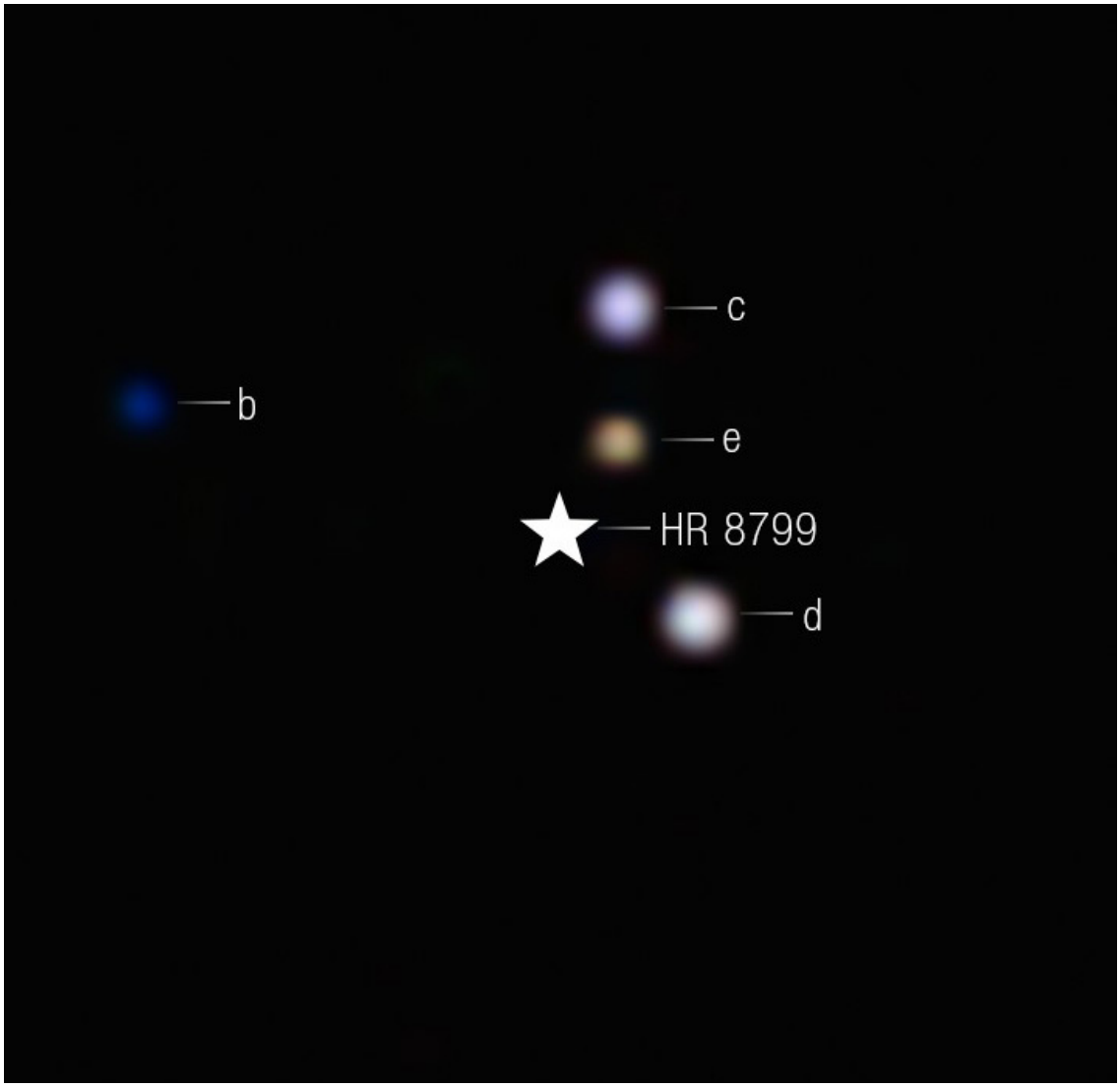
The ECLIPSE

May 2025

The Newsletter of the Barnard-Seyfert Astronomical Society



How Do We Find Exoplanets?

By: Dave Prosper
Updated by: Kat Troche

Astronomers have been trying to discover evidence that worlds exist around stars other than our Sun since the 19th century. By the mid-1990s, technology finally caught up with the desire for discovery and led to the first discovery of a planet orbiting another sun-like star, Pegasi 51b. Why did it take so long to discover these distant worlds, and what techniques do astronomers use to find them?

continued on Page 7

BSAS
Barnard-Seyfert Astronomical Society

Officers

Tom Beckermann
President

Steve Hughes
Vice President

Bud Hamblen
Secretary

Theo Wellington
Treasurer

Keith Rainey
Ex-officio

Directors at Large

Cory Brucker

Chip Crossman

Tony Drinkwine

Stephanie Brake

Andy Reeves

Kathy Underwood

Contact BSAS officers at bsanashville.com/contact, or email info@bsanashville.com

About BSAS

Organized in 1928, the Barnard-Seyfert Astronomical Society is an association of amateur and professional astronomers who have joined to share our knowledge and our love of the sky.

The BSAS meets on the third Wednesday of each month at the at the Dyer Observatory in Nashville. Experienced members or guest speakers talk about some aspect of astronomy or observing. Subjects range from how the universe first formed to how to build your own telescope. The meetings are informal and time is allotted for fellowship. You do not have to be a member to attend the meetings.

Membership entitles you to subscriptions to Astronomy and Sky & Telescope at reduced rates; the club's newsletter, the Eclipse, is sent to members monthly. BSAS members also receive membership in the Astronomical League, receiving their quarterly newsletter, the Reflector, discounts on all astronomical books, and many other benefits.

In addition to the meetings, BSAS also sponsors many public events, such as star parties and Astronomy Day; we go into the schools on occasion to hold star parties for the children and their parents. Often the public star parties are centered on a special astronomical event, such as a lunar eclipse or a planetary opposition.

Most information about BSAS and our activities may be found at bsasnashville.com. If you need more information, write to us at info@bsasnashville.com.

Free Telescope Offer!

Did someone say free telescope? Yes, you did read that correctly. The BSAS Equipment & Facilities Committee has free telescopes ranging in size from 2.6" to 8" that current members can actually have to use for up to 60 days at a time. We also have some other items in the loaner program such as a photometer, H-alpha solar telescope, educational CDs, tapes, DVDs, and books. Some restrictions apply. A waiting list is applicable in some cases. The BSAS Equipment Committee will not be held responsible for lost sleep or other problems arising from use of this excellent astronomy gear. For information on what equipment is currently available, contact info@bsasnashville.com.

Happy Birthday: Nancy Grace Roman

by Robin Byrne

This month, we celebrate the life of a woman known as the "Mother of Hubble," but who contributed so much more. Nancy Grace Roman was born in Nashville, Tennessee May 16, 1925. Her mother, Georgia, was a music teacher, while her father, Irwin, was a physicist. When she was only 3 months old, Nancy's family moved to Oklahoma, where her father took a job with an oil company. That was the first of several moves in Nancy's early life, living in Texas, New Jersey, Michigan, Nevada, and finally settling in Baltimore, Maryland when Nancy was 12 years old.

It was at about the same time that Nancy's interest in astronomy solidified, even founding an astronomy club with some of her classmates. It was Nancy's mother who was responsible for this interest, though inadvertently. Nancy's mother loved nature and would take her for walks to share its beauty. While the focus was on plants and animals, she also pointed out some constellations and the occasional aurora display. The plants and animals didn't make nearly as strong an impression as the night sky. Nancy was determined to pursue astronomy as a career, so in high school, she tried to take courses that would prepare her for a science major. When she asked her high school guidance counselor if she could take a second year of algebra, instead of Latin, the counselor asked, "What kind of lady would take mathematics instead of Latin?" Apparently, the kind who would go on to make a great success for herself.

After finishing high school in only 3 years, 17-year old Nancy enrolled at Swarthmore College, determined to major in astronomy in the face of both the dean of women and the dean of astronomy, both of whom were completely unsupportive of this plan. But Roman persevered, taking astronomy classes while learning observational techniques with two student telescopes that had fallen into disrepair, and which she had made functional. By her sophomore year, Roman was working in the campus observatory, processing photographic plates. In her junior year, Roman got what might have been the first true words of encouragement, and they were from one of her physics professors, who said, "You know, I usually try to talk women out of going into physics. But I think maybe — you might make it."

continued on next page

Roman, continued

When Roman graduated from Swarthmore in 1946, the dean of astronomy suggested the University of Chicago for her graduate work. Roman was more interested in observational astronomy over theoretical work, and requested from multiple professors the opportunity to work on an observing programt. Using the 12-inch telescope at Kenwood Astrophysical Observatory, Roman studied the motion of the stars in the Ursa Major Moving Group, basing her dissertation on the project. Nancy Grace Roman graduated with a PhD in astronomy in 1949.

After graduation, she moved to Wisconsin for the next six years as a research associate and assistant professor at Yerkes Observatory. Here, her research was primarily related to stellar spectroscopy, looking at high-velocity stars. She found that the motions of stars composed only of hydrogen and helium move in our galaxy in a different way than stars that also have heavier elements. This was early evidence for the two stellar populations we now know exist in the Milky Way.

When it became clear that women had little chance of receiving tenure at a university (only one woman had a tenured astronomy faculty position in the entire country at the time), Roman decided to take a job at the Naval Research Laboratory (NRL). It was at NRL that Roman became involved in the relatively new field of radio astronomy. As one of the few people in the program who had actually studied astronomy, Roman became the go-to person for all things astronomical, including the Vanguard satellite program. While not that interested in rocketry, Roman saw potential for pursuing astronomical observations from space. Roman was invited to speak in Armenia (then part of the Soviet Union) at the dedication of a new observatory there, becoming the first civilian to travel to that country during the Cold War. This trip led to invitations to give public lectures about visiting the USSR, as well as speaking about astronomy.

In 1959, shortly after the formation of the National Aeronautics and Space Administration (NASA), Roman attended a lecture there and was asked if she knew of anyone who would be interested in creating a space astronomy program for NASA. She knew exactly who to suggest - herself! Roman later said, “I knew that taking on this responsibility would mean that I could no longer do research, but the challenge of formulating a program from scratch that I believed would influence astronomy for decades to come was too great to resist.” In February 1959, Nancy Grace Roman officially was named Head of Observational Astronomy, with the title changing to Chief of Astronomy the following year. In addition to being the first person to hold this position, she was also the first woman to hold any executive role at NASA.

Initially, much of her job involved figuring out what her office would actually do. She travelled around the country, visiting astronomy departments to let them know about NASA's commitment to astronomy, and soliciting ideas about what kinds of programs they should be pursuing. She was effectively laying the groundwork for space-based astronomical observations. Early on, the decision was made that the data obtained through NASA-run projects would be made available to the entire astronomical community, not the sole property of the researchers initiating the observations. At first, Roman was the sole person responsible for deciding which projects were approved. It wasn't until the 1970's that outside peer review became the standard.

In 1959, Roman published a paper outlining a technique that could be used to detect planets around other stars. The idea was to use a space-based telescope, with a mask covering the bright star, in order to photograph the region around the star. This method was used much later by the Hubble Space Telescope to image Fomalhaut B.

As part of her duties, Roman was in charge of the Orbiting Astronomical Observatories program (OAO). The first successful OAO was launched in 1968, which was the Copernicus Ultraviolet Telescope. Other orbiting telescopes she oversaw included: the Uhuru X-ray telescope, the Small Astronomy Satellite 2 gamma-ray telescope, and the Small Astronomy Satellite 3 X-ray telescope. Additionally, she spearheaded the development of programs conducting astronomy from high altitude aircraft, including the Kuiper Airborne Observatory. Other orbiting telescopes that were developed later, during her time at NASA, included the Cosmic Background Explorer, the Infrared Astronomy Satellite, and the International Ultraviolet Explorer.

One thing you may have noticed about those instruments is that they were all devoted to wavelengths outside of the visible spectrum. From the start of the OAO, putting a large optical telescope into Earth orbit was a goal, but Roman approached it cautiously, starting with smaller telescopes, while also taking advantage of the space environment to observe at wavelengths not visible through Earth's atmosphere. Once the technology was proven to be successful, as early as 1969, Roman began to champion the idea of a space-based optical telescope. Originally called the Large Space Telescope, this program became her pet project. For several years, Roman devoted her time to leading planning committees comprised of engineers and astronomers, while also lobbying politicians. Over the next decade, the program took shape, including such milestones as deciding this would be the first major telescope that would use a CCD detector, plus creating a separate entity, the Space Telescope Science Institute (STScI), to manage operations of the observatory. Probably the toughest part of the entire endeavor was convincing congress to fund it. Countless trips to Washington, and endless meetings became Roman's regular

continued on next page

Roman, continued from previous page

routine. When Senator William Proxmire asked her why the average American would want to pay for such an expensive piece of equipment, Roman replied, "For the price of one night at the movies, each American would receive 15 years of exciting discoveries." In actuality, she undersold it - we're now in the 35th year of Hubble's contributions to science.

Nancy Roman retired from NASA in 1979 to take care of her mother. For the first year of her "retirement," she continued working as a consultant to help in establishing the STScI. Meanwhile, she learned to program in FORTRAN, leading to a consultation job supporting research in geodesy and creating astronomical catalogs - ironically, two areas of research she was involved in at the very start of her career.

Despite moving on from NASA, Roman kept up-to-date on what was happening with the Hubble Space Telescope. She was even in attendance (knitting in the back of the room) when NASA made their announcement for the first repair mission. And her semi-retirement was interrupted when Roman became the head of the Astronomical Data Center at Goddard Space Flight Center from 1995 - 1997, followed by three years teaching science teachers and advanced junior and senior high school students. And even then, she wasn't done. From 2000 to 2010, Nancy Roman worked for an organization called Reading for the Blind and Dyslexic, recording astronomical textbooks.

In 2017, Nancy Roman was included in the Women of NASA LEGO Set, which she described as being "by far the most fun" of all the honors she had received during her lifetime. On Christmas Day, 2018, at the age of 93, Nancy Grace Roman passed away after a long illness. Part of her estate included a large bequest to the American Association of University Women, an organization she had been active in during most of her career. The money was earmarked to encourage young women to pursue careers in the sciences, especially in engineering and the physical sciences.

In May of 2020, NASA announced one more honor for Nancy Roman. The next major space telescope would be named the Nancy Grace Roman Space Telescope. This infrared telescope, scheduled to launch in 2027, will, among other things, search for extrasolar planets using the very technique Roman had proposed in 1959.

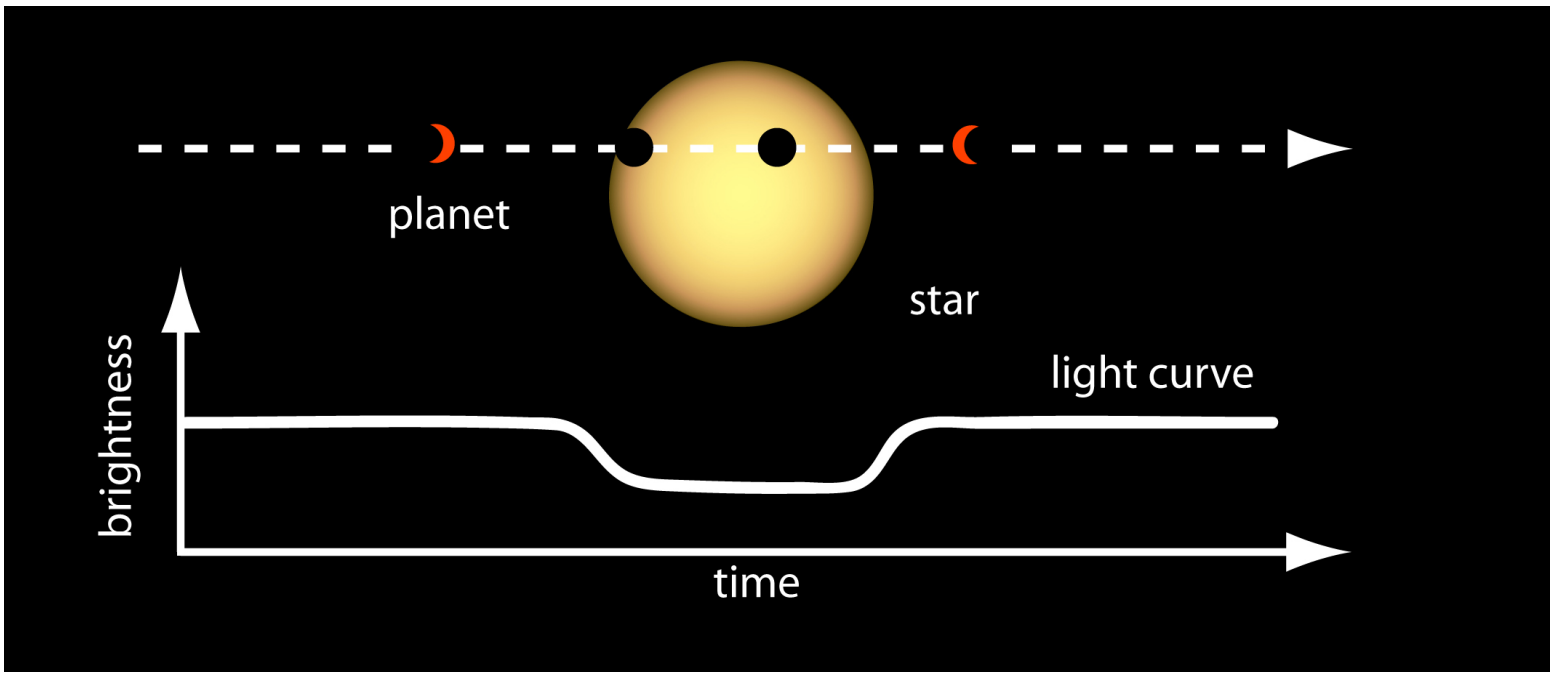
While dubbed the "Mother of Hubble," clearly Nancy Grace Roman contributed so much more to astronomy and NASA. This woman blazed a trail as an astronomer, an administrator, and as a visionary. As we await the launch of her namesake telescope, we owe it to Nancy Grace Roman to not only remember and honor her, but to also continue to encourage and support all women who pursue careers in the sciences. I believe that legacy would please Nancy Roman most of all.

References:

Nancy Roman - Wikipedia
Nancy Grace Roman (1925 - 2018) - NASA Science
Nancy Grace Roman: The Life and Legacy of a NASA Star - American Association of University Women

Photos of Nancy Grace Roman and the Roman Sapce Telescope Courtesy of NASA.

Expoplanets, continued from Page One



The Transit Method

One of the most famous exoplanet detection methods is the transit method, used by Kepler and other observatories. When a planet crosses in front of its host star, the light from the star dips slightly in brightness. Scientists can confirm a planet orbits its host star by repeatedly detecting these incredibly tiny dips in brightness using sensitive instruments. If you can imagine trying to detect the dip in light

A planet passing in front of its parent star creates a drop in the star's apparent brightness, called a transit. Exoplanet Watch participants can look for transits in data from ground-based telescopes, helping scientists refine measurements of the length of a planet's orbit around its star. Credit: NASA's Ames Research Center

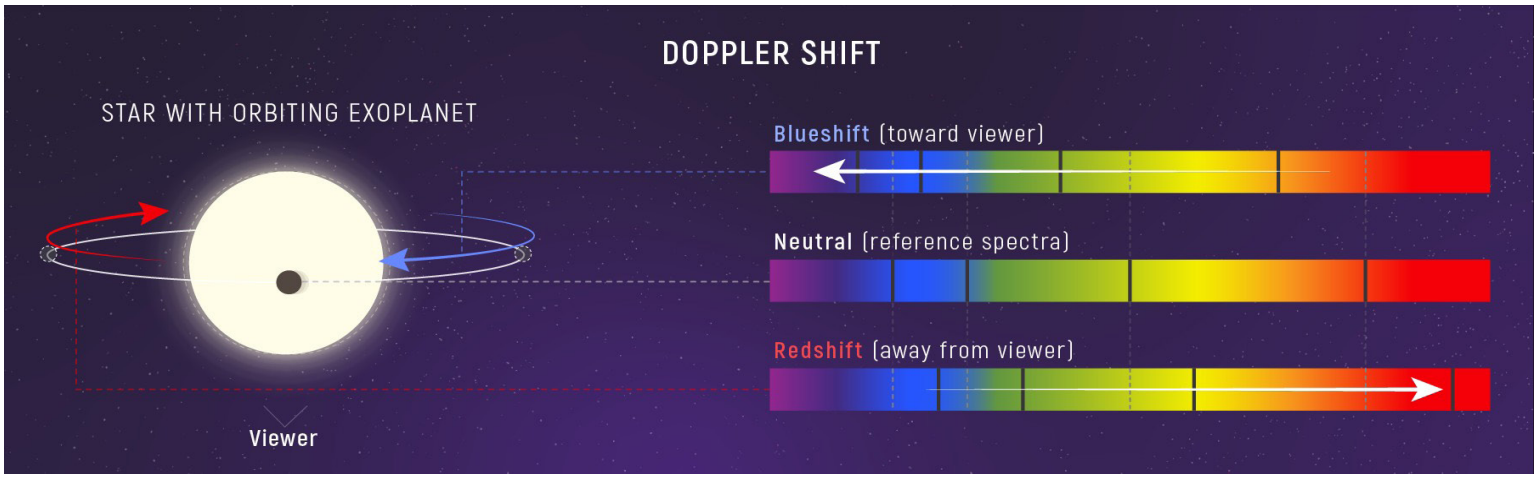
from a massive searchlight when an ant crosses in front of it, at a distance of tens of miles away, you can begin to see how difficult it can be to spot a planet from light-years away! Another drawback to the transit method is that the distant solar system must be at a favorable angle to our point of view here on Earth – if the distant system's angle is just slightly askew, there will be no transits. Even in our solar system, a transit is very rare. For example, there were two transits of Venus visible across our Sun from Earth in this century. But the next time Venus transits the Sun as seen from Earth will be in the year 2117 – more than a century from now, even though Venus will have completed nearly 150 orbits around the Sun by then!

The Wobble Method

Spotting the Doppler shift of a star's spectra was used to find Pegasi 51b, the first planet detected around a Sun-like star. This technique is called the radial velocity or "wobble" method. Astronomers split up the visible light emitted by a star into a rainbow. These spectra, and gaps between the normally smooth bands of light, help determine the elements that make up the star. However, if there is a planet

continued on next page

orbiting the star, it causes the star to wobble ever so slightly back and forth. This will, in turn, cause the lines within the spectra to shift ever so slightly towards the blue and red ends of the spectrum as the star wobbles slightly away and towards us. This is caused by the blue and red shifts of the planet's light. By carefully measuring the amount of shift in the star's spectra, astronomers can determine the size of the object pulling on the host star and if the companion is indeed a planet. By tracking the variation in this periodic shift of the spectra, they can also determine the time it takes the planet to orbit its parent star.



As a planet orbits a star, the star wobbles. This causes a change in the appearance of the star's spectrum called Doppler shift. Because the change in wavelength is directly related to relative speed, astronomers can use Doppler shift to calculate exactly how fast an object is moving toward or away from us. Astronomers can also track the Doppler shift of a star over time to estimate the mass of the planet orbiting it. Credit: NASA, ESA, CSA, Leah Hustak (STScI)

Direct Imaging

Finally, exoplanets can be revealed by directly imaging them, such as this image of four planets found orbiting the star HR 8799! Space telescopes use instruments called coronagraphs to block the bright light from the host star and capture the dim light from planets. The Hubble Space Telescope has captured images of giant planets orbiting a few nearby systems, and the James Webb Space Telescope

has only improved on these observations by uncovering more details, such as the colors and spectra of exoplanet atmospheres, temperatures, detecting potential exomoons, and even scanning atmospheres for potential biosignatures!

You can find more information and activities on NASA's Exoplanets page, such as the Eyes on Exoplanets browser-based program, The Exoplaneteers, and some of the latest exoplanet news. Lastly, you can find more resources in our News & Resources section, including a clever demo on how astronomers use the wobble method to detect planets!

The future of exoplanet discovery is only just beginning, promising rich rewards in humanity's understanding of our place in the Universe, where we are from, and if there is life elsewhere in our cosmos.

Cover Image: Image taken by the James Webb Space Telescope of four exoplanets orbiting HR 8799. Credit: NASA, ESA, CSA, STScI, Laurent Pueyo (STScI), William Balmer (JHU), Marshall Perrin (STScI)

This article is distributed by NASA Night Sky Network.

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.org to find local clubs, events, and more! You can catch up on all of NASA's current and future missions at nasa.gov.

With articles, activities and games NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!

April and May meeting minutes will be published in a future issue of The Eclipse.

In honor of the club's 90th anniversary we partnered with Hatch Show Print to create a unique poster that would honor the achievement of the club. For those who don't know Hatch Show has been making posters for a variety of events and concerts for 140 years. In all that time we are their first astronomy club.

On the poster at the center is the moon. This was made from a wood grained stencil that the shop has used for over 50 years. To contrast that the telescope that the people are using is a brand new stencil made for our poster.

The poster has three colors. First the pale yellow color of the moon was applied. Next the small stars, circles, and figures at the bottom were colored in metallic gold. The third color is a blue for the night sky.

Where it overlaps with the metallic gold it creates a darker blue leaving the figures at the bottom looking like silhouettes.

This was a one time printing so the 100 that we have are all that will be printed.

The prints are approximately 13 3/4" x 22 1/4" and are available for $20 at our membership meetings, or $25 with shipping by ordering through bsasnashville.com. Frame not included.

BSAS
Barnard-Seyfert Astronomical Society

Next BSAS meeting
Wednesday, June 18, 7:00 pm

Dyer Observatory
1000 Oman Dr.
Brentwood, TN 37027