April 2008

400 Years *of the* Telescope

A Journey of Science, Technology and Thought

Galileo's Telescope: The Instrument that Changed the World

Portrait of Galileo Galilei, copy of portrait of Justus Suttermans. Author unknown. Oil on canvas. Istituto e Museo di Storia della Scienza, inv. 3714

Exhibit at the Istituto e Museo di Storia della Scienza
March 4th – December 31st 2008
Florence, Italy

Introduction

In 1609, Galileo Galilei (1564-1642), professor of mathematics, received word of a curious optical device: a tube with lenses at both ends, known as a spyglass, developed by Dutch opticians. The instrument made distant objects seen through it appear to be near.

Motivated by his scientific curiosity, and with his technical expertise as an instrument maker, Galileo set about improving upon what the Dutch opticians had created. Within a few short months he was able to increase the magnification of the instrument to approximately thirty times. Galileo was the first to consider the astronomical

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Meet the Writers

David Levy: Inspired by the stars

Which is the most important telescope ever to focus its eye into space? For most people, the answer is easy: the Hubble Space Telescope. For others, it might be Galileo's first telescope in 1610. But not for David Levy. "The most important telescope ever," he says, "is the one that inspires you to look toward the stars."

Using telescopes comes easily to Levy, who has operated hundreds during his lifetime. When Levy relocated to Arizona from Montreal, Canada almost thirty years ago, he brought some sixty instruments with him. But now that number has dropped to seven. Inside his main observatory building, with a 14 x 32 foot sliding roof structure, is a sampling of telescopes. His collection includes Pegasus, an 8-inch f/7 reflector, Miranda, a 16-inch f/5 reflector, the "talking solar telescope" called Mintaka, and his first 3.5-inch f/11 telescope he calls Echo.

"In the early days," Levy recalls, "I named telescopes after satellites and other spacecraft. Now the naming is much more personal." This evolution dates from the time when Wendee entered his life. Their 11-year-old marriage has resulted in more informal and downright humorous names for his telescopes. Levy now has Flaire, a 14-inch telescope from Meade, and Clyde, a Celestron 14 named not simply for Clyde Tombaugh's discovery of Pluto, but rather as a commemoration of the stick-to-itveness personality of the man, as well as his humor

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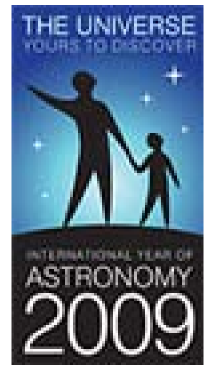
IYA Update

Organisational Matters:



New IYA2009 Nodes: The IYA2009 is growing fast; presently we have 109 National Nodes (53 with National web pages) and 18 Organisational Nodes. A warm welcome to Kuwait and Jamaica and to the organisations: International

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Canada IYA Update

by Jim Hesser
National Research Council of Canada

Professional and amateur astronomers in Canada are working to strengthen – and form new – partnerships with the formal and informal education communities, as well as with Aboriginal, arts and cultural, and other organizations, "To offer an engaging astronomy experience to every person in Canada, and to cultivate partnerships that sustain public interest in astronomy." At the core of our effort is a partnership formed in early 2006 between the ~5,000 members of the Royal Astronomical Society of Canada, the ~1,000 members of the Fédération des Astronomes Amateurs du Québec, and the ~600 (professional) members of the Canadian Astronomical Society.

The underlying philosophy of our volunteer-driven partnership includes: (1) Strong focus on activities expected to have impact beyond 2009. (2) Materials accessible in both Canadian official languages (French and English). (3) Wherever possible, leveraging and strengthening ex-

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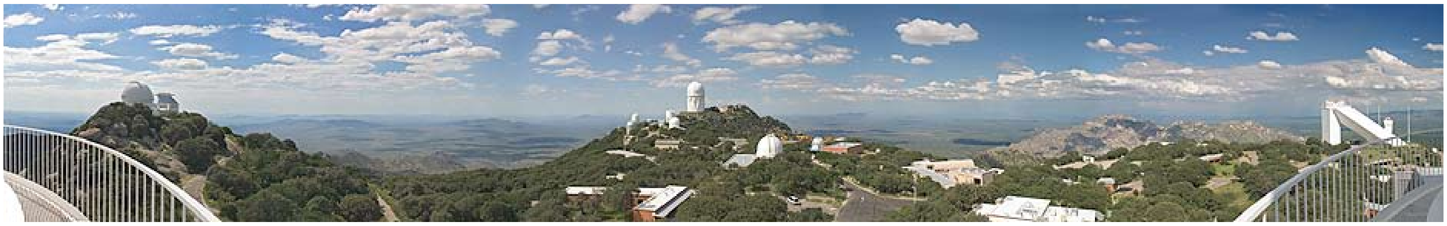

Kitt Peak Turns 50: The Historic Past and Bright Future of the National Observatory

by Douglas Isbell
Associate Director for Public Affairs and Educational Outreach

1958 was a landmark year for astronomy and space science, from the founding of NASA and deployment of the first satellite dishes that led to the Deep Space Network to the launches of Explorer 1 (and its subsequent discovery of the Van Allen radiation belts) and Vanguard 1 (which continues to orbit the Earth today, more than 50 years later). That same year, the National Science Foundation selected Kitt Peak in the Sonoran Desert southwest of Tucson, Arizona, on the land of the Tohono O'odham Nation (known then as the Papago tribe), as the site for its new national observatory.

WIYN telescope multi-fiber spectrograph

This farsighted action created a path for any optical astronomer with a world-class idea to obtain the ground-based telescope observing time needed to explore the cosmos. No longer would it be a requirement to be at a large research institution with its own private facilities. Kitt Peak National Observatory and its unique visual profile quickly became an icon of the popular vision of what a national astronomical research observatory can offer the community. Five decades later, as we prepare to celebrate the 50th birthday of the national observatory and all that is has created, Kitt Peak continues to be home to the world's largest collection of research telescopes as a world-class site for science and public appreciation of it.

The past and future mingle in a variety of interesting ways at Kitt Peak. The site of the original 36-inch (0.9-meter) telescope on the mountain is occupied today by the angular metal dome of the WIYN 3.5-meter telescope, completed in 1994. WIYN is taking delivery of exciting new instruments such as a high-resolution infrared camera and (soon) a high-tech digital imager that will routinely take snapshots of one full square-degree of sky—equivalent to four full Moons. Already tested in a one-quarter scale prototype, this instrument uses a mind boggling technique to compensate for atmospheric distortions above the telescope by electronically shifting the individual photons of incoming light around its focal plane in sync with the sky conditions, before a computer reads them out. WIYN is a partnership between the University of Wisconsin, Indiana University, Yale University, and the National Optical Astronomy Observatory (NOAO), which runs Kitt Peak National Observatory today. This blend of public and private institutions was a forerunner of many such relationships in astronomy today.

Next to WIYN is a small dome originally used to measure the seeing conditions of the site. Today, this dome is home of one of three telescopes used by the widely renowned Kitt Peak Nightly Observing Program for the general public. The south ridge of Kitt Peak is also occupied by a 0.9-meter telescope operated today by WIYN, and the historic 2.1-meter telescope. Known as the 84-inch when completed in 1963, this telescope was the first to detect an optical image of a gravitational lens, and it was used to discover the massive clouds of interstellar hydrogen gas known as the Lyman-alpha forest. The 2.1-meter remains oversubscribed by observing requests, more than 40 years after its construction, and the large Coudé feed spectrograph in its bowels continues to be used regularly by teachers and high school students (among others) for stellar research projects.

Solar astronomy is a major part of Kitt Peak's history and legacy, represented most noticeably by the striking angular profile of the McMath-Pierce Solar Telescope. With a primary mirror of 1.6 meters, this unique facility was dedicated in 1962 by decree of President John F. Kennedy and it remains the world's largest solar telescope (at least until the National Solar Observatory completes its planned 4-meter Advanced Technology Solar Telescope, probably in Hawai'i.) The extreme f/54 optical system of the McMath-Pierce can produce a 32-inch wide image of the Sun, thanks to the 500-foot length of the hypotenuse of its triangular structure. Named for Robert McMath, a University of Michigan solar scientist and influential patron of science in the mid-20th century, and renowned solar astronomer Dr. A. Keith Pierce, the McMath-Pierce has been used to detect water molecules and isotopes of helium on the Sun, as well as for versatile planetary science measurements ranging from the sodium atmosphere of Mercury to upper-atmosphere winds on Mars.

The northern end of Kitt Peak is dominated by the massive Mayall 4-meter telescope, the second largest telescope in the world when

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Featured Observatory

Canada-France-Hawaii Telescope

Since the end of the seventies, the Canada-France-Hawaii Telescope (CFHT), with its big white building topped by its more than hemispheric white dome, has been a landmark of Mauna Kea, sitting as a majestic figurehead at the bow of the summit ridge as it cruises through the North Pacific trade winds.

Dome of CFHT on Mauna Kea

With its main mirror 3.6-m in diameter, a far cry from its more recent neighbors and their 8 to 10-m mirrors, CFHT nowadays could feel small and worthless. However, the quality of its instrumentation and the impact of the scientific research it allows are at the image of its dome: big! With its old technology, the telescope equatorial mount is closer to the 200" Mt. Palomar than to the modern Keck or Gemini in nearby domes of similar size.

The observatory is set up as a non-profit corporation in the State of Hawaii and is governed by a tripartite agreement between Canada, France and the State of Hawaii. CFHT is the only international telescope on Mauna Kea in which the State of Hawaii actually has a shared ownership. This *ménage à trois* in the middle of the Pacific Ocean has been, and remains, an extremely successful collaboration between three communities though spread apart over two continents and two oceans.

CFHT has been for the 80s and early 90s the largest optical telescope operating in the visible and near-infrared part of the electromagnetic spectrum. Therefore, its no surprise that CFHT played a key role in establishing Mauna Kea as one of the best sites in the world for astronomical observations, thanks to the extraordinary qualities of the atmosphere above the summit. Using HRCam, a camera with a tip-tilt guider aimed at correcting automatically telescope guiding errors, in particular fluctuations induced by the wind, astronomers obtained for the first time images better than 0.5 arc-second, while many sites around the world are still very happy with just 1 arc-second.

When Adaptive Optics (AO) systems became available to eliminate atmospheric turbulence and providing images as sharp as the mirror allowed, CFHT offered the first user-friendly push-button AO system for a wide range of targets, from our solar system to extragalactic objects. Nick-named Pueo (the Hawaiian owl), this AO system allowed, among many premières, the discovery of a moonlet of the asteroid 45 Eugenia, the first companion of an asteroid found with a telescope from the ground.

Without instruments, a telescope would be only a bucket gathering light from the heavenly bodies. At CFHT, the suite of instruments available on the telescope to its users was designed very early on to be versatile and covering almost all the observing needs: high resolution imaging with high resolution cameras and later adaptive optics, wide-field imaging with photo-

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IYA Canada *continued from page 1*

isting efforts rather than reinventing the wheel. (4) Encouraging individual, grassroots initiative within the broad context proven by our national IYA2009 visions and those of the IAU. (5) Increasing Canadians' appreciation of the high-world impact of their astronomers and educators, thereby encouraging awareness among youth of S&T career opportunities.

Our **individual thrusts** fall into three broad themes with strong emphasis on involving young people:

(1) **Reconnecting With The Sky:** diverse observing experiences, increasing public awareness of the need for dark sky sites, providing educational materials, etc. (2) **Canadians at the Frontiers:** presentations across Canada by outstanding researchers who are also gifted public speakers; national planetarium shows, etc. (3) **Astronomy in Society:** Aboriginal traditional knowledge, collaborations with arts and entertainment organizations, astronomy in our multicultural society, etc.

Present efforts are focusing upon program development and fund raising in two broadly conceived national elements, while, delightfully, a third, grassroots initiative is emerging:

(1) Providing opportunities for more than a million Canadians to experience a "Galileo Moment" by observing the heavens at star parties, sidewalk astronomy events, and/or participating in an arts and cultural activity tightly linked to astronomy. (2) A partnership between Cape Breton University's Integrative Science Programme, the Mi'kmaq College Institute and our national coordinating team, planning for outreach to Aboriginal communities throughout Canada. Our vision includes bringing youth and elders together in a series of star parties at which Aboriginal knowledge of the heavens can be shared across generations, as well as across the indigenous and astronomy communities. (3) At the grassroots level, several people in two different cities (Montreal, Victoria) are actively exploring installation of **From Earth to the Universe Images**, an IAU IYA2009 cornerstone project, in public spaces.

We anticipate that a number of Canadians will participate in the AAS/ASP meetings and associated IYA2009 workshop in St Louis, and look forward to sharing developments with IYA colleagues from around the globe there.

Galileo *continued from page 1*

benefits of the device, and he turned his own refined instrument toward the sky. With this new instrument, the observer was able to see and analyze the physical structure of the planets. For the first time, the universe was not just measured, calculated and plotted, but closely observed and its true form revealed.

Technology

Not until the end of the 16th century was there a noted improvement in lens-making technology. This lack of technology could be used to argue as to why the Dutch spyglass or, for that matter Galileo's telescope, were only created in the early 17th century. Scant information regarding how Galileo obtained the lenses for his telescope is available. Curiously, a shopping list jotted down by Galileo, today preserved at the National Library of Florence, gives insight into his creative genius as an instrument maker. The list contained items such as chickpeas, rice, pepper, but also included two cannon balls, a tin organ pipe and German flat glass. Galileo was attempting to procure the items necessary to make telescopes, and perhaps planning to use the cannon balls to shape concave ocular lenses. Galileo's first instrument consisted of a tube with two eyeglass lenses inserted in each end: a plano-concave lens (objective) and a plano-convex lens (ocular). He then increased the magnification of the instrument by using a weaker lens for the objective and a stronger lens for the ocular. Armed with this instrument, Galileo made discoveries that changed how the universe was perceived and the position of mankind within the universe.

Observations

Viewing the moon, Galileo discovered that the lunar surface is not unlike that of the earth, with pits and cavities, valleys and peaks, and not a perfect sphere. This contradicted the predominant Aristotelian theory of the celestial bodies being perfectly spherical, nondescript and incorruptible.

In 1610, Galileo observed Jupiter and noted the existence of three, then four, starlets orbiting the planet. This observation demonstrated for the first time that the Earth was not the only center of rotation in the Universe, as the Ptolemaic theory suggested. Galileo considered this to be his most significant discovery to date and one that would bring him international recognition.

Detail of now framed objective lens used by Galileo to observe the satellites of Jupiter. Galileo Galilei, Objective lens, Padua, late 1609, Glass. Istituto e Museo di Storia della Scienza, inv. 2428

Detail of Telescope and objective lens. Galileo Galilei, Telescope, Florence, c.1610Glass, wood, leather. Istituto e Museo di Storia della Scienza, inv. 2428

Detail of Telescope. Galileo Galilei, Telescope, Florence, c.1610. Glass, wood, leather. Istituto e Museo di Storia della Scienza, inv. 2428

Such telescopic findings among others were published in his highly successful book: *Siderius Nuncius* (1610). It is noteworthy to mention that on the title page Galileo penned a lyrical dedication of the book, his astronomical findings and the rededication of the four satellites of Jupiter, which he prior named the Medicean Stars, to the Grand Duke of Tuscany, Cosimo II de' Medici.

In addition, he gifted the Grand Duke the telescope used to discover the satellites of Jupiter and a copy of the book. This form of gift giving and currying of favour was not foreign to the culture of the day and was generally accompanied by notice and reward. The Grand Duke granted Galileo the position of Court Mathematician and Philosopher, enabling him to pursue his scientific research wholeheartedly.

Insofar as Galileo's discoveries are concerned, his observations of Venus should not go without mention. Galileo noted that the planet Venus has phases like the Moon. Such a discovery was tangible support for the Copernican or Heliocentric theory –if Venus rotates around the Sun, it should show such phases. This revelation led to a defining moment in Galileo's career and the later writing of *Dialogue Concerning the Two Chief World Systems, Ptolemaic and Copernican* (1632).

Consequences

From the onset of his discoveries Galileo published his astronomical findings and research: *Siderius Nuncius* (1610), followed by the *Saggiatore* (1624), and finally the controversial *Dialogue Concerning the Two Chief World Systems*. However, the cultural and religious climate of the day cannot be dismissed, and the controversial book which debated and belittled the geocentric theory would not be tolerated. His astronomical discoveries that led to the discrediting of the Aristotelian and Ptolemaic systems of the Universe – with the immobile Earth at the centre – were not without consequence. By turning a simple optical curiosity into a full-fledged scientific instrument and by turning that instrument toward the sky, Galileo challenged centuries of scientific belief and religious dogma. Finally, in October of 1632, the year in which he published *Dialogue Concerning the Two Chief World Systems*, Galileo was asked to appear before the Holy Office in Rome. The courts then issued a condemnation, and forced Galileo to abjure. Forbidden to conduct further research on,

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US IYA Update: Announcing the Project Office Team

by Douglas Isbell and Susana Deustua
Cochairs, US IYA Program Committee

We are pleased to announce that the US effort for the International Year of Astronomy 2009 now has a core project staff to better engage the community and coordinate volunteer efforts. Dr. Stephen Pompea is the US IYA project director and Dr. Andrea Schweitzer is the US IYA project manager, assisted by Kristina Harding. Dr. Pamela Gay is the US IYA Web designer and New Media expert.


Dr. Stephen Pompea

Dr. Stephen Pompea is an astronomer and the manager of science education at the National Optical Astronomy Observatory in Tucson, AZ. With NSF approval, Steve will serve half-time as project director for the US IYA effort. Steve leads a dynamic team at NOAO that conducts programs in teacher professional development, optics education, astronomer-teacher research partnerships, programs with the Tohono O'odham Nation and other Native American groups in the region, and Spanish language education efforts in southern Arizona and Chile.

Before joining NOAO, Steve was an independent consultant working on a wide variety of instrumentation and national science education projects, including The Astronomy Village and several GEMS guides. He was an instrument scientist for the Hubble Space Telescope NICMOS instrument and for Gemini Observatory infrared instruments. Steve obtained a BS in physics, space physics, and astronomy at Rice University, a M.A. in teaching at Colorado State University and a Ph.D. in astronomy from the University of Arizona, where he studied star formation in early-type galaxies. He is also known for his work on the optical properties of surfaces and stray light analysis of ground and space-based telescope systems. He has extensive public-school and planetarium education program experience.


Dr. Andrea Schweitzer

Dr. Andrea Schweitzer is the US IYA project manager. Andrea received a BS in physics from Pomona College, CA, while a research assistant to the NASA Voyager program. After earning a Ph.D. in astronomy from the University of Wisconsin-Madison, Andrea returned to her home state of Colorado for a position with Honeywell, where she received two years of engineering project management training. Andrea now has her own consulting business, applying her expertise to managing multi-location project teams for clients including NASA, Boeing, the Southwest Research Institute, and the Space Science Institute.

Andrea is a founding member of the Little Thompson Observatory (LTO), an all-volunteer community project, built at Berthoud High School in northern Colorado, which opened in 1999. It averages 500 visitors per month. Much of her education and public outreach experience is through her work with LTO. Andrea is the PI of two NASA grants, which support her work in developing and teaching astronomy education workshops for K-12 teachers, including bilingual (Spanish) materials. She is a founding member of Colorado Project ASTRO. She also chaired the AAS Employment Committee.


Kristina Harding

Kristina Harding grew up in Cripple Creek, Colorado, a tiny mountain town west of Colorado Springs. Kristina earned a bachelor's degree in recreation management from the University of Northern Colorado in Greeley, Colorado. In 2005, she became the owner and publisher of a well-received regional magazine called the Northern Colorado Woman. Kristina's publishing skills will be a real asset for the US IYA effort.

Dr. Pamela L. Gay is perhaps best known for her work on the "Astronomy Cast" and "Slacker Astronomy" podcasts. Combining a solid background in astronomy with a radio-friendly voice, this young astronomer is working to bring the cosmos to the masses one download at a time. She also writes the popular blog StarStryder.com. With Astronomy Cast, Pamela has taken her research in new media in new directions, exploring the socioeconomic backgrounds of podcast audiences, and exploring in detail what topics people want to hear. (The answer to that question is planets and cosmology, topics that Astronomy Cast has recently taken on.)

Pamela received a B.S. in Astrophysics from Michigan State University and a Ph.D. in astronomy from the University of Texas. Today, she teaches at Southern Illinois University Edwardsville. Her first research love was (and remains) variable stars, but she has also worked on galaxy evolution and the Butcher-Oemler Effect. Pamela lives in a historic house in southern Illinois with her husband, two dogs, and a lot of books.

Please join us in welcoming the core US IYA project team!

IYA continued from page 1

Association of Astronomical Artists and International Olympiad on Astronomy and Astrophysics.

The official resolution adopted by the United Nations General Assembly about the International Year of Astronomy 2009 on December 19, 2007, is finally **available**.

Google Calendars: Check out all the important dates related with the IYA2009.

IYA2009 Cornerstone Projects

The IYA2009 cornerstone and special projects are evolving at an incredibly fast pace, please check the latest developments on the cornerstones webpages:

Link One **Link Two**

Resources

PowerPoint presentation: "Who invented the astronomical telescope?" This is a very tricky question and we would like to help you to answer it. Find out more in the PowerPoint presentation that we prepared for you.

IYA2009 Meeting 2008

The next IYA2009 meeting will happen in Cairo, Egypt from April 5-10. During the MEARIM2008 meeting we will have a session dedicated to IYA2009 programme, with special emphasis on Middle East and Africa: Session 7- Astronomical Scientific Research & Education in Africa and ME countries, IYA2009. **More information here**.

Upcoming IYA2009 meetings:

AAS 212th and ASP Meeting
St. Louis, USA, May 31-June 5, 2008

APRIM2008
Kunming, China, August 3-6, 2008

JENAM2008
Wien, Austria, September 8-12, 2008

Related IYA2009 Activities and events:

In celebration of the upcoming 2009 International Year of Astronomy, the Oregon Museum of Science and Industry's Kendall Planetarium is sponsoring an astronomy photo contest. Winning astronomy photos will be published in OMSI's 2009 Kendall Planetarium astronomy calendar. **More info**.

Galileo's Telescope: Read and see more about the instrument that changed the world, from the Institute and Museum of the History of Science in Florence, Italy.

Selected IYA2009 Press Coverage:

Catholic News Service, March 7, 2008: "Four centuries after he was called by church officials to retract teachings deemed suspect of heresy, the 17th-century Italian astronomer Galileo Galilei will be returning to Vatican City. A statue of the great scientist will be erected in Vatican City to help commemorate next year's celebration of the International Year of Astronomy and the 400th anniversary of Galileo's first use of the telescope to observe the cosmos." **Source**.

Scotsman News, March 8, 2008: Scotland's starry, starry nights are dazzling success. "It's not just the year past that counts – what will happen in the future? Hillier hopes the Dark Sky programme will be rolled out UK-wide for the International Year of Astronomy in 2009, a global celebration of all things astronomical." **Source**.

Galileo continued from page 4

or openly support the heliocentric theory, he was confined under house arrest in Siena, and later allowed to spend his twilight years at his villa in Arcetri. His last book, *Discourses and Mathematical Demonstrations Concerning Two New Sciences* (1638) was published in Leiden in order to avoid censorship by the Holy Office.

Celebrations

To mark the 400 years of Galileo's telescopic discoveries, the Istituto a Museo di Storia della Scienza with the collaboration of Istituto Nazionale di Fisica Nucleare, Florence, Istituto Nazionale di Ottica Applicata, Osservatorio Astrofisico di Arcetri and Stazione Sperimentale del Vetro, Murano, is presenting the exhibit, **Galileo's Telescope: The Instrument that Changed the World** from March 4th to December 31st, 2008. The exhibit of rare books, manuscripts and precious instruments, brings to light the full context of Galileo's experiences. Optics and astronomy will be explored and facilitated by interactive exhibits. The visitor will be able see and rediscover Galileo's astronomical observations.

To further celebrate this event, the Istituto e Museo di Storia della Scienza was involved in partnership with Interstellar Studios for the filming of 400 Years of the Telescope, *allowing the Istituto to display its fine collections of instruments, including the only two surviving telescopes made by Galileo.*

CFHT *continued from page 3*

graphic plates at prime focus replaced by larger and larger CCDs mosaics paving the focal plane, spectrographs offering either very high spectral dispersion or multi-object capabilities at a moderate dispersion, a Fourier Transform Spectrometer, and infrared cameras.

The need to specialize the telescope in a few niches to stay at the forefront of today's astronomy led to a configuration where only three main instruments are offered to the astronomers, each unique for the communities CFHT is serving: MegaCam, since 2004 the largest digital camera in operation in the world on a telescope (with 340 megapixels and a 1 square-degree field of view), WIRCam, a 16 megapixels mosaic of detectors working in the near infrared up to 2.5 microns, and ESPaDOnS, a one of a kind spectro-polarimeter on a 4-m class telescope, allowing the study of magnetic fields on stars other than our Sun.

To use MegaCam in the most efficient way, Canada and France decided to allocate together 500 nights of telescope time to a single big endeavor, the CFHT Legacy Survey (CFHTLS) with the goal of tackling some of the hottest questions of the day back in 2003, when it was finally decided: improving our knowledge of the large scale structures of the universe, and tracking its two main components, the dark matter and the dark energy. While the CFHTLS is coming to an end on the observing side, with most of it done by mid-2008 and a few more nights still to be observed by the end of 2008, the harvest of scientific results is already abundant.

Thanks to MegaCam, astronomers have been able to look for the first time at the distribution of dark matter inside filaments extending up to 270 million light-years in size. They discovered a chaotic scene unlike any witnessed before in a cosmic "train wreck" between giant galaxy clusters. They probed the acceleration of the universe and better characterized this mysterious dark energy (so far the best explanation to this acceleration), using hundreds of supernovae exploding in remote galaxies. The most distant currently known black hole has also been discovered with MegaCam.

With ESPaDOnS, astronomers just caught one star other than the Sun - τ Bootis A - in the process of flipping its north and south magnetic poles. They had discovered earlier a magnetic field on this star, which is orbited by a giant planet on a close-in orbit: the first ever detection of this kind! ESPaDOnS also provided a big surprise very early on: it showed that an ultra-cool star (V374 Pegasi) has a very simple, organized global magnetic field structure rather like that of the Earth. Surprise: such cold stars were predicted to be more chaotic and less structured than our Sun!

New large observing programs will follow the CFHTLS, but will not be restricted to MegaCam. They will use also WIRCam and ESPaDOnS for at least 40%, and likely more, of the observing time available on the telescope up to the end of 2012. A dozen of proposals have been already received, exploring exciting areas of astronomy, from our solar system to the origin of the universe. These programs will maintain CFHT at the forefront of astronomy for the years to come.

It is clear that new developments on other telescopes will make CFHT's current suite of instruments less unique and efficient in a few years from now. Therefore, new instruments are under study and one or two, depending on their cost and the funding raised for their construction, will be developed to be operational around 2013, in order to keep the observatory at the cutting edge of astronomical observations.

Meanwhile, CFHT will continue to play its leading role in the development of `OHANA, an extremely ambitious project aiming at linking the main optical observatories on Mauna Kea through a network of optical fibers, transforming these individual telescopes into a gigantic interferometer giving the resolving power of a single telescope nearly one kilometer in diameter. While there are many challenges on the road, this project could, in a couple of decades, really integrate all the current telescopes into a single one, a concept nobody would have dreamed of 30 years ago when the first domes started to blossom on the summit of Mauna Kea.

Dr. Christian Veillet, *Executive Director*
http://www.cfht.hawaii.edu

Levy *continued from page 1*

and deep love of the sky. Esther, a 10-inch, is named in honor of Wendee's middle name. Levy believes names are important for telescopes. Naming a telescope makes a statement that its influence is great; that it is more than glass and metal. To David Levy, a telescope is a thing of sublime beauty because it allows one to look at the stars.

Although Levy's primary observing goal is to search for comets, it is not his only passion. He is completing his Ph. D. dissertation on the night sky in the time of Shakespeare. "The sky I know and love is not the only one there is," Levy explains. Beyond his academic interest lies a yearning to explore the sky of a different time and place. The sky over England during Shakespeare's time seemed ideal. It is his hope that this earlier sky will help to inspire people to enjoy the one we see above each clear night.

David and Wendee Levy founded the **National Sharing the Sky Foundation** on March 9, 2006. The Foundation is a nonprofit charitable organization that sponsors a series of lectures around the country by David H. Levy to young audiences. By sharing Levy's passion for astronomy with young people, the Foundation hopes to inspire youth to consider potential careers in science and engineering.

Sharing the Sky has celebrated its anniversary on March 9th every year since its inception. It was on that date in 1962 that Levy arranged and managed his first public star night, on a drizzly evening in Montreal. There were films and lectures, and hopefully some of the hundreds of people who attended were encouraged to look more deeply into the mysteries of space. The Foundation's goal is to teach, but most importantly to inspire: to provide people with the opportunity to enjoy the night sky, and to reach for the stars.

David H. Levy is the discoverer of 21 comets and serves as the Science Editor of Parade Magazine. As co-discoverer of Comet Shoemaker-Levy 9 that crashed into Jupiter in 1994, Levy is one of the world's most famous amateur astronomers whose passion for astronomy is contagious.

Kitt *continued from page 2*

dedicated in 1973. It is named in honor of Nicholas U. Mayall, director of Kitt Peak during the 1960s, and a friend and colleague of most of the most famous names in mid-century US astronomy, from Walter Baade to Fred Whipple. Perhaps most famous for its role in the discovery of dark matter in the halo of galaxies by Vera Rubin and Kent Ford, the Mayall telescope has been used for an amazing variety of observations and long-term survey projects.

One example is the NOAO Deep-Wide Field Survey of a large swath of sky in the constellation Bootes, which when combined with results from NASA's Great Observatories has led to the discovery of new populations of obscured, high-redshift active galactic nuclei (AGN), the most distant radio-loud quasar, and rare examples of late-type stars. The analysis of the evolution of the clustering of galaxies imaged by this survey has helped quantify the role of satellite galaxy destruction in the evolution of the properties of luminous galaxies. Today at the Mayall telescope, you will often find a new wide-field infrared camera called NEWFIRM in use (observing, for example, intermediate-age galaxies when these "teenagers" were forming the bulk of their stars), as well as a 64-megapixel optical imager and several modern spectrographs.

The University of Arizona has several major telescopes on Kitt Peak, including the Bok 2.3-meter, the two meter-class telescopes of the well-known Spacewatch survey for near-Earth objects, and a 12-meter radio telescope. One of the 25-meter Very Long Baseline Array radio dishes operated by NOAO's sister agency, the National Radio Astronomy Observatory, is located on Kitt Peak, as are several other 1-2 meter-sized telescopes operated by university consortia and the Calypso 1-meter telescope owned by a private individual.

In total, there are 19 optical research telescopes, two radio telescopes and three public outreach telescopes on Kitt Peak, plus a new solar telescope array for public viewing in a small dome near the McMath-Pierce. The estimated total value of these telescopes is more than $200 million, a major part of more than $1 billion in astronomical facilities in the state of Arizona. An economic impact study in 2007 found that these observatories contribute $250 million annually to the state's economy and provide 3,330 jobs.

Beyond Kitt Peak, NOAO is also the route for U.S. astronomers to observe with the two 8-meter telescopes of the Gemini Observatory in Hawai'i and Chile, and it operates a modern 4.1-meter telescope called SOAR on the same peak as Gemini in Chile; this peak will soon be home to a third telescope, the Large Synoptic Survey Telescope (LSST). Scanning the entire visible sky every three nights, LSST is designed to return an awesome 30 terabytes of imaging data per night about variable objects in the night sky—with all the data publicly accessible—starting as soon as 2014.

The National Science Foundation, which funds the operation of NOAO via a contract with the Association of Universities for Research in Astronomy (AURA), recently reaffirmed its commitment to the telescopes of NOAO at Kitt Peak and at Cerro Tololo Inter-American Observatory near La Serena, Chile, by directing NOAO to prepare a plan for funding to modernize some key support facilities and to work with the astronomical community to build new science instruments to help keep both sites on the cutting edge.

The Kitt Peak Visitor Center has been the central hub for public visitation since 1964. It contains exhibits on the history and accomplishments of Kitt Peak, including a newly updated exhibit on large telescope mirrors, and a well-stocked gift shop with astronomical gift items and one of the area's most extensive collections of Native American jewelry and crafts. The visitor center is also connected to the primary 20-inch telescope for public programs, such as a spin-off from the nightly program that allows two people to observe or image with the telescope all night long with the help of an expert guide. (The third public telescope, and newest, is a 16-inch located in a roll-off roof building that is also available for classes and private groups.) Kitt Peak's knowledgeable volunteer docents lead daily tours of the Mayall, McMath-Pierce and the 2.1-meter telescope for an estimated 50,000 annual visitors from all over the globe.

We are planning a variety of anniversary events and activities for the public and the scientific community in partnership with the Tohono O'odham Nation, starting in 2008, throughout the International Year of Astronomy 2009, concluding in March 2010 on the 50th anniversary of the formal dedication of the U.S. national observatory for solar and nighttime astronomy.

Watch the NOAO website for more details.

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Editorial Team

Executive Producer
Kris Koenig

Editors
Jennifer Oman
Anita Ingrao

Design & Production
Michael Moretti

Contact
jennifer@interstellarstudios.com

Interstellar Studios
11 Ilahee Lane
Chico, California 95973
(530) 343 5635

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www.400years.org

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