ASTRONOMY BEAT

Nancy Roman: An Astronomer's Life

Nancy Grace Roman

When I was a girl, women were not supposed to be scientists. At least, that's what I was told, many times, by many people. My parents were supportive, though my mother offered subtle hints that she was not sure about my choice.

I don't remember precisely how I became interested in astronomy. What I do recall is that in Reno, Nevada, between fifth and sixth grades, I organized friends into an astronomy club that met once a week during the summer to learn the constellations. And in seventh grade, I read every astronomy book I could find in the Baltimore city library. By then my path was set, in spite of the years and years of education that I knew lay before me. I decided that if I did not make it, teaching high school math or physics would be a safe (and gender appropriate) Plan B.

However, first I had to get through my secondary schooling, which included overcoming one guidance counselor's condescension regarding my desire to take a second year of algebra versus a fifth year of Latin: "What lady would take mathematics instead of Latin?"

The first lukewarm encouragement I received was in 1945, during my junior year in Swarthmore College. The head of the physics department told me, "I usually try to dissuade girls from majoring in physics but I think *maybe* you *might* make it." After graduating with a BA in astronomy in 1946, I experienced no problems in graduate school at the University of Chicago, even though the professors clearly did not like educating women. "You just go off and get married," was their attitude.

Because of her tireless efforts in support of a space-based observatory, Nancy Roman is often considered the "mother" of the Hubble Space Telescope. *[NASA]*

Studying Stars in the Milky Way

I remained at the University of Chicago for six years after earning my

PhD in 1949 — as a postdoc, instructor, and assistant professor. Scientifically, 1949 to 1955 was a great time. I taught both formally and informally and had time for scientific research.

It was during this period that I made an exciting discovery. Among bright stars somewhat similar to the Sun, some contained a larger number of heavy elements (heavier than hydrogen) than others. In addition, stars with more heavy elements orbited the galactic center in nearly circular orbits and stayed near the plane of the Milky Way, while stars with fewer heavy elements circled the galactic core in slightly more elliptical orbits and strayed farther from the galactic plane. While it had been known for some time that a small number of stars with few heavy elements moved in very eccentric orbits, no one had ascertained that normal stars also demonstrate subtle differences.

This discovery provided the first clue to the evolution of the Milky Way. Stars make all elements heavier than hydrogen, helium, and lithium. When the stars get old, they spew these heavy elements into interstellar space, where they are incorporated into the process of starbirth. Hence stars with more heavy elements are younger (with circular orbits in the galactic plane), while the stars with fewer heavy elements are older and have galactic orbits that become more random with time.

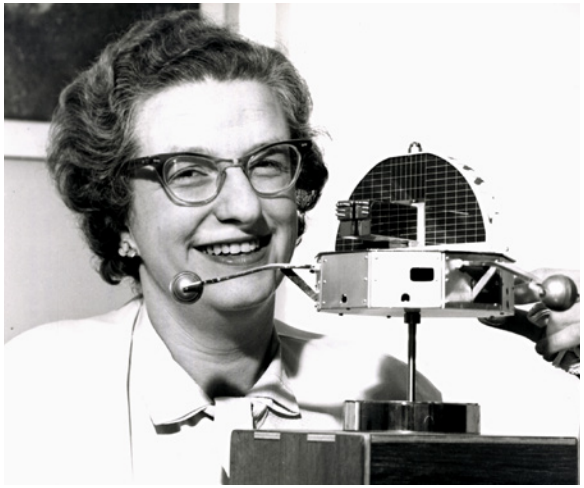
Discovery of a Strange Star

Work on bright stars sparked my interest in galactic structure and the galactic distribution of stars with various abundances. I discovered that it was easier for me to estimate the heavier element abundances by the colors of stars rather than by studying their spectra. However, I still trusted spectra to highlight possible peculiarities in the stars. Thus, I embarked on a program of measuring the spectra and colors of stars near the galactic plane, and at a distance away from the plane, to learn how the distribution of weak- and strong-line stars varied with galactic latitude.

Artist's drawing of NRL Building 43 with a bust of Thomas Edison (which honors his role in founding the Laboratory) in the foreground, and a 50-foot radio telescope dish atop the building. The antenna is the one Nancy Roman used to map the sky at 67 cm. The dish has become the unofficial symbol of the Laboratory. *[Courtesy Naval Research Laboratory.]*

During the course of this work, I observed a star that, according to a catalog, should look like the Sun. But the spectrum did not look at all like the Sun's, so I thought I had observed the wrong star. (Stars look pretty much alike, even through a telescope.) When it looked the same the next night, I observed it with a different spectrograph. After analyzing the spectra, I published a two-page note about the star (BD+67 922, now known as AG Draconis) in the *Astrophysical Journal* and continued with my stellar abundance project. I didn't realize how these observations would change my life.

In the early 1950s, women had little or no chance of acquiring



Nancy Roman is shown with a model of the Orbiting Solar Observatory (OSO) in 1962. Throughout her career, Dr. Roman was a spokesperson and advocate of women in the sciences. *[NASA]*

tenure in a university's astronomy research department. So when professor Gerard Kuiper alerted me to an opening in radio astronomy at the US Naval Research Laboratory (NRL), I decided to take it. Radio astronomy was new in this country at that time, and I thought it had much to contribute to our understanding of the structure of the Milky Way. I was correct, but it was too early. Back then, a radio astronomer was expected to build his or her own instruments, and I did not want to start over as an electronic engineer. Moreover, the technology was not yet up to the task. Nevertheless, I mapped the sky at 67 cm and participated in improving the value of the distance to the Moon using radar. By comparing my measurement of the galactic center region with those of a colleague at a shorter wavelength, I determined that Sag A, which was thought to be the galactic center, was actually a composite source.

After I had been at the NRL for about a year, I was invited to the dedication of an observatory in Armenia. I later learned this came about because of my two-page note on that strange star I'd observed several years before. When I returned, I gave a lecture on my visit to the Soviet Union, and then a series of lectures on astronomy. By this time I was well ensconced in the NRL, and it seemed that everybody there knew about me.

My First NASA Career

When NASA was formed in 1958, many NRL scientists were recruited to form the nascent Goddard Space Flight Center. At NASA Headquarters, the Associate Administrator for Space Science and Application (Homer Newell) and the Director of Geophysics and Astronomy (Jack Clark) were also from NRL. Shortly after the agency's founding, I attended a lecture at NASA Headquarters. Jack asked if I knew anyone who wanted to set up a program in space astronomy.

While uncertain that I wanted to leave research, I decided that the opportunity to organize a program that would influence astronomy for a half century was too tempting to resist. Thus, in early 1959, when NASA was only six months old, I initiated a program that eventually included 20 satellites, balloons, many sounding rockets, and an extensive program of ground-based research and technological development necessary to support the space observations.

During the next 20 years, I served as Chief of the Astronomy and Relativity Programs in the NASA Office of Space Science. I was responsible for developing the programs and the organization of the scientific participation, as well as for insuring both the scientific integrity of the programs and the maximum scientific return within budgetary and engineering constraints. Three of the numerous missions that were my scientific responsibility included the Orbiting Astronomical Observatories, International Ultraviolet Explorer, and the Hubble Space Telescope (early planning and development and program structure).

Nancy Roman sits at the control console for the OAO-3 satellite, launched in 1972 and nicknamed Copernicus. This is a publicity picture; she never actually worked in the Goddard control room. *[NASA/ASP]*

A Second Career

In 1979, NASA provided me with an opportunity to retire early. Although at 54 I felt too young to quit working entirely, family responsibilities made working full-time difficult. In considering a return to research, I had two new technologies to learn: modern computers and digital detectors. At the local community college, I audited a course in FORTRAN. At its conclusion, however, I realized that I could not return to forefront research after more than 20 years of management, so I began to look for a part-time job.

At a Hubble meeting, I asked a manager at ORI (a government contractor) for a job as a consultant. The company had a major contract to support NASA Goddard, and much of my work there concerned the Hubble. I also conducted two studies on various techniques to measure the motions of tectonic plates.

Dr. Roman and a model of the Hubble Space Telescope. In 1965 she decided that she'd better jump into the discussions about a possible space-based observatory and steer things in a direction that made sense. *[NASA]*

When ORI lost the NASA contract, I began consulting with McDonnell Douglas, where I worked primarily on Earth observations — instruments for looking down that boasted many similarities to instruments looking up. When the work slowed and I felt the need for a greater challenge, I went to Goddard to inquire about the Astronomical Data Center. I told them: "I know astronomical catalogs. If you will teach me computers, I'd like to work for you." I landed the job, which grew in scope and responsibility, and eventually (in 1995) I became Director of the Center.

A Second "Retirement"

In late 1997, I started a more relaxed program of social, volunteer, and cultural activities. Reading for the Blind and Dyslexic (now Learning Ally) was seeking volunteers who could read astronomy books. I started helping them in 1998 and continue to do so. For a number of years I also worked with school children, first once a week for seven weeks each semester at an elementary school in Washington, DC, and then with "Journey to the Universe," a program that sent scientists and engineers to underserved areas of the US to work with schools for week at a time. I continue to work with school classes individually and, occasionally, speak about astronomy to adults.

Dr. Edward J. Weiler, NASA's Associate Administrator of the Science Mission Directorate, presents the Association of Women in Aerospace's Lifetime Achievement Award to retired NASA Chief Astronomer Nancy Grace Roman at the organization's annual awards ceremony and banquet held at the Ritz-Carlton Hotel in Arlington, VA, on Oct. 26, 2010. *[NASA/Bill Ingalls]*

In 2010, I attended a conference at the Space Telescope Science Institute on abundances in stars. Today, abundance estimates are not limited to hydrogen versus heavier elements but also include details on the abundances of many other elements. Moreover, for

cruder estimates, instead of observing spectra of one star at a time, many abundance estimates are being done photometrically on hundreds or even thousands of stars simultaneously. It emphasized to me how far the field has come since my early work a half century ago.

About the Author

Although I love astronomy and it gave me a wonderful career, I have other interests both in and outside the home. Working part time lets me enjoy these as well. I am not sure I have hobbies — I like too many things! A major activity is reading (I'm in two book groups). I like to cook and sew, though I seem to have less time for them than I used to. I still enjoy music, playing the piano (badly) for my own enjoyment, and attending concerts. I take advantage of the art museums and the lectures in the Washington area. I am also doing some non-astronomical traveling to interesting places … without observatories!

Resources

- The "Mother" of the Hubble Space Telescope: www.youtube.com/watch?v=b2movHF4NzA
- US Naval Research Laboratory: www.nrl.navy.mil
- Oral History Transcript: Nancy Grace Roman, September 2000: www.jsc.nasa.gov/history/oral_histories/NASA_HQ/Herstory/RomanNG/NGR_9-15-00.pdf
- In 2011 NASA established the Nancy Grace Roman Technology Fellowship in Astrophysics, designed to foster technologies that advance scientific investigations in the origin and physics of the universe and future exoplanet exploration. http://science1.nasa.gov/researchers/sara/student-programs/nancy-grace-roman-technology-fellowships-astrophysics-early-career-researchers/ ✦

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