



VATICAN OBSERVATORY
FOUNDATION

2015 ANNUAL REPORT OF GIVING



President's Report

When Pope Leo XIII founded the Vatican Observatory in 1891, his goal was to show the world that the Church supports good science. The Vatican Observatory Foundation is your response to that mission: you support the Church as it supports good science.

Good science is the heart of our work. This past year, your contributions have first and foremost allowed Vatican astronomers to spend 80 nights at the Vatican Advanced Technology Telescope; they studied star clusters, near Earth objects, Trojan asteroids, exoplanets, and a survey of stars that look like our sun when it was young.

In January, we held our first Faith and Astronomy Workshop. Twenty five parish educators from the US and Mexico had a chance to visit our friends in the local scientific community, to see scientists at work. This included visits to The University of Arizona Mirror Lab, the headquarters of the OSIRIS-REX mission to an asteroid, and a tour of the Planetary Science Institute (with a special exhibit of space art by one of its founders, Bill Hartmann). They also got to see the stars themselves through telescopes set up under the dark desert skies.

In April we took a trip to Chile to see, close up, the telescopes around the Atacama Desert. The highlight was a visit to the Atacama Large Millimeter Array at an elevation of nearly 17,000 feet!

Our Catholic Astronomer blog is attracting a thousand hits a week. We have given a dozen talks in person or via the internet to high school students across the country. Through the Jesuit Virtual Learning Academy we've even taught a regular for-credit high school course on line. And Fr. Rich Boyle generously donated part of an observing run to give two high school astronomy classes time on our Vatican Advanced Technology Telescope (VATT) to image, and process, deep sky objects selected by the students.

But note, when I say "we" have done all these things, I really mean that you, the supporters of the Foundation, have done them. Your contributions made them possible; in many cases, your assistance helped make them happen. We all are the Church; we all are supporting, and doing, the science. As St. Paul says in the Letter to the Romans, since the beginning of time God has revealed Himself in the things he has made. When we do astronomy, we're paying attention to His revelation.

Br. Guy Consolmagno
President

Our Mission

The Vatican Observatory has a double-edged mission: scientific research into the knowledge of the universe, including our place in it, and the education of the public based upon the knowledge derived from that research. These two driving forces of our mission are very much intertwined. In 1987, the Vatican Observatory Foundation was established as a tax-exempt corporation to support this mission.

RESEARCH. In the early 1990s the marvels of technology and the commitment of a few visionary philanthropists made possible the creation of the Vatican Advanced Technology Telescope (VATT), which empowered scientists to look with more acute "eyes" into the universe. Today, the VATT continues to provide stunning access to the heavens for researchers from around the globe. Combined with other technologies and the continued commitment of Vatican Observatory scientists, our work is literally pushing the boundaries of what we know and how we know it. Joining in this research are many students of astronomy from around the world.

EDUCATION. Each year members of the Observatory staff share their expertise by making educational presentations on the average to over 5,000 persons from 90 educational, religious, and academic groups. In recent times Vatican Observatory scientists have played an increasingly important role in the dialogue between science and faith.

The Vatican celebrated the 80th Anniversary of the Vatican Observatory in Castel Gandolfo with an 80-cent stamp depicting Pius XI and the summer papal palace where he dedicated the facilities in 1935, and a 95-cent stamp that features Pope Francis with the Moon and the 1957 Schmidt telescope visited by Pope Paul VI during the Apollo 11 landing.



Chairman's Report

As I write this we have just celebrated the feast of Epiphany. As described in the Gospel of Matthew the Magi follow a star that leads them to the Christ child. Pope Benedict XVI, in his book "Jesus of Nazareth: The Infancy Narratives," states that the Magi were more than just astronomers driven onward by a celestial event.

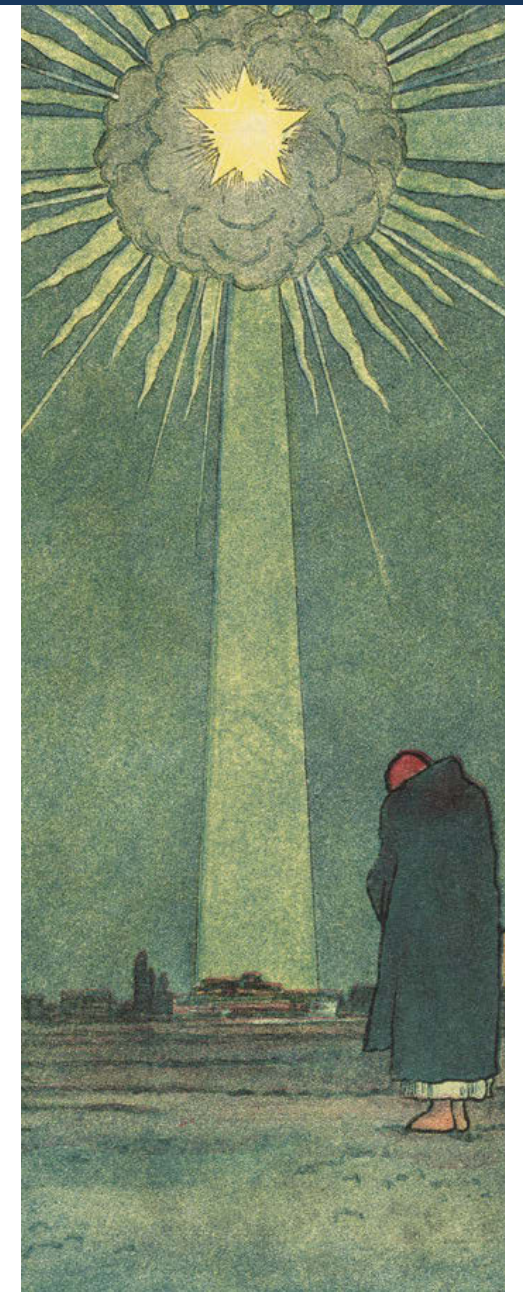
The wise men from the east are a new beginning... Not only do they represent the people who have found a way to Christ, they represent the inner aspiration of the human spirit, the dynamism of religion and human reason towards Him.

The astronomers of the Vatican Observatory continue this journey as they apply human reason in the search for truth, that is, the search for God. Humanity marveled at the vistas never before seen as the New Horizons robotic probe surveyed Pluto in July 2015. Br. Consolmagno published results on the asteroid Vesta using data from the Dawn robotic probe. Fr. Corbally is using high precision data from the Kepler spacecraft to understand the nature of young stars and pulsating stars, while the data analyzed by Br. Macke is being used to interpret the motions of spacecraft orbiting Mars and the Moon to measure their gravity fields. Fr. Omizzolo extends the quest to nearby clusters of galaxies 500 million light years away where he seeks to understand how gas and stars are stripped away from "Jellyfish galaxies," so called because they have tentacles of material streaming from the galaxy thus appearing like their namesake.

The Vatican Observatory is one of the few institutions where science and religion meet in constructive dialogue. I found myself in awe of the work of the Vatican Observatory when I first learned of the group fifteen years ago. The study of the universe by men of faith is fascinating on multiple levels, and I am honored to help guide the non-profit Vatican Observatory Foundation.

The Vatican Observatory Foundation was established in 1987 at the urging of Pope John Paul II in order to fund construction of the Vatican Advanced Technology Telescope to conduct leading edge research as well as to support education. The mission remains the same today and is made all the more relevant in a time when many misleadingly assert that religion and science are incompatible. In my view, the Vatican Observatory Foundation is a fascinating partnership between the Catholic Church, dedicated scientists, and benefactors who welcome the pursuit of knowledge and understand that the Heavens proclaim the

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The VOF has made every effort to ensure that all information is correct. If any errors or omissions are noted, we offer our apologies and ask that you notify us.

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Glory of the Creator. Our Board of Directors is committed to enhancing this community, and I am happy to present these pages to illustrate the important work taking place in the US and throughout the world.

In 2015 the Vatican Observatory achieved unique milestones in outreach to lovers of wisdom, young and old. Our new foray into social media, The Catholic Astronomer blog, saw five times more daily visitors in December than in February resulting in over 60,000 views for the year. The number of "Likes" on our Facebook page increased 50% to over 2100. Please share this page with your friends and see if we can get 5000 likes in 2016. Additionally, 30% of our donors were new in 2015. We thank you for being a part of this journey and becoming a part of this unique community. On behalf of the Board of Directors, I offer my profound gratitude to all who support the Vatican Observatory Foundation. Your support is paramount to the long-term viability of this vital endeavor. In these pages I hope you find insight, inspiration, and perhaps the same sense of awe I experienced the first time I met these Jesuit scientists over a decade ago.

Rich Friedrich
 Chairman

On-Going Educational Efforts



Br. Guy visited his hometown in the fall and spoke at Holy Family Regional School in Rochester Hills, Michigan.

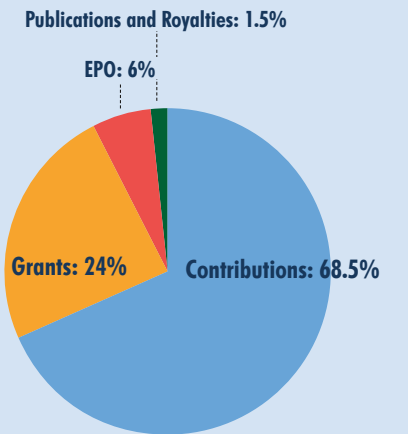


One of our High School Astronomy Program participants: The Astronomy Club from Mercy High School in Watertown, CT.

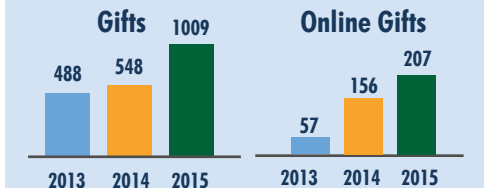
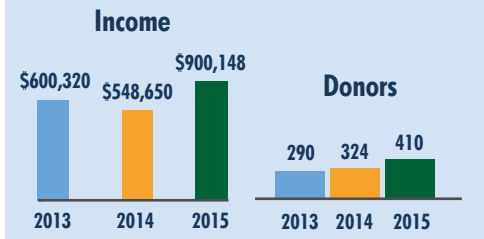
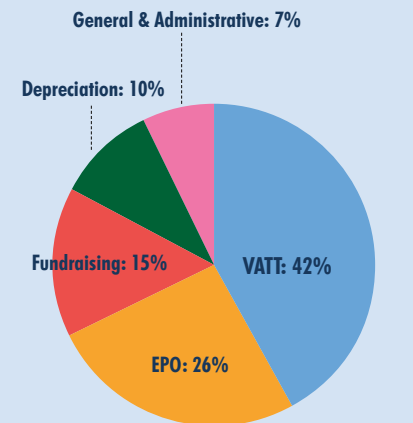


Rev. Jose G. Funes, S.J., Director of the Vatican Observatory, Archbishop Carlo Maria Viganò, Papal Nunzio to the United States, Br. Guy Consolmagno, S.J., President of the Vatican Observatory Foundation, our host Dr. Duilia de Mello, Physics Department, CUA, and Monsignor Mark Morozowich, SEOD, Acting Provost of CUA.

Income: \$900,148.00



Expenses: \$897,656.00





Development Report

2015 brought a few changes to the VOF. Perhaps the most significant was Pope Francis appointing Brother Guy as the next director of the observatory. This means he will be wearing two hats but rest assured that will not stop him from continuing to address groups all over the world telling our story.

The VOF outreach programs continued to thrive last year. At the new Faith and Astronomy Workshop parish educators spent 4 days in Tucson learning about astronomy, past and present, and how to share this information in their parish communities. Subscribers to the Catholic Astronomer blog have more than doubled during the past year with some articles reaching over 3000 readers. In 2015 several schools in our High School Astronomy Studies program collaborated with Fr. Richard Boyle using the VATT to create incredible astronomical photos of galaxies.

The annual Circles of Giving celebration was held in Tucson among the meteorites of the Drake Building. Dr. Mark Sykes, Director of the Planetary Science Institute, gave an amazing presentation with never before seen photos of Ceres from the NASA Dawn mission. The Annual Seminar a few weeks later in Washington, DC, was hosted by Catholic University in the presence of Archbishop Carlo Maria Vigano', Papal Nunzio to the United States.

The highlight of the year was the spectacular astronomy tour we had of Chile. Dr. Fernando Comeron, an alumnus of one of the first Vatican Observatory Summer Schools and ESO Representative, arranged for an outstanding experience. We visited magnificent telescopes, gazed at the Milky Way on desert mountaintops, cooked breakfast on geysers and we had our own personal oxygen tanks for the trek to ALMA. It was a once in a lifetime experience especially for those of us who were not astronomers.

The VATT and the Arizona Robotic Telescope Network

The Vatican Advanced Technology Telescope (VATT) or, more properly, the Alice P. Lennon Telescope and the Thomas J. Bannan Astrophysics Facility, is the keystone of Vatican Observatory's research infrastructure. The telescope's design was a pathfinder for new technologies. It is built around the very first prototype mirror made by Professor Roger Angel's team at the University of Arizona in the 1980s using a pioneering new method, called spin casting. It naturally produces parabolic mirrors (as opposed to the traditional block-ground spherical mirrors) with a new set of optical properties. Such "fast optics", as they are called, successfully tested at VATT, are now the basis of all of the world's largest telescopes.

VATT has allowed us to acquire valuable scientific data over the years but can it still be considered "advanced" in terms of its technology? We have upgraded VATT so that it can be operated remotely from UA campus (VOF Annual Report 2011), and we are now taking it further towards the future, with a general overhaul which will turn it into a fully autonomous unit (VOF Annual Report 2014).

Our effort has received generous support from the Papal Foundation as well as grants from the Dan Murphy Foundation and the Hearst Foundation. The work on VATT is carried out by University of Arizona's Steward Observatory who owns VATT's primary mirror, and has a 25% stake in VATT's operation. Steward is robotizing two other telescopes, the 61" Kuiper telescope on Mt Bigelow and the 90" Bok telescope on Kitt Peak. With VATT, they will form the Arizona Robotic Telescope Network (ARTN).

Remote operation has opened new possibilities and made VATT more attractive to observers but this comes at an extra cost: to ensure the safety of the equipment, the telescope needs human supervision on site. Fully autonomous operation will eliminate this need. What is more, robotic telescopes open a new realm of observational astronomy.

Everything flows, as Heraclitus said, but most astronomical changes are too slow to be perceptible on the timescales of a human lifetime. That is why few observing programs have studied them. Yet, many astrophysical phenomena are fast enough, provided that the astronomer acquires many brief glimpses of the same object separated by cleverly chosen time intervals. Such observing campaigns cover hundreds of objects per night in quick succession.

Human telescope operators and observers cannot keep up the high cadence of work typical of the nascent field of time-domain astronomy. This is going to be the realm of robots. The second unbeatable advantage of robots is networking. Two global robotic telescope networks are under construction, allowing one to observe a given object continuously, if needed, by identical telescopes strategically distributed longitudinally in both hemispheres.

ARTN will be one of the first (if not the first) facility to open another new path to knowledge, synoptic observations. With its three telescopes it will be capable of observing the same object at the same time with three different instruments, e.g., in three different wavelengths or with spectrographs and imagers. This may be the best way to characterize the physical properties of the surfaces of very small (< 100 ft.) and rapidly spinning asteroids as they rapidly fly by the Earth.

Last but not least, robotic operation will offer more flexibility to accommodate student work at the telescopes. Traditionally, telescope time was allocated to individual researchers for a whole night. During that single night, an observer did not share the facility with others. Queue scheduling in general, and robotic operation in particular, represents a much better use of the facilities. University of Arizona's "full-engagement initiative" towards its astronomy majors, involves them in research projects, including observing. The logistics have been difficult because undergraduates, with their other commitments, cannot be required to spend entire nights at the telescope. Under the old time allocation system, the facility is blocked for the whole night even though students use it only for a portion of that night. Robotic observing can also facilitate other educational and public engagement programs, notably with high schools and amateur groups where the time factor is an even greater constraint.

We are confident that by 2017, VATT and the ARTN will once again be at the forefront of astronomical technology, offering new research opportunities, as well as new ways to educate and engage the public in astronomy and science.

Paul Gabor, S.J., Ph.D.
Vice Director, Vatican Observatory

The technological advances being implemented at the VATT and the collaboration with the University of Arizona in the Arizona Robotic Telescope Network will assure years of excellent scientific research. None of this would be possible without the generosity of our friends. With so many individuals and foundations believing in our mission 2015 was a great year and with the advances on the telescope and the outreach programs the Vatican Observatory Foundation's future looks very bright. Thank you!

Katie Bannan Steinke
Development Director



The Kuiper Telescope atop Mt. Bigelow.



The Bok Telescope atop Kitt Peak.



The Kuiper Telescope at sunrise.



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INSIDE ✦ Annual Report 2015 ✦ *excelling in faith, education, and research*

The McCarthy-Stoeger Scholarship Awarded to Juan Nicolas Garavito Camargo



Photo by Frank Gacon

2014 Vatican Observatory Summer School (VOSS) student, Nico Garavito Camargo, was recently awarded the new scholarship that honors two late Vatican Observatory astronomers who continue to be sorely missed, Fr. Martin McCarthy, S.J., and Fr. Bill Stoeger, S.J. From his home country of Colombia Nico has moved to Tucson starting to work towards his graduate degree at Steward Observatory. His field of interest is Galaxy Formation and Evolution Theory. The scholarship is awarded by the Vatican Observatory and sponsored by the Jesuit Community in Tucson and Castel Gandolfo.



Nico at Bogota's Planetarium SpaceArt project building "exoplanets" with the children from the area's barrio.