Orbiter
October 2017

Aerospace Develops Camera to Look at Atmospheric Glow

by **Laura Johnson**
October 31, 2017

The Earth's atmosphere is never completely dark. Even at night, with no moon or stars, the atmosphere itself gives off light because of chemical reactions that are taking place. This phenomenon, appropriately known as airglow, is the basis for a camera an Aerospace team is developing to learn about the atmosphere and gather imagery.

The Near Infrared Airglow Camera (NIRAC) is a 45 kg device that will hitch a ride on the International Space Station (ISS) in 2018 as part of the Department of Defense Space Test Program.

"NIRAC has two mission objectives: to study lower atmospheric processes that affect space weather and also to exploit airglow for nighttime imagery applications," said Dr. Lynette Gelinas, an Aerospace senior scientist who is leading this project along with Dr. Richard Rudy and Dr. James Hecht.

Bright swaths of red in the upper atmosphere, known as airglow, can be seen in this image taken from the International Space Station. (Photo: NASA)

Collecting Imagery

Airglow is a natural atmospheric emission related to aurora – in both cases, light is emitted from an excited atom or molecule, although the cause of excitation is different. Also, airglow is dimmer than aurora and occurs over the entire Earth, not just the poles.

Left to right, Dr. Lynette Gelinas, Albert Lin, and Dr. James Hecht, confer in front of a full-size 3D-printed model of NIRAC. (Photo: Eric Hamburg)

Visible airglow is rather weak, but NIRAC uses the infrared portion of the spectrum, which is much brighter. Using this illumination, the camera will be able to capture images of the ground and clouds at night, when there is no other light.

"We're interested in using the airglow layer as a flashlight to look at the ground," Gelinas said. "In this band, it's pretty bright; it's almost as if you're looking at the ground under a full moon."

Space Weather

NIRAC will also contribute to the study of space weather. Weather on Earth, a more familiar concept to most, focuses on conditions in the lower atmosphere.

"Space weather describes conditions in the upper atmosphere and in the near-Earth space environment that can affect spacecraft, for example, ionospheric disturbances that degrade communications signals from satellites," Gelinas said.

Airglow, which occurs at about 85 kilometers altitude, is conveniently located between the lower atmosphere and space weather and can be used to gain information about interactions between the two.

“Airglow is a chemical reaction which means that density and temperature perturbations will change the amount of light emitted, helping us study the characteristics of the upper atmosphere,” said Gelinas.

Aerospace has previously used ground-based airglow cameras to study this, but they provide a limited field of view. NIRAC will take this capability to space.

Technical Challenges

In order to prepare the airglow camera for the ISS, the team had to downsize the focal plane array assembly, make it space compatible, and keep everything from overheating. They accomplished this, and in fact, the technology they developed could be used for other applications.

“The resulting space-qualified detector-cooler assembly will allow use of highly-capable focal plane arrays on small platforms, including small sats, hosted payloads, multiple-unit CubeSats, and unmanned aerial vehicles,” Gelinas said.

Another challenge cropped up when the team found out that NIRAC will have a tricky position on top of the ISS. This gives the camera a distorted field of view, making it difficult to compensate for the movement of the ISS and Earth during image exposure. Undaunted, the team developed a custom lens that solved the problem, and they have a patent pending.

Having overcome these technical challenges, the team is now building the camera and looking forward to the data NIRAC will collect.

Aerospace intern Nyija Butler works on a 3D-printed NIRAC model she designed to help assembly technicians determine how to route internal NIRAC cables. (Photo: Laura Johnson)

“We’ll be viewing airglow perturbations as never seen before – both in sensitivity and scale size, which will require development of more sophisticated data analysis techniques,” Gelinas said. “We also expect that NIRAC observations will lead to new science investigations studying the coupling of the lower atmosphere to space.”

The Science Heats Up in the Middle of the Night

by **Laura Johnson**
October 02, 2017

Being a scientist is not a 9 to 5 job, especially when the phenomena you want to study happen at midnight.

Aerospace’s Dr. Rebecca Bishop has received a $2.52 million NASA grant to study a specific aspect of what goes on in the upper atmosphere near the equator at night.

“We want to better understand ionospheric structures that may lead to formation of disturbances that can potentially adversely impact navigation, communication, and over-the-horizon radar systems,” Bishop said.

Artist's illustration of one of the LLITED CubeSats. (Illustration: Joseph Hidalgo)

The Low-Latitude Ionosphere/Thermosphere Enhancements in Density (LLITED) mission will launch two CubeSats in the fall of 2019 to study that topic.

“Scientific research is essential for fostering a creative, innovative community within Aerospace,” said Dr. Sherrie Zacharius, vice president of Technology and Laboratory Operations. “The knowledge we gain in pursuit of scientific understanding and the tools and methods developed along the way enable us to solve the most challenging problems facing our government and commercial customers.”

LLITED will study the region of the upper atmosphere called the ionosphere, where sunlight impacts neutral atoms and molecules resulting in electrically charged particles, or plasma. When the Earth is in darkness (the nightside), there is much less plasma being created.

“The sunlight produces the plasma. So when the sun is not shining, everything recombines and goes back to neutral. It doesn’t completely go away, but it decays a lot,” said Bishop.

There are two unusual nighttime phenomena that take place in the ionosphere/thermosphere near the equator: one is an increase in temperature and changes in winds around midnight, and the other is an increase in the density of the plasma at the same time.

Bishop and the Aerospace AeroCube group will design and build two 1.5U CubeSats to study these two phenomena and how they interact with one another.

The two CubeSats are identical and will each carry three instruments: an ionization gauge and GPS radio occultation sensor provided by Aerospace, and a planar ion probe provided by Embry-Riddle Aeronautical University. The CubeSats will fly in the same orbit, between 350 and 450 km, but will be spaced ¼ to ½ orbit apart, in order to measure spatial and temporal changes in the phenomena.

With the improved insight into the ionosphere/thermosphere, the LLITED mission helps address the 2014 NASA Science Plan Goal: “Explore the physical processes in the space environment from the Sun to the Earth and throughout the solar system.”

And that’s a worthwhile goal both day and night.

Aerospace’s Microelectronics Technology Department Images Space Parts at the Atomic Scale

by **Nancy Profera**
October 12, 2017

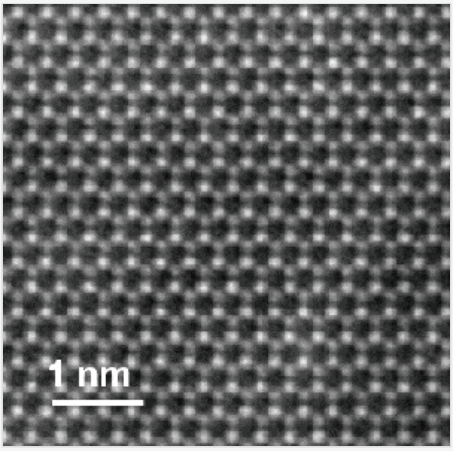
Zachary Lingley (foreground) and Dr. Brendan Foran work with the scanning transmission electron microscope in the Microelectronics Technology Department’s laboratory. (Photo: Eric Hamburg)

The Microelectronics Technology Department at The Aerospace Corporation is a center for understanding the reliability and physics of the failure of microelectronic and optoelectronic devices used in space systems. The department solves hard problems at the intersection of physics, chemistry, and materials science.

Spacecraft and launch vehicles have numerous onboard microelectronic and optoelectronic components. It is essential that these parts have extremely high reliability, yet components in space systems do fail. These failures can occur from defects in design or workmanship, or because of materials-dependent wear-out related to use conditions, such as thermal cycling and radiation effects.

“Our role is to understand how devices are made, how they are used, and how they fail. This requires understanding materials science, chemistry, physics, and electrical engineering. Our goal is to determine the root cause of failures, provide reliability assessments, and guide improvements, all while trying to minimize the chance of recurrence,” said Maribeth Mason, director of the Microelectronics Technology Department.

The team studies current and future technologies with a variety of testing, modeling and simulation, and analysis techniques to explore device design and fabrication. They test materials, devices, circuits, modules, systems, and packaging. The team also studies materials characterization at the nanoscale.



An atomic resolution, aberration-corrected scanning transmission electron microscope image of a single layer of molybdenum disulfide (MoS2). The Mo atoms appear slightly brighter than the S atoms due to their larger scattering cross section. (Photo: The Aerospace Corporation)

One of the department's newest pieces of hardware is an aberration corrected scanning transmission electron microscope (STEM) capable of imaging with 70-picometer resolution. This means this microscopy can resolve two small objects (such as atoms) that are 70-picometers apart. The typical atom-to-atom spacing in solids is on the scale of 100 picometers, so this microscope is capable of imaging single atoms. This level of resolution is necessary for seeing how modern microelectronics are made, and for learning how they fail, since modern device performance and reliability are often dependent on structures and interfaces where the ability to see atomic scale defects is critical.

For example, modern silicon-complementary metal-oxide semiconductor (CMOS) integrated circuits rely on gate dielectric layers that can be as thin as 10 atoms, where one defective atom site could play a significant role in allowing dielectric breakdown that would greatly change performance and reliability. "Knowing the quality of manufacturing greatly helps Aerospace assess the risk for use of such modern devices, where changes to operational use of a component could make or break mission success," said Mason.

"While our department has made good use of TEM in the past, our new TEM has significantly improved resolution at low incident beam energies, and significantly improved detector efficiencies that enable analyses of sensitive materials, as well as offering up to 100 times improved data collection speeds," said Zachary Lingley, manager, Electronic Materials and Devices Section. "With our new microscope, we can conduct dynamic experiments and look for changes in materials systems as a function of heating and/or electrical bias or current flow," he added.

The Microelectronics Technology Department routinely uses its instrumentation and capabilities to support a broad range of program efforts across Aerospace's customer base, from East to West coasts. This includes work supporting Civil Systems Group programs such as those for NASA and NOAA. The team also leads Aerospace Technical Investment Program (ATIP) projects to develop knowledge and capabilities in the areas of reliability for next-generation microelectronics and optoelectronics. The team conducts materials construction analyses and reverse engineering of devices, including on semiconductor integrated circuits, solar cells, laser diodes, ceramic capacitors, imaging sensors, such as charge-coupled devices and focal plane arrays, and a vast number of other types of microelectronic and optoelectronic devices, all of which are critical to Aerospace's customers' missions.

Feel the Thunder: Fifth Time's a Charm

by **Randolph L Kendall**
October 16, 2017

An Atlas V launches into the sky at Cape Canaveral in the Sunday morning darkness. (Photo: United Launch Alliance, LLC)

They say "the third time's a charm," but sometimes it's the fifth time.

After three previous scrubs due to weather and one to work a vehicle issue, this time did seem charmed with virtually no issues during the countdown and a very clean flight and successful orbit insertion.

The Atlas V, flying in the 421 configuration with a four-meter fairing, two solid rocket motors, and one engine in the Centaur upper stage, thundered off Cape Canaveral's Space Launch Complex 41 at 3:28 a.m. Sunday Eastern time. It carried a national security payload.

The early Sunday launch marked United Launch Alliance's seventh launch of 2017, the 74th of the Atlas V rocket, and the seventh in the 421 configuration.

Awards and Recognitions

by **Gail Kellner**
October 24, 2017

Aerospace employees frequently earn recognition for their professional accomplishments. This Orbiter feature acknowledges those honors and awards, including the publication of books. To nominate someone for consideration in this section, send details of the award in a timely fashion to orbiter@aero.org, or contact Gail Kellner at gail.d.kellner@aero.org.

Dr. Sherrie Zacharius

Dr. Sherrie Zacharius, vice president, Technology and Laboratory Operations, recently received the Chief of Staff of the Air Force Award for Exceptional Public Service. The award was established to pay tribute to private citizens "for their sustained unselfish dedication, contributions, and exceptional support of the Air Force."

The recipient must meet the following criteria: "Embodies dedication, patriotism, and personal sacrifice which has resulted in significant contributions to the Air Force; demonstrates exceptional leadership, and provides for the safety and welfare of Air Force personnel; and projects positive community relationships, which in turn has fostered positive mission accomplishments."

Dr. Thomas Adang, Dr. Vinay Goyal, Dr. Gretchen Lindsay, and Jeffrey Michlitsch

Four Aerospace employees were recently selected by the American Institute of Aeronautics and Astronautics (AIAA) for the Associate Fellow Class of 2018. They are: Dr. Thomas Adang, principal engineering specialist, Civil Systems Group; Dr. Vinay Goyal, senior project leader, Structures Department; Dr. Gretchen Lindsay, director, Systems Engineering Acquisition and Operations Department; and Jeffrey Michlitsch, principal engineer, Alternate Launch Vehicles.

The grade of Associate Fellow recognizes individuals "who have accomplished or been in charge of important engineering or scientific work, or have done original work of outstanding merit, or who have otherwise made outstanding contributions to the arts, sciences, or technology of aeronautics or astronautics."

To be selected as an AIAA Associate Fellow, an individual must be an AIAA senior member in good standing with at least 12 years professional experience, and be recommended by a minimum of three current Associate Fellows.

AIAA will formally honor and induct the class at its AIAA Associate Fellows Recognition Ceremony and Dinner on Jan. 8, 2018, in Kissimmee, Florida, in conjunction with the AIAA Science and Technology Forum and Exposition.

iWebinar Emphasizes Innovative Work at Aerospace

October 27, 2017

What's being done that's innovative at Aerospace? What is the corporation doing to stimulate more innovation? And what does innovation look like, exactly?

The Aerospace University and iLab have teamed up to explore those questions via a weekly webinar.

"We want to give our staff a chance to hear what their colleagues are up to," said Dr. Randy Villahermosa, iLab executive director. "The iWebinar is a great outlet for sharing innovation stories."

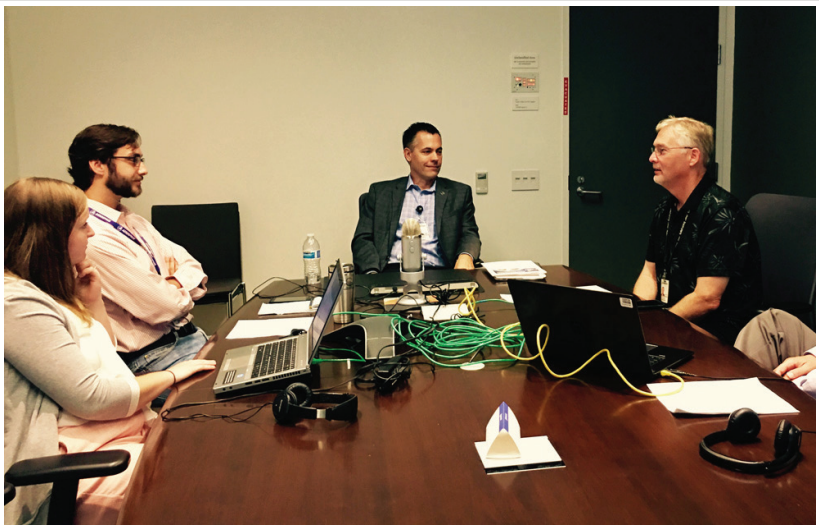
iWebinar features a variety of subject matter experts who regale their Aerospace colleagues with stories of their innovative work.

On Aug. 16, for example, Dr. Siegfried Janson discussed his work on Brane Craft, an innovative spacecraft measuring 1-meter square by 50 microns thick, with a mass of only 81 grams.

Dr. Toby Case highlighted innovations in nondestructive evaluation on Aug. 2. Dr. Rebecca Bishop shared about uses for GPS other than navigation, Robert Lee talked about Bitcoins, and Naoki Hemmi discussed shock propagation.

All these topics and more are readily accessible for all employees.

“The webinar format helps level the playing field across the corporation by offering learning opportunities to any employee, regardless of their operating location,” said Dr. Thomas Spiglanin, the Aerospace University project leader who came up with the idea for iWebinar. “For those who don’t have access to Aeronet from their workplace, there is an audio dial-in option, but the recordings with slides are also available after the event.”



Rob Sherwood (head of table) speaks live as the featured guest at an iWebinar session. (Photo: Lael Woods)

Board Member O’Sullivan Addresses Chantilly Employees on Workplace Skills

by **Melissa Parsons**
October 25, 2017

On Thursday, Oct. 19, the East Coast Aerospace Women’s Committee (AWC) hosted a workplace skills workshop in Chantilly’s Gambit Auditorium with board member Stephanie O’Sullivan serving as keynote speaker.

AWC Regional Vice President Brianna Aubin kicked off the event, which consisted of a keynote address, an executive panel, and an afternoon of activities geared towards enhancing workplace skills for all employees.

Following the welcome remarks, Senior Vice President for National Systems Group Cathy Steele introduced O’Sullivan, who was elected to the Aerospace board of trustees in June. Previously, O’Sullivan served in a variety of roles, including principal deputy director of national intelligence, associate deputy director of the Central Intelligence Agency (CIA), and director of science and technology at the CIA. She also held positions at the Office of Naval Intelligence and TRW.

Board of trustees member Stephanie O'Sullivan speaks at the Chantilly Workplace Skills event. (Photo: Kelly Hart)

With more than 100 people in attendance, O’Sullivan shared her experience as a female engineer in a male-dominated industry, lessons learned during her days at the CIA, and successes and failures that led her to the table of many White House intelligence briefings.

The event also included a workplace skills question and answer panel moderated by Jenny Oliveira, senior member of the technical staff. The panel consisted of Cathy Steele, Jamie Morin, Kevin Bell, and Courtney Moore. Each was asked a series of questions designed to provide insight on how employees can enhance their workplace skills and become as successful as possible.

Following a brown bag networking luncheon, Aubin and Tanya Zirbel, from the People Operations Group, facilitated an afternoon of learning based on the books “Quiet, The Power of Introverts in a World That Can’t Stop Talking” by Susan Cain, and “Emotional Intelligence 2.0” by Travis Bradberry and Jean Greaves. The event concluded with exercises in critical conversations.

Press Release: Eyerly Named General Manager Systems Engineering Division

October 16, 2017

Bruce Eyerly

EL SEGUNDO, Calif. (Oct. 17. 2017) – The Aerospace Corporation (Aerospace) announced today that Bruce Eyerly has been named general manager of the Systems Engineering Division effective immediately. In this role, Eyerly will oversee engineering support for a broad range of government, civil, and commercial customers in systems analysis and simulation, architecture development, acquisition and mission assurance activities. He will also support the Corporate Chief Engineers Office in activities related to space systems resiliency and the U.S. Air Force's continued focus on the Space Warfighting Construct.

"Bruce has a proven track record of both leading and developing teams of engineers throughout his aerospace career," said Chuck Gustafson, senior vice president of Aerospace Engineering and Technology Group. "He brings extensive space industry experience working with the Air Force, Intelligence Community, and Commercial customers. He has also collaborated with Aerospace technical experts on a number of key programs."

Eyerly joins Aerospace after a successful 38-year career at The Boeing Company. Previously, he led all space-segment engineering disciplines across a family of proprietary space programs, including the X-37B. His past leadership and technical assignments also included lead control systems engineer for the MILSTAR communications payloads, space/ground interface lead for the Geostationary Operational Environmental Satellite Program, and Integrated Product Team lead for two national security satellite programs.

Eyerly earned his bachelor of science degree in electrical engineering and a master of science degree in control systems from the University of Southern California. Eyerly holds a series of 11 issued patents. He is also a contributing author of the book, Space Vehicle Mechanisms: Elements of Successful Design.

About The Aerospace Corporation

The Aerospace Corporation is a California nonprofit corporation that operates a federally funded research and development center and has approximately 3,600 employees. It provides guidance and advice to military, civil and commercial customers to ensure the success of complex, technology-based programs. The Aerospace Corporation is headquartered in El Segundo, Calif., with multiple locations across the United States. For more information on Aerospace, visit www.aerospace.org. Follow us on Twitter: @AerospaceCorp.

Press Release: The Aerospace Corporation Shapes Leadership in Space Warfighting Construct

October 16, 2017

Retired Maj. Gen. Jay Santee

EL SEGUNDO, Calif. (Oct. 16, 2017) – The Aerospace Corporation (Aerospace) is pleased to announce the selection of retired Maj. Gen. Jay Santee as the new vice president of Strategic Space Operations based in Colorado Springs, CO. In his new role, Santee will oversee the company's support of the U.S. Air Force's Space Warfighting Construct (SWC), which combines transformational and warfighting-focused command initiatives to maintain space superiority in the 21st century. As Space Warfighting Construct continues to grow in importance, Aerospace will continue to play a leading role. Santee will also support the Space Security and Defense Program and the U.S. Strategic Command.

"A leader of Jay's strategic caliber brings the critical expertise and drive needed to advance the Space Warfighting Construct for the Air Force," said Steve Isakowitz, Aerospace president and CEO. "As SWC is a top priority for Aerospace, Jay's authoritative command of national security and policy development make him the ideal person to help accelerate the transition to this new warfighting domain."

Prior to joining Aerospace, Santee was the director of Resilient, Affordable Space at MITRE, responsible for integrating and synchronizing defense space projects. Santee retired from the Air Force as deputy director, Defense Threat Reduction Agency, Fort Belvoir, Virginia. He also served as acting deputy assistant secretary of defense for space policy in the Pentagon; vice commander of the 14th Air Force, Air Forces Strategic; and as an operations division chief at U.S. Space Command.

Santee is a Distinguished Graduate of the U.S. Air Force Academy and the National War College. He holds a master's in Business Administration from Golden Gate University.

About The Aerospace Corporation

The Aerospace Corporation is a California nonprofit corporation that operates a federally funded research and development center and has approximately 3,800 employees. It provides guidance and advice to military, civil and commercial customers to ensure the success of complex, technology-based programs. The Aerospace Corporation is headquartered in El Segundo, Calif., with multiple locations across the United States. For more information on Aerospace, visit www.aerospace.org. Follow us on Twitter: @AerospaceCorp.

October 2017 Orbituaries

by **Jessie Ding**
October 01, 2017

Sincere sympathy is extended to the families of:

Kirk Battleson, member of technical staff, hired Nov. 3, 1997, retired March 1, 2010, died Aug. 20, 2017
Felicisimo L. Dy, member of administrative staff, hired Aug. 2, 1982, retired Feb. 1, 2005, died Sept. 2, 2017
Daniel Holmes, member of technical staff, hired July 18, 1966, retired Jan. 1, 1994, died Aug. 15, 2017
Yvonne M. Hull, office of technical staff, hired Jan. 2, 1961, retired Dec. 1, 1985, died June 30, 2017
Eleanor Lanigan, member of administrative staff, hired May 9, 1961, retired Oct. 1, 1993, died Aug. 25, 2017
James L. Minos, member of technical staff, hired Aug. 4, 1981, retired May 1, 1993, died Sept. 24, 2017
Stanley Olsen, member of technical staff, hired Aug. 4, 1980, retired Feb. 1, 1994, died Sept. 15, 2017
Martha Shoebotham, office of technical staff, hired Nov. 14, 1960, retired July 1, 1989, died Sept. 15, 2017
Grover Sutton, member of technical staff, hired May 8, 1962, retired Nov. 1, 1993, died Sept. 19, 2017
Louis J. Tedeschi, member of technical staff, hired Oct. 23, 1961, retired Dec. 1, 1985, died Sept. 17, 2017
Dale Vrabec, member of technical staff, hired May 4, 1961, retired Aug. 1, 1988, died Sept. 9, 2017
Charles P. Wang, member of technical staff, hired April 1, 1974, retired May 1, 2003, died July 5, 2017
Johnson C. Wang, member of technical staff, hired March 5, 1984, died Aug. 30, 2017
Billy R. Warren, member of technical staff, hired Oct. 2, 1978, retired Oct. 1, 1995, died Sept. 4, 2017

To notify Aerospace of a death and have it included in the Orbiter, please contact People Operations at (310) 336-5107

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