National Aeronautics and Space Administration

THE SPARK

TECH TRANSFER, PARTNERSHIPS, AND SBIR/STTR AT GODDARD

UP, UP, AND AWAY!

Balloon Technology Takes Flight at Goddard

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NASA's scientific balloon flight program launches about a dozen balloons each year from sites across the world. Innovators at NASA's Goddard Space Flight Center are developing new technologies to help heavy payloads take flight. In this picture, a balloon nicknamed the "Big 60" launches from Fort Sumner, New Mexico, on Aug. 17, 2018. Photo Credit: NASA

OFFICE OF THE CHIEF

For more than a year now, the Strategic Partnerships Office (SPO) has worked remotely, spread out in home offices and connected through virtual platforms. Through today's technology resources, Goddard has continued forging partnerships, signing licensing agreements, and identifying promising NASA technologies to put forth for commercialization. I'm still amazed by what can be accomplished over a screen!

In this issue of *The Spark* magazine, we're highlighting some of the technology transfer and partnerships successes that have occurred during this time of telework. First, we check in with four participants of the NASA Commercialization Training Camp, a resource for current and retired professional athletes. They share their developing business plans and ideas for the future. In February of 2021, NASA hosted its first all-virtual training camp, marking the third official year of the program.

Next, we take a closer look at a Goddard-developed cooling technology licensed by Florida-based company Protodromics LLC. The electrohydrodynamic pump has applications in a wide range of fields, from electric cars to high-performance edge computing.

Keeping an eye to the future, we're sharing the story of a scientific balloon technology developed at Goddard. With walls as thin as a beer can, this ultralight dewar technology frees up mass for heavier payloads.

And finally, we're catching up with Goddard Technology Manager Josh Levine, who began working for NASA as a civil servant during the pandemic. He discusses his experience, areas of interest, and strategies when it comes to technology marketing and licensing.

Thank you for picking up this issue of *The Spark* – I hope you enjoy!

Daryl Mitchell

Darryl R. Mitchell, Chief

Strategic Partnerships Office
NASA's Goddard Space Flight Center

TRAINING CAMP

NASA Commercialization Training Camp attendees share their experiences a year later

The NASA Commercialization Training Camp, now in its third year, introduces current and retired professional athletes to the realms of technology transfer and commercialization of NASA technologies. The first few training camps spread the word about NASA's portfolio of licensable technologies to an audience of entrepreneurial, business-minded athletes with the drive and ambition to jumpstart new companies. Space Act Agreements with professional athletic organizations helped facilitate coordination between NASA and the players.

The NASA Technology Transfer Program checked in with four graduates from 2019 and 2020 to see how they're using the knowledge they gained in pursuit of their entrepreneurial goals.

Gary Baxter, Retired Cornerback/Safety for Baltimore Ravens and Cleveland Browns

With a passion for health and human sciences, Gary Baxter found a way to explore his interest in sports science research. When Baxter attended the NASA Commercialization Training Camp in 2019, he sought technologies with potential to improve human health and livelihood.

"I'm confident that American ingenuity is among the best in the world," Baxter said. "As an entrepreneur, it's awesome to think about how I can take a NASA innovation and use it to help people."

Baxter has been involved in business since 2008, when he began a career in commercial real estate. In addition to playing for the Baltimore Ravens and Cleveland Browns, Baxter has completed multiple internships, studied business management and operations, and served as a board member on an assortment of government and nonprofit boards.

Following Baxter's experience with the first training camp, he enrolled in the NASA Startup Studio, which is run by FedTech, an organization that specializes in connecting entrepreneurs with technologies from federal labs. Baxter and his team studied a NASA technology with potential in the health and wellness industry, assessing its commercial potential and evaluating whether or not a customer base exists.

Now, Baxter is working with potential business partners to determine if licensing the technology and pursuing commercialization can become a reality.

"I'm excited to continue working with NASA, and the training camp was very helpful in getting me to this point," Baxter said.

William Sweet, Offensive Lineman for Dallas Cowboys

As someone who likes a challenge, William Sweet attended the FedTech program while also participating in an NFL training camp. While juggling these two time-intensive pursuits, he met a business partner and refined his idea for a product based on a NASA technology. Earlier, Sweet was an attendee of the February 2020 NASA Commercialization Training Camp.

"One of my biggest takeaways from NASA's program is that there are so many technologies that NASA engineers have designed for space, and there are just as many use cases for those technologies to be applied here on Earth," Sweet said.

His interest focuses on renewable energy, with an eye to the future.

"It's very important that we find alternatives today to survive tomorrow," Sweet said.

During Sweet's FedTech experience, he met fellow entrepreneur Brittany Corsi. Together,

Attendees of the first NASA Commercialization Training Camp gather at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Cohort members included Joe Wesley far left) and Gary Baxter (center). Photo credit: NASA/Samantha Kilgore

they're working to investigate innovations related to solar and renewable energy. Sweet founded his own investment company in 2019, and through that experience, he decided to continue exploring the realm of entrepreneurship. He's also a venture partner with Fox Ventures, based in Champaign, Illinois.

Though their ideas are still in early stages, Sweet said he and Corsi are interested in imagining how renewable energy will change people's homes and day-to-day lives.

"As the technologies continue to develop and evolve, our homes should reflect that," Sweet said. "At the end of the day, we want to help people save money and be more efficient."

Aaron Wallace, Retired Player for Tennessee Titans and Denver Broncos

Aaron Wallace was newly retired when he first heard about the NASA Commercialization Training Camp.
"Entrepreneurship was definitely something I was interested in," Wallace said. "The training camp made it easier for me to connect with people and network with other entrepreneurs."

Wallace attended the training camp in February 2020, and in the following months, he participated in FedTech, where he studied an air filter technology developed at NASA's Glenn Research Center in Cleveland, Ohio. The multistage air filter, designed for the International Space Station, could have applications in HVAC systems for schools and commercial buildings.

At FedTech, Wallace worked with a team to study the technology's value proposition and conduct customer discovery, speaking with potential clients to assess interest. During the research process, Wallace and his team received feedback from building managers, construction, professionals and HVAC technicians, who helped them better conceptualize their product.

Based on his experiences at NASA and in FedTech, Wallace has decided to pursue a license for the technology. His company, Onedrus, will focus on air quality solutions to reduce the amount of maintenance that air filtration systems require.

"The training camp was a great resource for someone going through a career transition," Wallace said. "When you retire, it can be difficult to figure out where you want to go next, and I feel that the training camp is where my career transition started."

Joe Wesley, Retired Player for Jacksonville Jaguars

"I've always been entrepreneurial and business-minded," said Joe Wesley, who attended the June 2019 training camp at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Wesley also spoke at the February 2020 training camp at NASA Johnson and participated in the 2020 NASA Startup Studio.

Now, Wesley has teamed up with former NASA physicist Erica Morgan-West to license a NASA technology developed at NASA's Ames Research Center in Mountain View, California. Their company, ResQ Biometrics, plans to develop a product called Heartbeat ID that can detect an individual's unique biometric cardiac signature.

"It opens up the capability to identify persons of interest or missing persons without requiring the person to wear a device," Wesley said. "We hope this technology can help locate individuals who have been caught up in human trafficking, or people with dementia who have gone missing."

Wesley said that Heartbeat ID has potential customers in the medical and security industries. Wesley licensed the technology in spring of 2020, and currently, Wesley and Morgan-West are seeking grants to help move the technology forward.

"It's been great working with NASA," Wesley said. "I've definitely used what I've learned beyond the week of the program itself."

Attendees of the second NASA Commercialization Training Camp toured facilities at NASA's Johnson Space Center in Houston, Texas. Cohort members included Aaron Wallace (back row, far left) and William Sweet (back row, second from right). Photo credit: NASA/Bill Stafford

LICENSING SPOTLIGHT

Florida company licenses NASA technology that keeps electronics cool

From shutting down unexpectedly to exploding, electronics wreak havoc when they overheat. A Florida-based company called Protodromics LLC has licensed a NASA technology that takes advantage of a physical force called electrohydrodynamics (EHD) to pump water or other fluids and cool overheated electronics. Due to the technology's low power consumption, modular nature, and small size, it can be embedded into a variety of electronic devices, including ultra-cold storage containers, drones, and spacecraft instruments.

"Thermal control is a significant limiting factor in electronic power consumption today, and this technology seeks to overcome some of those limitations," said Eric McGill, a senior technology manager with the Strategic Partnerships Office at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

The micro-scale EHD modular cartridge pump, or EHD pump for short, uses electric fields to move fluid in a thermal loop, which dissipates excess heat and keeps electronics running smoothly. Because the EHD pump is small and consumes little power, it has a wide range of potential applications. The pump can integrate with computer chips for a seamless design.

"When electronics get too hot, they have to slow performance or shut down," said Adam Wexler, founder and CEO of Protodromics. "For a gaming computer, it's a mere annoyance, but it's a serious thing if the motor of your drone overheats and shuts down mid-flight."

While pursuing his graduate degree, Wexler studied the interaction of water and electric fields, including the floating water bridge, an EHD phenomenon that makes water "float" by applying high voltage to two beakers of distilled water. Wexler found Didion's work online and coordinated with Goddard to license the EHD pump in 2020. Now, he's exploring ways the technology can be infused into various commercial applications.

"One great feature of this tech is its ability to pump fluids very efficiently through tiny spaces," Wexler said. "We're looking at use cases such as the power modules for electric vehicles, where removing the highly concentrated heat is important for range as well as reliability."

The pump is part of a larger, ongoing project studying EHD force, with hardware development run by Goddard thermal engineer Jeffrey Didion and fundamental science research headed by Jamal Yagoobi of Worcester Polytechnic Institute. Their work began in 1992, and they've taken their research from scientific concept to thermal hardware demonstrations on the International Space Station (ISS).

"The pump itself was built entirely at Goddard," Didion said, "from assembly to integration and testing."

Protodromics is collaborating with the University of Florida's Innovation Fellows Program, which brings together engineering and business students who then study how to pursue the development of a project or technology. They've discussed using the EHD pump for addressing performance limitations in electric vehicles, a market expected to experience global growth in the coming years.

While potential market opportunities abound, Wexler said his company will focus on manufacturing in the coming months. Protodromics will continue to study how to turn NASA's EHD pump design into a product that can be manufactured at scale and modified to accommodate an assortment of applications. Wexler said that technologies like the EHD pump further the field of additive manufacturing or 3D printing, which he sees as advancing technology capabilities in space and on Earth.

"It's been fantastic to learn about the Startup NASA Program and how accessible NASA's technology is," Wexler said. "I'm excited to take this technology that Goddard has created and bring it to the market."

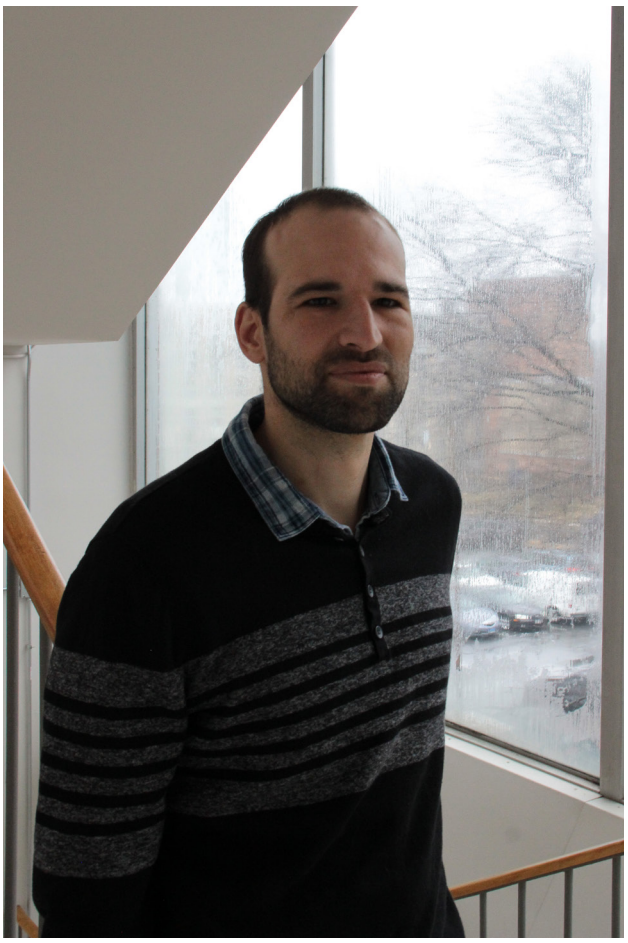
The EHD pump was invented by Matthew Showalter, Jeffrey Didion, Mario Martins, and Franklin Robinson, all members of the Mechanical Systems Division at Goddard. NASA Headquarters provided funding for technology demonstrations aboard the ISS and on NASA aircraft. Additional funding sources include the Goddard Internal Research and Development Program.

TO LEARN MORE ABOUT NASA'S TECHNOLOGY TRANSFER PROGRAM AND SPACE TECHNOLOGIES AVAILABLE FOR LICENSE, PLEASE VISIT:

HTTPS://TECHNOLOGY.NASA.GOV

This image shows the Defense Department's experiment pallet, STP-H5, hanging at the end of Canada's robotic arm during installation on the outside of the International Space Station. The EHD pump technology flew on the STP-H5 mission as part of a Goddard bundle of experiments in 2017. Credit: NASA

Q&A W/ JOSHUA LEVINE



Josh Levine began his career in technology as a research engineer at the University of Washington, where he worked in a lab studying how to improve the fit of prosthetic limbs on amputees. After that experience, he spent 10 years at the U.S. Patent and Trademark Office (USPTO) until joining the Strategic Partnerships Office at NASA, first as a contractor. He converted to a civil servant in 2020 as a technology manager.

"Tech transfer can be more of an art than a science," Levine says. "It's at the intersection so many different fields – economics, business, science, marketing, and more. It's at the nexus of all these things, and that is very exciting because it keeps things fresh."

Levine works with a diverse portfolio of Goddard innovations, from technologies that enable on-orbit servicing and manufacturing, to instruments that study the solar system. *The Spark* chatted with Levine virtually to see he's settling into his new role.

WHAT WORK EXPERIENCE DO YOU HAVE THAT PREPARED YOU FOR THIS ROLE?

I have a bachelor's degree in mechanical engineering with a minor in biomedical engineering from the Rose-Hulman Institute of Technology in Terra Haute, Indiana. After that, I spent about a year in Israel, first doing Kibbutz Ulpan, which is a kind of work-study program for learning Hebrew. Then I did a six-month project at Tel Aviv University.

My prosthesis work at the University of Washington lasted for three years. We ran trials with a thermal camera and took thermal images of people wearing their prostheses to see if certain activities had any association with the development of pressure sores. I created some hardware and software for them, and I also ran some experimentation trials with them.

I then spent 10 years at the USPTO as a patent examiner, where I specialized in implants. In many ways, it's an incredible place to work – thousands of examiners give judgement calls to allow patent claims. I have a lot of respect for the process.

WHY DID YOU CHOOSE TO WORK AT NASA IN TECHNOLOGY TRANSFER?

As a government agency, NASA's technology transfer mission is to populate the commercial marketplace with NASA technology. We want to see technology applications in the commercial realm. Because of that, the focus becomes finding a good match, which is more interesting for me as a technology manager.

Furthermore, NASA is a symbol of quality and innovation. Everyone knows NASA's on the cutting edge, and people know when you have something by NASA, it's been developed by really smart people.

PHOTO: *NASA/Samantha Kilgore*

TECHNOLOGY MANAGER

WHAT HAVE YOU BEEN UP TO IN YOUR FIRST YEAR ON THE JOB?
I've been getting familiar with the technology in my portfolio and making decisions about which technologies should move forward for commercialization. I've also started direct marketing, which means that I'm contacting companies and talking to them about specific Goddard technologies they might be interested in licensing. Even if these conversations don't result in a license, it's valuable to talk to companies because they can give feedback on applications or the current state-of-the-art standards.

WHAT IS IT LIKE TO WORK WITH GODDARD'S SCIENTISTS AND ENGINEERS?
For me, it's really fun to talk to an innovator about how their technologies could be used in fields outside their original purpose. So many times, you can see the wheels turning when they realize their innovation isn't quite what they thought it was. In a small way, you get to redefine how they might view their invention and show them how their work has even more impact than it already does.

When you're trying to make a product for market, you assess the market and design the product. NASA does the opposite. That's why innovator participation is so crucial when you're looking for niche markets for a technology. There's a small commitment required to provide documentation, talk to the licensees, and help the licensees to practice the invention. A lot of our innovators on campus do this because they care about the commercialization process and, in the case of an education license, they enjoy helping students learn about science and engineering.

WHAT'S ONE THING ABOUT TECHNOLOGY TRANSFER YOU THINK EVERYONE SHOULD KNOW?
Tech transfer is a way to show the public that NASA's theoretical science has value even outside of pure research. Our research has value to the companies that want it, and we're contributing to the economy as a whole. If you want a concrete justification for basic research, it's through NASA's licensed technologies that provide value for companies around the country.

For questions about technology licensing or other topics, you can contact Josh Levine via email: joshua.h.levine@nasa.gov.

> "NASA'S LICENSED TECHNOLOGIES PROVIDE VALUE FOR COMPANIES ACROSS THE COUNTRY."

UP, UP, AND AWAY

New Goddard innovation helps heavier payloads take flight

A NASA scientific balloon launches from Fort Sumner, New Mexico, in 2018. NASA's 2021 scientific balloon campaign aims to complete 18 balloon launches. Photo Credit: NASA

Spanning the length and width of a football stadium, scientific balloons fill an important niche in NASA's collection of tools that gather science data from the air and space. Though NASA is most famous for satellites and space probes, the agency employs sub-orbital sounding rockets, research aircraft, and unmanned aerial systems to gather information about Earth, the solar system, and the universe.

Hot-air balloons have historical origins dating back to the 1700s, but today's helium balloons take advantage of modern technological innovations to provide sleek, cost-effective, and versatile platforms for scientific instruments to gather data from high in the sky. A new technology developed at NASA's Goddard Space Flight Center adds even more capability to the already robust platform.

"Space missions have a certain conservatism built into them, due largely to the cost," explains Alan Kogut, a scientist with Goddard's Observational Cosmology Laboratory. "With scientific balloons, you get to work with really cutting-edge technologies, because balloons can take more risks."

Kogut has developed a specialized version of a vacuum-insulated flask called a dewar that will enable missions to carry heavier payloads. In Kogut's case, he's aiming to fly an enormous infrared astrophysics telescope with a mirror the size of a living room. NASA's space-based telescopes, such as the Hubble Space Telescope and the upcoming James Webb Space Telescope, escape the obscuring influence of the atmosphere, providing significantly better sensitivity than ground-based telescopes.

Balloons don't give telescopes quite the same lift as spacecraft, Kogut says, but they can still provide 100,000 times improved sensitivity compared to ground-based telescopes. Furthermore, by flying the telescope on a balloon instead of a spacecraft, NASA could reap cost savings amounting tens to hundreds of millions of dollars.

Of course, flying heavy optical equipment aboard a helium-filled balloon comes with its challenges. A dewar can keep optics at cryogenic temperatures, which is crucial for detecting the weak, far-infrared signals emanating from the Big Bang. If temperatures get too warm, the instrument itself can generate noise that drowns out the faint wavelengths from the beginning of the universe.

To fly large optics, Kogut and his team need a large dewar, but with increased size comes increased weight.

"If we used the same dewars we used for other missions, they would need to be around eight times bigger, which would bring the total payload weight to about 4 to 5 tons," Kogut says. "Our balloons can lift about 2.5 tons. So you could build the dewar, but the balloon would not make it into the air."

Dewars rely on a vacuum seal and cryogenic liquids to keep temperatures inside the flask much lower than external temperatures. Kogut and his team realized that the dewar only needs to hold its vacuum at full altitude, around 120,000 feet above sea level. At this height, there's much less atmospheric pressure, which means the team could use a thin-walled dewar designed specifically to hold vacuum at higher altitudes.

To get the mass down, Kogut developed an ultralight liquid helium dewar, consisting of two cryogenic containers. In Kogut's design, the first flask is a commercial storage dewar that contains the cryogenic liquid, and the second flask features thin, metal walls "not much thicker than a soda can," Kogut says. This lightweight dewar contains the scientific instrument.

The thin-walled dewar starts off warm and open to the air at launch. As the balloon rises, the vacuum space

TO LEARN MORE ABOUT THIS TECHNOLOGY AND OTHERS AVAILABLE FOR LICENSE, PLEASE VISIT HTTPS://TECHNOLOGY.NASA.GOV.

This NASA super pressure balloon launched from Wanaka Airport in New Zealand in 2016.
Photo credit: NASA

within the thin-walled dewar is vented through a large valve. When the balloon reaches its targeted altitude, the valve closes, and cryogenic liquid from the first tank gets transferred to the second tank.

Kogut and his team flew a technology demonstration mission in 2019 called the Balloon-Borne Cryogenic Telescope Testbed (BOBCAT) that tried out a version of this system with liquid helium and liquid nitrogen. The experiment, including the helium transfer at high altitude, worked exactly as planned.

On the next BOBCAT mission, which will launch sometime in June of this year, Kogut says they will repeat the experiment, but this time, they'll use the ultralight dewar.

If their demonstrations prove effective, Kogut says this technology could enable groundbreaking scientific discoveries with enormous cost savings to NASA. "It's hugely expensive to put a mirror in space," Kogut adds, "but our balloon program could provide 90 percent of the science at 10 percent of the cost."

For more information about this technology and for licensing inquiries, please visit https://technology.nasa.gov or visit this webpage for more information: https://technology.nasa.gov/patent/GSC-TOPS-263.

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Spiral galaxy NGC 2276 is pictured in this Hubble Space Telescope snapshot shared in 2021.
Photo credit: NASA, ESA, STScI, Paul Sell (University of Florida)

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This image captured by NASA's Hubble Space Telescope shows galaxy cluster ACO S 295, amid a backdrop of galaxies and stars. Photo credit:ESA/Hubble & NASA, F. Pacaud, D. Coe

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