National Aeronautics and Space Administration

Goddard View

Volume 10 Issue 2
February 2014

A BARREL OF FUN IN ANTARCTICA

www.nasa.gov

Goddard View

THE WEEKLY

NASA Video Recaps SDO's Year Four

The sun is always changing and NASA's Solar Dynamics Observatory is always watching. SDO's fourth year in orbit was no exception: NASA is releasing a movie of some of SDO's best sightings of the year, including massive solar explosions and giant sunspot shows. To see the video and more, click on the sun.

Technologies for Robotic Refueling

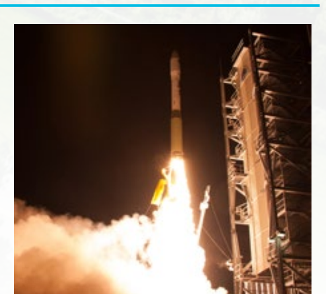
Building on the success of the ISS landmark Robotic Refueling Mission demonstration, the Remote Robotic Oxidizer Transfer Test is taking another step forward in NASA's ongoing development of satellite-servicing capabilities. Learn more and watch the video by clicking on the image.

GPM Status Update

GPM's Core Observatory has been installed into the fairing, the top part of the rocket that protects the spacecraft during launch. Starting at noon EST on Feb. 27, NASA scientists will discuss GPM's innovations and the GPM mission. Watch on NASA Television and ask experts your big questions using #gpm on Twitter.

New Range Safety Techn at Wallops

Range safety officers used the ORS-3 mission to carry out the first of three planned certification tests of a new technology that promises to eventually eliminate the need for expensive downrange tracking and command infrastructure to manually terminate rockets. Find out more by clicking on the photo.



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On the cover: A BARREL balloon is launched over Halley station to float above Antarctica and observe magnetic fields. Balloon Array for Radiation-belt Relativistic Electron Losses is a balloon-based Mission of Opportunity to augment the measurements of NASA's Van Allen Probes spacecraft.

Photo Credit: NASA/BARREL

GoddardView Info

Goddard View is an official publication of NASA's Goddard Space Flight Center. Goddard View showcases people and achievements in the Goddard community that support Goddard's mission to explore, discover and understand our dynamic universe. Goddard View is published by Goddard's Office of Communications.

You may submit contributions to the editor at john.m.putman@nasa.gov. Ideas for new stories are welcome but will be published as space allows. All submissions are subject to editing.

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A BARREL OF FUN IN ANTARCTICA

By: Rebecca Hudson

Researchers from Dartmouth College in Hanover, N.H., with the support of NASA balloon scientists, are having a BARREL of fun in Antarctica.

The Balloon Array for Radiation belt Relativistic Electron Losses, or BARREL, is a unique mission that hopes to unravel the mysteries of radiation belts surrounding Earth.

To study this radiation belt, BARREL uses small scientific balloons—20 of them—to launch over Antarctica. The balloon-borne instruments will gather data on magnetic systems and send that information back to scientists on the ground. This information helps scientists to understand the particles that escape the radiation belts around Earth.

The BARREL program is the NASA Balloon Program Office's first Living with a Star Announcement of Opportunity awardee. This program enables science teams to conduct their own remote balloon field campaigns.

This is the second time BARREL has taken to the skies over Antarctica in part of the "Living with a Star" program. BARREL conducted a successful 20-balloon campaign over Antarctica from December 2012 to February 2013.

This year's BARREL balloon campaign, with remaining flights planned, has already reached its comprehensive success requirements. The team has achieved more than 1,380 hours of observation time in the science field of interest.

NASA's Balloon Program Office, located at NASA's Wallops Flight Facility in Wallops Island, Va., provides programmatic support and management of the BARREL program. Prior to their two successful field campaigns, the BARREL team trained with Wallops and Columbia Scientific Balloon Facility teams to prepare them for the campaigns.

BARREL has a history with NASA's Balloon Program, as BARREL instrumentation hitched a ride—or piggybacked—on NASA's 7-million-cubic-foot Super Pressure Balloon.

NASA's Balloon Program routinely launches payloads in Antarctica aboard balloons that can be as large as 40 million cubic feet. The balloons used for the BARREL mission are much smaller, only 0.3 million cubic feet, but can reach similar altitudes of nearly 130,000 feet because the balloons carry far less suspended weight.

The NASA Balloon Program has a year full of large-scaled missions from Hawaii, New Mexico and Antarctica. ■

Above: Members of the BARREL team in Antarctica jump up and down in what they call the Low Wind Dance as they hope for the low wind conditions needed to launch another balloon. Photo credit: NASA/BARREL/Brett Anderson

> "...a capability we can leverage for future opportunities."

WASP GIVES NASA'S PLANETARY SCIENTISTS NEW OBSERVATION PLATFORM

By: Lori Keesey

Scientists who study Earth, the sun and stars have long used high-altitude scientific balloons to carry their telescopes far into the stratosphere for a better view of their targets. Not so much for planetary scientists. That's because they needed a highly stable, off-the-shelf-type system that could accurately point their instruments and then track planetary targets as they moved in the solar system. That device now exists.

NASA's Wallops Flight Facility in Wallops Island, Va., has designed a new pointing system—the Wallops Arc Second Pointer—that can point balloon-borne scientific instruments at targets with sub arc-second accuracy and stability. A planetary scientist—interested in finding less-expensive platforms for observing Jupiter and other extraterrestrial bodies—now plans to test drive the device later this year.

"Arc-second pointing is unbelievably precise," said David Stuchlik, the WASP project manager. "Some compare it to the ability to find and track an object that is the diameter of a dime from two miles away."

WASP is designed to be a highly flexible, standardized system capable of supporting many science payloads, Stuchlik added. Its development frees scientists, who in the past had to develop their own pointing systems, to instead focus on instrument development. Given the technology's potential, the WASP team has received NASA Science Mission Directorate funding to further enhance the new capability as a standard support system.

First tested in 2011 and then again in 2012, the most recent test flight occurred from Fort Sumner, N.M., in September 2013. During that flight, a 30-story balloon lifted an engineering test unit of the HyperSpectral Imager for Climate Science to an altitude of nearly 122,000 feet, far above the majority of Earth's atmosphere. From this vantage point, WASP precisely pointed HySICS so that it could measure Earth, the sun and the moon.

Developed by Greg Kopp of the University of Colorado's Laboratory for Atmospheric and Space Physics, the imager collected radiance data for nearly half of its eight-and-a-half hour flight, demonstrating improved techniques for future space-based radiance tests. Kopp now is preparing his imager for another balloon flight this September.

Also planned for September is the inaugural flight of the Observatory for Planetary Investigations from the Stratosphere—a notable event because so few planetary scientists have in the past employed less-expensive balloon craft to fly their instruments.

"Planetary scientists really haven't been involved in balloon payloads," said OPIS Principal Investigator Terry Hurford. "Planetary targets move with respect to the stars in the background. And because you need to track them to gather measurements, you need a system that can accurately point and then follow a target. These challenges are why planetary scientists haven't gotten into the balloon game."

For other scientific disciplines, the tolerances aren't as tight. The targets are either large, like the sun, or plentiful, like the stars, thereby making it much easier to target an object and then maintain a lock onto that object, Hurford said.

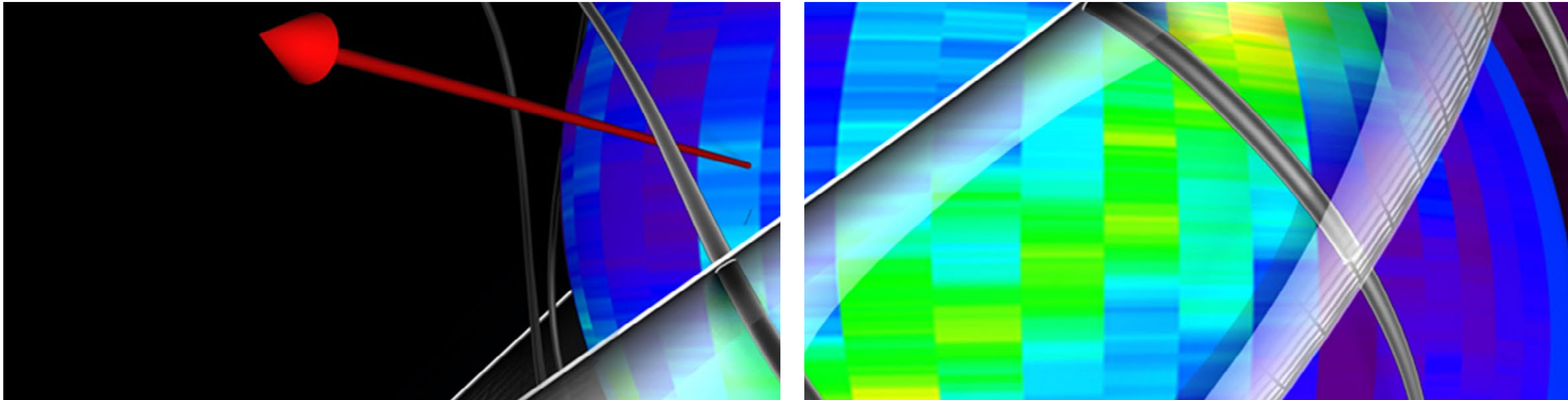
Now that Stuchlik and his team have proven WASP's effectiveness, Hurford wants to show that the system is equally as effective for planetary science when he flies his balloon-borne OPIS high above Earth's surface to study Jupiter and planets beyond the solar system.

He is using Goddard Internal Research and Development program funding to repurpose a telescope mirror originally built to calibrate the Goddard-developed Composite Infrared Spectrometer now flying on NASA's Cassini mission. He also is using NASA support to help upgrade WASP's existing avionics system to assure planetary tracking and expand its ability to follow targets above 25 degrees of elevation.

Like HySICS, OPIS will launch from Fort Sumner. Provided stratospheric winds cooperate, the mission is expected to last up to 24 hours during which Hurford plans to gather time measurements of Jupiter's atmospheric structure. His other objectives during his flight are to observe a transit of an extrasolar planet and the rotation of an asteroid.

"Time for planetary observations on ground-based observatories is difficult to obtain," Hurford said. "Moreover, high-altitude balloons above 95 percent of the Earth's atmosphere allow for observations in the ultraviolet- and infrared-wavelength bands, which aren't possible with ground-based telescopes. High-altitude balloons offer us a unique, low-cost platform to carry out our planetary observations. This effort provides us with a unique opportunity to build a capability that we can leverage for future opportunities. WASP gives us a new platform," he said. ■

Opposite: Principal Investigator Terry Hurford poses with a 21-inch-diameter mirror originally built to help calibrate the Cassini Composite Infrared Spectrometer. A CIRS team member found the mirror and Hurford is now repurposing it for the OPIS project. Photo credit: NASA/Goddard/Bill Hrybyk



IBEX PAINT PICTURE OF THE MAGNETIC SYSTEM BEYOND THE SOLAR WIND

By: Karen C. Fox

Understanding the region of interstellar space through which the solar system travels is no easy task. Interstellar space begins beyond the heliosphere, the bubble of charged particles surrounding the sun that reaches far beyond the outer planets.

Spacecraft data in the past five years from near Earth and cosmic ray observations have painted a better picture of the magnetic system that surrounds us, while at the same time raising new questions. Scientists are challenging our current understanding in a new study that combines observations of massively energetic cosmic ray particles streaming in from elsewhere in the Milky Way along with observations from NASA's Interstellar Boundary Explorer.

The data sets show a magnetic field that is nearly perpendicular to the motion of our solar system through the galaxy. In addition to shedding light on our cosmic neighborhood, the results offer an explanation for a old mystery on why we measure more incoming high-energy cosmic rays on one side of the sun than on the other. The research appears in the Feb. 13, 2014, issue of Science Express.

"It's a fascinating time," said Nathan Schwadron, of the University of New Hampshire in Durham and first author on the paper. "Fifty years ago, we were making the first measurements of the solar wind and understanding the nature of what was just beyond near-Earth space. Now, a whole new realm of science is opening up as we try to understand the physics all the way outside the heliosphere." The heliosphere is formed as the constant stream of particles from the sun's solar wind flows outward in all directions until it slows down to balance the pressure from the interstellar wind. The only information gathered directly from the heart of this complex boundary region is from NASA's Voyager mission. Voyager 1 entered the boundary region in 2004, passing beyond the termination shock where the solar wind abruptly slows down. Voyager 1 crossed into interstellar space in 2012.

IBEX, which orbits Earth, studies these regions from afar. The spacecraft detects energetic neutral atoms that form from interactions at the heliosphere's boundaries – an area that holds fascinating clues to what lies beyond. These interactions are dominated by electromagnetic forces. The incoming particles from the galaxy are made up of negatively-charged electrons, positively-charged atoms called ions, neutral particles and dust. Charged particles are forced to travel along the magnetic field lines that snake throughout space. Sometimes, a charged particle collides with a neutral atom at the outskirts of the heliosphere and captures an electron from the neutral atom. After stealing the electron, the charged particle becomes electrically neutral and speeds off in a straight line. Some of these fast neutral particles stream into the inner solar system and reach IBEX's detectors. Depending on the speed and direction of those neutral particles, scientists can determine information about the atoms and magnetic field lines involved in the original collision.

In 2009, IBEX scientists presented research showing an uneven distribution of neutral atoms. There was a ribbon along the heliospheric boundaries sending a preponderance of neutral atoms toward IBEX.

Researchers wondered if this shape might also relate to an unevenness seen in cosmic rays. On Earth, we measure more cosmic rays—particles that stream in from the rest of the galaxy at 99 percent the speed of light—coming in from near the tail side of the heliosphere than from the other side. Teasing out the source and paths of incoming cosmic rays isn't easy as the rays gyrate around magnetic field lines both inside and outside our heliosphere before colliding with other particles in Earth's atmosphere, giving a shower of secondary particles that, in turn, are what we detect. To complicate things further, the heliosphere is moving through the galaxy.

"At some level, it's like trying to determine the wind direction when you're riding a bike very quickly and the wind isn't particularly strong," said Eric Christian, the IBEX project scientist at NASA Goddard and a co-author on the paper. "There's some effect from the wind, but it's small and hard to measure."

To see if the IBEX data related to the cosmic ray observations, Schwadron used IBEX data to build a computer model of what the interplanetary magnetic field would look like around the heliosphere. Without the heliosphere, the field lines would be straight and parallel.

"But the heliosphere is kind of like an egg sitting in the middle of all these magnetic field lines," said Schwadron. "The field lines have to distort themselves around that."

With this model in hand, Schwadron simulated how the heliosphere would affect the cosmic rays. The simulations showed a non-uniform distribution of cosmic ray particles that jibed well with the unevenness seen in observations.

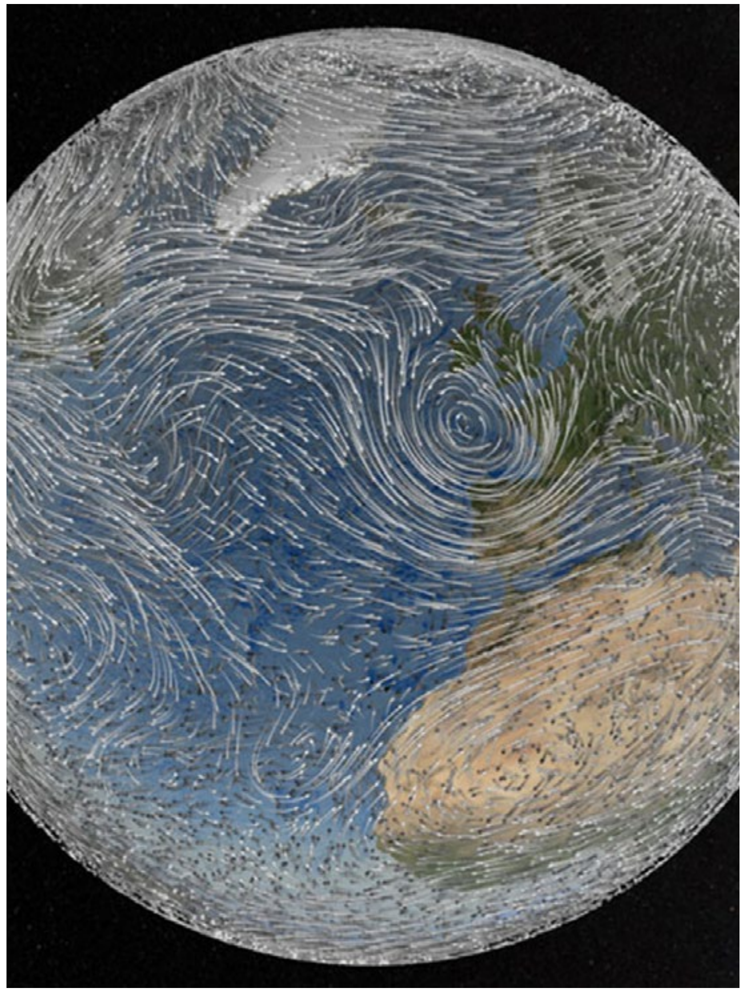
The agreement between what's seen in the cosmic ray data and by IBEX provides outside confirmation of IBEX's results of what the magnetic fields outside our heliosphere look like. That's an interesting piece of the puzzle, when compared with Voyager 1's measurements, because the Voyager 1 data provide a different direction for the magnetic fields just outside our heliosphere.

This doesn't mean that one set of data is wrong and one is right. Voyager 1 is taking measurements directly, gathering data at a specific time and place; IBEX gathers information averaged over great distances, so, there is room for discrepancy. Indeed, that discrepancy can be used as a clue. Understand why there's a difference between the two measurements and we gain additional information. More IBEX observations and more Voyager observations will keep coming in. As with all research, more data will help unravel the picture and soon we will learn even more about how we fit into the rest of the universe. ■

A model of the interstellar magnetic fields warping around the outside of our heliosphere, based on data from IBEX. The red arrow shows the direction in which the solar system moves through the galaxy. Image credit: NASA/IBEX/UNH. For more images, click on the image above.

SVS WINS FIRST IN VIDEO CONTEST

By: Patrick Lynch



The data visualization studio at NASA's Goddard Space Flight Center in Greenbelt, Md., was awarded first place for its video entry in a visualization challenge sponsored by the journal Science and the National Science Foundation.

The winning entry was created by the Scientific Visualization Studio to show how the particles from solar storms bombard Earth and how the sun's heat energy drives Earth's climate and weather. It won first place in the video category in the 2013 International Science and Engineering Visualization Challenge.

The visualization was created for a movie called "Dynamic Earth," a full-length planetarium film produced by Thomas Lucas and narrated by actor Liam Neeson. The film is showing around the world to an estimated viewership of 500,000 people.

While the full movie highlights many aspects of Earth's complexity, the contribution from the SVS depicts the vast scale of the sun's influence on Earth, from the flowing particles of the solar wind and the fury of coronal mass ejections to the winds and currents driven by the solar heating of the atmosphere and ocean.

"Moving through these flows gives the viewer a sense of grandeur in the order and chaos exhibited by these dynamic systems," said Horace Mitchell, director of the Scientific Visualization Studio.

The visualization represents a high point in the SVS's work in recent years to visualize flows—ocean currents, winds, and the movement of glaciers and ice sheets. By using lines and arrows to represent velocities of water, air and ice—and in the case of "Dynamic Earth," the solar wind—the SVS visualizers were able to produce a new way to envision these unseen forces.

"Usually we visualize things like temperature in the ocean or clouds in the sky. You see these things change, but that's not really visualizing the flow. That's visualizing something reacting to the flow," Mitchell said. "You can't really see currents in the ocean. But in your mind's eye you can picture how the currents would move as arrows or lines. And that's what we developed."

SVS visualizers Greg Shirah, Tom Bridgman and Horace Mitchell created the winning visualization, with assistance from Lori Perkins, Cindy Starr, Ernest Wright, Trent Schindler and Stuart Snodgrass. The elements of the four-minute segment were chosen in collaboration with Dynamic Earth writer and producer Thomas Lucas.

In showing the solar wind, atmospheric winds and ocean currents, the SVS relied on three modeling efforts that NASA leads or takes part in.

For the solar wind, the visualizers used data from the Community Coordinated Modeling Center at Goddard, a multi-agency partnership focused on improving our understanding of space weather.

To show Earth's winds, the visualizers relied on data from the Modern Era Retrospective Reanalysis, an effort based at Goddard to combine more than 30 years of satellite observations and modeling into a unified data set. And for ocean currents, the visualizers used data from the ECCO-2 modeling effort, a partnership between NASA's Jet Propulsion Laboratory in Pasadena, Calif., and Massachusetts Institute of Technology.

Mitchell credits the advancement of models such as these for allowing the data visualizers to push the boundaries of what they can create.

"They are so professional now," Mitchell said, "that you can get these amazing effects out of them." ■

Above: Part of the film "Dynamic Earth," this video won first place in the video category of the 2013 International Science and Engineering Visualization Challenge, sponsored by the journal Science and the National Science Foundation. Click the image to watch the video. Image Credit: NASA/Goddard

EXPLORING LEADERSHIP: DR. HECTOR DE J. RUIZ

By: Jacqueline Lofton

Dr. Hector de Jesus Ruiz is an engineer, corporate strategist and former chief executive of Advanced Micro Devices. He is the founder and chairman of Advanced Nanotechnology Solutions, Inc. Ruiz's advises governments, individuals and corporations globally on technology initiatives and on strategy fulfillment. Ruiz is the author of "Slingshot: AMD's Fight to Free an Industry from the Ruthless Grip of Intel." The book is a story of survival and a modern retelling of David vs. Goliath. On February 20, 2014, Dr. Ruiz spoke at Goddard at an Exploring Leadership colloquium.

Ruiz's discussion drew from his leadership journey from a small town in Mexico to industry leadership at the global level. Dr. Ruiz discussed how he was thrown into things that he thought he could not do or handle. He said he became an "accidental CEO" of AMD. He dreamed of becoming a mechanic but instead he became the CEO of a Fortune 500 company. Every decision that he made was a result of how he grew up.

As a kid, Ruiz was amazed when he looked through a friend's telescope and could see the rings of Saturn. He has always had close ties to NASA through friends that work at NASA. When he became the chief executive of AMD, he took his employees on field trips to NASA's Kennedy Space Center and Houston Space Center to learn more about NASA and the industry in general.

Ruiz discussed his leadership philosophy and what led him to file a lawsuit against Intel business practices. The historic battle against Intel was deeply rooted in Ruiz's beliefs that fair competition is the only true source of transformational innovation. Dr. Ruiz recruited a team of strategists and industry leaders to develop strategies based on top-quality technology and unique alliances to help AMD succeed in the microchip industry that its competitor Intel had on lock down because of, according to Ruiz, its unfair business practices.

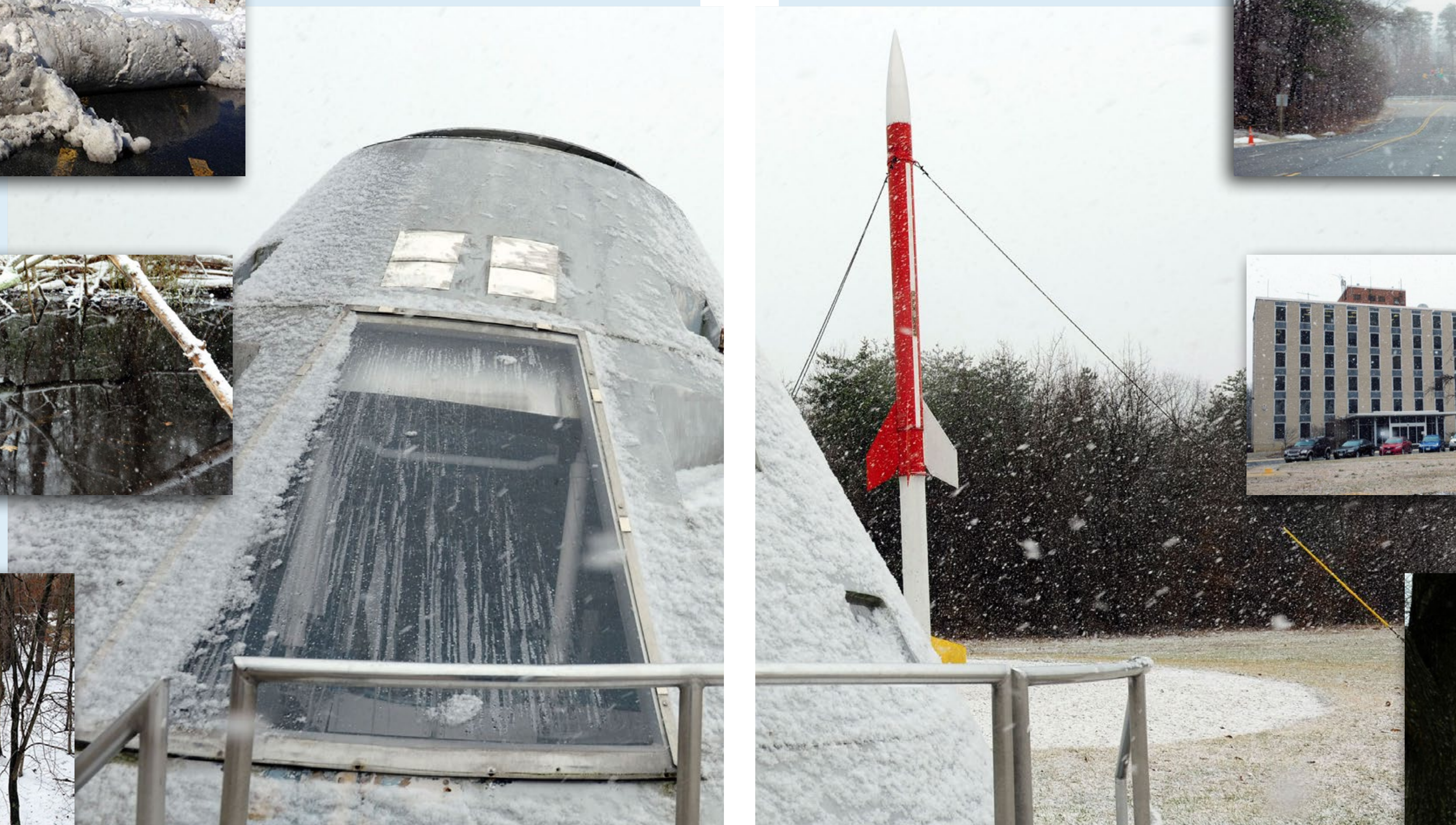
Intel had made it nearly impossible for customers to use competitors' microchips. Ruiz and AMD (David) battled against Intel (Goliath) in a rivalry that had been building for about a decade because to Intel's business practices. In November 2009, Intel agreed to pay AMD $1.25 billion to resolve all outstanding litigations and to move forward as competitors. Ruiz noted that it was one thing for Intel to play hardball but another thing to play spitball, unacceptable and unfair business practices.

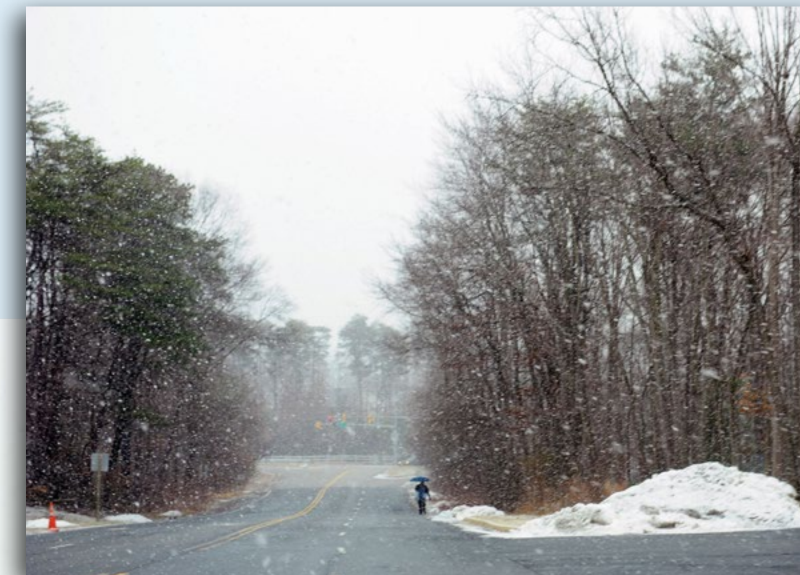
Ruiz concluded his discussion by showing the essence of what fair, open and transparent competition means to an industry. "It's anyone's game to win," he said. Ruiz discussed that one needs to formulate partnerships where it is a win-win situation, fostering transformational innovations that lead to better technological developments for everyone. ■

Photo credit: NASA

GODDARD GETS SNOWED

Photos by Debora McCallum and Quynh-Loan Pham





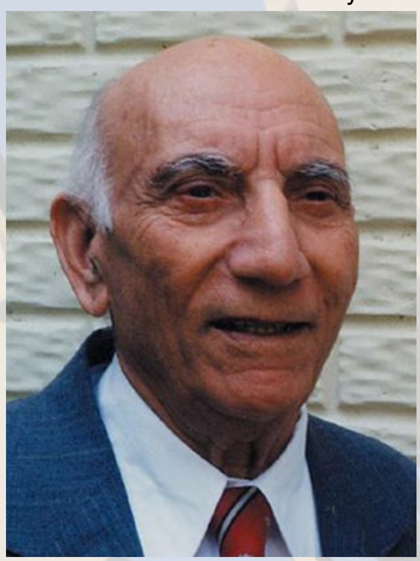
In Memoriam

Abolghassem Ghaffari

Renowned scientist Dr. Abolghassem Ghaffari, who had taught at Harvard and Princeton Universities, passed away in November of 2013 in Los Angeles, Calif. He was 106 years old. In the early part of his career, he was Albert Einstein's colleague at the Institute for Advanced Study at Princeton University under the direction of J. Robert Oppenheimer. On October 12, he was honored at Harvard University for his lifetime achievements.

Born in Tehran in 1907, Ghaffari was educated at Darolfonoun School in Tehran. In 1929, he went to France and studied mathematics and physics at Nancy University. After obtaining post-graduate diplomas in physics, astronomy, and higher analysis, he obtained in 1936 his doctorate from the Sorbonne (Doctor of Sciences with "Mention tres honorable") for basic research on Mathematical Study of Brownian Motion.

Dr. Ghaffari lectured as a research associate at King's College (London University), where he received his Ph.D. from the Mathematics Department on the "Velocity-Correction Factors and the Hodograph Method in Gas Dynamics." As a Fulbright Scholar, he worked at Harvard University as a research associate to lecture on differential equations and to continue his research on gas dynamics.



He was a research associate in mathematics at Princeton University and at the Institute for Advanced Study, where he worked in the early 1950s with Albert Einstein on the Unified Field Theory of Gravitation and Electromagnetism. J. Robert Oppenheimer, who headed the U.S. atom bomb program during World War II, was director of the Institute at the time and interviewed Ghaffari before the latter became a member of the Institute. Oppenheimer later befriended Ghaffari.

Ghaffari has lectured as a professor of mathematics at American University in Washington, D.C. and at Tehran University, where he joined the Faculty of Sciences and was appointed full professor of higher analysis from 1941 to 1956.

In 1956, Ghaffari moved permanently to the U.S. to take a position as a senior mathematician at the National Bureau of Standards. Part of his work there involved calculations of the motion of artificial satellites.

In 1964, three years into the manned space program, he joined NASA Goddard as an aerospace scientist. He studied the mathematical aspects of different optimization techniques involved in Earth-moon trajectory problems and different analytical methods for multiple midcourse maneuvers in interplanetary guidance. He later investigated the effects of solar radiation pressure on the radio astronomy explorer satellite booms as well as the effects of general relativity on the orbits of artificial Earth satellites.

He was awarded in Iran the Imperial Orders of the late Mohammad Reza Shah Pahlavi, and the U.S. Special Apollo Achievement award (1969) at a White House ceremony with President Nixon. He has published more than 50 papers on Pure and Applied Mathematics in American, British, French, and Persian periodicals. In addition to two textbooks, he is author of the mathematical book "The Hodograph Method in Gas Dynamics."
In 2005, Ghaffari received the Distinguished Scholar award from the Association of Professors and Scholars of Iranian Heritage at UCLA. In 2007, he received a proclamation from former Beverly Hills mayor and current Goodwill Ambassador Jimmy Delshad acknowledging his numerous lifetime achievements. Spirit of Noted Achievers at Harvard University also recently appointed him as a Hall of Fame inductee.

Ghaffari was also a past member of the Iranian National Commission of UNESCO. He was a Fellow of the New York Academy of Sciences, the Washington Academy of Sciences and the American Association for the Advancement of Sciences and a member of the London Mathematical Society, the American Mathematical Society, the Mathematical Association of America and the American Astronomical Society.

Ghaffari is survived by his wife, Mitra, and his two daughters, Ida and Vida. He is interred at Pierce Brothers Valhalla Memorial Park in Burbank, California.

Center: Dr. Abolghassem Ghaffari. Photo provided by Vida Ghaffari