. This PIC code has allowed us to study ring beam instabilities beyond the heliopause. I am having an amazing time here at UAH and strongly suggest students apply for ALPIP for summer 2020 and beyond."

Allison Price

The University of Alabama

"This internship has taught me so much about the role of data analysis and computer science in research. I have been able to use concepts I learned in school to solve different problems and have also been able to learn more coding languages and analysis techniques. As someone who came into this experience nervous because I had no background in plasma physics, I would recommend this internship to anyone who is willing to step out of their comfort zone and who wants to learn more about the research process."

THE STUDENTS

2019 ALPIP Interns

Shannon Baeske

The University of Alabama in Huntsville

“I’ve really enjoyed my time here! Princeton was a lot of fun and a great experience. I’ve made friends and learned a lot about data analysis. I never really understood the work that goes into data analysis with astrophysics but this experience really helped me understand the process behind all of it.“

Marisa Thompson

The University of Alabama in Huntsville

“This internship has been a great experience for me, both personally and academically. It has strengthened my love of chemistry and broadened my views of its applications. Prior to the start of this internship, I had minimal knowledge of plasma, knowing only that it was the fourth state of matter and an electrified gas, but my knowledge of plasma expanded exponentially over the course of this internship”

Chigozie Chinakwe

Tuskegee University

“I am so honored to be participating in this program and it has been such a great experience for me! At first, I was skeptical about dealing with plasma, but now it is the only 'matter' I care about! I never knew low-temperature plasma had so many applications, and I have taken a great liking to it! The ALPIP program has definitely made an impact on my career path, and I encourage other students to take the same leap of faith as I did by exploring the world of plasma!”

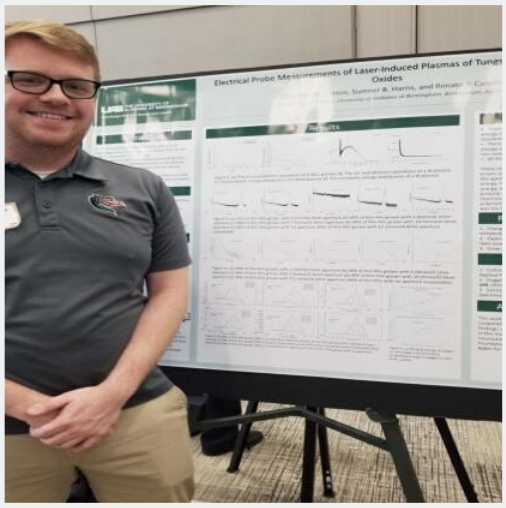
THE STUDENTS

2019 ALPIP Interns

Shakina Hogan

Alabama A&M University

"I believe research allows you to pursue your interests, to learn something new, to improve your critical thinking and problem-solving skills, and to challenge yourself in new ways. I truly enjoyed my internship this summer with the Alabama Plasma Internship Program (ALPIP), and I have gained valuable knowledge and skills that I will use in future careers."



Chandler Cotton

The University of Alabama at Birmingham

"My physics education before this internship was limited to only classroom lectures and physics labs. These lectures and labs are no doubt important, but I think putting everything I had learned thus far to the test with research has helped me learn more than any textbook ever has. This has been an incredible experience, and I can only hope that my future internships will yield the same results."

Jack Robertson

University of Georgia

"In the past few weeks I started by learning the basics of plasma physics and computer programming. I then downloaded spacecraft data recording the solar wind and began to graph it. My ultimate goal is to create a Magnetohydrodynamic simulation of the solar wind and compare it to the recorded data."

THE STUDENTS

2019 ALPIP Interns

Reece Frederick

University of Louisiana at Lafayette

"I have enjoyed my experience with ALPIP greatly. ALPIP is an excellent source of experience in working with others to find solutions to problems. I have learned that plasma is a very useful tool that has yet to be exploited. I would tell students that you will get what you put out; come ready to work and you will most definitely learn."

Arie Henderson

Kennesaw State University

"My internship experience has been amazing! I already had experience with microbiological research prior to starting this internship, but I had fairly little knowledge in plasma physics and technology. I was a little unsure about the plasma applications at first, but after working with it and learning about its versatility in a variety of fields, I'm definitely glad I chose this program. It has piqued my interest in plasma medicine, and it has helped me sharpen my skills in the lab to help me work more efficiently and produce better results in the near future."

THE STUDENTS

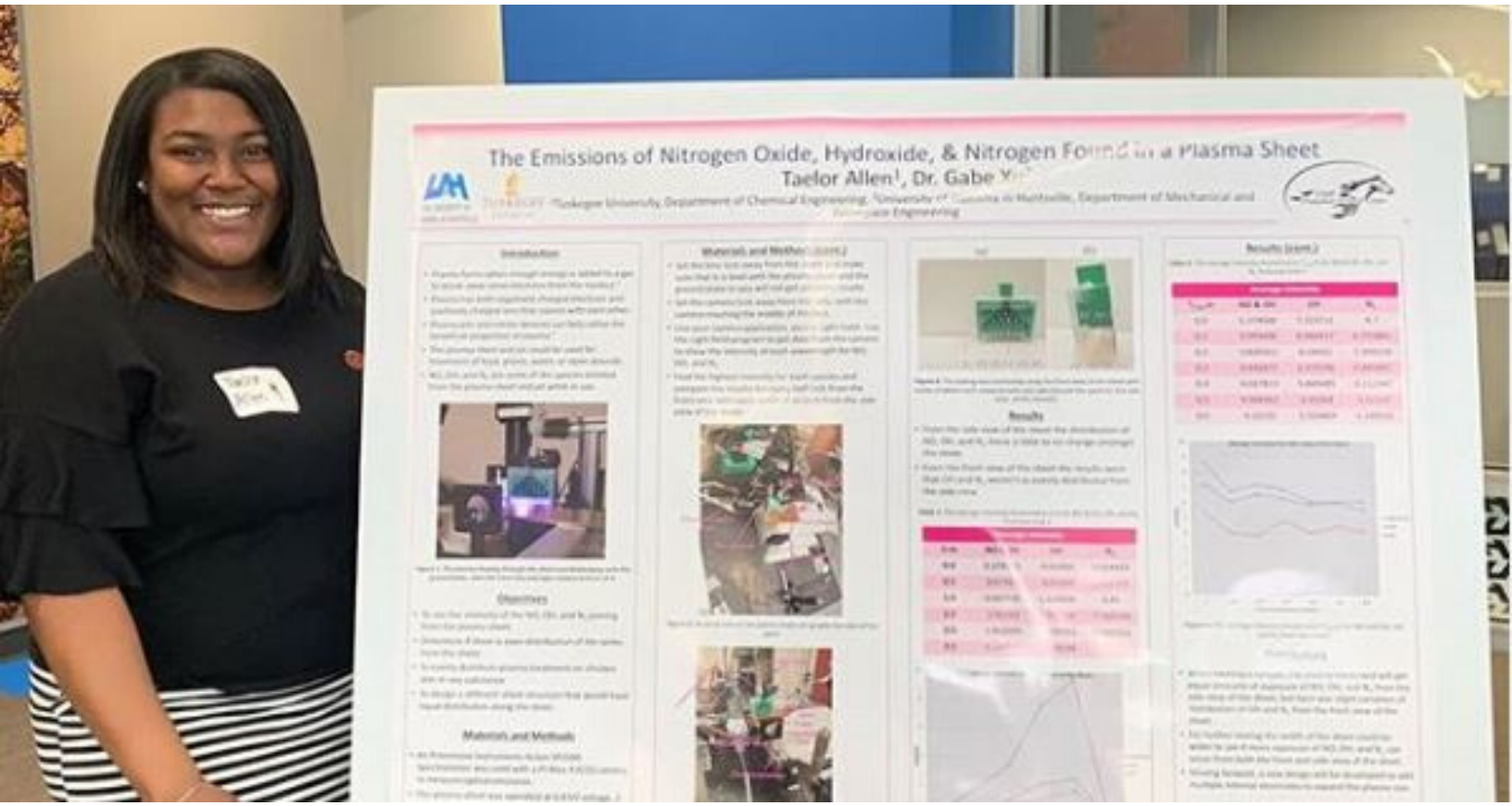
MEET TAELOR ALLEN, TUSKGEE UNIVERSITY STUDENT AND ALREU INTERN

WRITTEN BY EMILY MCGUIRE

Taelor Allen is a rising junior from Tuskegee University participating in the Alabama Research Experiences for Undergraduates (ALREU) summer internship under the guidance of Dr. Gabe Xu on a project designed to develop, test and characterize atmospheric pressure plasma (APP) sheet sources. The ALREU program, which lasts for 10 weeks, was open for applications from students attending HBCU institutions that are also apart of the nine universities comprising NSF EPSCoR's CPU2AL team. As part of the application process, students were asked to rank potential projects to allow them to be placed in an internship most suited to their interests. Taelor was most interested in working on plasma research and she has been able to do that at the Plasma and Electrodynamics Research Lab (PERL) at UAH as well as with Dr. Armitra Jackson-Davis at the Food Microbiology lab at Alabama A&M University.

Taelor described plasma as the fourth state of matter that doesn't get as much attention as the other states but occurs when electrons and ions are energized to a certain degree that turns them into plasma. Plasma is most commonly used for semiconductor processing but also has applications ranging from materials and agriculture to water treatment and more. For Taelor, the most interesting aspect of the project is interacting directly with the plasma. She said that you "would think it would feel hot or something weird, but it feels like someone just breathing cold air on you." The hands-on aspect of the research has proven to be informative and stimulating for her.

THE STUDENTS



Each day, Taelor spends time at PERL at UAH or she goes to A&M to work with the students at the Food Microbiology lab where she participates in testing and streaking chicken samples for pathogens to see the effect of the plasma on pathogen growth. Her time working at UAH focused on a recently developed plasma sheet that has the potential for commercial applications. She works in the lab with graduate and undergraduate students who are assisting with this experimental research by studying and characterizing the plasma generated by the plasma sheet. According to Taelor, the experience has been collaborative between both A&M and UAH and has allowed her to meet and interact with individuals from both universities, providing her with opportunities to observe areas that she may be interested in studying during graduate school. “Taelor has been a great student to have this summer.” Dr. Xu says. “Her measurements of the plasma has provided us with new results and insights on plasma uniformity which will help us to further develop the plasma source and understand some of the biological effects of the plasma.”

As part of receiving the summer internship, Taelor was allotted funds to attend a conference of her choosing to present the results of her research. She is currently in the process of writing the report to summarize her internship activities and the outcomes from it. She stated that writing the report and the presentation portion of the internship will help her with her preparation for graduate school in biomedical engineering or biochemistry. She hopes to present her research poster at Texas A&M in October of this year. The report is “a simpler version of a real lab report and explains what I did for the summer, what the outcomes of it were and how this internship will help me in my career,” says Taelor. Taelor expressed that the internship at UAH has been a good experience and has exposed her to a wide range of research activities and allowed her to form professional relationships with researchers and other students.

THE STUDENTS

2019 ALREU Interns

Mhiret Girma

Alabama A&M University

"I have learned a lot from how to start research, learn the basics before diving into the main part and how to use articles and papers that have been previously published. The best part of this research is to work on a project that benefits the world and science. I will definitely advise any student to be a part of this project because plasma is diverse and it has many applications and being able to come up with a technology that benefits the whole society is what I believe everyone is striving for."

Gemijah Gillespie

Alabama A&M University

"This experience has taught me the importance of food microbiology in the food industry. In food microbiology, the pathogens are observed and quantified in attempt to treat the food product and make it safe for consumption. I have learned how to perform serial dilutions, plate samples, and how to make microbiological media. I would definitely advise other students to apply for this internship to gain a deeper understanding of food microbiology as a whole."

Joseph Edoki

Alabama A&M University

"Over the past ten weeks, I have been granted the opportunity by ALREU to work at UAB at a Nano Material Lab. My research has been on Computational Analysis of Chalcogens and Metals; where I have ultimately combined computer simulations and visual data interpretations to achieve my project goals. I would urge other students interested in this area of research to take advantage of the ALREU program. It not only pays a stipend but greatly exposes young researchers to an array of interesting topics and laboratory experience."

NEWSWORTHY

NEWSWORTHY

ASU AWARDED A $2.25 MILLION NSF GRANT FOR BIOENGINEERING AND NANOBIOTECHNOLOGY

The National Science Foundation (NSF) has awarded a five-year $2.25 million dollar grant to Alabama State University to add in continuing its successful efforts in enhancing its research capabilities, STEM (science, technology, math & engineering) education and its emerging technology. Dr. Vig says that the project will have a special focus on undergraduate students providing a unique opportunity to gain multidisciplinary research knowledge and skills in bio-engineering and nano-biotechnology that will span across the science, technology, engineering, and mathematics (STEM) education at ASU,

NEW DISCOVERY BY TUSKEGEE RESEARCHERS HOLDS PROMISE FOR REDUCING CLIMATE CHANGE THREATS

At Tuskegee, Dr. Michael L. Curry, an associate professor in the Department of Chemistry, and engineering doctoral student Donald White have created a new means of capturing carbon dioxide from the atmosphere that promises to be more effective, environmentally friendly and less expensive than the conventional carbon-capture methods used currently.

NEWSWORTHY

DOCTORAL CANDIDATE RYAN GOTT EARNS DOE RESEARCH OPPORTUNITY AT SANDIA

Ryan Gott, a doctoral candidate in Dr. Gabe Xu's Plasma and Electrodynamics Research Lab at The University of Alabama in Huntsville (UAH), has been awarded a United States Dept. of Energy (DOE) Office of Science Graduate Student Research (SCGSR) Program research opportunity at Sandia National Laboratory (SNL) in Albuquerque, N.M.

DR. YU LIN FROM THE DEPARTMENT OF PHYSICS CONDUCTS RESEARCH WITH TEAM RECEIVING RECORD $115 MILLION GRANT

Dr. Yu Lin, a professor at Auburn University in the Department of Physics, is part of a team of researchers working on a record $115 million project awarded to the University of Iowa by NASA.

The grant will fund the creation and launch of two data-collecting satellites that will orbit a few hundred miles above. These satellites will be known as TRACERS standing for Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites.

NEWSWORTHY

CPU2AL TEAM HAS A SUCCESSFUL RESERVE SITE VISIT

CPU2AL members gathered for group dinner while in Alexandria for the Reverse Site Visit. This time was used to boost team spirit for the big day ahead.

Pictured are the presenters Dr. Gary Zank, Dr. Vladimir Kolobov, Dr. Edward Thomas, Jr., Dr.Yogesh Vohra, Dr.Carlos Reinhold, Ms. Dana Waller, and Dr. Ivan Arnold

MINI-WORKSHOP AT AAMU

Alabama A&M University hosted a mini-workshop to discuss the commercialization options of their various research projects. CPU2AL is constantly evaluating the paths to commercialization for all of its internal projects. Through this exercise additional resources may be focused on projects that are farthest along.

THE PEOPLE

THE PEOPLE

PATRICK HAMBLOCH JOINS CSPAR AS PROJECT MANAGER OF CPU2AL

WRITTEN BY EMILY MCGUIRE

Patrick Hambloch has joined the Center for Space Plasma and Aeronomic Research (CSPAR) of the University of Alabama in Huntsville (UAH) as Project Manager of the NSF funded EPSCoR project "Connecting the Plasma Universe to Plasma Technology in Alabama" (CPU2AL). Patrick comes to CSPAR as a PMP certified Project Manager with a master's degree in space systems engineering and a bachelor's in electrical engineering and brings over 10 years of experience in multi-discipline engineering, research, and project management to CSPAR. Hambloch worked at the Rotorcraft Systems Engineering and Simulation Center at UAH before his appointment as Project Manager of CPU2AL, and before coming to UAH, he worked at Microgravity User Support Center of the German Aerospace Center in Cologne, Germany on Space Station operations where he was team lead and in charge of operations for the material science laboratory on the International Space Station.

"We were very fortunate that Patrick was interested in joining the CPU2AL program since his skills and background, especially the connection to space and plasma, was ideal. My initial impression has been reinforced with Patrick's excellent start and the EPSCoR project is moving forward seamlessly. The team Management and I have found it very easy to work with Patrick and we're anticipating a long and productive partnership together," says Dr. Gary Zank, director of CSPAR and CPU2AL.

THE PEOPLE

As project manager of CPU2AL, Hambloch's responsibilities include organizing information for documentation and reporting of the research activities to NSF as well as running the student programs Corporate Internship Program on Plasma Technology Applications (CIPPTA), Alabama Plasma Internship Program (ALPIP), and Alabama Research Experiences for Undergraduates (ALREU). The student programs partner with industry and universities to provide 10-week long internship opportunities for students that are funded through CPU2AL. Through the NSF EPSCoR program funding, there are internships for undergraduate and graduate students, graduate research assistant opportunities, K-12 outreach activities as well as seed funding opportunities for research projects.

Another aspect of the appointment has been forming relationships with the other investigators from the eight other universities and one research corporation apart of CPU2AL. The management team meets monthly by phone, and in-person meetings are held twice a year. While furthering the low temperature plasma research thrusts of CPU2AL is the primary focus, the project also aims to grow the body of knowledge in Alabama specifically. For Patrick, this statewide effort has been very interesting, and he enjoys working with multiple universities across the state.

Outside of work, Patrick stays very busy with his involvement as chair of the Workforce Development and Young Professionals Program Committee in the International Astronautical Federation (IAF). His work with the IAF involves organizing events for the more than 500 young professionals that are attending the International Astronautical Congress (IAC) that is organized by the IAF. The IAC is held in a different country each year and took place in Washington, D.C. this year. Hambloch enjoys the congress because "the whole Space Community comes together at this one event every year and it has been very fun and fulfilling to meet all these people working from around the globe."

Hambloch began his post at CSPAR in June and was fortunate to have a six-week overlap working with his predecessor Carlos Reinhold who spent time getting him up to speed on exactly where any outstanding tasks on CPU2AL were. "It's good to have (the overlap) because it's essentially helping me to focus on the important things. Otherwise, I would have to read through all these documents and figure it out alone," says Hambloch. Having the insights from the previous project manager has allowed for a smooth transition into the role. "The management team has been helpful and everybody in the office has been great," says Hambloch.

"My goal is to make it as seamless of a transition as I possibly can because everything goes on, there's no waiting or time to spend a year reading up on everything," says Hambloch of his short term goals at CSPAR. His long term goals are to enable the science being conducted through CPU2AL and to progress the research thrusts to where they need to be as well as continuing the outreach and workforce development activities as planned. "We have had good grades from the NSF so far and the goal is to keep that going," says Patrick.

THE PEOPLE

DR. WENLI BI, NEW ASSISTANT PROFESSOR AT THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

WRITTEN BY EMILY MCGUIRE

Dr. Wenli Bi has joined the Department of Physics at the University of Alabama in Birmingham (UAB) as an Assistant Professor. In her new position, Dr. Bi will be teaching advanced physics courses, heading a research lab, and participating in research activities as part of the CPU2AL EPSCOR program. Dr. Bi's research is focused on understanding properties of novel materials under extreme conditions, particularly the quantum phase transitions in strong correlated electron systems driven by pressure. Dr. Bi stated that "at UAB I will combine lab-based characterization and synchrotron based spectroscopic techniques to provide unique and comprehensive information on properties of novel material at extreme conditions. Meanwhile, my group will collaborate closely with the high pressure material research group led by Prof. Vohra in the Physics Department."

Dr. Bi received a Ph.D. in Experimental Condensed Matter Physics from Washington University in St. Louis in 2011. After receiving her degree, she worked with the Inelastic X-ray and Nuclear Resonant Scattering group at the Advanced Photon Source (APS) and Argonne National Laboratory, first as a Postdoctoral Research Associate and then as a staff scientist until her recent appointment at UAB. "Working at a national synchrotron facility, I was fortunate to collaborate with research groups in interdisciplinary research programs. I have worked on many research topics including materials research under extreme pressure and temperature conditions using x-ray spectroscopic techniques," said Dr. Bi.

Currently, Dr. Bi has been spending most of her time preparing to teach the course Light Matter Interactions which combines the courses Electricity and Magnetism II and Quantum Mechanics II and represents one of the most advanced physics courses in the program. She has also been getting her lab up and running and is in the process of hiring a postdoctoral student to assist with research activities. There are two proposals with deadlines fast approaching that Dr. Bi has been involved with as well. Although she just started working at UAB in August 2019, Dr. Bi has been quite busy in her new position.

In addition to teaching, research, and proposal development, Dr. Bi will be participating in the CPU2AL program through a project focusing on microwave plasma chemical vapor deposition (CVD) for synthesis of superhard materials. “Prof. Wenli Bi has been tasked with the implementation of laser diagnostics on the large area microwave plasma chemical vapor deposition system at UAB under the CPU2AL project. The fundamental understating of reactive plasma species near the substrate surface is critical for the synthesis of novel superhard materials and for the plasma surface modification of biomaterials,” says Dr. Yogesh Vohra, Professor University Scholar in the Department of Physics and Associate Dean in the College of Arts and Sciences.

Dr. Bi stated, “I did a lot of synchrotron spectroscopy work in my previous job, and the (CVD) diagnostic tool is also a spectroscopy technique, so that fits in pretty well with my background and, although it is not a high pressure experiment, my background is high pressure in general, which fits in very well because superhard material has a very high significance in the applications of extreme conditions of high pressures.”

The CVD system is a new approach to synthesize superhard materials. Dr. Bi said that the traditional approach used a multi-envelop system which is a high pressure set-up in which the sample is contained in a chamber and high pressure is used to exert force on the sample. The volume of the sample size is limited with the traditional approach, but the CPU2AL project aims increase the volume and allow very large areas of superhard material to be able to synthesized using the CVD system. “We look forward to Prof. Wenli Bi’s contributions in achieving our research goals under this CPU2AL project,” expressed Dr. Vohra.

THE PEOPLE

STUDENT LIAISON BOARD

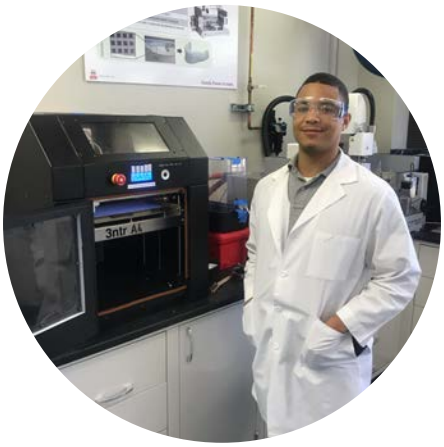
The purpose of the Student Liaison Board is to create a group of students to represent the student body interest of the CPU2AL project.

Lori Scott
Auburn University

Ryan Gott
University of Alabama in Huntsville

Bernabe Tucker
University of Alabama at Birmingham

Taylor Hall
Auburn University



Vincent Hembrick-Holloman
Tuskegee University

Shardai Johnson
Tuskegee University

THE EVENTS

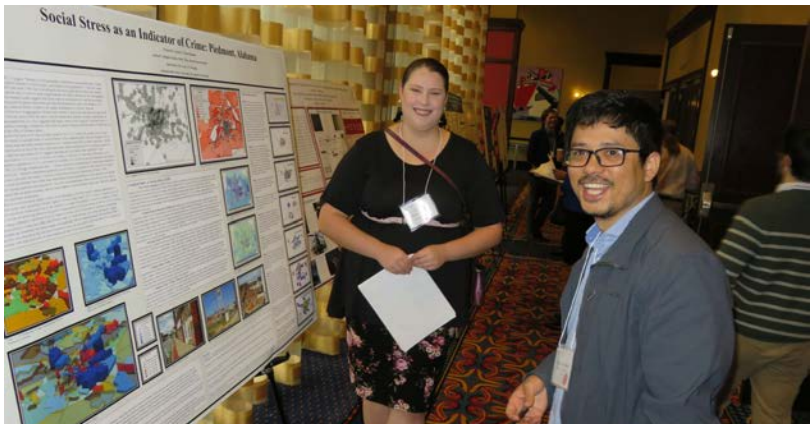
THE EVENTS

PAST EVENTS

NSF EPSCOR REGIONAL OUTREACH: ALL ABOUT RESEARCH CENTER PROGRAMS

The NSF EPSCoR Regional Outreach: All About Research Center Programs meeting was held on April 2, 2019, in Mobile, Alabama. It drew over 80 attendees from the different EPSCoR jurisdictions.

This event was also attended by NSF Center Program Officers and Center Directors. Each provided extensive information about the various centers sponsored by the NSF. It featured breakout sessions where attendees can ask questions about centers and speak with program officers and center directors.



2019 CPU2AL SCIENCE AND TECHNOLOGY OPEN HOUSE AND ANNUAL MEETING

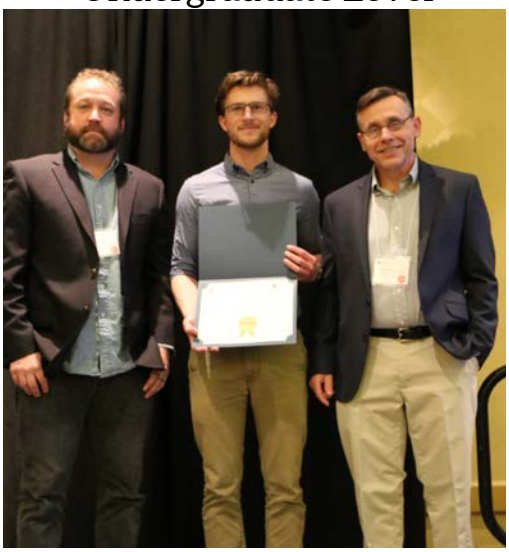
The 2019 CPU2AL Annual Meeting was held in conjunction with the Science and Technology Open House (STOH) from Wednesday, April 3 through Friday, April 5, 2019.

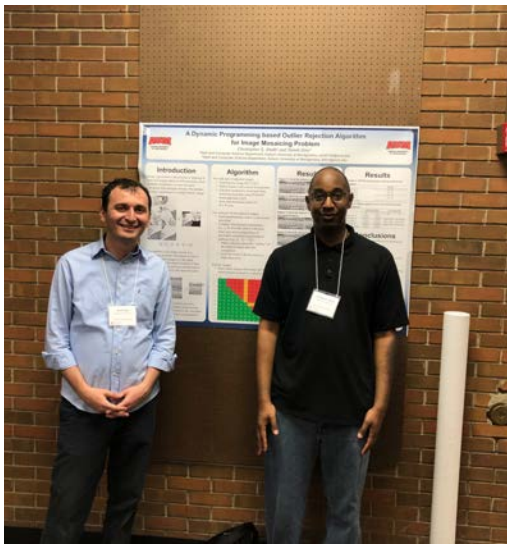
During the STOH, undergraduate and graduate students and post-docs presented their research posters. Awards were given to the top three student posters in physical and biological science at each academic level. The annual meeting served as a dress rehearsal for the CPU2AL members presenting at the Reverse Site Visit with the NSF.

WANT TO SEE MORE PHOTOS FROM THE 2019 STOH? SCAN THE QR CODE

2019 Science and Technology Open House Poster Awardees

Undergraduate Level





First Place: Gabrielle Maloy, Alabama State University
Thanatomicrobiome in Liver Samples of American and European Cadavers

Second Place: Tanner Hickman, University of South Alabama
Characterization of Non-volatile, Self-neutralizing Acids formed from Ionic Liquids and CO2

Third Place: Christopher Smith, Auburn University at Montgomery
A Dynamic Programming based Outlier Rejection Algorithm for Image Mosaicing Problem

Masters Level

First Place: Oluwaseyi Shofolawe-Bakare, Tuskegee University
Interfacial properties of CNTs-added carbon fiber epoxy composites through Nanoindentation technique

Second Place: Andrea Nicolau, The University of Alabama in Huntsville
A Spatial Pattern Analysis of Forest Loss in the Madre de Dios region of Peru

Third Place: Zachary White, The University of Alabama in Huntsville
Diagnostics of Striations in RF Capacitively Coupled and DC Positive Column Discharge Plasma

2019 Science and Technology Open House Poster Awardees

Biological Sciences: Ph.D. Level

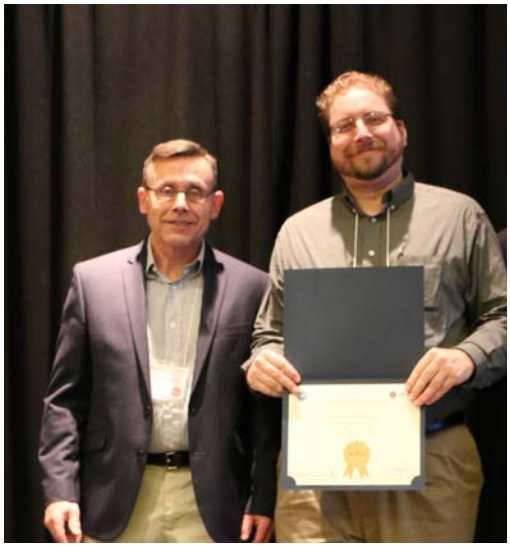


First Place: Terrance A. Platt, Tuskegee University
Modulating Effects of Intrathymic TNC Transplants on Cardiovascular Remodeling in Systemic Lupus Erythematosus - Induced Aortic Atherosclerosis

Second Place: Zaheeruddin Mohammed, Tuskegee University
Characterization of low-temperature Plasma treated biobased silica/carbon hybrid nanoparticles

Third Place: Aiesha L. Ethridge, Tuskegee University
Synthesis of Polyvinyl Alcohol and CaCO3 from Eggshells for Nanocomposites via Ultrasonication

Physical Sciences: Ph.D. Level



First Plcace: Michael McKinlay, Auburn University
Controlling dust charge with driven current fluctuations

Second Place: Siyuan Zhang, The University of Alabama at Birmingham
Improvement of Mobility and Stability of Motion of Skid-Steering UGV with New Individually Steering Inputs on Severe Terrain

Third Place: Eleanor Williamson, Auburn University
Characterization of a microwave generated plasma with varying fractional ionization on magnetic surfaces

2019 Science and Technology Open House Poster Awardees

Honorable Mention: Best Poster Title

Boss Davis, Alexus Herron, Wyatt Oliveras, Anthony Roberts, and Gabby Thomas,
Bishop State Community College
Toxic Rice Water Experiment "Sticks and Stones May Break My Bones but Words will Make Rice Smell."

THE EVENTS

PAST EVENTS

2019 CPU2AL K-12 SCIENCE AND TECHNOLOGY OPEN HOUSE HOSTED BY THE UNIVERSITY OF SOUTH ALABAMA

The K-12 outreach event was held on Wednesday, April 3, brought in upwards 200 local students. The open house included full access to the Gulf Coast Exploreum Science Center, hands on science demonstrations, and an IMAX presentation.

Science demonstrations were provided Auburn University, Bishop State Community College, The Dauphin Island Sea Lab, The University of Alabama, The University of Alabama at Birmingham, and The University of Alabama in Huntsville.

WANT TO SEE MORE PHOTOS FROM THE 2019 K-12 STOH? SCAN THE QR CODE

Designed and edited by Dana Waller
Education, Outreach, Diversity Coordinator