THE INNOVATION CATALYST

October 2022

IN THIS ISSUE:

TECH TRANSFER TIP

with Senior Technology Manager Viva Miller:

A new software application or computer program, or even just a few lines of code, needs to be reported in an NTR.

BREAST CANCER AWARENESS MONTH

UPCOMING EVENTS:

INNOVATOR HOUR

TUESDAY, OCTOBER 11, 2022

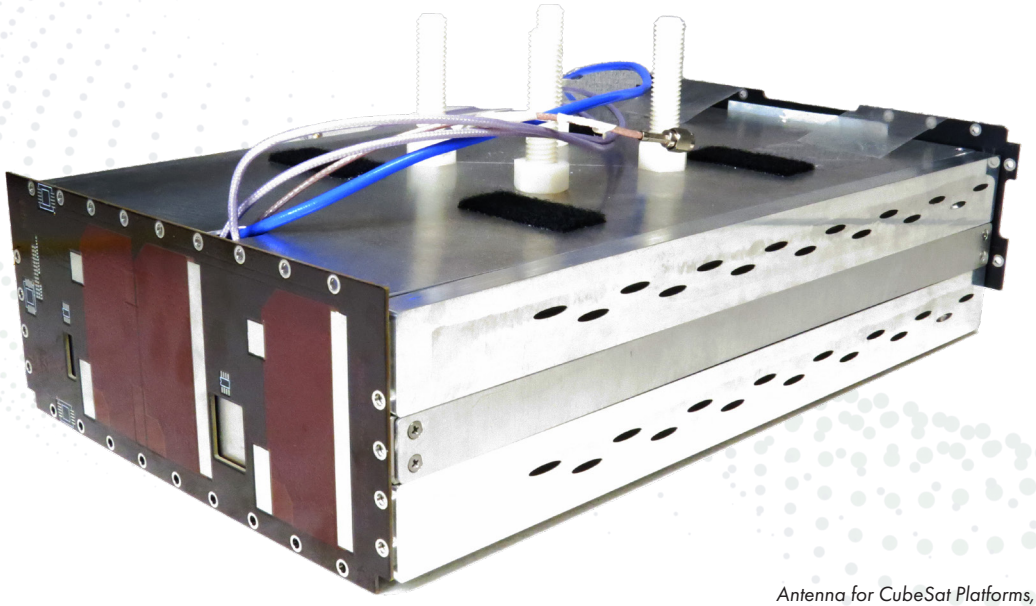
1:00–2:00 P.M.

STRATEGIC PARTNERSHIPS OFFICE

NP-2022-9-868-GSFC

Inventor of the Month

No Deployment Necessary



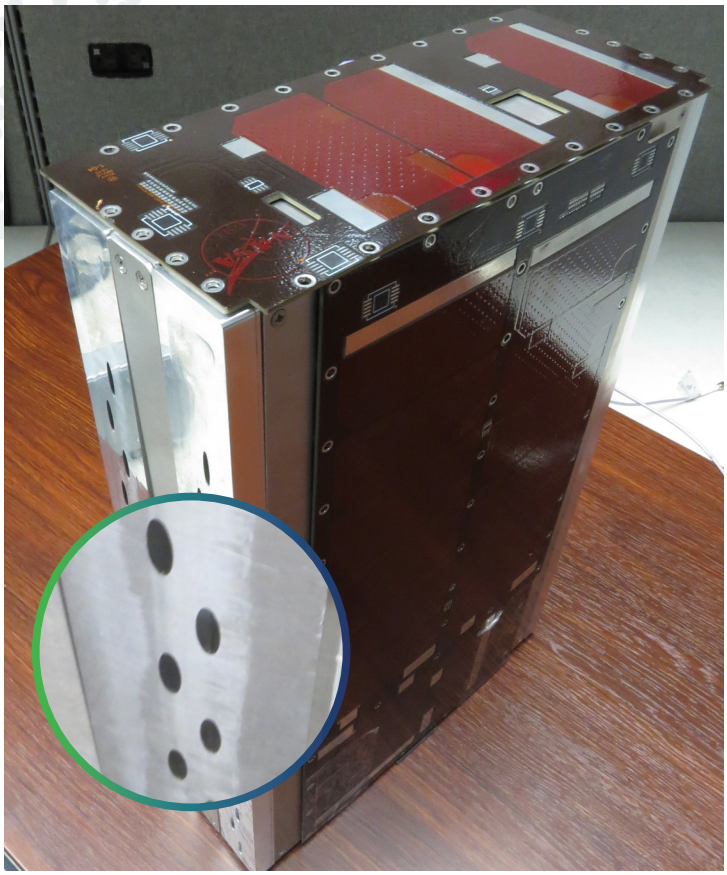
Antenna for CubeSat Platforms, Photo Credit: N4 Solutions

Back in 2011, because the spring-loaded deployment mechanism on the Intelsat 28 (formally New Dawn) satellite antenna got caught in the billows of its sun shield, it was unable to deploy – or unfold. That deprived the communications satellite of half of its intended functionality and limited the spacecraft's operational lifespan. When something like this occurs, typically NASA or private industry cannot send a repairman up to fix it.

After a satellite payload is launched into space and enters orbit, its antennas, tucked away during takeoff, need to deploy to be able to fully operate, receive commands, and communicate data back to Earth. As a result, NASA depends upon reliable methods for deploying satellite antennas to reduce the likelyhood of mission failure.

"Antenna deployment has been an issue on CubeSats in general," said Luis Santos Soto, chief engineer at NASA Goddard's Small Satellite Project Office. "An-

Manohar Deshpande, Photo Credit: GSFC



Antenna for CubeSat Platforms, Photo Credit: N4 Solutions

tennas actually have a hinge with a spring pushing things in, that could potentially jam during deployment. With CubeSats, most of the time the main issue is with the reliability of the release mechanism. In terms of deploying an antenna, pretty much every single time you have a moving part on a CubeSat or a satellite, something can go wrong."

Manohar Deshpande, an aerospace science and technology engineer at Goddard has developed a patented solution, simply called Antenna for CubeSat Platforms. Using a simple lightweight hollow rectangular tubed rod with a series of circular or rectangular openings or slots acting as a radio frequency (RF) antenna. Deshpande has been able to use these hollow rectangular tubed rods as a microwave transmission line capable of carrying RF signals, thus creating an antenna capable of receiving and sending data from a CubeSat. The advantage? These antenna rods have no moving parts, don't have to deploy; they are just secured to various sides outside of the CubeSat.

"As soon as the CubeSat is in orbit, the antenna is ready for use," said Deshpande of the technology, which was funded by NASA Headquarters. "This eliminates the risk of mechanical failure during deployment."

Most satellites use what are known as dipole antennas, which have various antenna wire rods that stick out to send and receive communications. Deshpande's Antenna for CubeSat Platforms by contrast, is a flat conformal antenna that can be designed in any shape or size to conform to the outside of the satellite. The antenna is also lightweight, which is important to launch and get off the ground and inexpensive to produce.

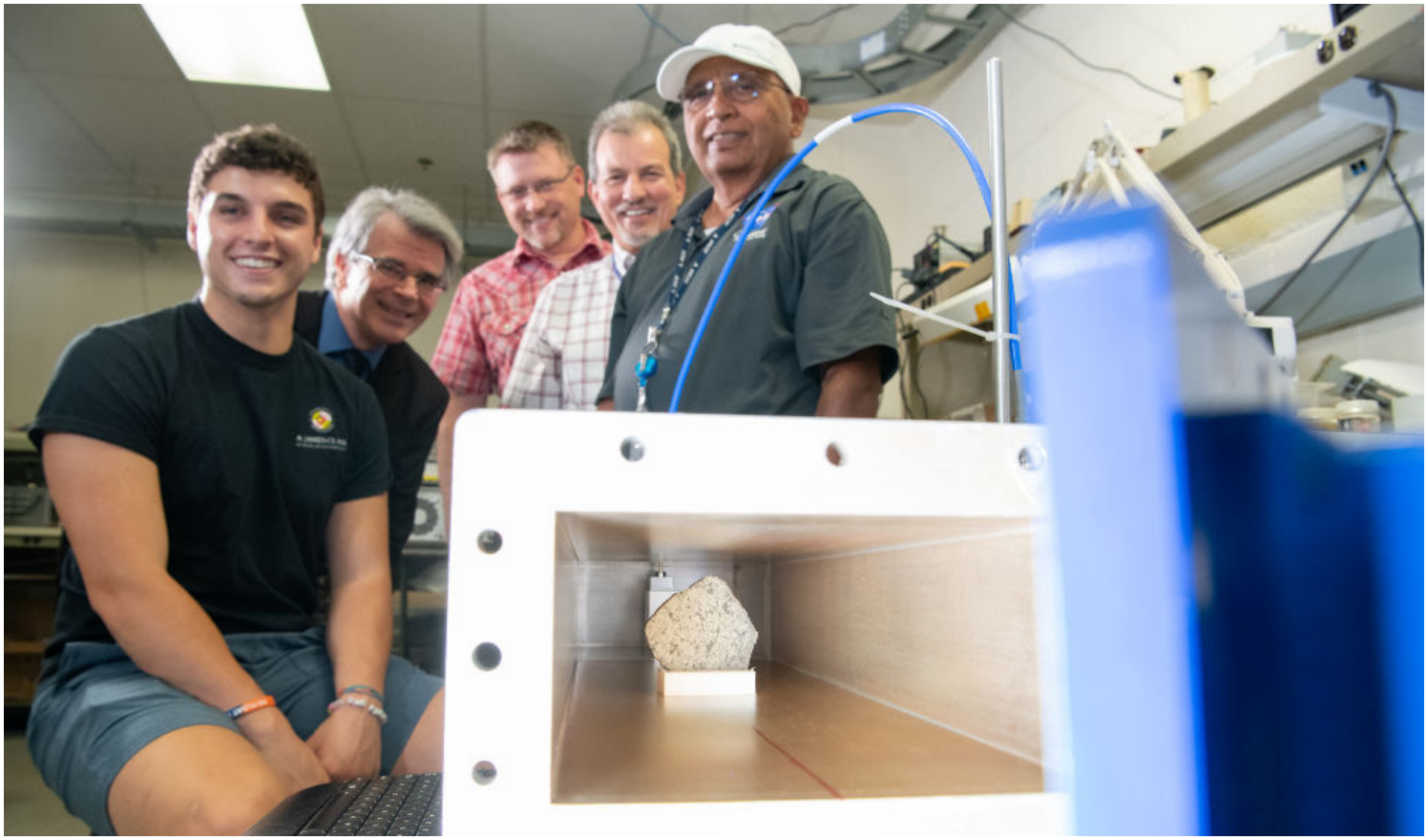
Deshpande said he began working on Antenna for CubeSat Platforms during the time he was assigned to work on the antennas for NASA's Dellingr CubeSat. He recalled, "They asked, if the antenna fails to deploy, how much signal will it lose? That gave me the thought, why risk the antenna anymore by deploying it and why not use the antenna as part of the CubeSat?"

A prototype of the Antenna for CubeSat Platforms was built and has been fully tested at Goddard's Microwave Sensors Lab. Presently, Deshpande is hoping to get additional NASA funding to test it on a future space mission. In the meantime, as a licensed and patented technology, several private companies have expressed interest in the antenna.

"As far as performance is concerned, [the Antenna for CubeSat Platforms] is almost equal in performance and capability as the dipole antenna," said Deshpande. "As far as the function of the antenna is concerned, they are the same."

M. Deshpande Antenna for CubeSat Platforms Patent Plaque, Photo Credit: N4 Solutions

Discovering Rock Properties on Mars and the Moon



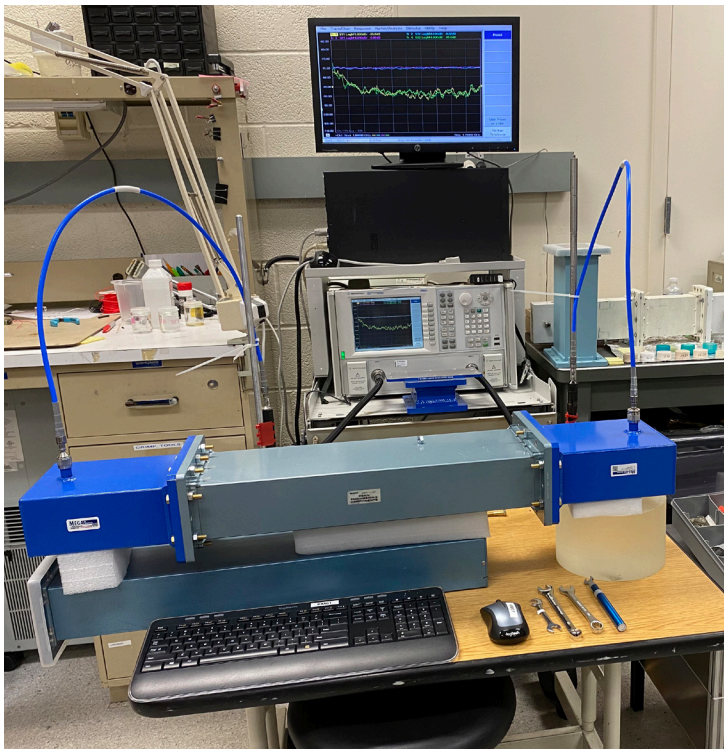
(Left to Right) Richard Lempicki, Jim Garvin, Justin Jones, Rafael Rincon, and Manohar Deshpande with martian rock SaU 008 in the box(foreground), Photo Credit: D. Stover/GSFC

Last month, *The Innovation Catalyst* shared the story of a group of Goddard engineers and scientists who developed and fully tested a new Spaceborne Synthetic Aperture Radar (SAR) System. This SAR System is capable of taking high-resolution images and measurement readings of what is buried up to 32 feet beneath the surface of the Moon, Mars, or several other planets in the solar system. But that is only half of the story of what is being developed.

Manohar Deshpande, an aerospace science and technology engineer at Goddard, along with Goddard's Chief Scientist James Garvin and Rafael Rincon, the Goddard electrical engineer who led the SAR project, have teamed up in the development of the Waveguide PNA (Precision Network Analyzer) Measuring (WPM) system. WPM analyzes 3D properties of rock and soil. Other members of the team include Mechanical Engineer Justin Jones and University of Michigan-Dearborn Student Intern Richard Lempicki.

Jim Garvin (GSFC chief scientist) holding the martian SaU 008, Photo Credit: D. Stover

Funded by NASA's International Mars Ice Mapping (IMIM) mission, WPM is taking the SAR technology one step further by creating a laboratory measuring



BLUE waveguide box, Photo Credit: GSFC

apparatus, which will be able to take rock and soil samples from the Moon, Mars, and other planets, and analyze their electrical and magnetic properties in 3D. IMIM is a radar orbiter mission designed to be the vanguard to the future human missions to Mars as early as 2030, which would detect the location, depth, spatial extent, and abundance of near-surface ice deposits on the Red Planet.

IMIM will enable the science community to capture a more detailed history of Mars. The radar-carrying orbiter, which would carry the SAR, would also help identify properties of the dust, loose rocky material – known as regolith – and rock layers that might impact the ability to detect the buried ice. Deshpande explained that the Waveguide-PNA system will allow them to collect rock samples from Mars (meteorites) and the Moon (Apollo mission samples) to analyze the electromagnetic (EM) properties of the materials in multiple directions.

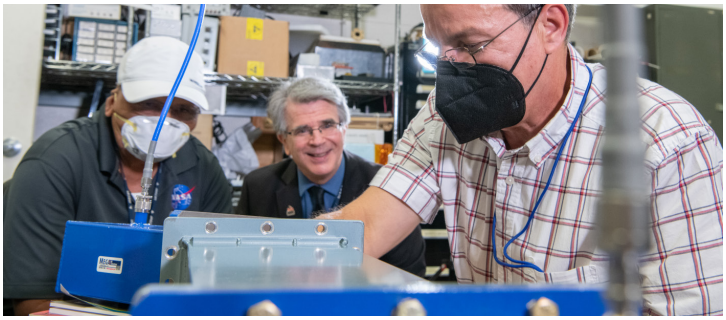
"The question is: how do we analyze arbitrarily shaped rocks in the Waveguide-PNA system," said Deshpande. "With this we create 3-D dielectric property models of the samples by scanning the actual rocks that can be imported into EM software. We can then model the reflection and transmission of microwave signals as they interact with the sample interiors. We also measured actual reflection and transmission of the signals with the rock sample in the waveguide. Then using what we call a forward model, both pieces of information are used to produce estimates of the rock EM properties at multiple orientations [in 3D]."

"In order to study a planet with a sensitive [SAR] radar you have to first know what the composition of the surface and the subsurface is," explained Rincon. "The EM properties will help us determine how radar signals will interact with Martian and Lunar regolith and what the surface and subsurface detection capabilities of the radar would be."

Presently as a proof-of-concept, the WPM system is being used at Goddard to analyze Martian, Lunar, and Earth samples. A more advanced WPM system is in development, which will significantly reduce test time and provide multiple measurements as the samples are automatically rotated within the Waveguide, similar to Computed Tomography (CT) industrialized X-ray scanning systems.

"These pioneering 3D measurements will pave the way for radar-based exploration on Mars and the Moon and beyond," Gavin said. "They have been enabled thanks to Goddard's incredible cadre of engineers."

"Right now, we are validating and demonstrating the WPM system," added Rincon. "We believe the measurements taken with the WPM should be more accurate than any other method previously explored and allow us to evaluate directional differences in [the rock] samples as we explore the Moon and Mars."



Manohar Desphande(L), Jim Garvin (center), and Rafael Rincon(R), Photo Credit: GSFC

Q AND A

with **JOSH**LEVINE

Photo Credit: N4 Solutions

How Goddard Markets and Finds Value in Your Invention

One of the main functions of Goddard's Strategic Partnerships Office (SPO) is to market and license Goddard-developed technologies and innovations to private industry. Through licensing agreements, private companies from all over the U.S. have been able to commercialize Goddard technologies. A licensing agreement is a legal document that spells out the terms and conditions allowing a company to turn a NASA technology into a commercial product. Josh Levine, technology manager at SPO, sat down with The Innovation Catalyst to discuss how SPO markets and licenses Goddard innovations.

Who is involved in the marketing of NASA technology and how do they do it?

I am involved in the marketing of NASA technology along with my colleague Hossin Abdeldayem. Our goal is to assess and commercialize NASA Goddard's inventions. Our process begins by looking at inventions originating on campus and investigating their value in the commercial landscape. One of our first steps is to define the value proposition of the invention. We look at the breadth of an invention's capabilities, its overlap with other industrial applications, and its position in the supply chain. We evaluate the invention as a conglomeration of individual components as well as an entire system.

How do we find your invention's commercial potential? Firstly, we can look at the prior history of this kind of invention, like previous industrial movements associated with the technology, to get a better understanding of the kinds of things people are looking for. For example, we may develop a piece of technology that fills a widely held need in the industry. However, when you look more closely at it, it deals with some kind of costly and regulated chemicals. When you look at the trend of industry, we see that companies are refraining from utilizing these chemicals due to their increased risk and cost. We then can narrow our potential landing spots for that technology to a small subset of companies capable of dealing with this constraint. I would them limit my

marketing campaign to companies that could actually deal with those chemicals.

My main point about marketing NASA technology is that we have to understand what the capabilities of the technologies are and see who can deal with what. So, by characterizing the invention, we end up knowing all about its value proposition and who uses it. So then, we can then call up different companies and say we have a technology right now and here is its value proposition and assess their interest.

Why is NASA interested in the licensing of technology? Why does NASA license technology?

Whatever research is done in federal laboratories, can come out into the commercial landscape; it does not need to be held by the federal government anymore. So, NASA is interested in licensing their technology to boost the capabilities of our domestic private business as mainly an altruistic endeavor.

There are also internal advantages to licensing. Innovators at Goddard can also benefit from licensing their technology. For example, if an innovator designed a certain satellite technology, they may build that in-house, which can be expensive. So, if they decide instead to commercialize it, they can just go to vendors and say, if you are interested in commercializing this technology, NASA can buy your products in the future. Then NASA has the capability of buying a COTS part instead of a custom one. This can save NASA a lot of resources from the labor, technical, and procurement prospectives.

Read part two of the Q&A next month in
The Innovation Catalyst

NASA **TECHNOLOGY TRANSFER** PROGRAM

email: techtransfer@gsfc.nasa.gov

STRATEGIC
PARTNERSHIPS OFFICE

The edge of a nearby, young, star-forming region NGC 3324 in the Carina Nebula, Photo Credit: NASA, ESA, CSA,STScI

Space As We Have Never Seen It Before

After more than a quarter century of development at NASA, the world's most powerful space telescope is now in orbit in space, about one million miles away from Earth. On July 12 NASA's Goddard Space Flight Center released its first stunning images to the world. The James Webb Space Telescope is an extraordinary scientific achievement, built to reveal space and time as it first appeared 13.8 billion light years ago. The expectation is that Webb will be able to look even further back in time to the early universe and the formation of its first stars and galaxies.

"There is an old proverb that says, 'May you live in interesting times,' and I will tell you what, these are interesting times," said Goddard Center Director Dennis Andrucyk at the press conference on July 12 as he unveiled the first images. "By now the superlatives are many but the required words are very few. In a way, the images speak for themselves. They are just so spectacular; things that I never even dreamed that we would be able to see are here before us."

The Webb images immediately captured the attention of people all over the country. They lit up social media feeds, New York City's Times Square, and even served as a backdrop for a Jimmy Buffett concert at Merriweather Post Pavilion in Columbia, Maryland. President Biden and Vice President Harris viewed them in private screening with NASA Administrator Bill Nelson. They also inspired their very own Google Doodle.

Galaxy cluster SMACS 0723, Photo Credit: NASA, ESA, CSA and STScI

"The reaction of me and all my colleagues [at NASA] is sheer joy and amazement," Mike Manzel, lead systems engineer at NASA Goddard for the James Webb Space Telescope, told The Innovation Catalyst. "The images that we see are great but the amount of detail that is in these images astounded us."

The first images that Manzel said he and his NASA Goddard team were attracted to were of a galaxy cluster about four billion light years away. What got Manzel and his team so excited was that these images contained galaxies that were even farther away than previous images from the Hubble Space Telescope.

"It took ten to 15 days to get those [previous] Hubble images. [With Webb], we did it in 12 hours," stressed Manzel. "We designed this telescope to see the very first galaxies that turned on in the universe, and, we knew in our heart, that whatever is out there, we are going to see it. This is a taste of things to come."

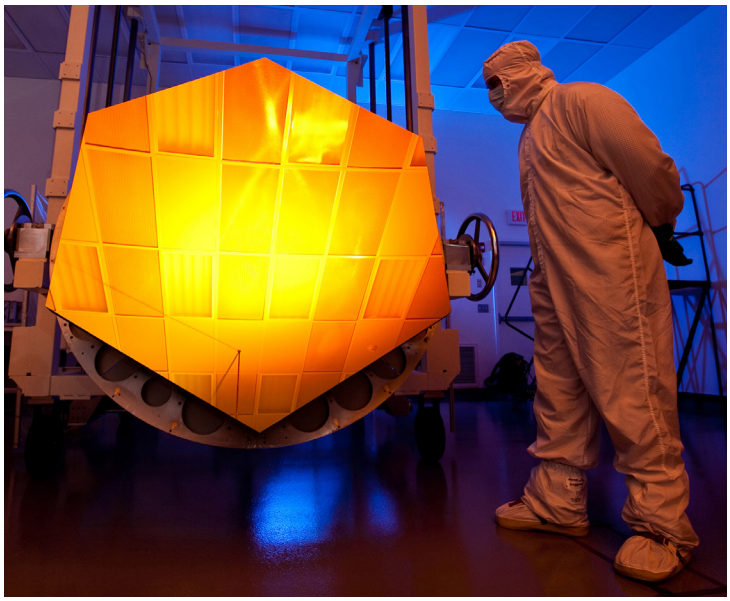
Manzel said the purpose of Webb is to peer into the universe and improve NASA's understanding of space science and to study every phase of cosmic history from within our solar system to the most distant observable galaxies in the early universe. Manzel stated, among the many mysteries NASA seeks to learn more about is the Big Bang Theory, which is the prevailing scientific theory that everything, everywhere suddenly burst into life in one big, high-density explosion.

"It could potentially tell us some of the conditions in the early universe that could provide some insights to the Big Bang," noted Manzel. "It will most certainly tell us what the early universe was like [and] how that early universe fostered galaxy formation. The other big question that Webb is fully capable of answering is looking for planets around other stars – exoplanets that may have biomarkers, signs of elements or compounds that either produce life or necessary for life. So, when you think about it, [Webb] possibly addresses two of the most fundamental questions in astronomy: how did it all begin and are we alone?"

"The biggest risks that we faced [with Webb] in the early days of deployment [in space] were during the unfolding [in the deployment sequence], which took about six months and that went smoothly," said Manzel. "Most of us [at NASA] feel that the majority of our risks are behind us right now. We have a fully operational, world asset for astronomy."

Manzel expects Webb may continue capturing unprecedented images of the early universe for the next 20 years. The James Webb Space Telescope is an international collaboration between NASA, the European Space Agency, the Canadian Space Agency, and 309 industry and university partners and contributors. With the unveiling of the first images, the observatory is now locked into the world's consciousness and Goddard will be at the center of each new image discovery. Nelson believes it is a sign that when the scientific community works together, they can achieve many astonishing scientific and technological achievements.

"Now, folks across this planet are going to see the images captured by this telescope and every new image is a new discovery that is going to give humanity a view of the universe that we have never seen before," said Nelson at the Goddard press conference. "Webb is going to be determining things that we don't even know what questions we should ask. NASA is no stranger to first steps as we enter this new era of space flight and discovery. We need to be bold and take risks, but the rewards are worth the risks, and this is proof of that. This telescope is one of these great engineering feats, not just for us but for humanity—for planet Earth and for [all] the citizens of planet Earth."



Primary mirror segment, coated with gold, Photo Credit: Drew Noel/GSFC

Goddard Had Big Presence at the Small(Sat) Conference

Josh Levine manning the SmallSat Booth, Photo Credit: GSFC

Hosting one of the largest NASA booths at the 36th Annual 2022 SmallSat Conference, Goddard had a big presence at what is recognized by industry as the premier conference on small satellites ("SmallSat"). The conference held at Utah State University in Logan, Utah, August 6-11, provided a forum for the best minds in the SmallSat community to review recent successes, explore new directions, and introduce emerging technologies in small spacecraft development.

The conference, held in person for the first time in three years, attracted over 3,300 attendees from 40 countries, with 240 exhibiting organizations representing approximately 1,000 private companies. Each year Goddard participates in the conference, and this year the Center showcased everything from a booth highlighting Goddard capabilities and technologies, to in-person posters and presentations. Goddard also participated in NASA's 'short talk' and Town Hall sessions. This created an excellent environment for Goddard representatives to network with other experts in the field about the challenges and opportunities facing the SmallSat community today.

At the conference, Goddard brought years of expertise in SmallSat/CubeSat technology development and mission planning and execution. Goddard shared with attendees how it is focused on developing architectures to support the Distributed Systems Mission (DSM) system concept. A DSM is a mission that involves multiple assets (spacecraft, aircraft, ground facilities,

and/or others) to achieve one or more common goals. Some DSM concepts include constellations, formation flying missions, or fractionated missions.

"In general, there was a great deal of interest in terms of what Goddard is doing with DSM, and developing potential partnerships for future missions," said Luis Santos Soto, chief engineer of the Small Satellite Project Office at Goddard, who attended the conference. "For the most part, the booth was always busy."

John Hudeck, deputy chief for Goddard's Small Satellite and Special Projects Office, also in attendance, said he spoke with many of the CubeSat vendors in Goddard's current portfolio. In general, he said these vendors were happy with Goddard as a customer. He added, a topic of great interest and discussion was how COVID was affecting every space project and mission, both in industry and the government.

"With COVID, there were still some challenges into how missions are operating and developing in terms of supply chain and other types of issues," noted Santos Soto. "This revolved around things like availability of facilities, people, and parts and hardware. Even at this time, we are still facing COVID challenges."

With NASA seeking to return to the Moon and go to Mars through the Artemis program, it opened the door for government and private industry to explore the development of secondary satellite payloads to reach these destinations. Fueled by these opportunities and other beyond low earth orbit (LEO) ventures, the conference highlighted the push for developing technologies designed for harsher environments farther out in space.

"This is something that NASA Goddard has been looking into for years now – understanding how we could build systems beyond LEO without bankrupting the mission," said Santo Soto. "Goddard has developed our own technologies to serve that purpose. At the conference, there was interest [among attendees] in licensing our beyond LEO technologies, such as MARES [Modular Architecture for a Resilient Extensible SmallSat – a highly integrated modular architecture that is designed to withstand harsher environments beyond LEO] and different types of components that we developed based on MARES."

Josh Levine, technology manager at SPO, also in attendance, said that many of these LEO technologies developed for Goddard's SmallSats, such as various MARES technologies, have received patents and can be licensed for use by interested companies in the public or government sector. Levine explained to attendees how they can license patented technologies for their own use.

"The reason why our booth was so inviting," said Levine, "is because people found out about all the great work Goddard is doing. If you went to most of the private industry booths, companies were trying to sell their wares. We, on the other hand, wanted to educate attendees on what Goddard is doing and show what our value is to the SmallSat community. At our booth, people saw things that they could not see within the commercial landscape."

"There was a lot of interest in the components that Goddard developed," added Scott Leonardi, technology specialist at SPO, who manned the Goddard booth. "We displayed models all along the counter and so, people would come over and say, 'hey, what is Goddard doing with SmallSats and we would talk about the missions that we had going on such as BurstCube, petitSat, GTOSat, Dione, SNOOP, and Pandora. This allowed us to talk about how innovation is on the rise with Goddard's SmallSats."

Dakotah Rusley explains all about SmallSats to attendee, Photo Credit: GSFC

THE STRATEGIC PARTNERSHIPS (SPO) OFFICE PRESENTS

INNOVATOR HOUR

Have questions about protecting your innovation?
Want to learn more about how to submit New Technology Reports?
Have general questions about technology transfer and partnerships?
Sign up for a one-on-one 20-minute timeslot with a SPO representative.
Meetings will be held virtually via Microsoft Teams

NEXT SESSION: TUESDAY, OCTOBER 11, 2022 1:00-2:00 P.M.

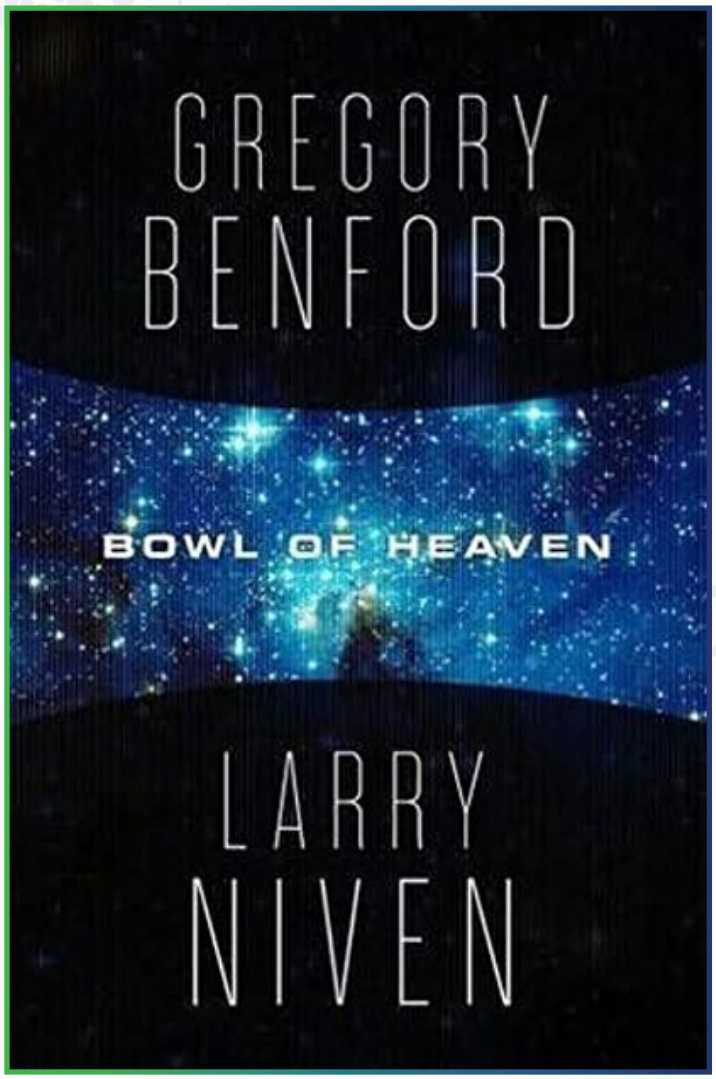
Available Timeslots

1:00-1:20 P.M.
1:20-1:40 P.M.
1:40-2:00 P.M.

How to Sign Up

To register for the upcoming session and secure your timeslot, complete the registration form.

THE LITERARY X-CHANGE BOOK OF THE MONTH



In Bowl of Heaven, the first collaboration by science fiction authors Larry Niven (Ringworld) and Gregory Benford (Timescape), the limits of wonder are redrawn once again as a human expedition to another star system is jeopardized by an encounter with an astonishingly immense artifact in interstellar space: a bowl-shaped structure half-englobing a star, with a habitable area equivalent to many millions of Earths...and it's on a direct path heading for the same system as the human ship.

A landing party is sent to investigate the Bowl, but when the explorers are separated—one group captured by the gigantic structure's alien inhabitants, the other pursued across its strange and dangerous landscape—the mystery of the Bowl's origins and purpose propel the human voyagers toward discoveries that will transform their understanding of their place in the universe.

(Publisher's Summary)

We Want to Hear From You

Have a suggestion? Want to leave a review of the latest book you read from the X-Change? Send your comments to rafael.j.mcfadden@nasa.gov. We'd love to hear from you.

WHAT IS THE LITERARY X-CHANGE?

In 2021, the Strategic Partnerships Office (SPO) launched a community library with a little help from Tor Books. Goddard has partnered for years with Tor, a leading publisher of science fiction, by connecting them with subject matter experts to promote the science in "science fiction." Located in the lobby of Building 22, The Literary X-Change is available to the entire Goddard community. Here's how it works:

TAKE ONE

If a book strikes your fancy take it. Read it, enjoy it, and—when you're done—share it with a friend or bring it back to the X-Change.

GIVE ONE

Everyone can pitch in to keep the library stocked. Bring books you'd like to share with the Goddard community when you can and continue being a friend of The Literary X-Change!