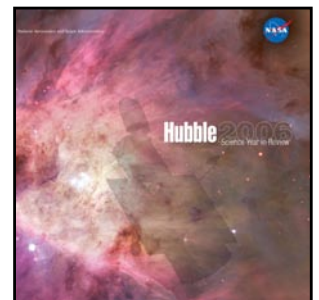


Supporting *Hubble*: Profiles

Taken from: Hubble 2006 Science Year in Review

The full contents of this book include more Hubble science articles, an overview of the telescope, and more. The complete volume and its component sections are available for download online at:

www.hubblesite.org/hubble_discoveries/science_year_in_review





A vibrant, multi-colored nebula, likely the Helix or Ring Nebula, is the central focus. The colors transition from deep blue on the left, through yellow and orange, to a rich, dark red on the right. A fine grid pattern is overlaid on the entire image, particularly visible on the right side. Several bright stars are scattered throughout, with a prominent one in the upper right. The overall composition is dynamic and colorful, representing a significant astronomical discovery.

Supporting Hubble



Daria Outlaw

Network Administrator
Raytheon

Daria Outlaw grew up in eastern North Carolina and came to NASA with a Bachelor's degree in Business Management and Administration from North Carolina Central University, in Durham. She joined the *Hubble* family in 1997 as a specialist in information technology, with the Raytheon Corporation. She works on the *Hubble* local area network, providing desktop, network, and technical support. While her specialty is Apple Macintosh support, she also has responsibility for audio-video conferencing systems. Daria works with *Hubble* staff at all levels, and takes satisfaction and pleasure at how the diversity of skills, interests, and backgrounds in the project contributes to making the perfect team.

She's proud to work on a project that provides so much fascinating knowledge about our universe to the science community, schools, and the population at large. "It's very personally motivating for me to work so close to the source of all this great information that the public desires."

Daria has many outside interests. For the past year, she has taught a weekly computer class as a volunteer at a local women's shelter. She also helps out at her daughter's high school as a parent volunteer. She is active in her church, where she works as an advisor and activities coordinator in the children's and youth ministries.

To maintain sanity in a busy life, Daria recommends—and makes a practice of—taking two vacations annually. "Vacations are relaxation for the mind, body, and soul," she likes to say. For her, the first break is for quality time with her daughter, Ebonee. The second is for down time, for herself or with close friends. Her favorite places for holidays are tropical and warm—or Europe. Daria also enjoys exploring the countryside by motorcycle.



Page 120–121: Located about 690 light years away in the constellation of Aquarius, the Helix Nebula, NGC 7293, is the result of a complex series of gaseous outbursts from its central star. The striated appearance of the inner rim is caused by a hot "stellar wind" of gas plowing into colder shells of gas and dust ejected previously by the volatile star.

Dave Campbell



Operations & Institutional Services Manager
NASA Goddard Space Flight Center

Dave Campbell was born and raised in Buffalo, New York. He started at NASA in 1983, fresh out of Morgan State University with a B.S. degree in Computer Science. He joined the Control Center Systems Branch, which is responsible for the design and implementation of control centers for spacecraft in low Earth orbit. Dave's first assignment was the early implementation of the *Hubble* operations control center. During that time, he also earned a second B.S. degree, in Electrical Engineering from the Johns Hopkins University. Over the next eight years, he helped develop the computer and network components that were incorporated in the ground systems of several missions managed by Goddard, including the *Cosmic Background Explorer* and the *Compton Gamma Ray Observatory*.

"I guess I had the classic engineer attitude growing up," Dave explains, "I loved science and math, but disliked English classes. When I was a kid, I loved taking things apart and putting them back together again. I was fascinated by the mechanics of how things worked. Even at the age of 12, I was extending and re-routing the telephone connections throughout the house."

Dave completed an M.S. in Engineering Management in 1991, when he became the Project Manager responsible for the real-time system in the control center for the *Rossi X-ray Timing Explorer*. Later, he returned to the *Hubble* project as the Deputy Operations and Testing Manager for the second servicing mission. Following that mission, he worked on the Earth Observing System for a few years before returning to *Hubble* for a third time, as the Deputy Manager for Operations Support.

Dave is currently the manager of the office responsible for the integrity of the operational ground system that controls the *Hubble* spacecraft, and for the network and voice communications in the day-to-day *Hubble* control center.

"Looking back on things, my dad was probably the biggest influence on me toward pursuing a career in engineering. He was an engineer, and I was very proud of him. It was guidance from my mom, though, that helped mold me into who I am today."

Dave lives in Clarksville, Maryland, with his wife and two children. He enjoys playing tennis, bike riding with his eight-year-old son and five-year-old daughter, swimming, and entertaining friends.



Denise Taylor

Head of the Observation Planning Branch
Space Telescope Science Institute

Denise Taylor grew up near Norfolk, Virginia. Her high school physics teacher sparked her interest in astronomy with field trips to the local planetarium. After obtaining a Bachelor's degree in Physics and Astronomy from the University of Virginia, Denise spent a year teaching physics and algebra at a military school in northern Virginia. There, she learned downhill skiing and minor auto repair (thanks to students' practical jokes). After that, she studied stellar evolution and star formation in spiral galaxies at the University of Massachusetts in Amherst, gaining an M.S. in Physics, an M.S. in Astronomy, and a husband (Engineering and Software Services Resource Manager, Dave Taylor).

For four years, Denise was the Assistant Director of Elementary Physics Laboratories at Mount Holyoke College in South Hadley, Massachusetts, in an otherwise all-male physics department for an all-female college. Her love of teaching brought her to Mount Holyoke's SummerMath program for several summers, where she developed and taught an astronomy class for high school girls. In 1989, Denise became the first Telescope Operations Assistant for the *International Ultraviolet Explorer (IUE)* at the Goddard Space Flight Center in Greenbelt, Maryland. For over two years, she assisted astronomers in planning their *IUE* observations and filling data gaps.

Denise came to the Institute in 1992 as a Technical Assistant. She became expert in implementing *Hubble* proposals using the High Speed Photometer, an original *Hubble* science instrument. She then took over all science and calibration proposals using the Fine Guidance Sensors (FGS), working closely with the Space Telescope Astrometry Team at the University of Texas in Austin. In 1994, as one of the first Senior Program Coordinators, Denise was responsible for implementing science and calibration proposals for the FGS, Faint Object Spectrograph, and Wide Field Planetary Camera 2. She also helped develop operational processes for analyzing bright-object alerts on all instruments. Later, she worked on proposals for the Space Telescope Imaging Spectrograph and Near Infrared Camera and Multi-Object Spectrometer. The year 1997 saw her move to Calibration Manager, coordinating the implementation and scheduling of all calibrations of scientific instruments. Denise has been the Head of the Observation Planning Branch since 1999, supervising Program Coordinators, assisting in long-range planning, and developing policies and procedures for *Hubble* users.

Denise's outside interests no longer include skiing. She finds reading and quilting to be relaxing, and enjoys spending time with her husband and son.

Jim Barcus



Launch Support Manager
NASA Goddard Space Flight Center

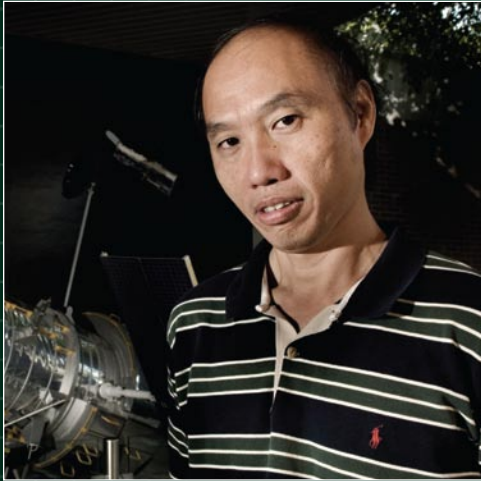
Jim Barcus was born in Cheverly, Maryland, just a few miles from Goddard Space Flight Center. He graduated from St. John's College High School and Prince George's Community College. He has worked at Goddard since 1968 and has been a part of the *Hubble* family since 1991.

As Launch Support Manager on the *Hubble* development project, Jim is responsible for *Hubble* ground and flight hardware worth over \$2.5 billion. He has performed logistical support for every *Hubble*-related shuttle mission—including the high-profile STS-95 mission, which carried Senator John Glenn and tested new *Hubble* equipment on orbit.

Jim is affectionately known as the “Radar O’Reilly” of the *Hubble* program for his resourcefulness and uncanny ability to anticipate the program’s needs. In addition to coordinating the movement of more than 400 truckloads of *Hubble* equipment, he sometimes orchestrates domestic and international transportation of *Hubble* hardware aboard C-5 military cargo planes and seafaring barges.

“As a kid, I used to lay out on the lawn during summer nights to look up at the stars and imagine what it would be like to see them up close. Contributing to *Hubble*’s development, I feel as though I’ve come as close to realizing that dream as one could without becoming an astronaut,” says Jim. “I feel a real sense of pride playing a small part in the goal of unraveling the mysteries of the universe. It’s also gratifying to know that the technologies we develop for *Hubble* benefit people in other ways. For example, I understand the sensitive instrument detectors developed for the *Hubble* cameras are also being used by the medical community to perform tissue analysis without the need for surgery. This is really great!”

Outside of work, Jim is an avid softball player—still competing after 38 years of team play. He enjoys landscaping around his new home on the water in Delaware, and relaxing at the beach with Linda and their grown children.



Ed
Moy

Safing Systems Engineer
Lockheed Martin

Ed Moy began working on *Hubble* over 20 years ago, as a Research Engineer for Lockheed Missiles and Space Company. He helped develop and test the pointing-control system. From 1986 until launch in 1990, he was responsible for refurbishing and integrating the independent safe-mode computer. This serves as a critical backup to the primary operational computer in detecting and responding to anomalous spacecraft conditions.

Ed supported the *Hubble* launch at the Marshall Space Flight Center, serving as Lead Pointing-Control Engineer. He was a key player during operational verification. Following his return to Sunnyvale, California, he helped develop and test the fix for spacecraft jitter caused by the solar arrays. He also helped improve the safe-mode design by developing and testing multiple schemes for stabilizing the spacecraft on the Sun—without using the gyroscopes.

In 1993, Ed came to Goddard as a System Engineer for the safing subsystem. He supported all four servicing missions in that position. This involved developing procedures for analyzing and responding to faults in advance of the missions, as well as providing real-time support at the console during the actual missions. Ed continues to work on the design, testing, and analysis of the pointing-control and safing subsystems of the *Hubble* spacecraft. He works to refine and improve control modes based on fewer than the normal three gyroscopes—in case of failures. These designs include the one- and two-gyro science modes, and the “Kalman filter Sun-point mode.”

Ed says a trusted graduate professor helped form his vision of pursuing a career in spacecraft design. “The *Hubble* operations and engineering teams always seem to be able to perform the impossible,” he says. “It is very rewarding to work daily with such a capable crew, and to know that our work enables major astronomical discoveries.”

Ed currently resides in Elkridge, Maryland, with his wife and their child. Among his outside interests are playing basketball and pursuing other outdoor activities. He enjoys spending his spare time with family and friends.

Darlene Spencer



Administrative Assistant, Science Missions Division
Space Telescope Science Institute

Darlene Spencer was born and raised in Baltimore, Maryland. She joined the Space Telescope Science Institute in February 1989 as a temporary employee, and was hired full time in June of the same year. She is an Administrative Assistant in the Science Missions Division, in charge of logistical support and arrangements for the annual peer review of *Hubble* proposals.

Darlene's responsibilities for the peer review include receiving proposals, handling sensitive review materials, maintaining comprehensive databases, and setting up the meetings of the disciplinary panels and the Telescope Allocation Committee, which evaluate proposals and make recommendations to the director of the Institute. Darlene coordinates the scrupulous process of selecting *Hubble's* observations for the coming year, and ensures that it runs efficiently. This year, during one week in March, 109 astronomers met in Baltimore for the peer review, and allocated observing time to 206 proposals out of a total of 733 submitted. The process ran smoothly, and the successful proposers were notified of their selection within 10 days of the final review session.

During her time at the Institute, Darlene witnessed the momentous transition from paper submission of proposals to the totally electronic version. This change brought welcome relief from the tedious tasks of filing, proofing, and mailing 30 hard copies of each proposal.

Darlene also supports the Hubble and Institute Fellowship programs. In addition to her administrative work, she arranges the meetings of the review panels that select the fellows, and organizes the annual Hubble Symposium, where Hubble Fellows meet each other and present their research.

Darlene is strongly involved in her community. She teaches children ages three to six, and actively participates in ministries at the Central Church of Christ. Her hobbies consist of shopping, traveling, reading religious, inspirational, and motivational books, listening to music, and collecting snow globes and state magnets.

Darlene resides in Owings Mills, Maryland, with one of her daughters, Dwayaa'. She spends much joyful time with her granddaughter ZaRiah, the child of her second daughter, Unique.



Pete Pataro

Lead, Flight Operations Support Team
Lockheed Martin

Very few people who work at the Goddard Space Flight Center have been around as long as Pete Pataro. He started in 1967, as a member of the network support team for the operations center of the *Apollo* program. He worked on all the *Apollo* missions, from the early *Saturn V* test flights through the final moon landing of *Apollo 17*. He then moved on to the *Apollo-Soyuz*, *Skylab*, and the shuttle programs before joining the next great program to come to Goddard—*Hubble*—in 1985.

Pete is part of the flight-operations group for *Hubble*. He started on the console, as a flight controller responsible for operating the data management and communications systems of the spacecraft. Later, he became a shift supervisor, and served in that capacity for the *Hubble* deployment and first servicing missions. For the second through fourth servicing missions, he again served on the console, coordinating between the Goddard *Hubble* team and the payload officer at the Johnson Space Center.

Pete is now a member of the Operations Support Team under the Lockheed Martin Systems Management Office. He manages the daily use of the operational and backup ground systems, and is the point of contact between the flight operations team and external operational organizations, including the Space Telescope Science Institute, the Tracking Data and Relay Satellite System, the Deep Space Network, the NASA Ground Network, and the NASA Communications and Internet Network.

Pete once said in an interview: “Working with the *Hubble* team on this project is the highlight of a great career. To be part of something that makes history every day is the best place in the world to be. When people ask and I tell them what I do, they always say that my job sounds like a lot of fun—and you know what? It is!”

Pete’s love for aeronautics began at an early age; his father was in the U.S. Air Force, and Pete grew up on Air Force bases, where the latest planes, avionics, and electronics were constant topics.

When not supporting *Hubble*, Pete and his wife, Alice, enjoy visiting inspiring places to study American history, and seeking out good restaurants to enjoy a meal and discuss what they have learned. Pete also enjoys hiking in the Blue Ridge Mountains and along the Appalachian Trail, fly-fishing in Pennsylvania’s fabled limestone streams and creeks, and reading everything from Harry Potter books to the history of the 8th Air Force.

Jean Plants



Resources Analyst
NASA Goddard Space Flight Center

Jean Plants was born and raised in Maryland and graduated from the University of Maryland, College Park with a Bachelor's degree in Economics. After graduation, she began working for the Federal Energy Regulatory Commission. Two years of commuting to Washington, DC, made Jean envious of her husband's 15-minute commute to Goddard Space Flight Center. Along with first-hand knowledge that Goddard is a great place to work, the easy commute made it a logical place to search for a job when she began to plan a career move. In 1987, she accepted a position as a Cost and Price Analyst in the Procurement Support Division. Four years later, Jean switched to a role in resources and budgeting. Shortly thereafter, Jean became a Resources Analyst for the Communications Division, taking on financial responsibilities for a \$72 million budget.

Jean joined the *Hubble* team in 2000 as a Resources Analyst in the Operations Project. For five years, she served as the analyst for the major contract providing for the day-to-day operations of the telescope, including the development and maintenance of its ground system. Jean prepared yearly budget estimates for the contract, monitored its monthly costs and funding needs, and supported procurement actions—all the while keeping the contract synchronized with the project's requirements.

Last fall, Jean became the resources analyst on the Space Telescope Science Institute contract. The contract scope includes solicitation of observation proposals, allocation of telescope time, implementation of the weekly observing plans, and creation of processed data products. Jean considers herself very fortunate to work for *Hubble* and is continually amazed by the engineering behind operating and servicing the observatory—and by the incredible science it produces.

"I am a nature lover," she explains. "My kids get tired of me 'oohing' and 'aahing' over the scenery we travel through—the sunsets, clouds, stars, mountains, lakes, birds—endless natural beauty. NASA brings the beauty of the universe to us all. For me, it shows the awesome power of God. As a non-scientist and non-engineer who could be doing budgeting work for any type of organization, I count myself as really blessed to be able to do what I do for NASA and *Hubble*."

Jean and her husband, Michael, celebrated their 20th anniversary this year and are the proud parents of Kacie, 14, and Julia, 12. Jean and her family live in Ellicott City, Maryland, and enjoy camping, music, playing games, and visiting with their extended family.



Patricia Coleman

Operations Systems Management Manager
Honeywell Technology Solutions, Inc.

Pat Coleman's interest in space and astronomy started when she was young. She remembers being inspired by the children's book she was given, *You Will Go to the Moon* by Mae Blacker Freeman. It wasn't until she watched the touchdown of the first space shuttle flight, however, that she realized it was really time for her to get involved. It was then that Pat made a major career change, deciding to give up teaching, which she had done for 10 years, and pursue aerospace work, which more directly utilized her education in computer programming and degree in mathematics.

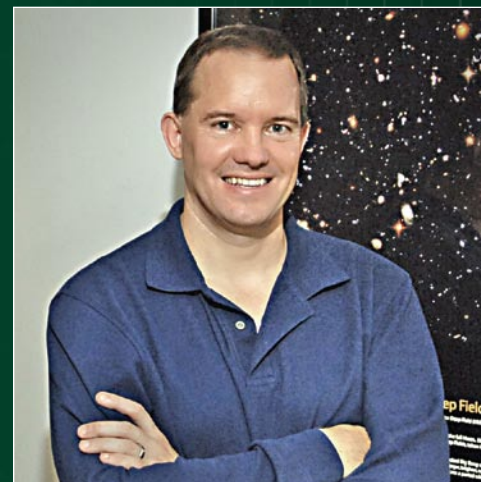
In the spring of 1984, Pat began working for the Bendix Field Engineering Corporation (now Honeywell) at the Goddard Space Flight Center. She worked in the command management facility, providing support to two flight projects: the Solar Maximum Mission and the *Solar Dynamics Explorer*. She later transferred to the *Hubble* mission operations program, supporting various engineering aspects of *Hubble* operations ever since.

Before *Hubble* was launched in 1990, Pat worked in the Mission Planning Office, writing documentation and procedures to establish interfaces between *Hubble* operations at Goddard with those at the Space Telescope Science Institute. She also evaluated software output products to resolve errors, and supported ground-system tests between Goddard and Lockheed in Sunnyvale, California, where the spacecraft was built. "One of my greatest thrills was to see *Hubble* prior to launch," she says. "It was impressively large, marvelously complex, and strikingly beautiful."

By the first *Hubble* servicing mission, Pat was managing the project database office—building parallel-command and telemetry databases to support operations and servicing mission development. For the next nine years, she managed a test team responsible for integrated testing of the ground system, deliveries of flight software, and servicing-mission operations and ground-system testing of the *Hubble* replacement hardware and science instruments.

Pat is a talented seamstress. She has made drapes (for 20 by 20 foot windows!) for a home listed on the historical register in Washington, DC. Such attention to detail and the ability to oversee large projects have served her well in tackling her current *Hubble* assignment—leading the Systems Management Operations Team, which coordinates engineering acceptance testing, oversees on-orbit activities performed by the spacecraft subsystem engineers, investigates anomalies, and supports operations with planning and preparations for the next servicing mission. "I consider myself very fortunate to have been given the opportunity to continually learn and grow on the *Hubble* project all these years," she says.

Keith Walyus



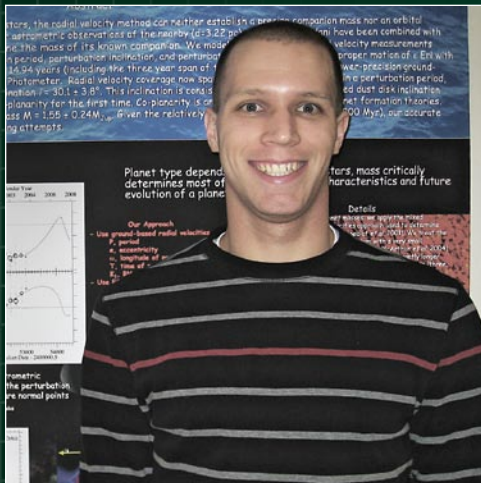
Servicing Mission Operations Manager
NASA Goddard Space Flight Center

Keith Walyus joined the *Hubble* operations team in 1998. He has held various jobs on the project, starting as a systems engineer and then becoming the deputy flight operations manager in 2000. He has been the Servicing Mission Operations Manager since shortly after Servicing Mission 3B in 2002.

Keith began his NASA career in 1985 as an Air Force 2nd Lieutenant working at the Johnson Space Center in Houston, before becoming a NASA employee in 1989. He moved to the Washington, DC area and became a Goddard Space Flight Center employee in 1993. For Keith, working in conjunction with the staff at Johnson Space Center on a servicing mission is a kind of a homecoming. In fact, some of the engineers and managers who are supporting the next *Hubble* servicing mission were fellow Air Force officers with Keith in Texas.

Keith is a member of the Goddard's Speakers Bureau and enjoys giving talks to various internal and external organizations. "What always impresses me is the deep and genuine interest everyone has in the status of *Hubble*," he comments. "To me, it seems that *Hubble* has passed beyond being just a telescope and is now a cultural icon. It gives one a tremendous feeling of accomplishment to be able to show people pictures from *Hubble*, and to know that I've played a part in these discoveries."

Keith and his wife, Christine, have three daughters, ages three and under. He hopes that a successful servicing mission will allow the telescope to operate long enough for his girls to also be amazed by some of *Hubble's* discoveries as they occur. In his spare time (which isn't too often with three small children!) Keith enjoys biking, running, and martial arts.



Graduate Student
University of Texas at Austin

Jacob Bean is a fourth year doctoral candidate in astrophysics at the University of Texas in Austin. His dissertation research is focused on determining the atmospheric compositions of the lowest-mass stars—the so-called “red dwarfs.” Building on previous work in the field, Jacob developed the first technique to accurately determine the atmospheric compositions of these stars. He uses his newly developed technique to quantify the relationships between composition, luminosity, and the probability of planet formation in red dwarfs.

In 2002, Jacob earned a B.S. in Physics from the Georgia Institute of Technology. After graduating, he chose to attend the University of Texas for graduate school and to work with the *Hubble* Astrometry Science Team.

In addition to his dissertation research on red dwarfs, Jacob is involved in projects using *Hubble's* Fine Guidance Sensors (FGSs) to make precise measurements of the distances to planetary nebulae and Cepheid variables, the absolute dimensions of extrasolar planetary systems, and the masses of red dwarfs. Jacob is responsible for reducing the *Hubble* data for these projects. He also coordinates the collection and analysis of supporting spectroscopic data obtained at ground-based telescopes.

Jacob says he particularly enjoys working with the high-quality data from the FGSs, because *Hubble* was one of the reasons he chose a career in astronomy. “The stunning images of distant galaxies, gaseous nebulae, and star clusters that *Hubble* produced in the late 1990s came at a time when I was deciding what degree to pursue as an undergraduate. The popular articles that accompanied those images in the media left me wanting to know more details.”

Outside of astronomy, Jacob enjoys competitive road cycling and long-distance swimming. He enjoys training with his wife, who shares similar interests. Together they also enjoy hiking, traveling, cooking, and are trying to raise an unruly cat named Spock.



Risa Wechsler



Hubble Fellow
University of Chicago

Risa Wechsler is finishing her third year as a Hubble Fellow at the University of Chicago, where she works at the Kavli Institute for Cosmological Physics. She is a theoretical cosmologist, who primarily studies the formation of large-scale structure and galaxies in the universe.

Risa was an undergraduate in physics at MIT. She received her Ph.D. in Physics in 2001 from the University of California at Santa Cruz, where her work focused on galaxy clustering and the assembly history of the dark matter concentrations that host galaxies. Before starting her Hubble Fellowship, she was a postdoctoral fellow for two years at the University of Michigan.

As a Hubble Fellow, Risa's research has focused on theoretical interpretations of data from the *Hubble Space Telescope* and ground-based surveys relating to the evolution of concentrations of dark matter and the galaxies that form within these concentrations. Particularly important are new observations from *Hubble* on the clustering properties of distant galaxies and the evolution of the size, color, and brightness of galaxies. She hopes to discover how these properties depend on the nature of the dark matter, the cosmological parameters, and the heating and cooling of the interstellar gas available to form new stars. By varying those parameters in her models, she can form different hypothetical universes to compare with the observations. Through such comparisons, she tests and improves the basic assumptions of the models, leading to an improved understanding of galaxy formation and the connection between light and the nonluminous mass in the universe.

Risa enjoys sharing the excitement of cosmology and astronomy with the public. In 2005, she gave the Compton Lectures, a series of public lectures at the University of Chicago extending over an academic quarter. Her series was entitled "The Story of Galaxy Formation in our Universe." This "story" has become much easier to tell with the beautiful and inspiring images taken by *Hubble* in the past several years.

In fall 2006, Risa became an Assistant Professor of Physics at Stanford University and at the Stanford Linear Accelerator Center, where she is associated with the Kavli Institute for Particle Astrophysics and Cosmology. Although she enjoyed Chicago immensely, she has been looking forward to living in San Francisco and to getting back to her native West Coast and some topographical contrast. When she's not working, she enjoys traveling, hiking, dancing, yoga, and eating great food.