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A Time of Transition and Excitement for Research

Welcome to this edition of FOCUS: The UAH Research Magazine. In May, Dr. Ray Vaughn retired and I was honored to take the reins as the interim VP for research and economic development. You may have also heard that President Robert Altenkirch will retire in the coming academic year, so UAH will enter a year of transition. Fortunately, Bob and Ray have strengthened the foundation of the UAH research enterprise and positioned the university for success. I thank them for their exceptional leadership of the university, and in the community.

Please indulge me for a moment to introduce myself. I have served UAH for 19 years in several capacities. I advanced from an assistant to a full professor in the Electrical and Computer Engineering Department. I was a department chair, the director for the Center for Applied Optics, and an associate VP for research. Prior to UAH, I conducted research at Penn State University and at Corning, where I successfully brought four products out of research and into production. Research is a passion of mine and I have been fortunate to work with people and organizations that share the excitement for how research can transform a university, organization, a company and a society.

In the cover story of this issue, Dr. Sean Lane, the new dean of the College of Arts, Humanities & Social Sciences, talks about his research-influenced vision for the college with an emphasis on promoting interdisciplinary research. Our Alumni Focus section spotlights Steve Hill, the founder of AEgis Technologies and a 1987 UAH graduate with a B.S. in Electrical and Computer Engineering.

We highlight two UAH researchers honored for their work. Dr. Narayana Bhat received the MSFC Golden Eagle Award for quickly restoring the Gamma-ray Burst Monitor to operations aboard Fermi. Dr. Patrick Reardon was invited on the NASDAQ podium during the ringing of the market's opening bell for his effort with an industrial partner.

I am very proud of the efforts of UAH researchers and the Office of Research Security that led to UAH being a recipient of the James S. Cogswell Outstanding Industrial Security Achievement Award. And two of UAH's top researchers, Dr. John Christy in climate research and Dr. Gary Zank with the Parker Solar Probe effort, are featured in the Research Focus section.

The upcoming year is the 50th anniversary of the Apollo 11 moon landing, and Huntsville made that historic event possible. Huntsville has changed over the past 50 years but the passion to make an impact on the world remains. UAH recently hosted the Wernher von Braun Memorial Symposium with the theme "Galvanizing U.S. Leadership In Space." At that event, Jody Singer, the director of NASA Marshall Space Flight Center, and Jim Bridenstine, the NASA administrator, challenged and inspired the next generation workforce in space exploration.

In addition to NASA, the FBI presence is growing on Redstone Arsenal. The Hazardous Devices School and the Terrorist Explosive Device Analytical Center already have a considerable footprint on the Arsenal, and construction continues to expand the FBI's 200-acre campus. UAH is supporting the FBI's needs. In support of warfighters and the U.S. Army on Redstone Arsenal, UAH is contributing research priorities in areas include hypersonics and high-energy laser systems.

To bolster economic and workforce development in Huntsville and the surrounding areas, UAH expands its role with the opening of the Dorothy S. Davidson Invention to Innovation Center (I^2C) in spring 2019. I^2C is an on-campus business incubator that fosters, promotes and accelerates commercialization of technology-based ventures.

We are proud of the accomplishments of our faculty, staff, students and alumni. We are excited about the future and welcome collaborative partnerships. Please contact the Office of Research and Economic Development to provide information on the efforts featured in this magazine or any other research project at UAH. ■

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A Tier 1 **"RESEARCH INTENSIVE"** national university that is located within the second–largest research park in the United States, UAH is considered one of the nation's premier research universities.

IN ALABAMA

1ST

IN ALABAMA

- environmental sciences including atmospheric sciences
- math & computer sciences
- physical sciences

2ND

IN ALABAMA

- federally funded research expenditures

NATIONALLY

- **5TH** Federally financed Aeronautical/ Astronautical engineering research
- **9TH** in Economics
- **10TH** Federally financed Computer Sciences research expenditures
- **11TH** NASA R&D expenditures
- **12TH** Federally financed Atmospheric Sciences research expenditures
- **21TH** Federally financed Astronomy research expenditures
- **28TH** Department of Defense R&D expenditures

SOURCE: National Science Foundation

RESEARCH

$463 million
Five-year contract and grant research total

$5 million
Five-year license and royalty revenue total

$94.4 million
Fiscal 2017 research expenditure total

ISSUED PATENT TOTAL – 75

NEW CAHS DEAN says growing research collaborations can convey many benefits

"In my mind, what we are trying to do is to set up the conditions for exciting things to happen."

- Dr. Sean Lane

Seated at the oval conference table in his temporary office space in the Conference Training Center while Morton Hall is being renovated, Dr. Sean Lane, the new dean of the College of Arts, Humanities, and Social Sciences (CAHS), outlines a research-influenced vision for the college's future that's strikingly organic.

First cross-college roots spread, then a collaborative stem arises to support multi-disciplinary branches that, in turn, sprout their leaves of broadly talented students and graduates, and bear the fruit of interdisciplinary research that benefits both The University of Alabama in Huntsville (UAH) and the businesses and industries for which it is done.

CAHS encompasses the departments of art, art history and design; communications arts; English; history; music; philosophy; political science; psychology; sociology; and world languages and cultures.

"I think there are some things that are really exciting about being part of a university that is so focused on technology and its development, that can provide unique connections for our college faculty and students and lead to creative endeavors that are deeply compelling," he says. "In my mind, what we are trying to do is to set up the conditions for exciting things to happen."

The roots must grow first, and Dr. Lane says he started building upon that process with "some exciting ideas that have come from our faculty" about ways in which CAHS can reach out and integrate itself more fully with other UAH colleges. He's also fostering growth through outreach to area businesses, industries and non-profit groups.

"One of the things I see as my charge is to spend a lot of time outside the university, listening to people in the region to see what their needs are and whether we can help meet them," he says.

Finding the questions these entities are asking is the first step to sprouting a collaborative stem by creating the interdisciplinary teams on campus that can do the research to answer them.

That's a process Dr. Lane has been personally immersed in working as part of the technology industry prior to an academic career that resulted in joining UAH after being associate dean of the graduate school at Louisiana State University.

"A lot of my work, starting in graduate school, was in human memory and eyewitness suggestibility, and how people can incorporate post-event information into their perceptions of events," Dr. Lane says. Although his research was in the laboratory, he saw the cross-disciplinary usefulness it could have for criminal justice and law.

"One of the things I did in my first academic position was to start a new doctoral program in applied experimental psychology at the University of Nevada in Las Vegas," he says. The program admitted its first students in 1999.

"In the process, I started interacting with people in the technology industry that was growing exponentially at that time. As a result of that, I got the opportunity to leave academia and be in industry at a really exciting time in Silicon Valley."

His tech industry experience in human factors and user experience design taught him what could be unlocked when interdisciplinary teams incorporated members from the arts and psychology as well as engineering minds.

He learned how the collaborative stem supports the branches.

"The blending of the arts, humanities, and social sciences with technology can be a very powerful one," he says, citing Apple's product successes as examples of the fruits of such interdisciplinary work.

"I was seeing the work I was doing, and that the writers and graphic artists were doing, all brought important things to the table to our work with business strategists and computer engineers."

These insights travelled with Dr. Lane when he returned to LSU, and later headed up the Cognitive and Brain Sciences doctoral program.

"I began working with the doctoral students to make them more broadly aware of the multiple pathways they could take for a career, in order to prepare them for a wide variety of work possibilities beyond academia," he says.

These broadened students are like leaves that have formed along the branches. Now, Dr. Lane has brought that broadening viewpoint to UAH.

"It is about preparing students for the skills that are needed now, the skills that will be needed in the future, and making them adaptable to change. Studying the arts, humanities, and social sciences for their own sake is important, but it can also provide professional benefits."

A goal is to graduate students to become what he calls T-shaped professionals.

"These are professionals with a deep expertise in one area and also a breadth of skills from the liberal arts that makes them more adaptable and resilient in a variety of career situations," Dr. Lane says. "One thing you can do to help students be successful is to help them communicate better to an employer the value of the skills they learn in the classroom."

Cross-college research opportunities combined with internships can create a complementary environment where students can discover the value of all aspects of their broad-based education and increase their desirability to employers, he says. "Often, they need a broader sweep of skills."

Students who combine a liberal arts degree with a technical area "do very well in the job market," Dr. Lane says, because in addition to technology, they have learned communication and adaptability skills that are in demand and can help them later rise to managerial positions. Successful students mean a successful university. "The best people you can have to be your ambassadors are your students."

In addition to broad-based, in-demand students, the collaborative environment bears fruit in research results.

"On the research side, we can connect the faculty to various companies or other organizations in order to solve problems," he says. " In order to solve these difficult problems, we need different perspectives."

Continuing to intertwine the College of Arts, Humanities, and Social Sciences with other aspects of UAH's research enterprise can bring positive and strong alliances, Dr. Lane believes.

"Students who combine a liberal arts degree with a technical area do very well in the job market."

Dr. Sean Lane

"What we want to do is to set up a situation where creative ideas can flourish and we can try new things out," he says. "If we can bring some of that excitement here, then people can flourish professionally."

Among faculty suggestions are new programs in criminology and justice studies, entertainment technology and an intelligence analysis certificate program. Each would incorporate CAHS studies with other UAH colleges and departments.

"What I find exciting here is that previous deans and faculty have laid the groundwork for connecting the outstanding work we do in the college with the impressive efforts of our colleagues across the entire university," Dr. Lane says. "I want to take advantage of the unique opportunities here for collaboration on campus and with people across the region." ■

Center for Applied Optics director joins VirTra Inc. as NASDAQ bell is rung

The director of the UAH Center for Applied Optics (CAO) was invited on the NASDAQ podium during the ringing of the market's opening bell recently after the center developed a patented lens system for a rifle scope used with VirTra Inc.'s virtual reality training program for police and other first responders.

In New York, CAO Director Dr. Patrick Reardon joined VirTra Chief Executive Officer Bob Ferris and almost all of the company's employees to celebrate its March listing on the NASDAQ with the honor.

VirTra is a global provider of training simulators for the law enforcement, military, educational and commercial markets. The company's patented technologies, software and scenarios provide intense training for de-escalation, judgmental use-of-force, marksmanship and related training that mimics real world situations. VirTra's mission is to save and improve lives worldwide through realistic and highly effective virtual reality and simulator technology.

"First, I felt honored that I was invited to take part in something that so few people have been able to experience," Dr. Reardon says. "One of Bob Ferris' longest supporters noted that the percentage of businesses that make it to listing on the NASDAQ is extremely small. It was also both exciting and exhilarating – being part of a group of people who have all contributed to the success of this company."

Early video training systems used a single screen downrange to present a video of potential shooting scenarios. Unfortunately, this method also taught an unwanted sense of tunnel vision. VirTra's systems fill the trainee's field of view, up to 300 degrees wide, all within a reasonably sized room space.

"The challenge they discovered is that the standard military scope is not designed to operate looking at objects as close as the walls upon which the scenes are projected," Dr. Reardon says. "This is the optics issue Bob Ferris contacted us to solve."

The lenses of basic military scopes are designed to view objects at great distance. Yet for VirTra's system, the scope would be used with a scene as close as 2 meters away. That's a distance at which the standard scopes both perform poorly and also create a condition known as parallax, where the direction of an object appears to differ when viewed from different positions.

"To correct the errors, we developed a concept which ended up being patented," says Dr. Reardon. The patent is U.S. 8,950,102 B1.

"Our original concept prototype consisted of relatively inexpensive lenses that would fit in a clever and simple mounting system developed by Ted Rogers and Chris Underwood, also of the CAO, that attached to the scope. This optic was able to accommodate video screens from about 2 to 4 meters distance."

The CAO has been re-engaged to assist VirTra in modifying the projection system to further enhance the trainee's experience.

"This experience, from the technical side, is the kind of project the CAO often takes on," Reardon says. "We can serve as the optics department for a small business which needs a solution for a critical issue. We have the experience and expertise in optical and optical systems design, fabrication and testing." ■

▸ Dr. Narayana Bhat says the work he does is itself a reward and the Golden Eagle "is more like an icing on the cake."

Quick Gamma-Ray Burst Monitor fix earns **Golden Eagle Award** for UAH researcher, others

Center for Space Plasma and Astronomic Research (CSPAR) research scientist Dr. Narayana Bhat and two others on the contractor team for NASA's Fermi Gamma-ray Space Telescope and its Gamma-ray Burst Monitor (GBM) have been awarded the Marshall Space Flight Center (MSFC) Golden Eagle Award for quickly restoring GBM to operations an anomaly aboard Fermi.

Joining Dr. Bhat in being awarded are Bill Cleveland and Lisa Gibby. All three work at the National Space Science Technology Center (NSSTC) on the UAH campus. Part of Marshall's broader Mission Success is in Our Hands initiative, the Golden Eagle aims to strengthen team members' commitment to mission assurance and flight safety.

The trio each played crucial roles in quickly reviving a ground-based Spacecraft/Simulator Interface System, determining starting point settings for the GBM instrument and developing the commanding script to restore GBM to its pre-shutdown settings.

Dr. Bhat says the work he does is itself a reward. "Any additional reward, if any, is more like an icing on the cake," he says. "The most exciting aspect of my work with GBM is that our extensive testing of the entire GBM hardware along with its firmware and the flight software resulted in a fully functional experiment today, even after 10 years of operation. Each and every design element is functioning today as it was tested to be."

Because of its reliability, Dr. Bhat says GBM was able to obtain outstanding scientific results like the recent detection of an electromagnetic counterpart of a gravitational wave event detected by the LIGO experiment. ■

Helping others also succeed a priority for AEgis cofounder

Back in 1989, with his job at the Riverside Research Institute in Huntsville going away because the company was closing that office, Steve Hill (B.S., Electrical & Computer Engineering, '87) says he "had a week to either get a job or start something."

When he partnered with Bill Waite to create AEgis Technologies, a privately-held small business focused on modeling and simulation technology and emerging training solutions for military and commercial applications, the support of the Huntsville business community was fundamental to the fledgling enterprise.

Even as AEgis today has surpassed $90 million in sales and has 10 locations nationwide, as its President and Chief Executive Officer Hill has not forgotten the advice and partnering opportunities the community extended to his company in its formative stages, and he is doing his part to continue the tradition.

"If you've had some success and good fortune, you have an obligation to pay it forward, and we're real active in trying to help other small businesses," he says. "We often give documents and processes we have figured out along the way to other small businesses so they don't have to figure it out for themselves. Even though we are often competitors, there's plenty of work available in the market and if we can be helpful to other businesses, then we want to do that."

A member of the UAH President's Advisory Council and the Engineering Advisory Board, Hill has spoken on leadership and entrepreneurship for several community organizations including Leadership Huntsville/Madison County.

"We've had a really good relationship with UAH President Bob Altenkirch, and I think he's done a fantastic job of listening to the community and improving and growing UAH. The community is really going to miss him as he transitions to a new role," Hill says.

"As far as the community, our mayors and politicians have really worked together over time to support all of the Huntsville area, and the Huntsville-Madison County Chamber of Commerce does a great job of supporting economic development here. The Huntsville-Madison community is the most cooperative area I have ever seen. I think people are really embracing that a rising tide helps us all."

Hill's father is a retired U.S. Army colonel and he says his thoughts always have been about "either being a warfighter or supporting our warfighters." After his family moved to Huntsville, he attended Grissom High School and earned a full scholarship to UAH.

"I co-oped while attending UAH, so during work quarters I could take a class at night and still graduate in four years," he says.

Following graduation, he found himself supporting the Ballistic Missile Defense Organization – now known as the Missile Defense Agency – in Huntsville by working at Riverside and using Cray supercomputers to analyze allocation of strategic defense assets to protect the United States from nuclear attack. Riverside was the original support contractor for the Strategic Defense Initiative under President Ronald Reagan.

After learning of the office closure, Hill and Waite evaluated their options.

"The economy was good," Hill said. "We really were motivated by wanting to support the warfighter. Bill had a long, excellent career and he was way ahead of me in modeling and simulation (M&S)."

An IBM 286 computer was state of the art for personal computing at the time, so the advance of M&S was being throttled by technical capabilities, but the pair felt good about the future of the field.

"We really felt that M&S would grow over the next couple of decades, and it did grow into a very cost-effective tool for weapon systems development, analysis and training," he says. "We really did believe it would save our customers money and it was an effective way to train our

Steve Hill says one of the greatest things about America is that "you can make anything work if you are passionate and persistent enough to stick with it."

warfighters. At that time, it was difficult to utilize modeling and simulation in a way that saved resources, but as we acquired more computer power and simulation applications, M&S become more affordable and saved our customers a lot of money."

The young business got its start as so many entrepreneurial endeavors do – with limited resources..

"We had no resources at all," Hill says. "We took a thousand dollars between us and spent $900 to get incorporated, and then took a series of small consulting jobs to get ourselves going."

That's where the support of the local business community was crucial, he says. Established businesses partnered with AEgis on projects, so it could build a track record required to become a prime contractor.

"There were a lot of great people around town who were really helpful and good to us," Hill says. "There's no doubt that in the aerospace and defense industry, there is a lot of competition and much to learn about how to partner with other organizations and write proposals to the government. Then your company has to evolve into a high-performing contractor in order to be able to obtain additional work."

The hand up from other companies and the entrepreneurial spirit of the founders are what gained AEgis the important foothold it needed.

"It takes a reasonable amount of confidence in yourself to get things going, and it takes persistence so that when things get tough or there are roadblocks to your success, you can still stick to it," Hill says. "That's one of the greatest things about America – you can make anything work if you are passionate and persistent enough to stick with it."

Persistence and the support of talented and smart employees have resulted in AEgis' success, Hill says.

"Today, I have a much easier job," he says. "All I have to do is hire a bunch of people smarter than me who know what they are doing and support them in doing it." ■

I²C FIRM **RADIOBRO WINS FIRST PLACE** IN WARFIGHTER TECHNOLOGY CONTEST

From left, RadioBro President **Mark Becnel, Jordan Teats, A.J. Dragotta, Jessie Chapman, Liam Redmond, Lexandra Lutz** and Dennis Rouleau. *(Credit: RadioBro)*

A small business at The University of Alabama in Huntsville (UAH) Dorothy S. Davidson Invention to Innovation Center (I²C) has won a $10,000 first prize in a nationwide contest to improve field communications for U.S. warfighters.

RadioBro Corp., an aerospace engineering and solutions firm that is located in the I²C, recently won for its submission to a TeamWERX technology challenge by the group SOFWERX. The contest challenge was to extend radio frequency (RF) using a repeater/amplifier.

UAH's I²C is a regional initiative that fosters, promotes and accelerates commercialization of technology-based ventures through incubation, co-working, mentorship, funding and strategic support.

"We are proud of RadioBro for achieving this recognition. This is one of the many accolades one can expect to see from companies that are part of I²C," says Director Rigved Joshi. "Our 'start-up fraternity' at I²C is a thriving and environment supporting entrepreneurship at absolute grassroots level."

RadioBro's proposal, based on its own miniaturized ultra-high-frequency hardware, beat eight other submissions from across the nation.

"The group SOFWERX identified a need to find new problem solvers that can help with RF bridging," says RadioBro President Mark Becnel, a UAH alumnus who founded the firm in 2014 with his twin brother, Eric, who is also a UAH alumnus.

SOFWERX was created under a Partnership Intermediary Agreement between Doolittle Institute, a U.S. Air Force research laboratory innovation institute, and the U.S. Special Operations Command (USSOCOM). Located in Tampa, Fla., SOFWERX has a growing ecosystem that promotes divergent thought and neutral facilitation with the goal of bringing the right minds together to solve challenging problems.

"We showed how we can bridge RF data using the same technique we apply to relay information through a small spacecraft," Becnel says. "We used four of the MiniSatCom modules we designed in 2014 to demonstrate a solution!"

The RadioBro solution uses miniature devices that are activated and deployed by a user making his or her way through, around or into structures that would normally block or degrade a radio signal.

Deploying the tiny, hard-to-detect devices reroutes a radio signal from its origin through a chain of devices to the receiver. The size of the devices makes them hard for enemy forces to find and disrupt, and the low cost per unit allows the devices to be left behind if necessary.

RadioBro's first place selection includes the opportunity to work with U.S. defense agencies and the defense industry to turn its innovative idea into actual hardware used in the field.

Participating in the contest opened new application horizons for RadioBro technologies, Becnel says.

"We did not look at terrestrial applications of our device," he says. "We now show strength in new market areas in which we previously were not involved."

Locating at the I²C's temporary facilities in Executive Plaza has helped RadioBro in non-traditional ways, Becnel says, and he awaits relocation to I²C's permanent building, now under construction.

"There is synergy in the hallways to make and deliver innovation. There's just tremendous energy," he says. "When we start to edge out of our knowledge sphere, we can quickly lean on other embedded companies or the university for support. This has helped accelerate our goals."

That atmosphere helps focus the RadioBro team on developing technologies and products that advance the state of the art, Becnel says.

"We're excited to see our efforts supporting Special Operations take hold. We appreciate supporting the country."

SPACE HARDWARE CLUB tests telescope radiation shield in New Mexico

▸ SHC members in New Mexico with ALFRED aboard the gondola for its test flight. From left to right: Back – **Christopher Helmerich**, **Jared Fuchs**, **Dr. Francis Wessling**, **Matthew Haskell and Erik Korzon**. Front – **Kyle Renfroe**, **Samantha Johnson**, **Elena Pradhan and Wayne Baumgartner**.

The Space Hardware Club (SHC) was recently at the Columbia Scientific Ballooning Facility (CSBF) in Ft. Sumner, N.M., test flying a device it developed to protect NASA's balloon-born X-ray telescopes from stray X-rays that can spoil their view.

Stray X-rays can spoil an X-ray telescope's view because, with more energy at higher frequency than visible light they can penetrate metal and other materials and interfere with optics.

The Active Luminescence For X-ray Emission Detection (ALFRED) system is an anti-coincidence shield designed to reduce the background in X-ray detectors by recording radiation that interacts in both a shield and detector and vetoing those coincidence events. The SHC project is fully funded by $50,000 from NASA's Undergraduate Student Instrument Project (USIP).

"Our experiment is testing a new type of material and configuration that could be used in future balloon or space missions," says Jared Fuchs, a senior physics major and the system engineer.

The SHC payload was hoisted on a zero-pressure balloon. During flight, instruments gathered the energy of X-rays interacting in the detector with the active shield on and off to compare how the resulting histograms differ, an indication of the shield's effectiveness.

The club is advised by Dr. Francis Wessling, professor of mechanical and aerospace engineering, and has as its NASA mentors Dr. Jessica Gaskin and Dr. Wayne Baumgartner of Marshall Space Flight Center (MSFC) and the National Space Science Technology Center (NSSTC).

SHC's shield design uses a combination of lead shielding and scintillation detectors. The scintillation material is a cesium lithium yttrium cerium combination with very little flight heritage, so the tests conducted were some of the first using it as a shielding system in a high altitude environment.

The test flight was long anticipated by the club following delays, Fuchs says.

"Our main delay last year was from the weather issues in Ft. Sumner, and because we were manifest as last on the flight list, the delay ended up bumping us off and into the next year," he says. "This time around we are first up, alongside other USIP payloads, as hitchhikers on the 60 million cubic-foot test flight."

Being delayed was a big setback, but it allowed the SHC to fly a better payload.

"Through all of it, the team itself has remained intact, and most all of the original members are in Ft. Sumner working on the project," Fuchs says. "This is one of the longest projects the club has undertaken and it's been great to see the team stick together through the delays and setbacks we have faced."

Many long nights were spent en route to a unique opportunity to fly with a NASA ballooning campaign, he says.

"It's great to see all of our hard work come to fruition. I personally was involved with this project as a freshman when we first proposed to NASA, and getting to see our team build this payload and be out here at CSBF preparing to fly is a highlight of my undergraduate experience." ■

INSTRUMENT ON WHICH UAH COLLABORATED NEARS HISTORY-MAKING ORBITS OF THE SUN

NASA's Parker Solar Probe (PSP) mission began its historic first daisy petal-like loop through the sun's corona in November, augmented by a gravitational boost via a Venus fly-by – an important milestone for the craft's groundbreaking seven-year effort to better understand the nature of the star responsible for all life on Earth.

Aboard is a Faraday Cup instrument designed, created and tested by The University of Alabama in Huntsville (UAH), Marshall Space Flight Center (MSFC) and the Harvard Smithsonian Astrophysical Observatory (SAO) to sample the solar wind while exposed directly to it and traveling closer to the sun than spacecraft from Earth have ever been.

The cup is part of the Solar Wind Electrons Alphas and Protons (SWEAP) instrument array and will directly collect charged particles that comprise the solar wind as the spacecraft travels through coronal gases super-heated to temperatures greater than 1 million degrees K (1.8 million degrees F).

Also aboard as part of SWEAP are two Solar Probe Analyzer instruments known as SPAN-A and SPAN-B. With a wider area of coverage, the SPAN devices collect particles and sort them though a series of deflectors and voltages based on their mass and charge. SPAN-A measures electrons and ions. SPAN-B is dedicated to electrons only.

"Everything appears to be working well, so everyone is excited and anticipating groundbreaking science," says Dr. Gary Zank, director of UAH's Center for Space Plasma and Aeronomic Research and the Aerojet Rocketdyne chair of the university's Department of Space Science. PSP's orbit is intended to keep the craft from burning up as it repeatedly enters and exits the hot corona.

"This is a mission that had its genesis at the beginning of the space age, and after 50-plus years is finally coming to fruition," Dr. Zank says. "We will, for the first time, look into the heart of the corona and learn its secrets." But data that will be the basis for new science has already been collected during PSP's Venus fly-by, he says.

"The Venus encounter is interesting, since Venus has no magnetic field, and so its neutral atmosphere tends to escape quite easily into interplanetary space," Dr. Zank says. The escaping atmospheric neutral molecules can be ionized – in other words, they become charged particles – in the supersonic solar wind and gain a lot of energy as a result. These new ions are called pickup ions.

"Besides Venus, pickup ions are found around comets and also in the distant solar wind. So the physics of pickup ions is exceedingly interesting from many perspectives," says Dr. Zank, who is a member of the National Academy of Sciences. "The SWEAP instrument, including the SPAN-A instrument, will play key roles in the measurement of pickup ions at Venus and related solar wind observations. So I expect the first papers from SWEAP – and indeed several other instruments – to be about Venus pickup ions."

Following PSP's close encounter with Venus, the craft's instruments will be collecting solar wind data as it approaches the sun at the first perihelion at 35.7 solar radii – well within the orbit of Mercury.

◂ An artist's rendering of the Parker Solar Probe approaching the sun. *(NASA)*

Dr. Gary Zank says no spacecraft has ever gone so close to the sun.

"This will yield new data closer to the sun than ever before, by about a factor of two," Dr. Zank says. "So everything that we see after the Venus encounter is going to yield new insights. Very exciting!"

Launched Aug. 12 from Space Launch Complex 37 on Cape Canaveral Air Force Station in Florida aboard a United Launch Alliance Delta IV Heavy rocket, PSP's mission is to inform the physics underlying the atmosphere of the sun and inform researchers about the corresponding physics of all stars that are like the sun.

"It will be the first in situ exploration of the atmosphere of a star," Dr. Zank says. "The work will therefore be incredibly far-reaching."

The SWEAP Faraday Cup acts something like a solar catcher's mitt, utilizing its window screen-like surface to scoop up samples of the atmosphere of the sun and to measure the detailed properties of electrons, protons and helium ions – the main components of the corona and solar wind.

"The most important question to be answered is how the sun heats the solar corona, the region above the surface of the sun, and then drives the huge, highly supersonic solar wind and creates the bubble within which the solar system resides," says Dr. Zank.

"The surface of the sun is relatively cool – 6,000 - 7,000 degrees K – but the atmosphere above is heated to more than a million degrees over a relatively short distance," he says. "We do not know how or what the physical process is. We have some ideas, and by measuring the distribution function, we will be able to finally quantitatively identify the physical processes that lead to the existence of the solar wind."

Besides SWEAP aboard PSP are instruments to perform four other scientific investigations.

- The Fields Experiment will measure electric and magnetic fields, radio emissions and shock waves in the sun's atmospheric plasma.
- The Integrated Science Investigation of the Sun uses two instruments to monitor electrons, protons and ions in the sun's atmosphere.
- The Wide-field Imager is a telescope that will make images of the sun's corona to see the solar wind, clouds and shock waves as they pass by the spacecraft.
- Heliospheric Origins with Parker Solar Probe will provide an independent scientific assessment of scientific performance and be a community advocate with principal investigator Marco Velli of NASA's Jet Propulsion Laboratory in Pasadena, Calif., as the mission's observatory scientist, responsible for serving as a senior scientist on the science working group

The 1,350-pound craft has an 8-foot diameter, 4.5-inch thick carbon-carbon/carbon foam heat shield to protect it with all instruments behind that shield except the one for SWEAP and the antenna for the Fields Experiment.

PSP is on course for close encounters with a sun 20 times larger and 500 times brighter than it is at Earth. It will explore hot plasma arches as well as solar coronal holes and coronal bright patches discovered in the early '70s by a Skylab X-ray telescope. PSP will measure the range of energetic particles that compose the features.

"Particles that stream out from the sun through the solar corona will be measured directly by SWEAP, essentially capturing and measuring the density, velocity and temperature/energy of the thermal particles that comprise the bulk solar wind flow," says Dr. Zank.

These measurements will provide a somewhat bell curve-like distribution function that describes how solar wind particles are organized in terms of velocity and energy, and whether the magnetic field of the sun plays a role in organizing the shape of the distribution function, he says. The mission is scheduled for seven years, ending in 2025.

"Of course, there is always the possibility of an extension thereafter. This typically happens after a senior review exercise conducted by NASA to see if the potential and need for further important science warrants reinvestment of further funding," says Dr. Zank. "If all goes well and the designs of the instruments and spacecraft hold up to the very hostile radiation environment, the mission could last as long as fuel and power are not a problem."

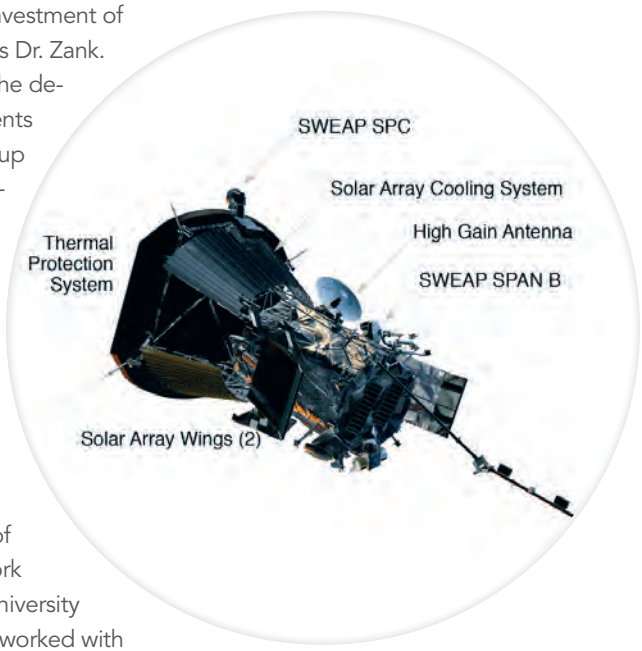
UAH worked closely with its partners in designing, testing and fabricating many elements of the Faraday Cup, work that was led at the university by Ken Wright, who worked with MSFC partners, a group that at the time included Jonathan Certain.

"Both Jonathan and I supervised UAH graduate student Phyllis Whittlesey, who was involved in a lot of testing of the cup, including exploring the virtual design of the instrument computationally, as well as developing techniques and algorithms to establish that SWEAP could answer some of the fundamental questions that PSP was designed to address," says Dr. Zank.

MSFC had technical expertise and excellent plasma testing facilities and much of the work that UAH did was done directly at the NASA labs on Redstone, he says.

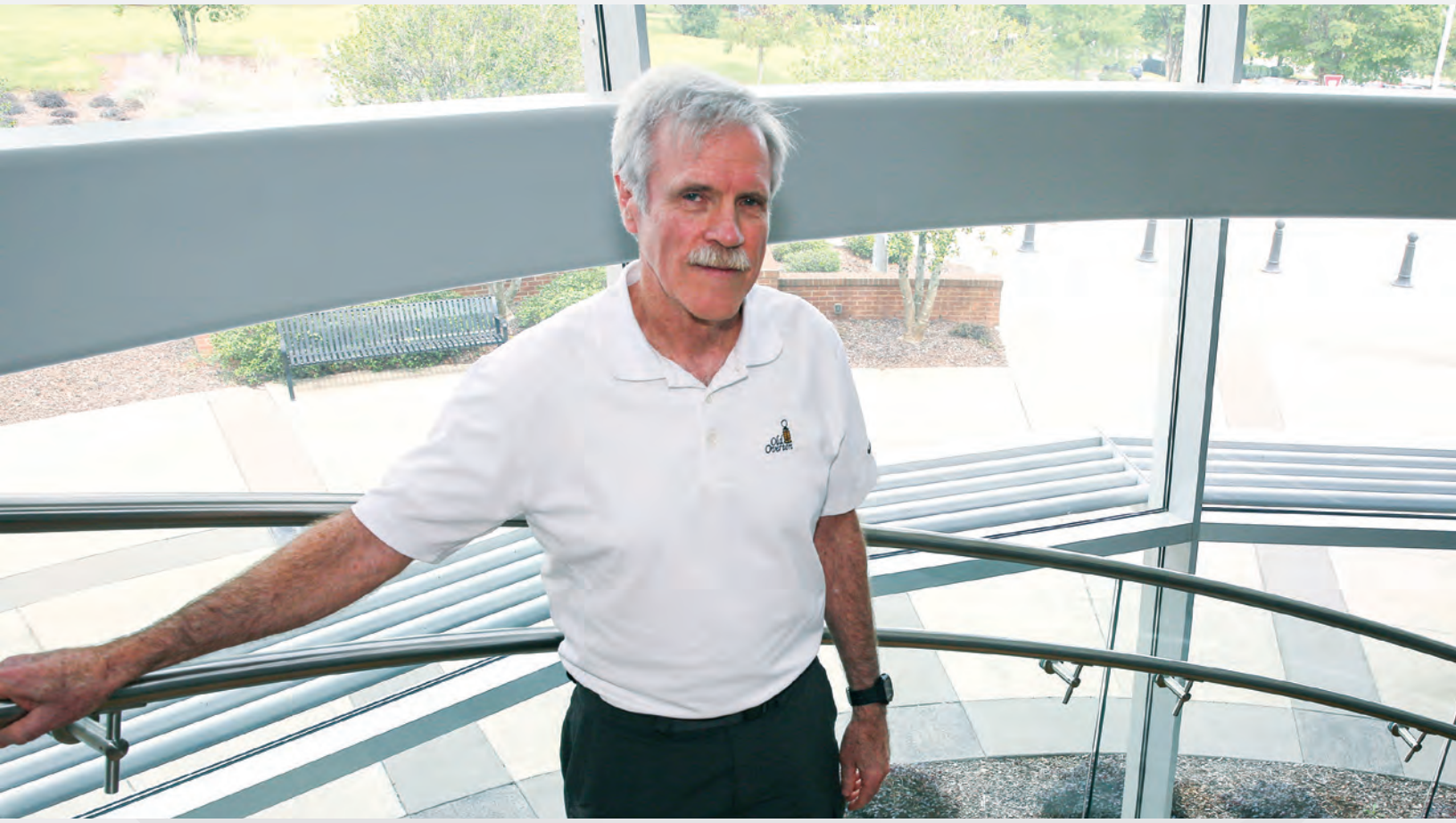
"It's been over five or six years invested in the preparation of the PSP, from the original conception to the pulling together of a team, the proposal writing and submission, and of course the building of the SWEAP instrument," says Dr. Zank.

The principal investigator for SWEAP is Justin C. Kasper of the University of Michigan with funding through the Smithsonian Astrophysical Observatory (SAO) in Cambridge, Mass. It is a multi-institutional project that includes the University of California, Berkeley Space Sciences Laboratory, the Massachusetts Institute of Technology, Los Alamos National Laboratory and NASA Goddard Space Flight Center, as well as UAH and MSFC. ■



▲ SWEAP SPC designates the Faraday Cup's position on the spacecraft.

UAH CLIMATOLOGISTS TO DEVELOP NEW CLIMATE SENSITIVITY INFORMATION



Climatologists at The University of Alabama in Huntsville (UAH) have received a grant from the United States Dept. of Energy to develop a new method of determining how the Earth's climate is responding to greenhouse gases that they think will be more accurate than current methods.

Also part of the expected $1.5 million, three-year project is work to devise a method to assess the climate impacts of greenhouse gases on snowfall in three Western Pacific coastal states in order to accurately determine impacts on the snowfall, an important water supply for the region. Initial funding is $489,399.

Dr. John Christy, Alabama State climatologist and director of the UAH Earth Systems Science Center, is the principal investigator for the research, and is joined by UAH co-investigators Dr. Roy W. Spencer and Dr. Richard T. McNider.

"We intend to create indices of climate variables that can be calculated from models as well as from observations. The basic idea is to determine to what extent the observed climate responds to extra greenhouse gases like CO2 and compare that with models," says Dr. Christy, who is also a professor of atmospheric science. "At present, our studies suggest the climate models are more sensitive to the extra gases than the real world is. In other words, the models show much more global warming than is actually occurring."

Dr. Christy says the sensitivity value is important because the amount generated by models has been used in taxation policy regarding carbon-based energy like gasoline, coal and natural gas, since burning them produces CO2.

"This has tremendous importance for tax and energy policy," says Dr. Christy.

The researchers plan to use global satellite observations in their work for the energy balance and response project and to construct a long-term record beginning in 1878 of snowfall in the three adjoining U.S. Pacific Coast states, in which over 50 million Americans live. The new work will utilize satellite global atmospheric temperature data of the deep atmosphere from the surface to about 50,000 feet that is already being gathered by the ESSC to compile monthly global temperature reports.

"The main climate components used to determine the sensitivity of climate to extra greenhouse gases will be based on satellite measurements of atmospheric temperature and the incoming and outgoing energy of the Earth," Dr. Christy says. "The snowfall data will be collected from surface stations, some of which go back to the 1870s. This long period will give us an idea as to whether there have been recent changes related to extra CO2. So far, we haven't found any significant changes in western snowfall either up or down since the late 19th century."

Dr. Christy says the team will pull together a tremendous amount of satellite data that measures the atmospheric temperature and the energy absorbed and emitted by the Earth.

"So, we will need to determine how much of the sun's energy is absorbed by the Earth as precisely as we can, then how much is emitted by the Earth, which is not easy, as the numbers change from place to place and day to day," he says. "If there is a difference in the average over a large area, then there is either a net energy loss or gain in that area – and this should show up as a change in atmospheric temperature."

The key metric researchers will calculate is how much the temperature changes when there is an imbalance of energy.

"For example, if the imbalance for a few months is +1.0 watts, how much does the temperature rise?" Dr. Christy asks. "This is not an easy project since the natural climate system has energy flows of over 200 watts in and out, so we are teasing out a small temperature response to a small imbalance between two large numbers. This relates directly to the impact of extra CO2 because we have a pretty good idea of how much extra energy is retained by the CO2, but we don't have a precise value for the temperature change that it causes."

The team will also access huge amounts of climate model data from which to calculate the same metric – the change in model temperature whenever there is an imbalance in the model energy flow.

Snowfall data will be collected from station data found in the federal archive in two forms. One is imagery of the actual forms that were filled out prior to 1910 by the observers, which will be entered into a database. The second source is the federal archive that has already been digitized.

"The key result is to quantify the sensitivity of the climate system to extra greenhouse gases and will be used to estimate future changes in the climate since greenhouse gases, primarily CO2, are increasing each year and will do so for the foreseeable future." ■

▸ Dr. John Christy is the principal investigator for the research.

▸ Denise Spiller

UAH IS THE **ONLY** INSTITUTION OF HIGHER LEARNING IN THE NATION TO BE CHOSEN BY THE DSS FOR THE 2018 AWARD

UAH gets distinguished research security award

The University of Alabama in Huntsville has been chosen by the Defense Security Service (DSS) to receive the 2018 James S. Cogswell Outstanding Industrial Security Achievement Award.

Nationwide, only 39 organizations were selected for the 2018 award from a population of approximately 13,300 cleared facilities that are subject to recurring assessment.

UAH is the only institution of higher learning in the nation to be chosen by the DSS for the 2018 award.

"This recognition from one of the nation's leading agencies providing oversight for America's security operations is quite an accomplishment for UAH and our team of security professionals," said UAH President Robert Altenkirch. "This award is indicative of the investment and dedication of a lot of individuals on our campus and we're pleased their efforts are being recognized."

"The Cogswell award represents the best of the best and the winning security programs stand as models for others to emulate," said UAH Security Administrator Denise Spiller. "The award is presented to organizations that have significantly contributed to industrial security, as well as national security."

The award criterion focuses on principles of industrial security excellence. Factors include establishing and maintaining a security program that far exceeds the basic National Industrial Security Program requirements, and providing leadership to other cleared facilities in establishing best practices while maintaining the highest standards for security.

The Cogswell Award selection process is rigorous, according to Spiller.

A DSS industrial security representative may only nominate facilities that have at a minimum two consecutive superior industrial security review ratings, and which show a sustained degree of excellence and innovation in their overall security program management, implementation and oversight. The nomination is based on the overall facility security program, senior management support, security vulnerability assessments, security education and awareness, facility security officer and security staff level of experience. Once nominated the DSS field chief's approval is required. It is then sent to DSS headquarters where 56 agencies review the nominations.

The Cogswell Award is given for outstanding achievement in matters related exclusively to a facility's security program. DSS makes the final selections.

The award was established in 1966 in honor of the late Air Force Col. James S. Cogswell, the first chief of industrial security within the Department of Defense. Cogswell was responsible for developing the basic principles of the Industrial Security Program, which includes an emphasis on the partnership between industry and government to protect classified information. This partnership ultimately ensures the greatest protection for the U.S. warfighter and our nation's classified information. ■

ABOUT THE DEFENSE SECURITY SERVICE

The Defense Security Service (DSS) strengthens national security at home and abroad through security oversight and education operations. DSS oversees the protection of U.S. and foreign classified information and technologies in the hands of cleared industry under the National Industrial Security Program by providing professional risk management services. As functional manager for the Department of Defense (DoD), DSS provides security education, training, certification, and professional development for DoD and for other U.S. Government personnel, contractor employees, and representatives of foreign governments.

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At UAH, education and research collide. Our high-tech research centers, academic colleges, and research investments are responsible for over **$96 MILLION** in R&D funding, while graduates of our academic programs consistently reinforce the region's professional workforce. That's why supporting research at UAH really means supporting the institution as a whole. By joining the President's Corporate and Foundation Partners, you can ensure UAH continues to push the boundaries of knowledge – not just in the classroom, but also well beyond.

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UAH'S DEPARTMENT OF ATMOSPHERIC SCIENCE **NAMED**

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The National Geospatial-Intelligence Agency (NGA) and the U.S. Geological Survey named UAH's Department of Atmospheric Science a Center of Academic Excellence (CAE) in geospatial sciences.

The selection confirms that the Department's undergraduate and graduate programs in Earth system science meet the standards set by NGA, and that students receive the knowledge and skills needed to become active members of the geospatial sciences field.

Part of the U.S. Department of Defense, the NGA provides geospatial information and support for military and intelligence projects around the world. It also assists in humanitarian and disaster relief efforts in the U.S. and abroad, an area closely aligned with work done by UAH students and faculty affiliated with NASA's SERVIR and DEVELOP programs.