TUES SPACENEWS SHOW DAILY | small SATELLITE

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Northrop Grumman turns to Firefly for 'fully domestic' Antares 330

Northrop Grumman and Firefly Aerospace announced Aug. 8 that they will work together to develop a new first stage for Northrop's Antares launch vehicle as well as a future medium-lift rocket.

The new version of the Antares, called the Antares 330, will feature a first stage using seven Miranda engines under development by Firefly. The stage will also use Firefly composites for its structure and tanks.

The Antares 330 upper stage will be similar to what Northrop is currently using on the Antares, with the company's Castro 30XL solid-fuel motor and existing avionics and structures. The vehicle is designed to launch from the current pad at Virginia's Mid-Atlantic Regional Spaceport, which has hosted all previous Antares launches.

"Through our collaboration, we will first develop a fully domestic version of our Antares rocket, the Antares 330, for Cygnus space station commercial resupply services," Scott Lehr, vice president and general manager of launch missile defense systems at Northrop, said in a statement.

The partnership would solve Northrop's current reliance on Ukrainian and Russian suppliers for the Antares first stage that put the future of the vehicle, used for launching Cygnus cargo missions to the International Space Station, in doubt. Ukraine's Yuzhnoye State Design Office and Yuzhmash Machine Building plant produces the Antares first stage, which is powered by RD-181 engines from Russia's NPO Energomash.

The supply of both the engines and the first stage has been in doubt since Russia's invasion of Ukraine in February. Northrop officials noted they have completed first stages for two more Antares launches, the first of which is scheduled for October, and that the company was working on options should either the stage or the engines become unavailable. Those executives, though, had declined to go into details about those backup plans before the Firefly partnership announcement.

JEFF FOUST

Northrop Grumman's existing Antares uses a Ukrainian first stage and Russian engine, raising questons about the rocket's future. The illiustration above depicts the envisioned Antares 330 featuring a first stage developed by Firefly Aerospace.

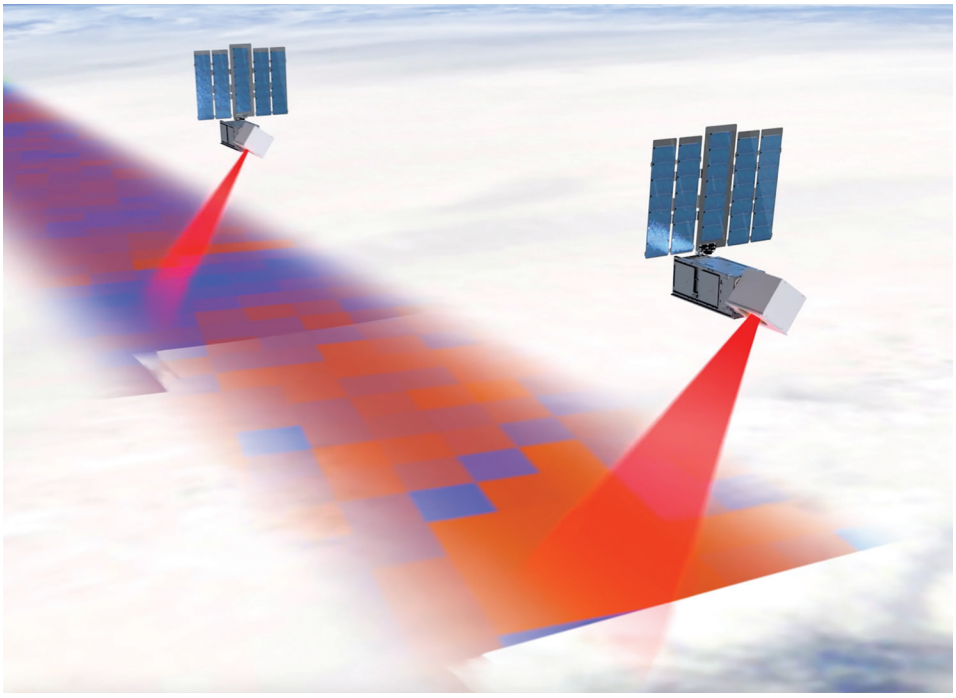
The two companies provided few other details about their partnership, including financial aspects and when the Antares 330 would be ready for launch. The companies said the Antares 330 would "significantly increase" the vehicle's payload capacity compared to the existing Antares, but did not quantify the increase.

The companies also said the partnership would lead to the development of a separate "entirely new" medium-lift launch vehicle, details of which the companies did not disclose. Firefly is working on its own medium-lift vehicle, called Beta, whose first stage will also incorporate the Miranda engine. That engine, which uses liquid oxygen and kerosene propellants, is designed to produce about 230,000 pounds-force of thrust.

"Firefly prides itself on being a disrupter in the new space industry and collaborating with a proven space pioneer like Northrop Grumman will help us continue that disruption," said Peter Schumacher, interim chief executive of Firefly, in the statement. SN

FIREFLY AEROSPACE

NASA looking for new launch for remaining TROPICS cubesats



NASA is looking into alternative ways to launch its TROPICS Earth science cubesats after Astra discontinued the rocket that would launch them.

NASA

Astra is pulling the plug on Rocket 3.3 after latest failure destroys first two TROPICS cubesats

NASA is investigating alternative ways to launch four Earth science cubesats after Astra discontinued the rocket originally contracted to launch them.

Four Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) cubesats were to launch on two Rocket 3.3 vehicles by Astra, after the first two TROPICS cubesats were lost in a June 12 launch failure on another Rocket 3.3.

However, Astra announced Aug. 4 it was canceling all remaining Rocket 3.3 launches to focus on the much larger Rocket 4. The Rocket 3 series of vehicles had reached orbit successfully on only two launches in seven attempts.

With Rocket 3.3 no longer available, NASA is looking for alternative options to launch the remaining TROPICS cubesats. "We are still looking for a ride and, once the ride is found, we'll launch it," said Sachidananda Babu, a program manager in NASA's Earth science division, during a NASA town hall meeting at the Small Satellite Conference here Aug. 8.

Astra executives said in the earnings call where they announced the termination of the Rocket 3 program that NASA was considering launching TROPICS on the new Rocket 4. "We are in discussions with NASA to proceed with TROPICS on Launch System 2.0," said Chris Kemp, chief executive of Astra. Launch System 2.0 includes Rocket 4 and its ground systems.

However, Rocket 4 would be a poor fit for TROPICS, as the vehicle is designed to place up to 600 kilograms into low Earth orbit, where each TROPICS cubesat weighs only a few kilograms. TROPICS has specific orbit requirements — an altitude of 550 kilometers and an inclination of about 30 degrees — needed to meet its science goals. That orbit, though, is not commonly used by other spacecraft, ruling out rideshare opportunities.

"We need to go to a 30-degree inclined orbit, and no one else really wants to go there. The rideshares are all going to sun-synchronous orbits or mid-inclinations, so it's very well targeted to a smaller vehicle with a very targeted insertion where they can get us exactly where we want to go," said William Blackwell, principal investigator for TROPICS at MIT Lincoln Laboratory, in a video about the mission produced before the June launch failure.

Astra's contract with NASA called for three dedicated Rocket 3.3 launches, each carrying two TROPICS cubesats. The satellites would be placed in three orbital planes to maximize revisits of tropical latitudes to study the formation of tropical storms. TROPICS, though, can meet its science goals with just four satellites.

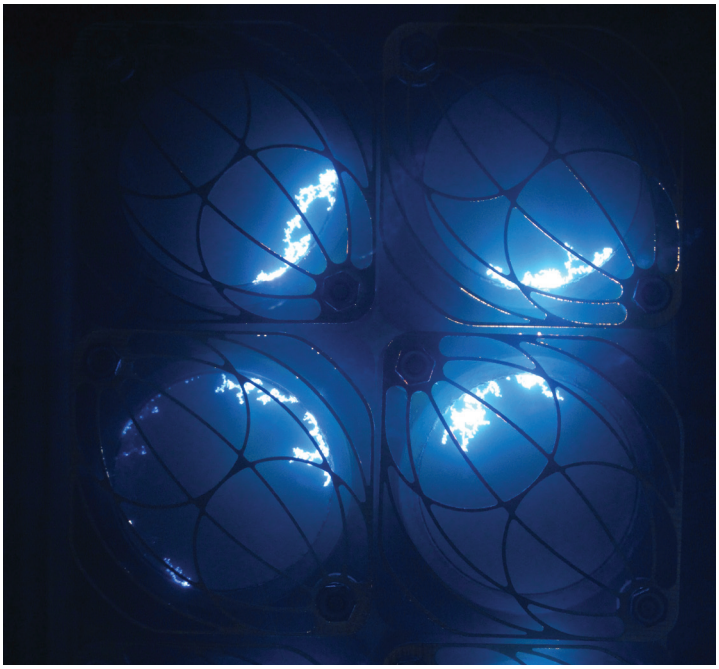
Agency sources said Astra's announcement that the company was discontinuing the Rocket 3.3 took them by surprise. Switching vehicles pose cost and schedule challenges that NASA is still studying.

However, even before the announcement, NASA was looking into alternative options while awaiting the outcome of the investigation into the June launch failure.

Karen St. Germain, director of NASA's Earth science division, said at an Aug. 2 meeting of its Earth Science Advisory Committee that she was in discussions with the Launch Services Program "to figure out what that path forward will be" for launching the remaining TROPICS cubesats. SN

JEFF FOUST

Benchmark acquires Alameda Applied Science Corp. electric propulsion



Left: Rendering of spacecraft with Benchmark hybrid propulsion system. Right: AASC metal plasma thrusters undergo testing.

Benchmark Space Systems announced plans Aug. 8 to acquire Alameda Applied Science Corp.'s electric propulsion technologies, and to begin offering customers hybrid chemical-electric propulsion systems.

Hybrid propulsion eliminates "the need for satellite operators and end users to compromise between speed and endurance," Chris Carella, Benchmark executive vice president of business development and strategy, told *SpaceNews*. The Burlington, Vermont, company intends to offer hybrid systems that are "not only cost competitive, but also increase return on investment and capability," he added.

After determining that many customers would benefit from a hybrid propulsion system, Benchmark, a company rapidly expanding its chemical propulsion manufacturing line, conducted an extensive review of millinewton-class electric propulsion technologies.

"The metal plasma thruster technology by AASC was compelling and differentiated enough in its class where we decided to acquire the technology." — **Chris Carella**, Benchmark Space Systems

"The metal plasma thruster technology by AASC was compelling and differentiated enough in its class where we decided to acquire the technology," Carella said.

AASC Xantus thrusters, which are scheduled to be demonstrated in space later this year, are "deceptively simple," said AASC President Mahadevan Krishnan. "You take a 45-volt capacitor, put it in a box with a chunk of metal, and the metal spits out plasma at 10 miles a second and propels the spacecraft."

Benchmark intends to pair its own Halcyon high-test peroxide thrusters with Xantus thrusters in a turnkey propulsion system.

In the near term, satellites weighing 50 to 200 kilograms will benefit from Benchmark's new hybrid propulsion systems, Carella said.

Millinewton thrusters already serve the needs of cubesats. For microsatellites and ESPA-class satellites, electric propulsion can take over "all of the things that chemical propulsion doesn't do well," Carella said.

For example, chemical thrusters could rapidly move satellites into their optimal orbits before electric thrusters take over station-keeping.

Adding electric propulsion also promises to reduce volume and mass compared with chemical propulsion alone, Carella said. "We're downsizing what would be a chemical propellant-only system by putting in this lightweight, miniature cruise control functionality," he added.

AASC's metal plasma thrusters have undergone extensive ground testing and have been integrated with a weather satellite Orion Space is scheduled to launch later this year under a U.S. Space Force contract.

If the weather satellite demonstration is successful, AACS anticipates strong demand for the thrusters, which it would not be able to meet without Benchmark's help.

If a customer wants 50 or 100 of these thrusters, Krishnan said he would give the customer Benchmark's number.

"As a small business, I wouldn't even be credible to many customers if they were serious about putting a constellation of 300 satellites and they needed 600 engines to begin with and a refresh rate of 100 engineers every six months," Krishnan said.

As part of the acquisition agreement, Benchmark is gaining AASC intellectual property associated with the metal plasma thruster, emerging technologies in metal plasma physics, one AASC employee who will head Benchmark's electric propulsion line and a portion of Krishnan's time.

Someday, metal plasma thrusters could run on metal discarded in space.

"Any metal can be used as a propellant," said Krishnan. "You can eventually think of covering an entire spacecraft with these. As it goes further into deep space, it consumes itself, leaving behind just your payload when you get to wherever you're going." SN

DEBRA WERNER

BENCHMARK SPACE SYSTEMS/AASC

NASA heliophysics smallsats to share launch with astrophysics mission

Four smallsats designed to study the solar wind will share a ride to space on a Falcon 9 with a NASA astrophysics mission in 2025.

NASA announced Aug. 3 that the Polarimeter to Unify the Corona and Heliosphere (PUNCH) mission, a set of four smallsats, will fly as a rideshare on the Falcon 9 launch of the agency's Spectro-Photometer for the History of the Universe, Epoch of Re-ionization, and Ices Explorer (SPHEREx) mission.

NASA awarded a contract to SpaceX in February 2021 for the Falcon 9 launch for SPHEREx alone, valued at $98.8 million. The agency updated the SpaceX contract July 14 to include PUNCH on the same launch but did not disclose any change in contract value.

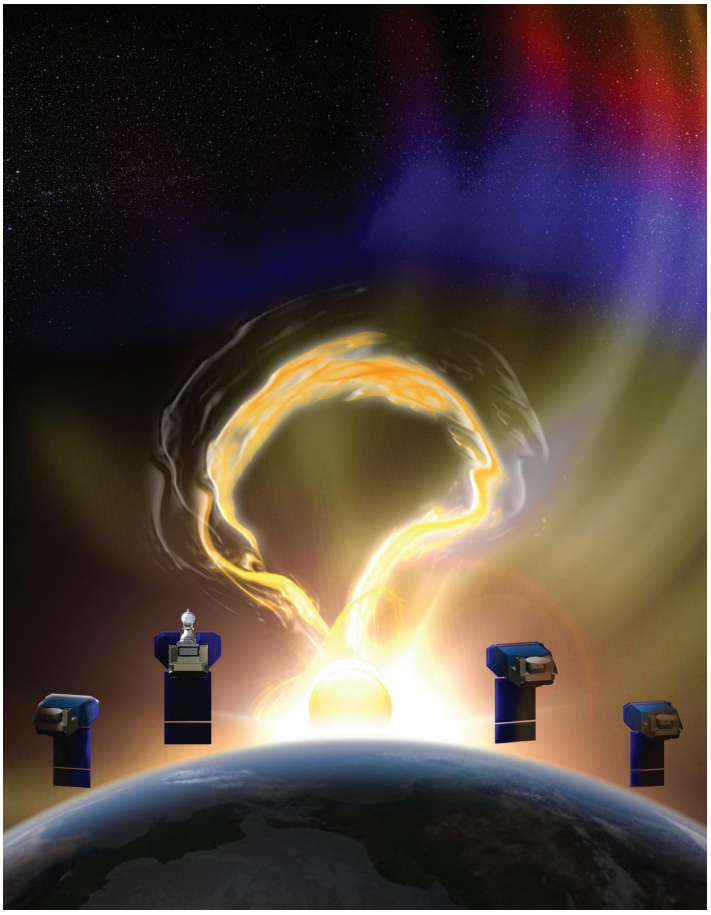
"It's great to have a definite launch date and vehicle, and we're looking forward to working with the SPHEREx team as we 'carpool' to orbit," Craig DeForest, principal investigator for PUNCH at the Southwest Research Institute, said in a statement about the rideshare announcement.

The launch remains scheduled for no earlier than April 2025, the date NASA announced when it awarded SpaceX the launch contract for SPHEREx. PUNCH was planning to launch in October 2023, but the 18-month slip provides "new schedule flexibility to mitigate some schedule constraints due to supply chain challenges," NASA said.

PUNCH features four satellites, each weighing about 40 kilograms. The satellites will go into a sun-synchronous orbit along the terminator, providing continuous observations of the sun. The four spacecraft carry instruments to study how the solar corona transitions into the solar wind.

SPHEREx itself is a small spacecraft weighing about 200 kilograms.

JEFF FOUST



The four PUNCH smallsats, designed to study how the sun's corona transitions into the solar wind, will fly on the same Falcon 9 as NASA's SPHEREx astrophysics mission.

SWRI

It carries a wide-field telescope designed to carry out an all-sky survey every six months, collecting spectra of hundreds of millions of stars and galaxies.

The small size of SPHEREx suggested at the time of the award that NASA might add more spacecraft to the launch. The agency has, in recent years, sought to take advantage of excess capacity on launches it procures for science missions to fly additional spacecraft.

While the rideshare approach offers cost savings, it can also create scheduling problems. NASA originally planned to fly a small lunar orbiter mission, Lunar Trailblazer, as a rideshare on the Interstellar Mapping and Acceleration Probe (IMAP) mission. However, while Lunar Trailblazer was expected to be ready for launch as soon as late 2022, IMAP will not be ready for launch until early 2025.

NASA announced in June that it would take Lunar Trailblazer off the IMAP launch and instead launch it as a secondary payload on a commercial lunar mission, the IM-2 lunar lander by Intuitive Machines. IM-2 is expected to launch in 2023. SN

In Brief

■ **India's Small Satellite Launch Vehicle (SSLV)** failed its inaugural launch Aug. 6 when its final stage malfunctioned. The SSLV lifted off from the Satish Dhawan Space Centre at 11:48 p.m. Eastern. The rocket's first three solid-fueled stages performed normally, but a liquid-fueled kick stage appeared to shut down its engines after just 0.1 seconds. ISRO later confirmed that "failure of a logic to identify a sensor failure" in the stage meant the two satellites it carried were placed in an orbit with a perigee of just 76 kilometers and immediately reentered. ISRO Chairman S. Somanath said the agency believes it knows what went wrong and will attempt to perform a second launch "very soon." The rocket carried the EOS-02 Earth science satellite and the student-built AzaadiSAT cubesat.

■ **MAIA, a NASA Earth science instrument originally intended to launch on a commercial smallsat**, may fly on an Italian satellite instead. NASA officials said last week they were in discussions with the Italian Space Agency to fly its Multi-Angle Imager for Aerosols (MAIA) instrument on a future Italian satellite. MAIA, designed to study particulate matter air pollution in urban areas, was to launch on the Orbital Test Bed 2 satellite from General Atomics. However, NASA and General Atomics "mutually agreed" to terminate that agreement, citing technical and programmatic issues. NASA has been separately working with General Atomics to resolve problems with TSIS-2, another spacecraft the company is building for the agency.

Launch startup SpaceRyde adds Kepler CEO to advisory board

Canadian launch startup SpaceRyde said Aug. 8 it has added a second member to its advisory board with the appointment of Mina Mitry, the CEO of small satellite operator Kepler Communications.

Mitry joins Jeff Thornburg, SpaceRyde's inaugural advisory board member and a former vice president of propulsion engineering at SpaceX.

Kepler, also based in Canada, operates 19 cubesats that provide low-data-rate connectivity to devices out of range of terrestrial networks. The operator also plans a data-relay constellation of larger satellites that it expects to start deploying in 2023.

SpaceRyde said Mitry's expertise will help the startup scale up operations as it plans to perform its first commercial mission in 2024.

Founded in 2018, SpaceRyde is developing a small, three-stage rocket that would fire engines after a balloon takes it above most of the Earth's atmosphere.

SpaceRyde CEO Sohrab Haghighat said it plans to launch test payloads to sub-orbit and low Earth orbit (LEO) next year ahead of its first commercial mission, which is for an undisclosed biotechnology customer.

"The customer requires ultimate flexibility in planning the mission and can only deliver the payload to be integrated into the rocket few hours before the launch," Haghighat said on the sidelines of the Small Satellite Conference in Logan, Utah.

"As you can imagine, they cannot use rideshare missions and need a private rocket."

SpaceRyde ultimately plans to develop 20-meter-tall rockets that, after launching a customer payload, would leave its third stage in orbit for future missions.

SpaceRyde plans to send a rocket to the moon as part of a 2024 refueling demo.

Called Black Bay, this third stage would use a liquid-fuelled engine for applications including in-orbit servicing and missions to the moon.

Haghighat said SpaceRyde plans to send two rockets to LEO in the fourth quarter of 2024. One of them would refuel the other, which would then fly on a demonstration mission around the moon and back.

"This mission is an important milestone not just for SpaceRyde, but for the industry as it will show the first ever multi-purpose rocket," he said.

SpaceRyde has secured $10 million to date, he added, and is planning to raise another funding round early next year to finance its plans. SN

JASON RAINBOW

Outfitting school kids to hunt asteroids

Space logistics startup TransAstronautica announced a partnership Aug. 9 with online astronomy platform Slooh to offer U.S. schools access to a global network of ground-based and space-based telescopes.

"We will find moving objects in space with a partnership between education, industry and government," Joel Sercel, TransAstra founder and CEO, told *SpaceNews*. "For the first time, thousands of amateurs and kids of all stripes will be able to log on to the global network of telescopes that are optimized for finding moving bodies in space."

Under the agreement, TransAstra and Slooh will work together to install TransAstra's Sutter telescopes at Slooh and TransAstra observation sites around the world.

Slooh currently operates telescopes at the Canary Islands Institute of Astrophysics and the observatory at the Pontifical Catholic University in Chile. Slooh plans to add telescope sites in the United Arab Emirates and India.

TransAstra's first Sutter telescope, which is designed to detect high-speed objects moving through cislunar and deep space, was installed in April at the Winer Observatory in Arizona. TransAstra operates a second Sutter telescope at the Sierra Remote Observatory in California.

Taken together, the observatory locations will provide students with 24-hour coverage of the night sky.

"This removes an important barrier to everyone being able to get in on the new space age," said Michael Paolucci, Slooh founder and CEO. "We're all not going to be able to get up in a spaceship, and even Ph.D. astronomers battle to get time on telescopes. We're offering 24-hour access to the night sky that is not weather dependent."

TransAstra, a Los Angeles startup focused on orbital logistics and space mining, developed the Sutter telescope to survey asteroid minerals. In addition to the ground-based observations, TransAstra and Slooh plan to launch a small commercial telescope within two years.

"Once deployed, that telescope will be the first of its kind to allow school children and amateurs from all over the world to control a spaceborne astronomical instrument for finding moving bodies in space," according to an Aug. 9 TransAstra news release.

The spaceborne telescope will serve as a demonstration for Sutter Ultra, a mission that involves "hundreds of inexpensive commercial telescopes fitted out with Sutter technology to be mounted on just three modest size spacecraft and flown in heliocentric space," Sercel said. "Our calculations show that in the first year of operation, Sutter Ultra can find up to 300 times more asteroids than have been found in the entire history of astronomy. That's a game-changing breakthrough."

TransAstra also is working with Slooh to determine how students could share credit for asteroid discoveries or name their discoveries. SN

DEBRA WERNER

SPACERYDE

Busek finds headroom to meet thruster demand

Busek is rapidly expanding its staff and facilities in response to strong demand for the Natick, Massachusetts, company's spacecraft propulsion.

"We definitely have the headroom now to double in size," Busek Vice President Peter Hruby told *SpaceNews*.

This summer, Busek acquired a 1,022-square-meter facility, bringing the company's total offices, laboratory and manufacturing space to nearly 4,645 square meters.

As the business footprint expands, Busek is hiring. The company intends to add 15 people to its 60-person staff by the end of the year.

Busek is producing 6-kilowatt Hall-effect thrusters for the NASA lunar Gateway Power and Propulsion Element being built by Maxar Technologies.

"It will be the first human-rated mission to use electric propulsion," Hruby said. "For us to have our engines on it is a great accomplishment."

Busek, founded in 1985, also manufactures mid-power thrusters for commercial satellite constellations and low-power thrusters for small satellites.

"That's one of the things that makes us unique," Hruby said. "We serve a variety of customers."

Busek is supplying BHT-350 Hall thrusters to Florida-based Airbus OneWeb Satellites.

The company's product line has expanded to include gridded ion engines with iodine propellant, and miniature electrospray thrusters based on technology Busek developed with NASA's Jet Propulsion Laboratory for the European Space Agency Laser Interferometer Space Antenna (LISA) Pathfinder gravity wave mission launched in 2015.

Finding thrusters, which are essential for many satellite missions, has become more difficult since Russia invaded Ukraine, the world's dominant supplier of common satellite thruster propellants, including xenon and krypton. The war also severed OneWeb's relationship with Russia-based electric propulsion supplier EDB Fakel.

Hruby declined to offer details about the war's impact on OneWeb but said Busek has been working with the broadband constellation developer for about six years.

"We started with a clean-sheet design to accommodate the prime contractor's rigorous requirements," Hruby said.

Because of growing demand for thrusters, much of Busek's work with prime contractors "has been focused on bringing critical processes in-house, ensuring robust supply chains and scaling manufacturing operations," Hruby said.

Busek's newest thruster systems, including electrospray and iodine-fueled ion engines, are scheduled for first flight next year.

Iodine propellant is not appropriate for every mission or every customer, Hruby said, but it offers key advantages.

"One, there's a domestic source for iodine. Two, it stores as a solid, so you don't need a pressure vessel," Hruby said. "And three, iodine is a fraction of the cost of xenon and krypton." SN

DEBRA WERNER

Busek's BHT-350 Hall thruster in production

BUSEK/ALL.SPACE

In Brief

■ **Momentus** deployed four more spacecraft from its first orbital transfer vehicle that suffered problems after its launch in May. The company said Aug. 2 the four "PocketQube" satellites from FOSSA Systems were deployed in July from Vigoride-3, along with two others from the company released shortly after launch. Three satellites remain on the tug. That vehicle suffered power and communications issues after launch, and Momentus said in its statement that it had identified the root cause of the problems and was implementing changes to its Vigoride-5 tug scheduled for launch late this year.

■ **The National Reconnaissance Office** will increasingly rely on lower-cost commercial smallsats and payloads developed with international partners. Chris Scolese, director of the NRO, said during an Aug. 4 Mitchell Institute webcast that the agency was "proliferating our architecture" with smaller spacecraft, like one launched earlier that day on a Rocket Lab Electron. A mix of small and large satellites launched to different orbits "will become the norm," said Scolese. For lower-cost smallsat missions, the NRO will buy satellite buses from the open market like the ones used by commercial operators.

■ **Isotropic Systems** has unveiled a new product as well as a new name for the company. Isotropic, now called All.Space, announced a fifth-generation "smart terminal" able to suport multiple simultaneous satellite links. The flat-panel antenna will start production late this year.

HawkEye 360 opens satellite factory to speed up constellation deployment

HawkEye 360 has opened a new manufacturing facility near its northern Virginia headquarters that will help the company accelerate the deployment of its constellation of radio-frequency (RF) monitoring satellites.

In a July 21 ceremony, the company formally dedicated its Advanced Technology and Development Center, a 1,765-square-meter building that will consolidate its satellite production. The facility will host up to 70 employees handling the development and operations of its constellation, which has 15 satellites in orbit.

A major aspect of the facility is that it will allow the company to build the satellites in-house. While HawkEye 360 has always built the RF monitoring payloads, it has used satellite buses from the Space Flight Laboratory (SFL) at the University of Toronto Institute for Aerospace Studies.

That approach is intended to improve the efficiency of producing the satellites, said John Serafini, chief executive of HawkEye 360, in an interview. "Being able to do it together allows us to scale faster and not have to ship the payload back and forth. That saves a meaningful amount of time and energy."

HawkEye 360 plans to maintain its relationship with SFL. "What we're moving towards is two manufacturing lines, running in parallel," he said. "By doing so, we'll be able to build these satellites faster. We can better control the timeline and better control the costs."

The company's goal is to have 20 clusters of three satellites each in orbit by the end of 2025. Serafini said the goal is to produce and launch at least four satellite clusters per year to complete the constellation and replace aging satellites. He said the first satellites built in Herndon would likely launch late this year on the first Rocket Lab Electron mission from Wallops Island, Virginia, part of a five-launch block buy HawkEye 360 announced in April.

The Rocket Lab missions will augment the SpaceX rideshare missions that HawkEye 360 has used for recent satellite launches. "They are so cost-effective and so routine," he said of the SpaceX missions. Dedicated Electron launches, he said, will be used to target specific orbits needed to fill out the constellation and provide desired revisit times.

The new facility and the expansion of its satellite constellation are backed by $200 million HawkEye 360 raised in two funding rounds last year. Serafini said the company does not expect to have to raise more money in the foreseeable future.

"We've got a very robust balance sheet," he said. "We've got cash for multiple years, and I think we can achieve profitability with the cash that we have. If we wanted to go out and raise more capital, I think we could, but we don't need to."

The ceremony to open the facility attracted a number of local officials as well as two members of Congress, Reps. Jennifer Wexton and Don Beyer (D-Va.), who thanked the company for expanding in the area. The company now has about 150 employees, with plans to grow to 200 by the end of the year.

Serafini said the company is looking at options to expand or consolidate the new facility with its existing headquarters a short distance away, also in Herndon. "The bottom line is that we're going to be in Herndon for a long time," he said. "It's a great place to be for us: proximity to the customer, proximity to D.C. and an amazing talent base here." SN

JEFF FOUST

HawkEye 360 will manufacture satellites as well as their RF monitoring payloads at the new Northern Virginia facility it opened this summer.

HAWKEYE 360

Spire adding microwave sounders to improve weather forecasts

Spire Global plans to improve its weather forecast services by fitting future smallsats in its fleet with microwave sounders from RAL Space, the British government's national laboratory.

RAL Space's Hyperspectral Microwave Sounder (HYMS) instrument would enable Spire to measure atmospheric moisture for the first time, Spire spokesperson Kristina Spychalski said.

Spire's constellation of more than 100 multipurpose satellites currently uses radio occultation and reflectometry to collect atmospheric, surface and space weather data.

Radio occultation instruments can measure atmospheric temperature, humidity and pressure. Spire uses reflectometry sensors for data on soil moisture, ocean winds and sea ice.

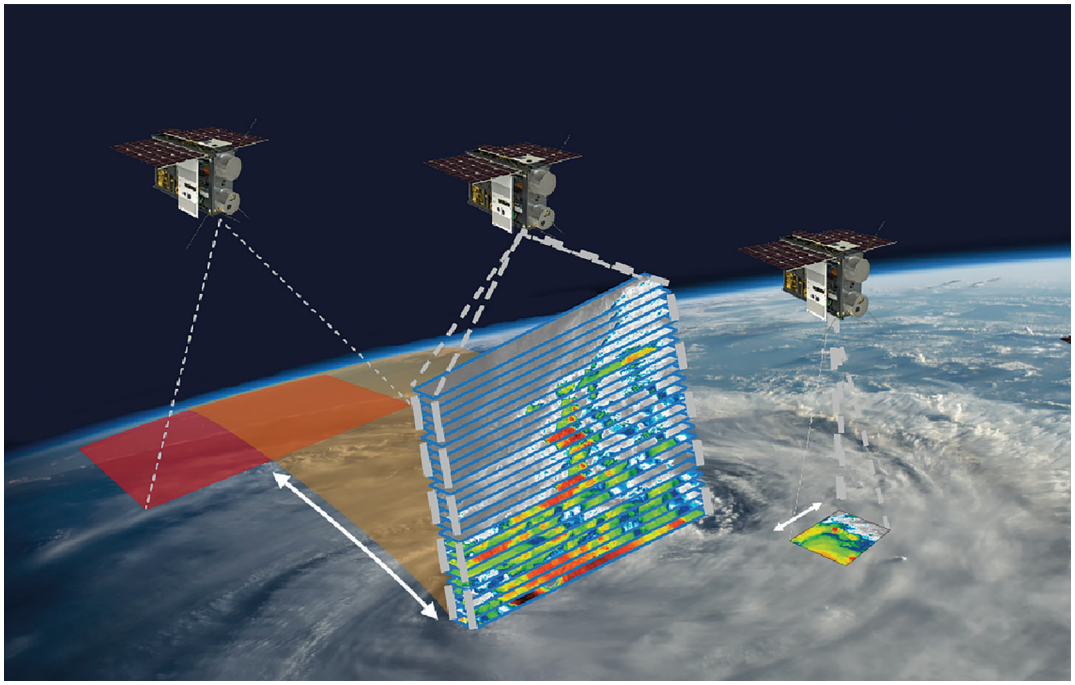
Adding HYMS to future satellites would provide meteorological agencies that use Spire's space-based data "with the inputs needed to deliver even more accurate forecasts," said Kevin Petty, vice president of weather and Earth intelligence at Spire.

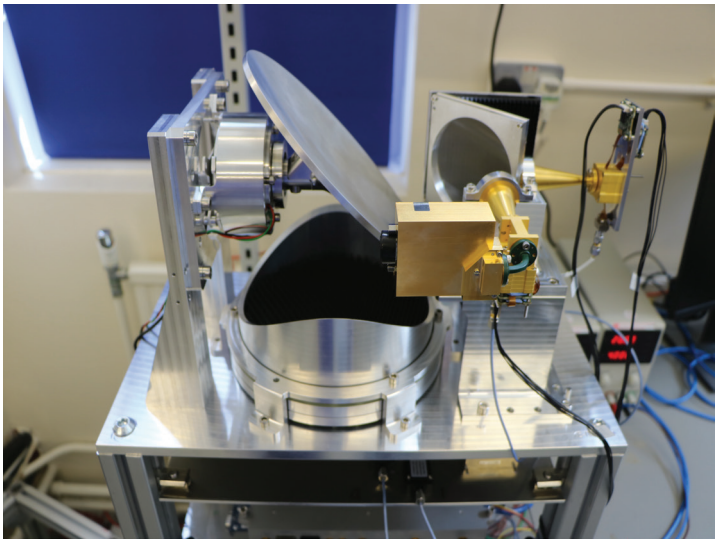
Spychalski said a demonstration mission using a Spire satellite the size of 16 cubesats will take place "by late 2023 to early 2024" and will fly HYMS in space for the first time.

According to RAL Space, the shoebox-size HYMS offers up to four times more frequency resolution than much larger sounders flying on government-operated weather satellites.

"The HYMS technology we've created is more advanced than anything that is currently on the market, and it is extremely exciting to be able to offer its use to industry for space applications," said Peter Huggard, Millimetre Wave Technology Group Leader at RAL Space.

"The improved spectral resolution of our HYMS instrument will provide better atmospheric information for weather forecasting and, when deployed in a constellation of small satellites, a much-reduced interval between measurements."





Above: An artist's concept of a constellation equipped with RAL Space's Hyperspectral Microwave Sounder (HYMS). Right: A photo of the HYMS hardware licensed for space deployment with Spire

STFC RAL SPACE

JASON RAINBOW

Boston-based startup Tomorrow.io announced plans in March to add satellites with microwave sounders to the weather constellation it expects to have deployed in orbit by the end of 2024.

Rei Goffer, Tomorrow.io's co-founder and chief strategy officer, told *SpaceNews* that the company is working with U.S. government-funded MIT Lincoln Laboratory on a microwave sounder.

The instrument will be an improved version of a payload used by NASA's tropical storm-monitoring TROPICS cubesat constellation, or Time-Resolved Observations of Precipitation Structure and Storm Intensity with a Constellation of SmallSats.

A pathfinder satellite for TROPICS was successfully launched last year.

However, the first two cubesats for the TROPICS constellation failed to reach orbit June 12 after the upper stage of Astra's Rocket 3.3 vehicle shut down prematurely.

The launch was one of three NASA had booked from Astra to complete the constellation, which can still meet its science goals with four satellites. (See TROPICS, p. 3)

Goffer said Tomorrow.io selected MIT Lincoln Laboratory after a comprehensive study of sounder technologies primarily because of TROPICS' higher technology maturation level. SN

SMALLSAT KEYNOTE

Beck: CAPSTONE proves feasibility of low-cost interplanetary smallsats

Left: Rocket Lab CEO Peter Beck addresses the 36th Small Satellite Conference in Logan, Utah, via video Aug. 8. Below: Artist rendering of NASA's CAPSTONE spacecraft

Rocket Lab's launch of a NASA lunar cubesat mission lived up to its name, serving as a capstone for the company's efforts to develop end-to-end space systems and interplanetary missions, according to its chief executive.

Giving a keynote at the Small Satellite Conference here Aug. 8, Peter Beck said the company's work on both small launch vehicles and spacecraft came together with the June 28 launch of NASA's Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment (CAPSTONE) mission to the moon.

Rocket Lab provided the launch on its Electron rocket as well as the Lunar Photon kick stage that performed a series of maneuvers to place CAPSTONE on a ballistic lunar trajectory.

The mission came as Rocket Lab expanded from being strictly a small launch vehicle developer to one that also developed spacecraft and components for them, in part through a series of acquisitions. "Where all this really came together is when we did the CAPSTONE mission," he said. "We not only just needed a rocket, we needed to build a spacecraft as well."

The CAPSTONE mission pushed the limits of Electron's performance. The vehicle was originally designed to place 150 kilograms into low Earth orbit, but CAPSTONE and Lunar Photon weighed 320 kilograms at launch. "Every gram was accounted for," he said, including the decision not to include onboard cameras usually flown on Electron to conserve mass. "We really pushed that vehicle as hard as we could."

Rocket Lab is continuing to operate Lunar Photon more than a month after it deployed CAPSTONE. The spacecraft is currently about 1.3 million kilometers from Earth, he said, and will swing back to Earth later in the month.

The spacecraft still has 10-15% of its propellant remaining. "As it scoots past Earth," Beck said, "we'll have a crack at doing something cool with it and see how far into the solar system we can get with it."

That test will support Rocket Lab's future plans for deep space smallsat missions, including a privately-funded mission to Venus and building the two spacecraft for NASA's ESCAPADE Mars orbiter mission. "We're using this opportunity to learn what it's going to take to get to Venus and other destinations," he said.

He reiterated past comments that the CAPSTONE mission demonstrated the feasibility of low-cost interplanetary smallsat missions. "What we intended to do with the Lunar Photon spacecraft is to really lower the barrier for interplanetary missions," he said. "The biggest thing that came out of that was there's a spacecraft now that, for some tens of millions of dollars, that you can buy and go and visit an asteroid, go and visit the moon, go and visit another planet. That's never existed before."

Beck, speaking remotely from New Zealand after illness prevented him from coming to the conference in person, touched on another key Rocket Lab initiative, creating a reusable version of the Electron booster. The company attempted to catch the booster with a helicopter on a May 2 launch, but unexpected loads forced the helicopter to release the booster seconds after grappling it.

The company has been "somewhat opportunistic" with making recovery attempts, he said, depending on the requirements for each mission. "You shouldn't need to wait long" for the next recovery attempt, he said, but was not more specific.

He was confident that Rocket Lab would be able to soon recover and reuse the booster, given the progress made so far. "The biggest learning from the last one is that it is going to work," he said. SN

JEFF FOUST

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