



Department Report

INTRODUCTION

The summer was a busy time for the Adler Astronomy Department: Astronomy Conversations continued to draw large crowds in the SVL, the Adler hosted the annual VERITAS summer Collaboration Meeting, AstroScience Workshop was conducted, and a slew of grant requests went out. In addition summer represents prime conference season, with many interesting results presented.

This summer also represented an important milestone for the research endeavors of the department. Dr. David Steele, our first post-doctoral fellow, moved on to a position at the Los Alamos National Laboratory. David's arrival in the Astronomy department to focus on the VERITAS high energy gamma-ray project marked a significant advance for the research program at the Adler. His hard work over the ensuring five years raised the Adler's profile in the VERITAS Collaboration and brought a new sense of cohesion to the Adler's research efforts. Over the upcoming academic year we expect to welcome our fourth postdoc. We wish David the best in his future career.

continued on page 4



This photograph of the Waxing Gibbous Moon was compiled of 400 stacked video frames by Adler Astronomer Larry Ciupik and Adler Volunteer Jeff Wiedemann using the 6-inch Doane Observatory refractor. It shows the southern polar region of the Moon, target of the LCROSS impact mission.

Interview

JOSÉ FRANCISCO SALGADO, ASTRONOMER AND SCIENCE VISUALIZER



Dr. Salgado has been with the Adler for nine years. He is currently working on many projects at the Adler, including the Adler Video Suites and show production. The two suites, Gustav Holts's The Planets and Astronomical Pictures at an Exhibition, have achieved worldwide acclaim and have had him

traveling to such diverse places as Taipei and Prague. Dr. Salgado also provides astronomical visualizations for new Adler productions.

PF: Was there a pivotal moment that got you interested in astronomy?

JFS: When I was in third grade I found a book about the first man on the Moon that my dad owned and was instantly fascinated by the science as well as the technology involved in the lunar flights. I didn't even know the word "astronomy", but that did it for me. The movie *Star Wars (Episode IV, the first movie of the series)*, which was released around that time (1977), also played a role in my interest in studying the Universe.

PF: Your career has evolved quite a bit since you arrived at the Adler, how did it begin?

JFS: It has been a gradual evolution since adolescence that has taken rather significant steps in the past several years. In 1995 while doing my graduate work at the University of Michigan in Ann Arbor I discovered Photoshop and Illustrator. Back then, digital photography was in its infancy. Using these tools and my growing interest in the graphic arts, I could develop astronomy materials to teach and disseminate astronomy.

Thanks to that initial public outreach work I obtained a job at the Adler which has involved an exciting array of roles including: teaching courses (including my own graphics), working as a science advisor on projects, interacting with

continued on page 2

Interview: José Francisco Salgado, Astronomer

continued from page 1

the media, hosting Nuestra Galaxia, an Emmy-nominated Spanish language astronomy news segment on Univision, and producing two astronomy video suites to accompany classical music performances. The interesting thing about my professional work these days is that it involves disciplines that I considered as a career when I was young, photography and music.

PF: What is your inspiration for the video suites?

JFS: My passion, admiration, and respect for music and science. The selection, pacing and editing of the materials presented (many of them produced by very talented colleagues of mine) are my visual interpretation of what the music “tells me”. I don’t want to make the music and the visuals compete for the audience’s attention. I want them to reinforce each other in such a way that our senses don’t get overburdened.

PF: Tell us a bit more about the video suites tour.

JFS: Well, the response to the Planets and Pictures At An Exhibition has been amazing. With the video suites now an official “Special Project” of the International Year of Astronomy 2009, I’ve had a chance to represent and promote the Adler around the world: Paris, Torino, Taipei, Madrid, Venice, San Francisco, Prague etc. But no matter where I go, the public’s reaction to the beauty of astronomy is the same.



California Symphony Music Director Barry Jekowsky and José Francisco Salgado address questions from the audience after the West Coast premiere of the video suite *Gustav Holst’s The Planets* on 16 October 2007. Image credit: William McFarland

PF: Describe your typical day.

JFS: A typical day involves the following activities in varying different degrees: reading about astronomy and technology news, planning upcoming video suites concerts, editing or rendering visuals for new productions, interacting with my

colleagues and talking to visitors in the Space Visualization Lab (SVL). I tend to avoid meetings where I am not really needed. I prefer one-on-one work discussions than meetings on the bloated side.

PF: What is the best part of your job?

JFS: Seeing the expression of awe and amazement on a person’s face when they get exposed to the beauty of the Universe through visuals and then explaining the science to them. The experience is even more gratifying when the visuals are something that I have put together, such as ste-



Dr. Salgado retrieves a stereoscopic camera rig that was set up all night to produce a 3D time-lapse sequence of the Southern Celestial Pole and the Very Large Telescope. Cerro Paranal, Chile. Image credit: Laura Ventura

reoscopic photographs or a video suite movement.

PF: What is the worst part of your job?

JFS: The least fun is definitely filling up the electronic timesheet. This is not because of the chore itself but because I strongly dislike its graphical user interface. Also, I dislike going through so many emails where I have been copied but that really do not concern me.

PF: With all you Adler Video Suites travel, how many frequent flyer miles have you accumulated?

JFS: Let’s say that I could visit New Zealand three times with the miles I have accumulated. I am still flying coach though! 🌅

Project Notes

TOUCH THE SOLAR SYSTEM

Imagine that you could touch a piece of the Moon, Mars or the dwarf planet Vesta. What a thrill it would be to be able to personally connect with “what’s out there”. That is exactly what visitors to the Adler will be able to do when our new exhibit, Touch The Solar System, premieres in early 2010. Adler visitors won’t have to go to Mars to touch it – Mars will come to the Adler.

Going to Mars to collect rocks is a mission for NASA for another day. A day probably far in the future. So how will the Adler get a piece of Mars or any other world of the Solar System?



Above left, Howardite meteorite NWA 3117, a mix of shattered rocks possibly from the the asteroid Vesta. Above Right, Lunar meteorite NWA 5000, a feldspathic breccia, from the highlands of the Moon. Image credit: Craig Stillwell

Pieces of these other worlds fall to Earth frequently. The violent impact of a comet or asteroid into the surface of a planet like Mars is powerful enough to blast pieces off into space. The same thing can happen when asteroids collide. A rock launched into an independent orbit around the Sun most likely won’t hit the Earth immediately. Over thousands or millions of years, however, the gravitational pulls of the planets in our Solar System may change its orbit and cause it to crash into the Earth as a meteorite.

How do we know that piece of rock and metal originally came from Mars? Meteorites that fall to the Earth have different chemical compositions than the rocks surrounding them. Based on the chemical make-up of each meteorite, scientists can tell how far from the sun it came from. In addition, every planet has its own chemical composition. By comparing the chemical composition of the meteorite to the chemical compositions of planets, scientists can match the meteorite to its parent body.

Thanks to a \$97,000, 3-year NASA Education and Public Outreach grant, Dr. Mark Hammergren will be leading a multidisciplinary Adler team to design and implement the new Touch The Solar System exhibit. The exhibit will feature meteoritic samples of other worlds that visitors will be able to see and touch. Scientists at the Planetary Science Institute (PSI) in Tucson, Arizona will be working with us on the development of the text and graphics for the exhibit display panels as well as

for the videos. These scientists will also be on-screen experts in the video segments. In addition, PSI will advise on meteorite sample selection.


Touch The Solar System is a multi-sensory approach to experiencing meteorites. Combined with the opportunity to touch the meteorite, there will be video and audio displays with background information about the sample, as well as text panels. These displays will include information about what the meteorite is made of, where it is from, how it got to earth, where on earth it landed, the culture of the area it landed and what scientific studies were done on this meteorite. If the discoverer(s) is known and if it is possible, the discoverer(s) will also be interviewed. There will be animated segments that will portray the evolution and formation of the meteorite’s



A massive impact on the Earth or another planet produces a wave of ejecta. Some of this material will be launched into orbit around the Sun. Image credit: “Sixty Seconds after Impact of 10km Asteroid”. William K. Hartmann, March 1983.

home world. Visitors who desire even more information will be directed to websites where they can learn more about these worlds. Combining vision, touch and hearing will help bring alive the concept that meteorites are pieces of the Solar System here on Earth and helps make the connection to the Solar System outside of Earth more real.

Located in the Our Solar System gallery (next to Galileo’s Café) the exhibit will consist of a series of stand-alone kiosks, one for every meteorite sample. This will allow the exhibit to expand in an orderly manner as samples are obtained, as well as allow museums and other planetaria to use the design to fit their space and funding allowances.

Kiosks with Lunar and Martian samples will be on exhibit by early 2010, with planned samples of a basaltic specimen from Vesta (a dwarf planet and target of the Dawn spacecraft) and a carbonaceous chondrite coming later in the year. – Rivka R. S. Rosen, B.S. 

Department Report

continued from page 1

BROADENED AUDIENCE

Adler astronomers continue their very active outreach activities. The following is just a sampling of their recent efforts:

At the May 6 preview screening of the newest Star Trek movie at Navy Pier, Dr. Mark Hammergren hosted a Question and Answer session from the audience.

In May, Dr. Grace Wolf-Chase moderated a session on “Chaos and Emergence” at a student symposium held at the Zygon Center for Religion and Science.

Later in May, Dr. Wolf-Chase gave a Career Day presentation to 40 eighth grade students at Hill Middle School in Naperville.

On May 3 Dr. Michael Smutko participated in “Immerse Yourself: A College Symposium”, a day long outreach program hosted by Northwestern University for Chicago Public School high school students. The program gave students an opportunity to learn about college, sample college courses and find out about financial aid.

Over the past few months Dr. Smutko has hosted groups of grammar school children at Northwestern University for telescope viewings. With a combined total of over 160 children and chaperones, gathered for solar viewings.

In June Mr. Larry Ciupik a featured speaker at a career fair at Madero Middle School in Chicago.

In June, Dr. Wolf-Chase gave a “Lunch and Learn” presentation on Astrobiology at Commonwealth Edison (ComEd).

In July Dr. Smutko spoke to an audience of over 20 preschoolers at Northwest Suburban Montessori School about rockets and traveling to the Moon.

Mr. Ciupik was the guest astronomer at a Junior Science Café in Glen Ellyn in July.

Dr. José Francisco Salgado and Dr. Mark SubbaRao are continuing national and international presentations of the Adler Video Suites. Presentations have been made by the California, Boston and San Francisco Symphony Orchestras and in Madrid and Valencia, Spain and Prague, Czech Republic. There is a full schedule planned through the first half of 2010.

On August 29 Dr. Hammergren was the host of a live webcast from Bareket Observatory, Israel. The webcast was the observatory’s contribution to IYA2009.

Dr. Wolf-Chase contributed an article to Lutheran Partners, a publication of the Evangelical Lutheran Church of America. The article titled “Science and Faith in an Evolving Cosmos” will be published in the November/December 2009 issue.

PROJECT EXPLORATION

In July Dr. Hammergren participated Project Exploration Chi-

cago, Science Teacher Field Institute, at Lost In Time ranch in eastern Montana. Dr. Hammergren has been their the resident astronomer at the Field Institute since its inception in 2006.

The Science Teacher Field Institute is a professional development program for Chicago Public School teachers to promote leadership and excellence in science education. Each summer, the ten teachers in the program spend one week at the Lost in Time Ranch engaging in geology, paleontology and astronomy fieldwork with scientists.

On the evening that Dr. Hammergren gave his astronomy lecture, open to the public as well as to the Project Exploration participants, he was able to point out the International Space Station as it orbited overhead.

A surprising phenomenon occurred one evening. What appeared to be a line of cirrus clouds being illuminated by the



Northern Lights in eastern Montana. July 21, 2009, Lost in Time Ranch near Wibaux, Montana. Image credit: Mark Hammergren

sunset continued to brighten as twilight deepened revealing themselves as the Northern Lights. It is unusual for the Northern Lights to be so bright at the bottom of the solar activity cycle.

MEDIA INTERACTIONS

Interactions with the media are another important facet of our informal outreach efforts. Astronomy department members have had many interviews over the past few months:

Dr. Hammergren spoke with National Geographic Online about the Jupiter–Neptune conjunction occurring on May 27.

Mr. Ciupik gave an interview with the Daily Herald in July about the new spot on Jupiter and general space debris.

In July Dr. Salgado spoke with Univision, the Spanish language network about the Adler’s exhibits and shows.

Dr. Smutko gave a number of interviews about the 40th anniversary of the Apollo 11 Lunar Landing. These include Somerset Daily American, Chicago Tonight, Northwestern University’s radio/podcast series and Carleton Washburne Middle School.

Dr. Hammergren spoke with the Chicago Tribune and WBBM-AM radio about the annual Perseid meteor shower. The shower appears every year in mid August as the Earth passes through the dust trail of Comet Swift-Tuttle.

Mr. Ciupik also spoke about the Perseids for an Adler Night and Day podcast.

On August 20 Dr. Hammergren spoke with Popular Science answering a reader question "What would happen if you swallowed a teaspoon of white dwarf?" For the curious, the white dwarf material, weighing more than two tonnes, would punch a hole in your stomach and fall out.

Dr. Hammergren also spoke with National Geographic Online about how the ancient Egyptians used pre-dawn sightings of the star Sirius to set their calendars.

On August 26 Dr. Geza Gyuk spoke with National Geographic Online and once again helped debunk the "Mars Hoax". The Mars Hoax, a claim that Mars will appear as large as the moon, surfaces every few years in a viral email.

Dr. Gyuk also answered a selection of questions for Kids, Ink, a syndicated column based on questions from school children.

GRANTS

The Department received grants from both the National Science Foundation (NSF) and NASA in the past few months to increase both our research and education and public outreach goals.

Dr. Fortson received a 3-year, \$1.8 million grant from the NSF, "Zooniverse – Conquering the Data Flood with a Transformative Partnership between Citizen Science and Machine". This grant is under the NSF Cyber-Enable Discovery and Innovation initiative and will seek the help of the average citizen in mining the massive amounts of data collected on the Zooniverse.

Dr. SubbaRao and Ms. Carney received a 1-year, \$99,000 NASA Science Museums and Planetaria grant for their "Explore the Galaxy!" proposal. This grant will allow the Adler to research how visitors interact and learn in the Deep Space Adventure gallery. It will also develop allow the Adler to further develop their partnership with the Air Force Academy High School in Chicago.

OBSERVING

Dr. Karlsson spent 2 weeks in May and June in Arizona at the VERITAS site observing galactic and extragalactic sources of very high energy gamma-rays.

Mr. Ciupik spent 3 weeks in August in Arizona at the VERITAS site preparing the image quality systems for the next observing season.

CONFERENCES AND PRESENTATIONS

Astronomy department members have been meeting regularly

with their fellow scientists in the past few months:

May 6-8 was the Astronomy Visualization Workshop at the California Academy of Sciences attended by Drs. Roberts, Salgado and SubbaRao. Dr. Roberts' presentation was titled "Near Real-Time Interactive Data Visualization Systems", Dr. Salgado's increasingly popular "Astronomical Pictures at an Exhibition" were a featured ticketed option, and Dr. SubbaRao gave a presentation showing data from the Sloan Digital Sky Survey using Sky-Skan's DigitalSky software.

On May 7 the Adler hosted the annual Women in Space Science Event. Dr. Wolf-Chase hosted Dr. Heidi Hammel, the recipient of the 2009 Women in Space Science award.

June 15-18, the Adler hosted the VERITAS collaboration meeting. Attending were Drs. Fortson, Grube, Gyuk, Karlsson, Steele and Mr. Ciupik.

In early July Dr. Niklas Karlsson attended the TeV Particle Astrophysics 2009 conference at Stanford University in California where he presented the VERITAS results on M82.

In July, Dr. Smutko attended the Ninth Biennial Notre Dame History of Astronomy Workshop at the University of Notre Dame (Indiana). There he presented an invited talk titled "Un-Twinkling the Stars".

Also in July, Mr. Ciupik attended the International Planetarium Society's Council meeting in Toulouse, France.

Wrapping up the month of July, Dr. Gyuk was in Sante Fe, New Mexico for three weeks for the annual Cosmology Workshop.

In August Dr. SubbaRao attended the inaugural meeting of the Institute of Data Intensive Engineering and Science at Johns Hopkins University.

In August, Dr. Doug Roberts presented "Scientific Visualization at The Adler Planetarium" on 2D Scientific Visualization at the Computer Animation Festival, SIGGRAPH in New Orleans.

August 5 – 7 the Adler hosted the American Association of Variable Star Observers (AAVSO) for the Citizen Sky workshop. Citizen Sky is a NSF funded IYA2009 project designed to engage the public to help professional astronomers solve the mystery of epsilon Aurigae. Participants from the Adler included Ms. Julieta Aguilera, Mr. Ciupik, Ms. Rivka Rosen and Drs. Fortson and SubbaRao. Learn more about it at www.citizen-sky.org!

August 14 – 20 Drs. Fortson, Gyuk and SubbaRao were in London, England the Zooniverse collaboration at Oxford University.

ASTRO-SCIENCE WORKSHOP

This summer's very successful Astro-Science Workshop (ASW) ran from June 22 – July 10. The year's ASW, it's 45th, focused on high altitude ballooning. ASW, funded by National Science

continued on page 6

Department Report

continued from page 5

Foundation grant, teaches students about astronomy, physics, electronics and atmospheric science. They put their new knowledge to use by building experimental sensors to measure properties in the Earth's atmosphere. They launch the sensors on board a high-altitude balloon, which they then chase, and recover. After recovery the data is analyzed.

This year's balloon launch was a great success rising to more than 91,000 ft. and traveling over 35 miles landing near Hoopeston, Indiana.

They had a number of guest speakers including Paul Sipiera, Dr. Aaron Ridley, Dr. Smutko (from the Adler) and astronaut and ASW alumnus Dr. John Grunsfeld.

AWARDS AND SERVICE

Dr. Smutko received the Northwestern University Associated Student Government Faculty Honor Roll for 2008-2009. This is the third year in a row that Dr. Smutko has received this award, the highest honor that the students can give directly to faculty.

July 14–16 Dr. Fortson traveled to Washington, D.C. in her capacity as a member of the NASA Advisory Council (NAC). The NAC meets quarterly and provides advice and council directly to the NASA administration at the highest level.

VISITORS

The Astronomy Department welcomed a number of visiting scholars these past few months.

In May Dr. Mary Barsony from San Francisco State University came to collaborate with Dr. Wolf-Chase on data acquired with the Spitzer Space Telescope.

Also in May Dr. Kirk Borne from George Mason University visited the Adler to work on the Zooniverse project.

Dr. Chris Lintott of Oxford University, UK made a visit to the Adler in August to work on the Zooniverse project as well.

PERSONNEL CHANGES

In June we bid farewell to Dr. David Steele, our VERITAS Post Doctoral Fellow after almost 5 years at the Adler. Dr. Steele has taken a post doctoral position at Los Alamos National Lab in New Mexico. We wish him the best of everything.

In July we welcomed Dr. Jeff Grube, our new VERITAS Post Doctoral Fellow. Dr. Grube comes to us from University College Dublin (Ireland).

PUBLICATIONS

Astronomy department members have had a highly produc-

continued on page 8

Images of Astronomy

DARK MATTER HALOS

The Universe seen through our telescopes, from the glorious spiral galaxies to the delicate veils of star-forming nebulae, is only a very small part of the story. Modern cosmology has provided convincing evidence that only 4% of the energy density of the Universe is in the form of baryons, that is, the gas, dust, stars, planets that we can see directly. Of the remaining 95% of the Universe, 22% is an unknown form of matter called simply "dark matter". The balance is not in the form of matter at all.



A simulated dark halo with approximately the same mass as the halo surrounding our own Milky Way Galaxy. Thousands of sub-halos can be seen. The area shown is over a million light years across. Image credit: Virgo Consortium

The dark matter, which is more than 5 times as abundant as "normal" matter, interacts very weakly, perhaps only via the gravitational force. As the Universe evolved from a smooth initial state, huge clumps of dark matter called halos formed. As normal matter fell into these dark halos galaxies were formed. Although we are immersed in a sea of dark matter particles, the weakness of their interactions means we cannot see it directly. Thus much of our understanding of the behavior of dark matter has come from massive simulations run on supercomputers that track the gravitational response of every particle to every other particle.

The image above shows a visualization of the Aquarius Project simulation. This simulation, utilizing more than three million cpu hours on an Altix 4700 supercomputing cluster in Garching, followed the motions of over four billion dark matter particles under the influence of gravity in an attempt to model the dark halo of a galaxy the size of our own Milky Way. The brightness of the image is proportional to the density of the dark matter. The thousands of bright dots are sub-halos, some of which have their own sub-halos. Theory predicts that those sub-sub halos should have sub-halos and so on, down to the level of objects smaller than the Earth.

Astronomy News

LUNAR RECONNAISSANCE ORBITER

The United States and its partners have begun a program to extend the human presence in the solar system, starting with a return to the Moon. The return to the Moon will enable the pursuit of scientific activities that address our fundamental questions about the history of Earth, the Solar System and the Universe. It will also allow us to test technologies, systems, flight operations and exploration techniques to reduce the risk and increase the productivity of future missions to Mars and beyond. It will also expand Earth's economic sphere to conduct lunar activities with benefits to life on our home planet. The specific LRO objectives are to find safe landing sites, locate potential resources, characterize the radiation environment, and demonstrate new technology for future missions. The Adler Planetarium is the Education and Public Outreach (E/PO) partner for the high-resolution camera aboard LRO, called the Lunar Reconnaissance Orbiter Camera (LROC).

On June 18 the Lunar Reconnaissance Orbiter (LRO) lifted off from the Cape Canaveral Air Force Station aboard an Atlas V rocket. Adler staff (and LROC team members) Dr. Doug Roberts and Mr. Julian Jackson were fortunate to be able to attend the launch.

After launch LRO reached the Moon in about four days. It then entered an elliptical orbit, called the commissioning orbit. On September 15 the orbiter entered its final, circular polar orbit approximately 50 km above the Moon's surface (a little over 30 miles) for a 1- year mission exploratory mission. During the primary mission, LRO will utilize a set of seven instruments to return data such as day and night temperature maps, a lunar



Atlas Centaur upper stage separates from the LCROSS spacecraft bus on its approach to the Moon. Both the upper stage and the spacecraft will impact the Moon on October 9, 2009. Image credit: NASA

3D cartographic map, the radiation environment of the Moon, high resolution color imaging and the moon's UV albedo (how much of the Sun's light is reflected from the Moon's surface). However there will be particular emphasis on the polar regions of the moon where continuous access to solar illumination may be possible and the prospect of water in the permanently shadowed regions at the poles may exist. Two of the instruments will provide ways of searching for the signatures of water in these polar regions. Although the objectives of LRO are explorative in nature, the payload includes instruments with considerable heritage from previous planetary science missions, enabling transition, after one year, to a science phase under NASA's Science Mission Directorate (SMD).

The Lunar Reconnaissance Orbiter will create a comprehensive atlas of the Moon's features and resources necessary to design and build a lunar outpost. LRO follows in the footsteps of the predecessors to the Apollo missions - missions designed in



Liftoff of the Lunar Reconnaissance Orbiter, June 18, 2009. Image credit: Ben Cooper

part to search for the best possible landing sites (such as the Ranger, Lunar Orbiter and Surveyor missions). However, building a lunar outpost implies extended periods on the lunar surface and so the goals of LRO go beyond the requirements of these previous missions. LRO focuses on the selection of safe landing sites, identification of lunar resources, and the study of how the lunar radiation environment will affect humans.

LROC will retrieve high-resolution black and white images of the lunar surface, capturing images of the lunar poles with resolutions down to 1m, and will image the lunar surface in color and ultraviolet. These images will provide knowledge of polar illumination conditions, identify potential resources & hazards, and enable safe landing site selection.

As the E/PO partner on LROC, the Adler works closely to engage the public with the amazing ultra-high resolution imagery from LROC, specifically using Adler's new Moon Wall exhibit. The Adler will also hold a viewing event in the early morning hours of October 9 when a portion of LRO is crashed into the Moon's polar regions as part of the search for buried ice. - Doug Roberts, PhD 🌟

Astronomy News

continued from page 7

smaller than the Earth.

One of the surprises is the number of satellite halos we see in simulations like these. By contrast the Milky Way has only a dozen or two satellite galaxies. This apparent contradiction has long been a puzzle. Apparently not all halos are populated by stars. Something kept the smaller halos from forming stars or even retaining much gas. Most likely this is a result of feedback from the earliest stars to form. Supernovae explosions from these earliest stars would have enough energy to expell all the remaining gas from such a small galaxy. Hence, after the first few stars died star formation was shut off in these systems for good. The Milky Way probably has hundreds of these "dark satellites" orbiting around it undetected. - *Geza Gyuk, PhD*



Department News

continued from page 6

tive research cycle with a number of papers reaching publication. The following is a sampling of these papers.


"Multiwavelength Observations of LS I +61° 303 with Veritas, Swift, and RXTE", V. Acciari et al. (the VERITAS collaboration -- including L. Ciupik, L. Fortson, J. Grube, G. Gyuk, N. Karlsson and D. Steele), *ApJ* 700, 1034-1041 (2009).

"Evidence for Long-Term Gamma-Ray and X-Ray Variability from the Unidentified TeV Source HESS J0632+057", V. Acciari et al. (the VERITAS collaboration -- including L. Ciupik, L. Fortson, J. Grube, G. Gyuk, N. Karlsson and D. Steele), *ApJ* L 698, L94-L97 (2009).

"Observation of Extended Very High Energy Emission from the Supernova Remnant IC 443 with VERITAS", V. Acciari et al. (the VERITAS collaboration -- including L. Ciupik, L. Fortson, J. Grube, G. Gyuk, N. Karlsson and D. Steele), *ApJ* L 698, L133-L137 (2009).

"Radio Imaging of the Very-High-Energy Gamma-Ray Emission Region in the Central Engine of a Radio Galaxy", The VERITAS Collaboration, the VLBA 43 GHz M 87 Monitoring Team, the H.E.S.S. Collaboration, the MAGIC Collaboration, *Science*, 325, 444 (2009).

Planetary-Scale Terrain Composition, R. Kooima, J. Leigh, A. Johnson, D. Roberts, M. SubbaRao, T. DeFanti, *IEEE TVCG* Vol. 15, No. 5, 719 (2009).

Other publications are in preparation. 

About the Adler Astronomy Department

The Adler Planetarium & Astronomy Museum has taken the lead among planetaria world-wide in establishing an astronomy and astrophysics research group in a museum setting. Adler Planetarium astronomers possess rich and diverse expertise in many areas of astronomy as well as other closely related science fields such as particle physics and geophysics. Several members of the Adler Astronomy Department also hold joint appointments at the University of Chicago and Northwestern University. The nature of these joint appointments strengthens the integration of the Adler and its educational mission with the research community.

You can download this newsletter and our Annual Report published in the Bulletin of the American Astronomical Society from: <http://www.adlerplanetarium.org/astronomy/>



PRIME FOCUS

A Publication of The Adler Planetarium
Astronomy Department
1300 S Lake Shore Drive
Chicago, IL 60605

Editor-in-Chief Geza Gyuk, PhD

Designer José Francisco Salgado, PhD

Contributing Writers Geza Gyuk, PhD
Doug Roberts, PhD
Rivka R. S. Rosen, B.S.

Colophon Produced using InDesign 4.0,
Illustrator 12.0, and Photoshop 9.0.
Body copy is set in Cronos Pro.
Headlines are set in Trebuchet.

All contents © 2009 Adler Planetarium & Astronomy Museum
unless otherwise noted. All rights reserved.