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# MEMORANDUM

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Date: January 24, 2017

To: The Honorable Chair and Members  
Pima County Board of Supervisors

From: C.H. Huckelberry  
County Administrator

A handwritten signature in black ink, appearing to read "CH Huckelberry", is written over the printed name and title.

Re: ***BizTucson*** Winter 2017 Article on World View and the Emerging Space Industry  
Employment Cluster in Pima County

The attached article discusses World View, as well as the recently completed Spaceport Tucson owned by Pima County.

As the Board of Supervisors knows, the County recently completed the world headquarters and manufacturing facility for World View. The building has been turned over to World View; and they anticipate a more extensive opening in February and, quite likely, the first launch from Spaceport Tucson during the same time period.

Based on continuing interest expressed by space-related companies, Tucson is becoming a major attractor for space-related industry expansion and relocation. The University of Arizona's involvement with OSIRIS-Rex and other NASA-related space missions, World View, Vector Space and Raytheon establish a new and emerging space-related employment sector within Pima County.

The newest space-related employers, World View and Vector Space, are located on property acquired by Pima County to buffer Raytheon from residential urban encroachment. The County works closely with Raytheon to ensure that any employer located within this specific area is fully compatible with Raytheon. Raytheon welcomed both World View and Vector Space with their plans to locate in the County-acquired Aerospace Research Campus. The County acquired 382 acres in 2012 to buffer Raytheon, which were added to 103 acres acquired decades ago to form what now comprises the 485-acre Aerospace Research Campus. Our economic development agreements with World View and Vector Space indicate that of the County's original investment of \$5.9 million, \$3.1 million has been or will be recovered through lease payments of both World View and Vector Space. However, their combined facilities comprise only 27 acres of the County-owned property within the Aerospace Research Campus. Therefore, the County will recover 53 percent of our investment by utilizing only 5.5 percent of the land area acquired.

The Honorable Chair and Members, Pima County Board of Supervisors  
Re: ***BizTucson* Winter 2017 Article on World View and the Emerging Space Industry  
Employment Cluster in Pima County**  
January 24, 2017  
Page 2

The Board's decision to acquire this residentially-zoned property to prevent unwise urban encroachment on Raytheon has already paid huge economic development dividends in high-tech employment expansion of up to 3,000 new employees, substantial payback of our original investment, and an emerging world reputation as a space employment center.

CHH/anc

Attachment

c: Dr. John Moffatt, Director, Economic Development  
Patrick Cavanaugh, Deputy Director, Economic Development

# Biz Tucson

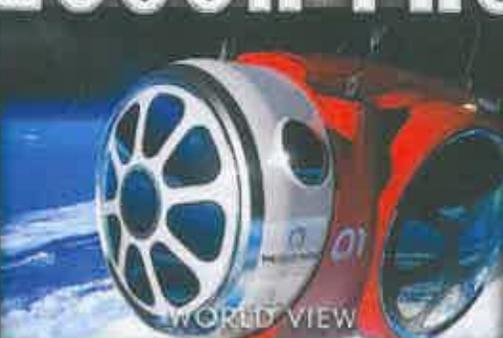
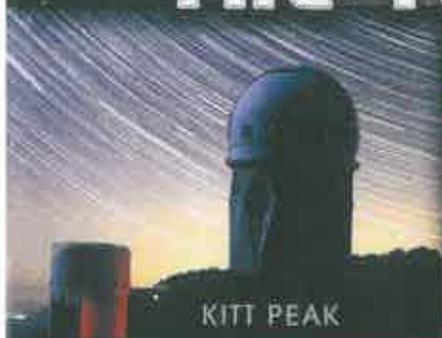
WINTER 2017

THE REGION'S BUSINESS MAGAZINE



# SPACE

## THE TUCSON FRONTIER



+ MAJOR EXPANSION FOR RAYTHEON - 2,000 NEW HIGH WAGE JOBS

SPECIAL REPORTS:  
& Tucson Metro Chamber  
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# The New Frontier

## Space Industry Takes Off

By Eric Swedlund

What began on a far-flung edge of the University of Arizona campus a century ago has grown into one of Tucson's signature industries with a burst of fresh momentum over the past year set to propel the region even further.

Space, which has captured the human imagination since the first stargazers turned their eyes to the night sky, is a massive economic engine in Southern Arizona with a rich history of scientific discovery that not only continues as strong as ever in the 21st century, but has branched into a robust and growing slate of private businesses.

The dry, clear air that first attracted pioneering astronomer Andrew Ellicott Douglass gave Arizona a natural advantage at the turn of the 20th century with the establishment of Lowell Observatory near Flagstaff. Then in 1916, Douglass, by then a UA professor, secured one of the most forward-thinking investments in Tucson's history, a \$60,000 donation from Oracle philanthropist Lavinia Steward, to build a world-class observatory.

"We have the best location of any educational institution in America. The

University ought to make itself famous with a telescope," wrote Douglass as part of his determined effort to establish a campus observatory.

Fast-forward 100 years and the development of space and planetary science as a key economic engine has positioned Tucson and Pima County to leverage the region's strengths – innovation, education, entrepreneurialism and a critical mass of existing companies – to expand its reputation as a global leader and accelerate growth in the private sector.

Today, that once far-flung corner of campus has blossomed into one of the nation's most consistent academic partners for NASA missions, playing a role in nearly every planetary exploration mission the space agency has undertaken since its formation in 1958. And as the private space industry has grown, officials with the city, state and county have collaborated with industry leaders to establish the Pima County Aerospace, Defense and Technology Business and Research Park south of the city to enable expansion of current companies and attract next-generation businesses.

*continued on page 48 >>>*



Frank Borman



Mark Kelly



Ron Garan



Charles Walker



James McDivitt

## Tucson's Astronauts

**Frank Borman** - Born in Gary, Ind. and raised in Tucson. Graduated from Tucson High School and the U.S. Military Academy, West Point. Was the commander of the first space flight to orbit the moon on Apollo 8 in 1968. Lives in Las Cruces, N.M. (PHOTO COURTESY OF NASA)

**Mark Kelly** - One of only two astronauts to go to the International Space Station four times. Commanded the last flight of the Space Shuttle Endeavour. Lives in Tucson and is married to former Congresswoman Gabrielle Giffords. Is director of flight crew operations for World View Enterprises. (PHOTO COURTESY OF NASA)

**Ron Garan** - Completed 2,842 Earth orbits and more than 178 days in space. Flew on the Space Shuttle and the Russian Soyuz spacecraft. Currently lives in Tucson and is the chief pilot for World View Enterprises. (PHOTO COURTESY OF NASA)

**Charles Walker** - Flew three Space Shuttle missions as a payload specialist in 1984 and 1985. Also was responsible for training astronaut crews in earlier shuttle flights. Is retired and living in Tucson. (PHOTO COURTESY OF NASA)

**James McDivitt** - Was commander of the Apollo 9 mission which was the first to take the lunar module to the moon's orbit. Also was on Gemini 4, which orbited the earth 66 times in June 1965. Now spends his retirement in Tucson and Michigan. (PHOTO COURTESY OF NASA)

### Background Image

M31 is a spiral galaxy very similar in size and mass to our own. Image Courtesy National Optical Astronomy Observatory/Association of Universities for Research in Astronomy/National Science Foundation

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## Expanding in 2016

Though closely tied to its predecessors - aviation, defense and aerospace - commercial space technology is a relatively new industry, and several of Tucson's strategic advantages are aligned to accelerate its expansion as the sector grows.

Collectively, aerospace, defense and optics already are serious business in Southern Arizona. That foundation becomes more significant as regional leaders work to both lure companies and nurture homegrown startups in the emerging space technology sector, said Alex Rodriguez, Southern Arizona VP of the Arizona Technology Council.

"Because of the actions of Pima County and the collaboration and interest from the City of Tucson, Sun Corridor and others, Arizona has a presence and functional economic base in the commercial space-tech market," Rodriguez said. "That has assured that Arizona is now being looked at as a strong contender for new entrants or to attract other players that are in the marketplace already."

Progress in 2016 began with the Pima County Board of Supervisors voting in January to establish the \$14.5 million, 120,000-square-foot Spaceport Tucson, leased to World View Enterprises, to anchor the Pima County Aerospace, Defense and Technology Business and Research Park. Then, in October, Vector Space Systems made an attention-grabbing announcement that its headquarters and manufacturing will be located in Tucson.

"We experienced a historic first here in Tucson, with Vector Space Systems taking their Vector-H rocket right down the middle of Congress Street downtown," Rodriguez said. "That sight has since become a symbolic point of departure for what's next in the regional economy. Aerospace has been a significant contributor and factor to our Southern Arizona economy since the old hangars were built at the Tucson airport.

"Bring that forward to today and we've come a long way. There's no question there's a strong positive upside in helping land both World View and now Vector Space Systems here. In effect, by taking those steps, it assured that Arizona joined the commercial space tech market."

**Creating Space for Space**

Planning for the county's aerospace research park began after Raytheon selected Huntsville, Ala., over Tucson for an expansion plant in 2010. Giving Raytheon and other large-scale high-tech manufacturers enough room to operate became a crucial goal, said John Moffatt, director of the Pima County Economic Development Office.

With his own aerospace background starting as a programmer working on the Apollo missions in the 1960s, Moffatt had seen how large-scale technology programs do wonders for regional economic development.

"They're long-term investments," he said. "The thing that I learned is this is an industry that is inclusive. There are so many moving parts, there are lots of subcontractors and it's a collection of specialties."

To give Raytheon room to grow and establish the Aerospace, Defense and Technology Business and Research Park, the county developed a master plan - with the input of the City of Tucson, Tucson Airport Authority, Arizona Air National Guard and others. The Pima Association of Governments funded the relocation of Hughes Access Road to create a buffer zone for Raytheon and begin planning to widen and extend the Aerospace Parkway. Securing the headquarters of World View and Vector is a direct result of those moves.

"Part of this is looking forward, having a plan and executing. Everything is a theory until reality shows up," Moffatt said. "The concept of this being aerospace-based was ours. We kept focusing on finding companies that fit that. The key to this is you have to break the ice. We're very fortunate the first two were home runs."

Over 10 years, Moffatt anticipates World View and Vector will have a combined \$5 billion economic impact on Tucson.

"I've lived in Tucson my whole life and I've never seen more momentum and more of the community working together," he said. "The cooperation that's going on regionally is unprecedented."

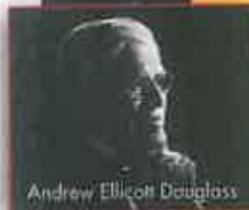
Becoming a hotbed for the commercial space sector means extending Arizona's reputation as a "national treasure" when it comes to astronomy and optics, Rodriguez said. Just as dark-sky policies served to enable development in the state's observatories, creating the research park can help push the envelope on what's to come.

"By design, it's a research park whose vision is built around serving the needs of the companies that co-locate here. In essence, Arizona as a state is providing a disruptive and transformative model for the companies that are doing that themselves," Rodriguez said. "Any of these companies could become the next Lockheed Martin or the next Intel in a different industry sector. That's what's important. We are helping enhance what is an open-ended frontier. That is really a visionary paradigm shift in Arizona's approach to economic development."

Vector's arrival shows outside businesses, venture capitalists and potential startups that Tucson is actively promoting the industry, supportive and ready to expand, said Ken Sunshine, co-founder and CFO of Vector.

"What Tucson can expect to see with Vector is just the

*continued on page 51 >>>*



Andrew Ellicott Douglass

**1906**

University of Arizona professor Andrew Ellicott Douglass begins astronomical research using an 8-inch telescope borrowed from Harvard University.

**1916**

Douglass persuades philanthropist Lavinia Steward of Oracle to donate \$60,000 to fund a UA observatory.

**1923**

Steward Observatory is officially dedicated on April 23, with a 36-inch telescope that was moved to Kitt Peak in 1963 and is still in use today.

**1942**

Consolidated Vultee Aircraft builds three hangars at the then-new Tucson airport to modify B-24 bombers for World War II.

**1951**

Hughes Aircraft Co. builds a missile plant in Tucson, which in 1997 was acquired by Raytheon Missile Systems.

**1955**

Aden B. Meinel of the Yerkes Observatory at the University of Chicago selects Kitt Peak, about 50 miles southwest of Tucson, for a national observatory. Meinel is later named the founding director of Kitt Peak National Observatory.



Aden B. Meinel

**1960**

The UA recruits famed astronomer Gerard P. Kuiper to establish the Lunar and Planetary Laboratory. Kuiper's groundbreaking photographic Lunar Atlas published later that year became a crucial guide in NASA's preparations to send a manned mission to the moon.



Gerard P. Kuiper

**1964**

With Kuiper as the mission's lead scientist, NASA's Ranger 7 spacecraft becomes the first U.S. spacecraft to reach the moon, returning unprecedented high-resolution images of the lunar surface used to prepare the Apollo missions. (Photo: Ranger 7 Spacecraft Model - Photograph number: A-2988b; image credit: NASA/JPL-Caltech)



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From left  
Taber MacCallum & Jane Poynter  
CTO & CEO of World View Enterprises  
Ron Garan  
Chief Pilot, World View Enterprises

PHOTO: BRENT G. MATHIS



A World View  
Enterprises stratosphere  
on the launch runway



World View Enterprises  
Capsule on runway

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tip of the iceberg. It's going to be more and more attractive for companies to come here," he said. "Now is the time for us all to prove we can do what we said we can do. It's a great time to be in the space business."

**SpacePort Tucson**

For Jane Poynter and Taber MacCallum, CEO and CTO of World View Enterprises, Tucson was a natural place to launch their new business, yet ultimately factors beyond their already-established connections here were the most significant.

Both original crewmembers of Biosphere 2, Poynter and MacCallum knew they could leverage the region's advantages for their new firm, which is designed around launching scientific instruments into the stratosphere using balloons, with plans for a space tourism component as well.

World View conducted a nationwide search before selecting Tucson, so it's not by accident or out of a sense of familiarity that the company's headquarters are here. For an analogy of Tucson's current potential in space technology, MacCallum points to Austin, Texas, at the dawn of the personal computer craze.

"It takes a whole bunch of stars to align for a community to become attractive to these kinds of things," MacCallum said. "Austin was really well-positioned to take advantage of that because of a strong university, state and local governments that were very business friendly, a smart workforce in the area, and a very attractive area to live in."

"Tucson is that exact same formula now. It's an amazing university for space, we have some of the best optics folks in the world here, and there's a great workforce that has its base with Raytheon and other aerospace firms in the area."

Advancing technology and a decreasing emphasis for the federal space program have combined to open the door for private companies to launch rockets, putting satellites, and potentially people, into space.

"We're seeing now a huge growth in this market. Thirty years ago, it was government doing major projects in space," Poynter said. "Not only has technology improved to the point it doesn't take huge programs to do these things, there's an incredible market surge with people addressing markets in completely different ways."

Poynter describes World View as a "flight services company," offering its high-altitude balloons - or "Stratolites" - to carry a payload into the stratosphere. That payload, which can be sensors, telescopes, communications arrays or other scientific instruments, can be positioned for months on end over a targeted area. Weather monitoring, storm detection, remote communications and emergency assessment are but a few of the applications World View anticipates. Just as the internet has permeated daily life, Poynter sees the Stratolites as having such a myriad of applications as to be ubiquitous.

"Every day we seem to see new uses for this that we hadn't thought of, which is very exciting," Poynter said.

Operating out of SpacePort Tucson, World View is an early entrant into an emerging industry that may come to

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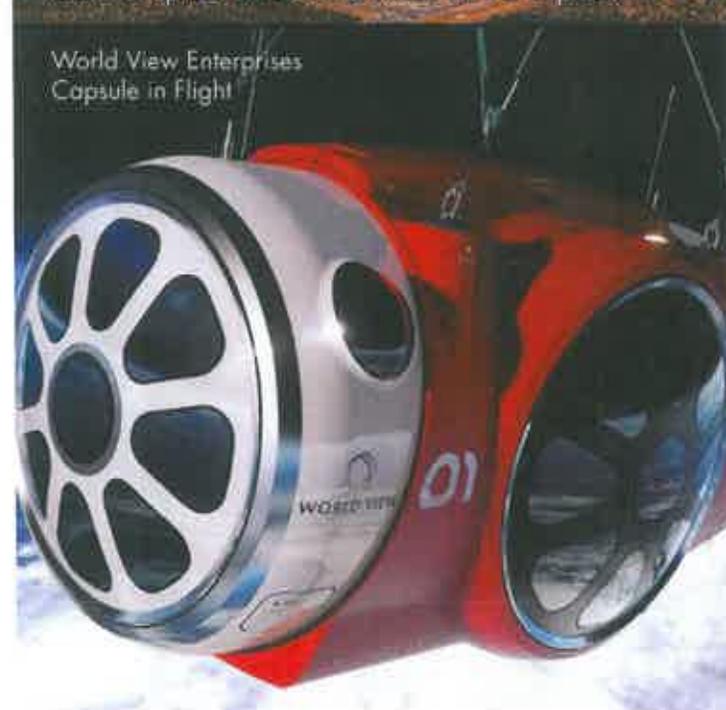
PHOTOS: COURTESY WORLD VIEW ENTERPRISES



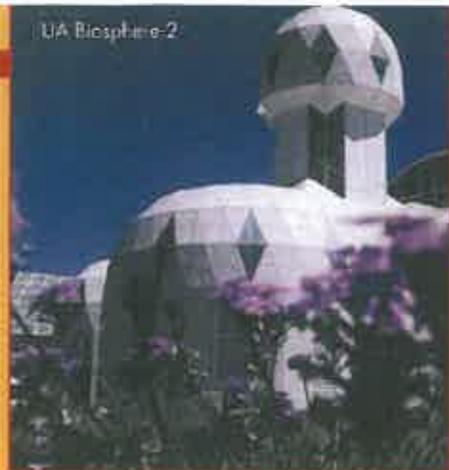
World View Enterprises  
Stratolite & Capsule  
in Flight



Aerial of SpacePort Tucson & World View Enterprises



World View Enterprises  
Capsule in Flight



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**1964**

Meinel becomes founding director of the UA Optical Sciences Center, later to become the College of Optical Sciences.

**1972**

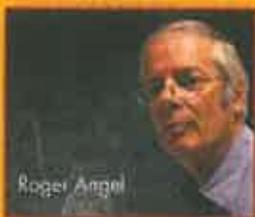
The Planetary Science Institute is founded. The private, nonprofit research institute is dedicated to solar system exploration, and PSI scientists have been involved with numerous NASA and international missions.

**1976**

Learjet opens a manufacturing plant at Tucson International Airport. When Bombardier Aerospace purchases Learjet in 1990, the Montreal-based company begins expanding the local facility.

**1979**

Meinel's breakthrough Multiple Mirror Telescope begins making observations from Mount Hopkins south of Tucson.



Roger Angel

**1985**

The Steward Observatory Mirror Laboratory begins work under the east wing of Arizona Stadium on the UA campus.

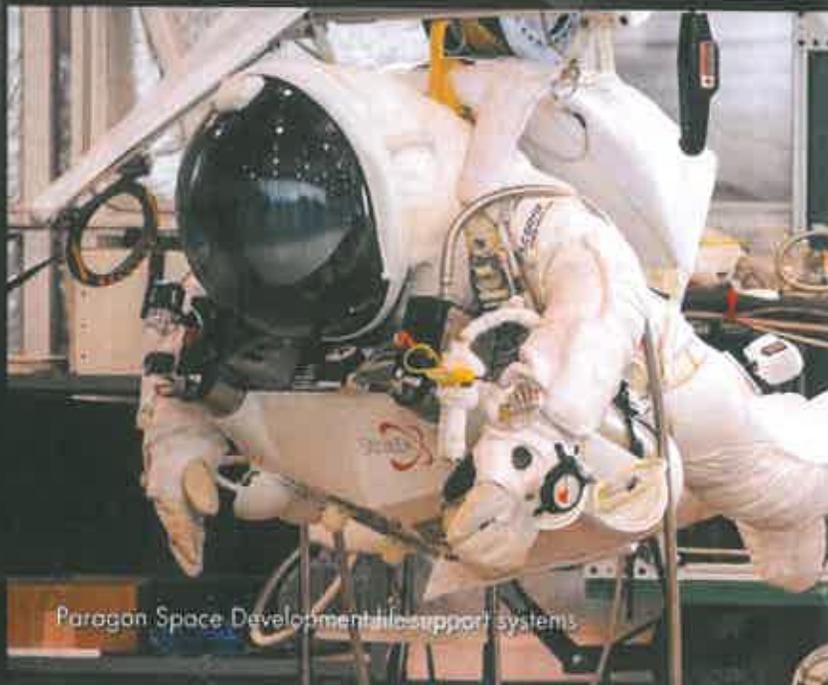
The lab continues the pioneering work of Roger Angel, whose backyard kiln experiments with borosilicate glass established a new method of building large, lightweight mirrors.

**1991**

Biosphere 2 launches its first mission. Intended as a prototype for off-Earth colonies, the 3.15-acre terrarium near Oracle captures the world's attention when a crew of eight is sealed inside.



Paragon Space Development IWP



Paragon Space Development life support systems

*continued from page 51*

define the region for years to come.

"For every state that really drives into this industry, it's been a huge boom. It's a field that is truly untapped. The sky is not the limit. We can grow very rapidly in Arizona," Poynter said. "It takes a long time to really nurture the kind of ecosystem that's thriving here. I have great expectations for the space industry. It's hit an inflection point and you'll see it take off in a big way in Tucson."

**Paragon Helped Set the Stage**

When Paragon Space Development Corporation began in Tucson in 1993, the International Space Station was still five years away from launching its first phase. But the Paragon founders anticipated that life-support systems would be a crucial component of the next generation of space exploration.

"We recognized that there are biologists and chemists and there are aerospace engineers and they don't necessarily all talk the same language. The concept was to bridge that gap," said Grant Anderson, Paragon CEO, president and co-founder. "There's no capsule that's ever been designed for humans that didn't include a life-support system. We felt like the industry would move toward longer and longer duration missions and the solutions would be different than say Apollo. When you start talking months instead of days, it's a different problem."

Fast forward to 2016, and the company's long-developed expertise paid off with a new NASA contract for the full-scale development of Paragon's patented Ionomer-membrane Water Processor System to be demonstrated on the International Space Station. The contract is part of the continuing refinement and development of Paragon's long-duration water recovery technology.

Paragon's IWP system is designed to improve water recovery from the astronaut's urine up to 98 percent, from the current level of 65 to 75 percent. Launching water into space is expensive – about \$10,000 for every kilogram – so Paragon's system can ultimately save NASA one launch per year. The IWP will be deployed to the ISS in the third or fourth quarter of 2017.

"NASA wanted to close the loop more," Anderson said. "There's a better way to process water that's more efficient and simpler."

Having anticipated the growth of private space technology companies, Paragon began working with Elon Musk even before he founded SpaceX. "We saw that the commercial companies were eventually going to become more self-sustaining and not just rely on government work. The evolution has been decades in the making," Anderson said. "We are consistently providing hardware to the commercial as well as the government side of it."

With close ties to others in Tucson's space technology community – World View is a Paragon spin-off company and Vector CEO Jim Cantrell is a former Paragon board member – Paragon is an example of how cornerstone companies can create an environment for greater expansion in the industry.

"It's exciting to see concentration of space companies happening here in Tucson," Anderson said. "It's a good melding of the university and the industry here and the lo-

*continued on page 55 >>>*

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**1993**

Paragon Space Development Corporation is founded by a group of Biospherians and space scientists to design and build life support systems for extreme and hazardous environments.

**2000**

The UA's Controlled Environment Agriculture Center begins operating its computer-controlled greenhouse. The center operates a prototype Lunar Greenhouse in collaboration with NASA and the South Pole Food Growth Chamber to provide crops for researchers stationed on the Antarctic Plateau.

**2005**

The Large Binocular Telescope on Mount Graham begins operation using the first of its two 8.4-meter mirrors. The LBT is among the world's most advanced optical telescopes.

**2006**

Aboard the Mars Reconnaissance Orbiter, the HiRISE camera captures its first images from Martian orbit. Led by the UA's Alfred McEwen, HiRISE is the largest and most advanced camera used on any deep space mission to date.

**2008**

The Phoenix Mars lander successfully touches down on the Red Planet on May 25. It is the first NASA mission led by a public university, with the UA's Peter Smith serving as principal investigator.

**2011**

After three flyby passes, NASA's MESSENGER probe becomes the first to orbit Mercury. It was a long-awaited return to the planet for the UA's Robert Strom, the only scientist to serve on both NASA missions to Mercury.

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**2014**

With a donation of \$20 million from the founder and chairman of Interface Inc., the UA's mirror lab is renamed the Richard F. Caris Mirror Lab.

**2014**

The UA establishes the interdisciplinary Defense and Security Research Institute to expand partnerships and collaborations between the university and industry.

**2015**

Construction of the Large Synoptic Survey Telescope begins on Cerro Pachón ridge in north-central Chile. The LSST will be a wide-field survey telescope, with an 8.4-meter mirror built by the UA and a 3200 megapixel camera designed to map the entire visible sky every few nights.



**2016**

The OSIRIS-REx mission launches on Sept. 8, led by the UA, the \$800 million NASA-sponsored mission aims to return a sample of the carbonaceous asteroid Benu to Earth by 2023.

mission aims to return a sample of the carbonaceous asteroid Benu to Earth by 2023.



**2018**

Scheduled launch of the James Webb Space Telescope, which includes the Near Infrared Camera as its primary imager. Developed by a UA team led by Marcia Rieke, NIRCam will search in the infrared for galaxies that were among the earliest formed in the universe.

Developed by a UA team led by Marcia Rieke, NIRCam will search in the infrared for galaxies that were among the earliest formed in the universe.

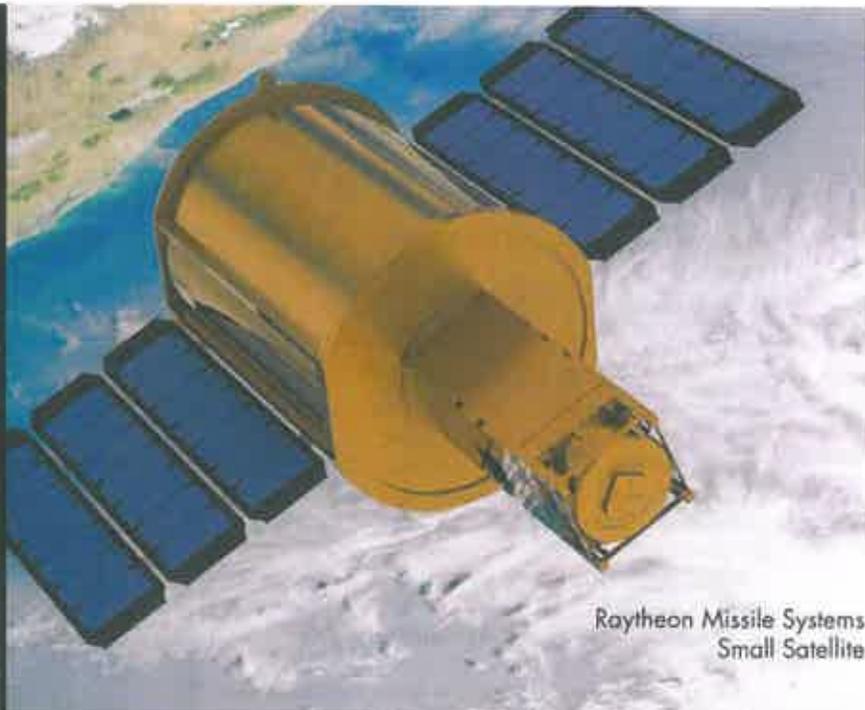


**2025**

Anticipated completion date for the Giant Magellan Telescope, which will feature seven 8.4-meter mirrors cast by the UA Steward Observatory's Richard F. Caris Mirror Lab. To be built at the Las Campanas Observatory in Chile, the GMT will have a resolving power 10 times greater than the Hubble Space Telescope.

To be built at the Las Campanas Observatory in Chile, the GMT will have a resolving power 10 times greater than the Hubble Space Telescope.

**Biz**



Raytheon Missile Systems  
Small Satellite



Raytheon Missile Systems  
Robotic Arm Moving  
Small Satellite



Raytheon Missile Systems  
Small Satellite  
Manufacturing

*continued from page 53*

cal governments have been cooperative. It's all come together."

**Raytheon Blends Defense and Space**

Even though its main business in Tucson exists in the defense sector, Raytheon's work reaches into the space technology realm. Currently the plant is under contract with the Defense Advanced Research Projects Agency in the U.S. Department of Defense to produce small satellites while also pursuing opportunities to potentially manufacture the company's own designs or produce "build to print" of other companies' designs.

"Raytheon is applying the experience and discipline with missile production - precision, size, mass production and affordability - to the development and production of small satellites," said Buck Larkin, business development lead for Raytheon's small satellite business. "We see multiple uses for this technology both in the government and commercial sectors."

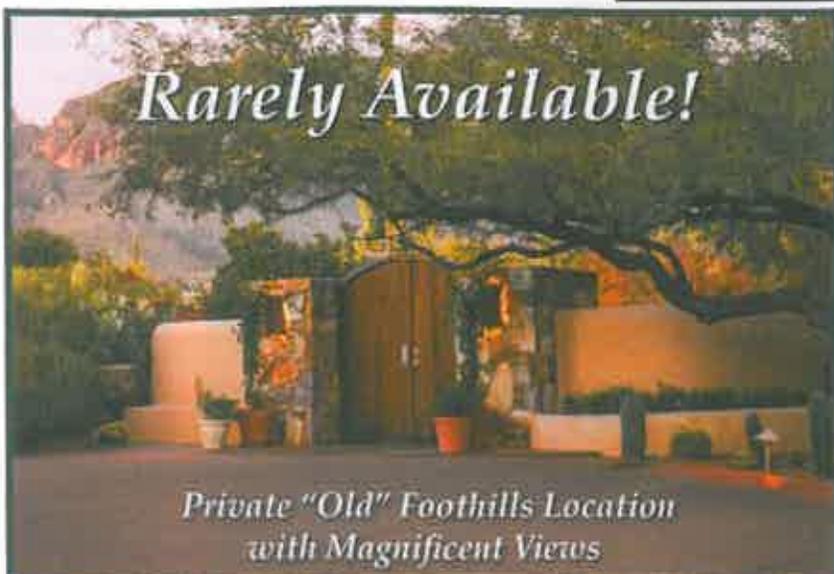
In 2015, Raytheon completed a 9,600-square foot, \$9.2 million expansion of its Space Systems Operations factory, where the company designs and manufactures its missile defense systems that are the first line against potential ballistic missile attacks. The company is the world leader in designing and building kill vehicles that travel into space to intercept enemy missiles.

Raytheon is working simultaneously on four kill vehicles. Guarding against intercontinental ballistic missiles, the Exoatmospheric Kill Vehicle is the intercept component of the Ground-Based Interceptor, while the Standard Missile-3 is a defensive weapon used by the U.S. Navy to destroy short- to intermediate-range ballistic missile threats.

Also in the design phase at Raytheon are two next-generation kill vehicles with improved reliability and greater cost effectiveness. The Redesigned Kill Vehicle will leverage Raytheon's expertise with the EKV to deliver a simpler replacement at a reduced cost, while the Multi-Object Kill Vehicle, as part of a 2015 contract, will use Raytheon's advances in sensor, guidance, propulsion and communication technologies to be able to destroy several objects in space.

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WJVA-TV 100.5/21

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### **Kitt Peak Remains Vital**

One lesson that Southern Arizona's astronomy legacy can offer for the expansion of industry is that crucial infrastructure, once established, can enable cutting-edge work for decades to come.

As Kitt Peak National Observatory nears its 60th year, it remains one of the world's premier sites for astronomy with 25 telescopes in operation, more than any other single site in the continental United States. Dozens of universities and research consortia around the world use the telescopes for research and education, while Kitt Peak's robust public outreach program is responsible for creating a steady "astro-tourism" presence in the state.

"This is an investment in a very special kind of infrastructure that's devoted to the attainment of knowledge and understanding of our place in the universe," said Kitt Peak Director Lori Allen. "It's an extremely valuable resource for the state."

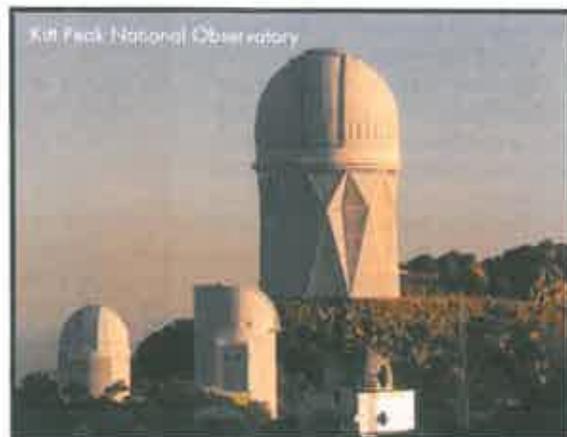
The two largest optical telescopes at Kitt Peak are being re-configured with new instruments for new projects to research dark energy and exoplanets.

The 4-meter Mayall Telescope, completed in 1973, will embark on a new Department-of-Energy-funded project to study dark energy, using an instrument called the dark energy spectroscopic instrument. Known as DESI, the instrument will create the most detailed three-dimensional map of the universe that's ever been made, conducting a five-year survey of the night sky to measure the red-shift of 30 million galaxies and quasars, yielding new information on the history and expansion of the universe and the role that dark energy plays.

"Telescopes are just big light buckets," Allen said. "The characteristics of telescopes themselves don't change much over the years. The basic function remains the same and what keeps them relevant is the modern instrumentation that's built to attach to these telescopes."

The 3.5-meter WIYN Telescope, completed in 1994, will add a new instrument commissioned by NASA to capture ground-based measurements of the velocities of stars that are hosting planetary systems. That data will join with NASA's Transiting Exoplanet Survey Satellite to study newly discovered exoplanets.

"We're very excited that we have these two cutting-edge instruments being built now for our telescopes to work on the two most exciting problems in astrophysics today, the role of dark energy and the existence of Earth-like planets orbiting other stars," Allen said.





Buell T. Jannuzi  
Director  
Steward Observatory

### Symbiotic Partners

Though questions surrounding the origins of the universe will remain on the minds of next-generation astronomers, UA has expanded its reach to industry over time to ensure a strong connection that has mutual benefits. Steward Observatory Director Buell T. Jannuzi said a long-standing refusal to be pigeonholed into existing boundaries gives UA scientists an innovative edge.

"Now we're in a new era where we're also doing applied astronomy, where some of the techniques have broader applications, so we're collaborating with industry," Jannuzi said. "There are times when industry wants to have access to the newest idea, the newest innovation, so they work with our faculty here. There are times when we're going to want the expertise of a major engineering firm, when we want to draw on their experience dealing with large construction projects, or manufacturing or engineering and design challenges."

Major NASA space exploration grants to the UA have not only brought millions upon millions of dollars to the local economy, but have also given students the opportunity to join in cutting-edge research even as undergraduates. That in turn has led to the UA attracting more top students to programs across the science, technology, engineering and math – STEM – fields.

"I'm just ecstatic for future university graduates," said Rodriguez of the Arizona Technology Council. "They'll have a huge sandbox of opportunities. That helps put our region on the global map and can lead to stronger attraction for other companies to locate here."

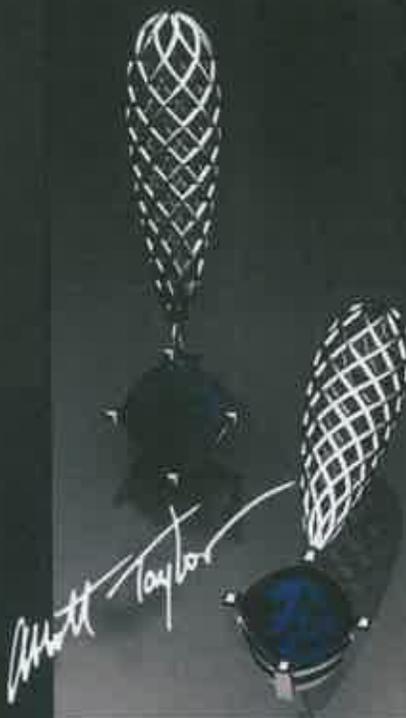
A well-educated, high-tech workforce then enables more innovation and exploration in the private sector, he said. "That ongoing ability to connect engineers at the university with engineers at private businesses has the same positive effect that the ecosystem itself lends to attract even more projects."

As long as there's support for cutting-edge research and taking some risks, the UA will continue tackling the most interesting and difficult scientific challenges, Jannuzi said.

"The details are unpredictable, but we have every reason to expect exciting and wonderful things based on past and present activity," he said. "The reason groups like World View choose to come here, I hope, is because they see potential partners with other industry and with the university by being located in Tucson."

"When you're part of an exciting, innovative community like Tucson is for space science, it attracts the best people. We're very excited by the companies wanting to come here. It's part of the bigger picture of Arizona influencing the next century of space exploration."

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