TRENDING

NASA Named Best Place to Work, Six Years Running
The Partnership for Public Service has named NASA the best place to work among large federal agencies for the sixth straight year. Goddard ranked second among 150 agency subcomponents, highest among all NASA centers.

NASA Launches Latest Polar-Orbiting Satellite
NASA has launched for the National Oceanic and Atmospheric Administration the Joint Polar Satellite System-1, the first of four advanced polar-orbiting satellites designed to improve U.S. weather forecasts.

Army Veteran Discusses Transition to Civilian Life
In honor of Veterans Day, several Goddard committees welcomed to the center Army veteran Jared Marinos, who spoke about his two combat tours and transition to civilian life. A few Goddard veterans also shared their experiences.

Goett Auditorium Renovations Complete
After several months of renovations, the Goett Auditorium in Building 3 is once again in operation. The new design features a sleeker seating configuration, better acoustics and improved audiovisual capabilities.
NASA scientist Paul A. Newman and NASA’s Goddard Space Flight Center were awarded the United Nations’ highest environmental honor: the Champions of the Earth award. In its announcement, the U.N. Environment Programme, or UNEP, recognized Newman and Goddard “for outstanding contributions to the Montreal Protocol.”

An international agreement signed in 1987, the Montreal Protocol and its subsequent amendments ultimately led to phasing out the production of 99 percent of ozone-depleting substances, such as the chlorofluorocarbons that were once used in aerosol sprays and refrigeration systems.

Scientists credit the agreement with halting the damage to Earth’s ozone layer that was rapidly occurring in the 1980s and beginning what is a decades-long recovery. The ozone layer acts to block harmful ultraviolet radiation from the sun, which can damage human health, wildlife and crops. Newman likens this protective ozone to an “unseen, natural sunscreen,” and said, “It’s crucial to understand and carefully watch this vital Earth resource.”

Newman is the chief scientist for the Goddard Earth Sciences Division, and he is also a Goddard senior fellow. Newman and his team at Goddard monitor ozone levels using satellites as well as manned and unmanned aircraft.

Newman, a Seattle native, received his undergraduate degree in physics from Seattle University before completing a doctorate in physics at Iowa State University. He first came to Goddard as a postdoctoral fellow in 1984 and has been a Goddard scientist ever since.

In addition to his roles at Goddard, Newman is co-chair of the U.N. Scientific Assessment Panel to the Montreal Protocol. This panel is responsible for the quadrennial international assessments that are produced by the international scientific community. The foundational reports document our understanding of the ozone layer and the naturally occurring and human-induced processes that affect it.

As a result of the Montreal Protocol and subsequent amendments, the ozone layer is projected to recover to 1980s levels by 2050. The panel continues to improve upon the original Montreal agreement. In 2016, the Kigali Amendment pledged to phase out hydrofluorocarbons, an alternative to ozone-depleting substances but which are powerful greenhouse gases. This agreement will prevent a future increase in global temperatures of up to 0.5 degree Celsius, or about 1 degree Fahrenheit.

The annual Champions of the Earth prize is awarded to outstanding leaders from government, civil society and the private sector whose actions have had a positive impact on the environment. Founded in 2004, the award has recognized 84 laureates in policy, science, business and civil society. The Champions of the Earth award was announced on Dec. 5 by UNEP at the U.N. Environment Assembly in Nairobi, Kenya.

Above: NASA scientist Paul A. Newman, who was recently named a recipient of the United Nations’ Champions of the Earth award.

Photo courtesy: Paul. A. Newman
FOUR DECADES AND COUNTING: NEW INSTRUMENT CONTINUES MEASURING SOLAR ENERGY INPUT TO EARTH

By Kasha Patel

For nearly 40 years, NASA has been measuring how much sunshine powers our home planet. NASA has launched an instrument to the International Space Station to continue monitoring the sun’s energy input to Earth’s system. The Total and Spectral Solar Irradiance Sensor (TSIS-1) will precisely measure what scientists call “total solar irradiance.” These data will give us a better understanding of Earth’s primary energy supply and help improve models simulating Earth’s climate.

“You can look at the Earth and sun connection as a simple energy balance. If you have more energy absorbed by Earth than leaving it, its temperature increases and vice versa,” said Peter Pilewskie, TSIS-1 lead scientist at the Laboratory for Atmospheric and Space Physics (LASP) in Boulder, Colorado. Under NASA’s direction, LASP is providing and distributing the instrument’s measurements to the scientific community.

But it’s not so simple: The sun’s output energy is not constant. Over the course of about 11 years, our sun cycles from a relatively quiet state to a peak in intense solar activity — like explosions of light and solar material — called a solar maximum. In subsequent years, the sun returns to a quiet state and the cycle starts over again. The sun has fewer sunspots — dark areas that are often the source of increased solar activity — and stops producing so many explosions, going through a period called the solar minimum. Over the course of one solar cycle, or one 11-year period, the sun’s emitted energy varies at about 0.1 percent on average. That may not sound like a lot, but the sun emits a large amount of energy — 1,361 watts per square meter. Even fluctuations at just a tenth of a percent can affect Earth.

In addition to those 11-year changes, entire solar cycles can vary from decade to decade. Scientists have observed unusually quiet magnetic activity from the sun for the past two decades with previous satellites. During the last prolonged solar minimum from 2008 to 2009, our sun was as quiet as has been observed since 1978. Scientists expect the sun to enter a solar minimum within the next three years, and TSIS-1 will be primed to take measurements of the next minimum.

“We don’t know what the next solar cycle is going to bring, but we’ve had a couple of solar cycles that have been weaker than we’ve had in quite a while, so who knows. It’s a pretty exciting time to be studying the sun,” said Dong Wu, TSIS-1 project scientist at NASA’s Goddard Space Flight Center. Goddard is responsible for the overall development and operation of TSIS-1 on the International Space Station.

TSIS-1 data are particularly important for helping scientists understand the causes of total solar irradiance fluctuations and how they are connected with the sun’s behavior over decades or centuries. Today, scientists have neither enough data nor the forecasting skill to predict whether total solar irradiance has any long-term trend, according to Doug Rabin, deputy project scientist at Goddard. TSIS-1 will continue a data sequence that is vital to answering that question.

These data are also important for understanding Earth’s climate through models. Scientists use computer models to interpret changes in the sun’s energy input. If less solar energy is available, scientists can gauge how that will affect Earth’s atmosphere, oceans, weather and seasons by using computer simulations. The input from the sun is just one of many factors scientists use to model Earth’s climate. Earth’s climate is also affected by other factors, such as greenhouse gases, clouds scattering light and small particles in the atmosphere called aerosols — all of which are taken into account in comprehensive climate models.

TSIS-1 will study the total amount of solar radiation emitted by the sun using the Total Irradiance Monitor, one of two sensors on the instrument. The second sensor — the Spectral Irradiance Monitor — will measure how the sun’s energy is distributed over the ultraviolet, visible and infrared regions of light. TSIS-1 spectral irradiance measurements of the sun’s ultraviolet radiation are critical to understanding the ozone layer — Earth’s sunscreen that protects life from harmful radiation.

“Knowing the sun’s behavior and knowing how Earth’s atmosphere responds to the sun is even more important now because of all the different factors that affect climate change. We need to understand how all of these interact on Earth’s system,” said Pilewskie.

Center: A rendering of the Total and Spectral Solar Irradiance Sensor, affixed to the International Space Station.

Photo courtesy: NASA, Laboratory for Atmospheric and Space Physics
Perched atop the Elvey Building at the University of Alaska Fairbanks is NASA’s newest communications antenna, called AS-2, which became operational on Oct. 3. Moments after the ceremonial ribbon-cutting, AS-2 took its first pass and downlinked data from a satellite in space.

“Alaska is one of many stepping stones to space,” said Badri Younes, deputy associate administrator for space communications and navigation at NASA Headquarters in Washington. “It’s where we communicate with our satellites and how we bring back data to Earth.”

NASA spacecraft collect immense amounts of scientific data every day. Getting that data back to Earth isn’t trivial. That’s where the agency’s three communications networks come in.

AS-2 is part of NASA’s Near Earth Network (NEN), which provides communications support to spacecraft up to 1.2 million miles from Earth. The new antenna replaced its outdated predecessor and greatly expands on the services the previous antenna was able to provide.

Today, there are three operational NASA antennas at the University of Alaska Fairbanks – AS-1, AS-2 and AS-3. The location in Alaska is ideal for communicating with polar-orbiting satellites, most of which are Earth science missions.

The partnership between NASA and the Alaska Satellite Facility (ASF) at the university began more than 25 years ago with the installation of NASA’s first antenna at the site.

“This is becoming a habit,” joked David Carter, NEN project manager, to the crowd gathered at the ribbon-cutting. “It shows the important role ASF plays in the Near Earth Network. This new antenna increases our capability, capacity and flexibility.”

AS-2 is equipped with both S-band and X-band radio frequency ranges that many spacecraft use to communicate. In addition to data transference, AS-2 and the other NEN antennas provide constant telemetry, tracking and command for the spacecraft. They track a spacecraft’s location in space and facilitate sending commands from mission operations to the spacecraft.

In addition to being an important part of the NEN, AS-2 is a campus landmark. The blue base can be seen miles away. More importantly, ASF plays a large role in the university’s mission.

“The Alaska Satellite Facility rounds out the broad data and support the university provides,” said university Chancellor Daniel White. “This is a place where valuable scientific data are generated and downloaded. All of that is because of our partnerships.”

The NEN is located throughout the world. Network assets owned by NASA are located at Wallops Flight Facility in Virginia; McMurdo Ground Station in Antarctica; White Sands Complex in New Mexico; and owned by NASA, but operated by the university, is the Fairbanks facility. The NEN also contains commercially owned stations from Kongsberg Satellite Services, the South African National Space Agency, the Swedish Space Corporation and the U.S. Navy.

NASA’s Space Communications and Navigation program, part of the NASA Human Exploration and Operations mission directorate at the agency’s headquarters, is responsible for all of NASA’s space communication activities. The NEN is managed, operated and maintained at NASA’s Goddard Space Flight Center. Team members are located at Goddard and Wallops.

Above: AS-2, NASA’s newest communications antenna, is located at the University of Alaska Fairbanks.

Photo credits: NASA/Goddard
**January**

**NOAA’s GOES-16 Satellite Sends First Images to Earth:** GOES-16, the first spacecraft in the National Oceanic and Atmospheric Administration’s next-generation of geostationary satellites, sent back the first high-resolution images from its Advanced Baseline Imager instrument. Included among them are a composite color full-disk visible image of the Western Hemisphere, captured on Jan. 15.

**February**

**NASA Telescope Reveals Largest Batch of Earth-Size, Habitable-Zone Planets Around a Single Star:** NASA's Spitzer Space Telescope revealed the first known system of seven Earth-size planets around a single star. Three of these planets are firmly located in the habitable zone, the area around the parent star where a rocky planet is most likely to have liquid water.

**March**

**Sea Ice Extent Sinks to Record Lows at Both Poles:** Arctic sea ice appeared to have reached on March 7 a record low wintertime maximum extent. On March 3, on the opposite side of the planet, sea ice around Antarctica hit its lowest extent ever recorded by satellites at the end of summer in the Southern Hemisphere.

**April**

**A New Angle on Two Spiral Galaxies for Hubble’s 27th Birthday:** In celebration of the 27th anniversary of the launch of NASA's Hubble Space Telescope on April 24, 1990, astronomers used the legendary telescope to take a portrait of a stunning pair of spiral galaxies. This starry pair offers a glimpse of what our Milky Way galaxy would look like to an outside observer.

**May**

**Webb Telescope Completes Goddard Testing:** NASA’s James Webb Space Telescope successfully passed the “center of curvature” test, an important optical measurement of Webb’s fully assembled primary mirror prior to cryogenic testing, and the last test held at Goddard before the telescope was shipped to NASA’s Johnson Space Center in Houston for more testing.

**July**

**Goddard Dedicates Hyperwall to Late Climate Scientist, Astronaut:** On July 17, the NASA Center for Climate Simulation’s Data Visualization Theater, more commonly known as the hyperwall, was dedicated to Piers Sellers, a climate scientist and astronaut who passed away in December 2016.
MILESTONES AT A GLANCE

August

**Solar Eclipse Highlights:** On Aug. 21, 2017, all of North America was treated to an eclipse of the sun. Viewers worldwide were provided a wealth of images captured before, during and after the eclipse by 11 spacecraft, at least three NASA aircraft, more than 50 high-altitude balloons and the astronauts aboard the International Space Station.

September

**NASA Provides Coverage During a Busy Atlantic Hurricane Month:** NASA satellites provided continuous coverage of tropical cyclones around the world, and in September 2017 the tropical Atlantic Ocean was extremely busy, generating several hurricanes that made landfall in the United States. NASA's hurricane web page provided satellite data, images and animations on all storms around the world.

October

**NASA Missions Catch First Light From a Gravitational Wave Event:** For the first time, NASA scientists detected light tied to a gravitational wave event, thanks to two merging neutron stars in the galaxy NGC 4993, located about 130 million light-years from Earth in the constellation Hydra.

November

**Liftoff of Orbital ATK’s Antares Rocket From Wallops:** The Orbital ATK Antares rocket, with the Cygnus spacecraft aboard, lifted off on Nov. 12, 2017 from Wallops Flight Facility. Orbital ATK’s eighth contracted cargo resupply mission with NASA to the International Space Station delivered approximately 7,400 pounds of science and research, crew supplies and vehicle hardware to the orbiting laboratory and its crew.

**JPSS-1 to Provide More Accurate Environmental Forecasts:** The JPSS-1 satellite, developed and launched on behalf of the National Oceanic and Atmospheric Administration, will provide essential data for timely and accurate weather forecasts and for tracking environmental events such as forest fires and droughts.

December

**Goddard Named NASA’s Best Place to Work:** NASA was named the “Best Place to Work” among large agencies in the federal government for the sixth year in a row, and Goddard ranked No. 1 within NASA.

Compiled by Sara Blumberg
I have two offices, about 3,500 miles apart. I spend about six months a year at Goddard and the other six months at the University of Glasgow as an Ernest Rutherford Fellow, named after the father of nuclear physics. I am a solar physicist. I analyze data from the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) solar flare observatory and the Solar Dynamics Observatory mission teams to understand the physics behind solar flares, colossal releases of energy in the sun’s atmosphere.

I grew up in a small fishing village in County Down, Northern Ireland. My father had a fish processing plant, mostly herring and mackerel. When I was 13, I refused to cut my hair and was expelled from school. My parents sent me to an all-boys boarding school in Armagh in the middle of Northern Ireland. I hated boarding, so I was sent to a third high school, a technical school.

After high school, I took a year off to study recording engineering in Dublin. I played the drums. I don’t play much anymore, but I go to as many concerts as possible.

Then I went to work for my father for another three years. I drove forklifts and shoveled fish guts. It was here that I first learned to drive 18-wheelers and get my truck license. I continued truck driving while I was in college, which I still occasionally do on weekends to switch off from science.

I decided to go to Queen’s University, Belfast, and got a Ph.D. in astrophysics, specializing in solar flare physics. I didn’t even study physics in high school, but I always had a keen interest in astronomy and mathematics. My undergraduate adviser was a solar physicist, so he steered me toward the same. To me, the most interesting things about solar physics are large, explosive events.

I kept driving trucks all along, mainly semi-tractor trailers. Our 18-wheelers aren’t as big as those in the United States just because our roads are smaller, but they are as big as we can fit. University tuition was free and truck driving paid my rent and bills.

Beginning in 2004, during my postgraduate years, I worked at Goddard for two to three months at a time for Peter Gallagher, who is now at Trinity College, Dublin. Goddard awarded me a postdoctoral fellowship to work for Brian Dennis, the project scientist for RHESSI at Goddard. I got to lead my own research and present my work all over the world and ended up staying at Goddard for four years. I moved back home to Belfast for three years and continued my research at Queen’s University. Around 2012, I was awarded my own research funding through NASA grants. That’s when I began dividing my time between Belfast and Goddard.

When I am back in Belfast, I still occasionally drive trucks to relax. Truck driving occupies a different part of your brain than academia and science. When you’re on the highway, you’re listening to music. You are trying to fit a large rig into tight spaces. It’s a nice escape.

This year, trucks came back into my life. I’ve come full circle. In early 2017, Peter Gallagher began building a radio telescope, the Low-Frequency Array (LOFAR) radio telescope, in the middle of Ireland, in a pretty small town called Birr. He called and asked me to help transport some of the components from the Netherlands, where the components were being built, to Ireland.
The LOFAR telescope is a radio telescope with 196 separate antennae that detect radio waves from space and send the data to a supercomputer. The entire telescope, including the antennae, is about the size of a football field.

Transport was a mammoth production. I helped with the logistics and planning. We had 18 truckloads in total that came to Ireland at different times. Some arrived by sea and were picked up at the docks. The truck owner and I spent a week driving back and forth between the collection points in the Netherlands and the docks in Belgium collecting various containers.

The last shipment was the supercomputer that would gather all the data from the telescope – the only really delicate load. We had a special shipping container designed to house the servers and electronics for the telescope. It was a lot of pressure. I felt a great responsibility to ensure that this delicate, half-a-million-dollar piece of equipment arrived safely in Ireland on a 70-foot-long, 18-wheeled truck.

The truck owner and I took a boat from Dublin to Belgium, and then drove from Belgium to the Netherlands. The team in the Netherlands loaded the supercomputer, already in a self-contained unit, onto the flatbed of the truck and secured it with twist locks. Then we drove back to Belgium and then took the boat home to Ireland. We had a very tight deadline to catch the ferry. We were actually racing to catch the ferry. We made it with minutes to spare.

The telescope was built on the grounds of Birr Castle. In the 1850s, the biggest telescope in the world was at Birr Castle, so there is astronomical history on-site. Our 70-foot truck could not fit onto the castle’s two-mile, narrow driveway, so we had to negotiate tight, winding country lanes and park on an adjacent farm. The farm’s cows and sheep were staring at us while we were transferring the supercomputer onto a smaller truck that was able to navigate the roads leading onto the field at Birr Castle.

Being part of this project was an incredible experience. Sometimes scientific research can be a bit esoteric, but here we had built something tangible. There is now a brand new, state-of-the-art radio telescope operating at Birr Castle.

In September of this year, the sun became the most active it has been in more than a decade. The LOFAR telescope at Birr Castle captured many of these solar eruptions, which I am now studying.

Our entire trip was the subject of a BBC documentary called “Space Truckers,” which aired in the United Kingdom on Dec. 4.

My spirit of adventure probably comes from my mom. Born in New Zealand, she came to Ireland as a young woman. She loves animals. Her lifelong dream was to go to Africa to see elephants in the wild. She is now so taken with African wildlife that she goes on photo safaris to Tanzania every year. Last year, I went with her chasing a solar eclipse.

I still don’t know what I want to be when I grow up, but it will be fun finding out. And it will probably involve trucks. ■

Above (right): Ryan Milligan next to one of the truck-size LOFAR containers in Ireland.

Photos courtesy: Ryan Milligan
ENDING THE YEAR WITH HOLIDAY CHEER: PHOTOS
FROM THE SIXTH ANNUAL HOLIDAY OPEN HOUSE

Photo credits: NASA/Goddard/Bill Hrybyk
Allen Mirkadyrov has given nearly a decade of service to NASA's Goddard Space Flight Center. He got his engineering start at the U.S. Air Force Academy in Colorado Springs, Colorado, studying astronautical engineering. He then received his master’s degree in aerospace engineering from San Diego State University. From there, he spent more than five years at Wallops Flight Facility in Virginia as a space flight systems safety engineer and then transferred to Goddard to oversee the Goddard Telecommunications Networks and Technology Branch.

During Mirkadyrov’s time at NASA, he helped contribute to the future of human spaceflight through the Hawai‘i Space Exploration Analog and Simulation, or HI-SEAS, program. His particular mission was an eight-month expedition that studied how mission crews interact with each other and collect data that could be useful for future long-duration missions to Mars.

**How did you get selected for the HI-SEAS program?**

I learned about it in 2012. I actually saw it online, and I applied for the first crew. I wasn’t selected for the first one or the second one. I kept my profile active, and eventually they picked me for the third one.

The program initially picked eight people to go on a 10-day outdoor survival trip in Wyoming. This was the point of the program during which you meet your potential crewmates for the first time. I was in the military prior to all of this, so I’ve done several survival trainings in the past; this was nothing new.

**What was it like walking out of your habitat at the end of the mission?**

The fresh wind was something welcome because for eight months we breathed oxygen. We had breathable air, but we didn’t have any fresh air. It was surprising to see how you don’t appreciate these things until you get locked up.

The crew also experienced physical changes. Within about 30 to 35 minutes I got sunburned, as well as the rest of the crew. We were so deficient in vitamin D because we hadn’t seen the sun or basically got any of that vitamin; it really burned us up.

**What was it like leaving your position for almost a year?**

I had to get permission from my management at Wallops. Without their approval and their understanding of the importance of the study, this wouldn’t have been possible. I really appreciate my management for giving me the opportunity.

**What would you say to someone who wants to follow a similar path?**

Not everyone gets to become an astronaut. This year’s astronaut class had thousands of applicants, and NASA only selected 12. HI-SEAS is a way for people to help human spaceflight in other ways. That’s why I really encourage people to apply for this program.

My role models have always put an emphasis on education. Do as well as you can in school and don’t be afraid to ask questions. Keep going and reach new heights.

Mirkadyrov completed his HI-SEAS mission in 2015. Today, he oversees a portfolio of more than 30 telecommunications projects in his branch, which builds new communications technologies and monitors satellites in space.

When he’s not working or catching up with his HI-SEAS crewmates when they come to town, Mirkadyrov loves joining in on pickup games of volleyball or basketball. He follows professional basketball and is also looking forward to the upcoming FIFA World Cup in 2018.

Center: Allen Mirkadyrov works on a project inside the HI-SEAS mission habitat.

Photo courtesy: Allen Mirkadyrov