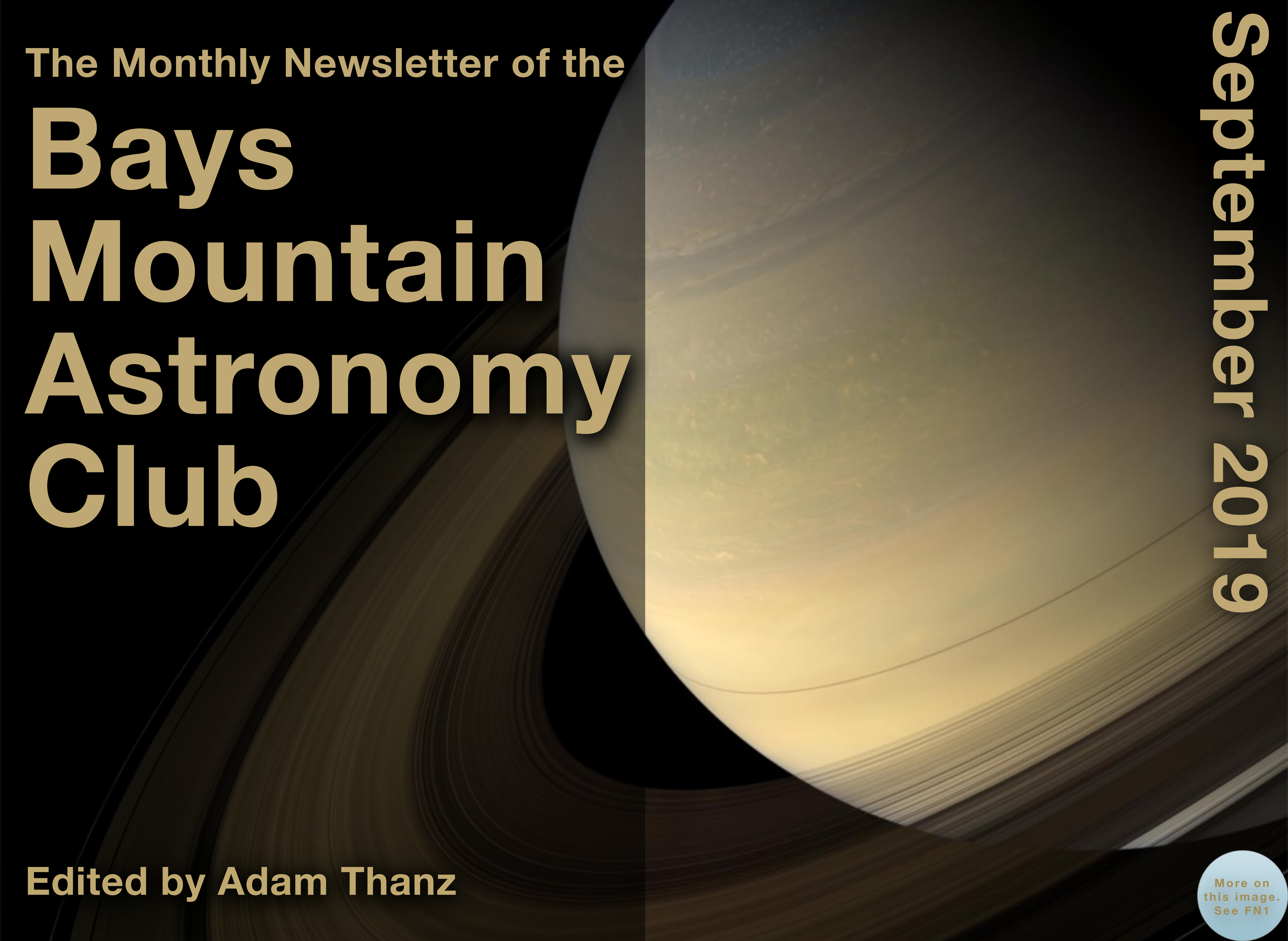
The Monthly Newsletter of the

Bays Mountain Astronomy Club

September 2019

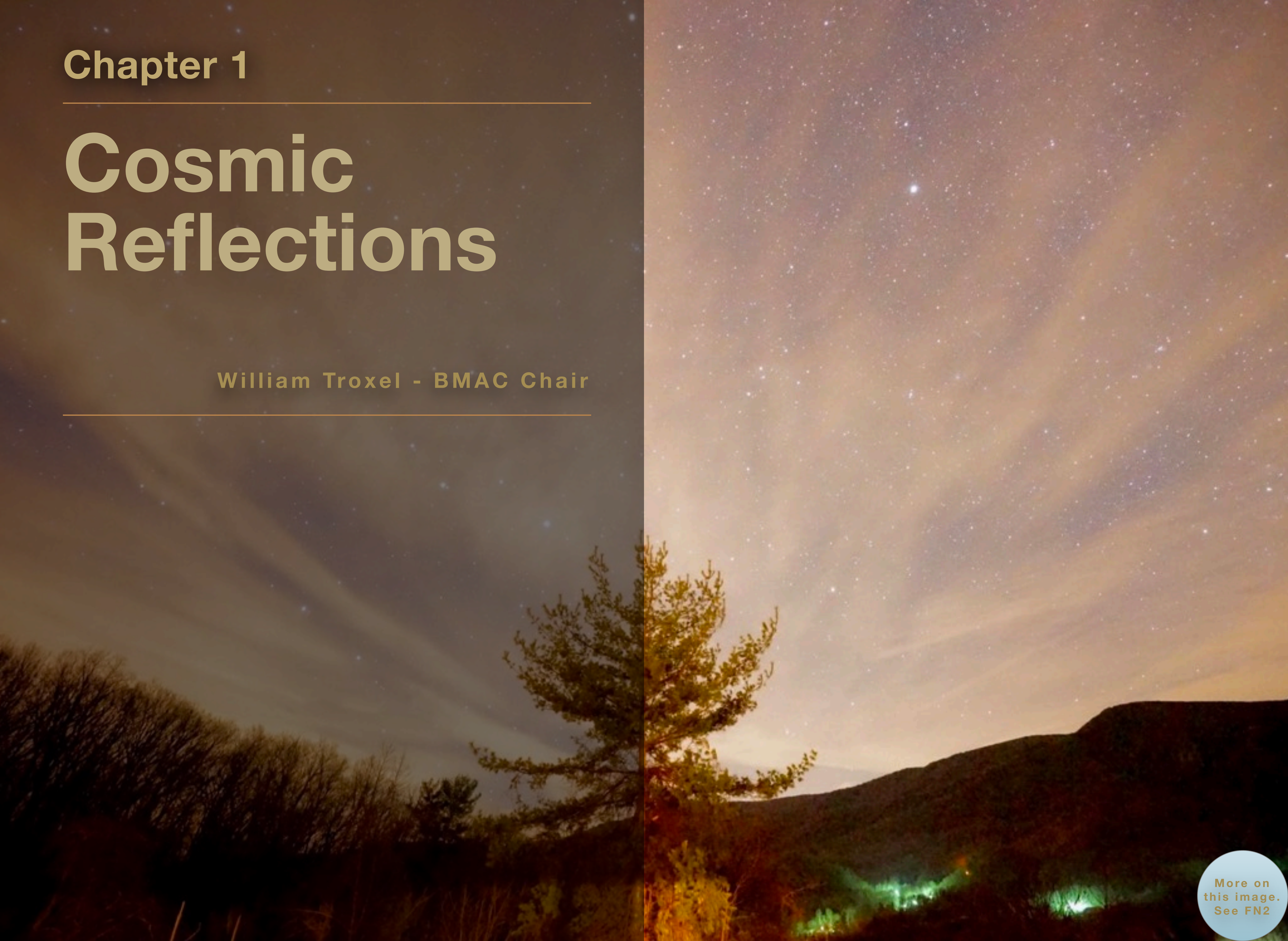


Edited by Adam Thanz

Chapter 1

Cosmic Reflections

William Troxel - BMAC Chair



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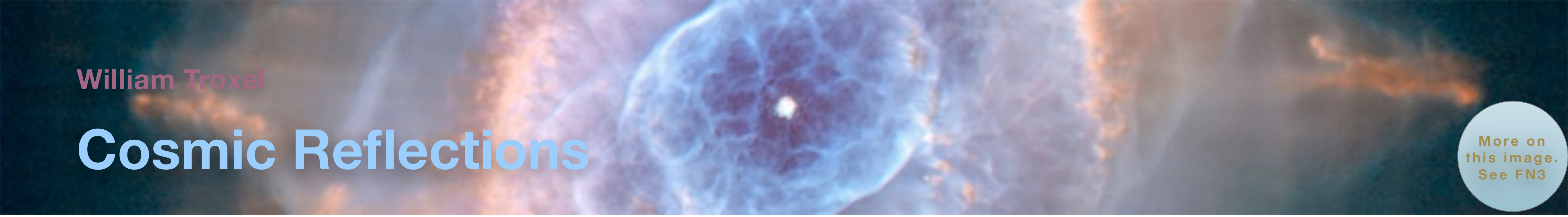

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William Troxel

Cosmic Reflections

Greetings everyone. I hope your month has been going well. First, I want to thank Brandon for contacting our speaker last meeting, Steven Conard from Johns Hopkins University and NASA. Steven had a wonderful presentation. If you did not get to come see and hear him you missed a good meeting. Steven shared information on the current location and updates of the mission. He also shared some exciting new missions for the future. Thanks to Adam and Jason for letting the club use the Planetarium for the presentation. If you want to see the talk again or if you missed it, you can watch it on the club's YouTube channel:

https://www.youtube.com/channel/UCwIQM6nUs9qxJtDQe4AaAWQ

Based on many of your conversations, I got the feeling most of you enjoyed the meeting. I want to continue to encourage you to share your ideas for meeting topics. I know I write this so much, however it is important that you understand that this is YOUR club. I want to have meetings that will interest you and help you learn more about astronomy. Please continue to share your thoughts and ideas.

Everyone knows that September marks one month until StarFest. Registration is open and if you have not looked at the event details yet, you are in for a treat. The speakers look so interesting. I know Adam will have a section on more of the details later in this issue, please be sure and look it up.

September's Astronomy Vocabulary list is as follows:

Aphelion - a·phe·li·on / əˈfēlēən

noun: aphelion; plural noun: aphelia; plural noun: aphelions

The point in the orbit of a planet, asteroid, or comet at which it is furthest from the Sun."Mars is at aphelion."

Constellation - con·stel·la·tion / ˌkänstəˈlāSH(ə)n

noun: constellation; plural noun: constellations

A group of stars forming a recognizable pattern that is traditionally named after its apparent form or identified with a mythological figure. Modern astronomers divide the sky into eighty-eight constellations with defined boundaries. A group or cluster of related things. "No two patients ever show exactly the same constellation of symptoms."

Zodiac - zo·di·ac | \ ˈzō-dē-ˌak\

noun: An imaginary band in the heavens centered on the ecliptic that encompasses the apparent paths of all the planets and is divided into 12 constellations or signs each taken for astrological purposes to extend 30 degrees of longitude.

For September’s meeting, we will have as our speaker Professor Richard Ignace of the ETSU Astronomy and Physics Department. Here is the title and abstract of Professor Ignace’s presentation:

“Massive Stars: All About the Drama!”

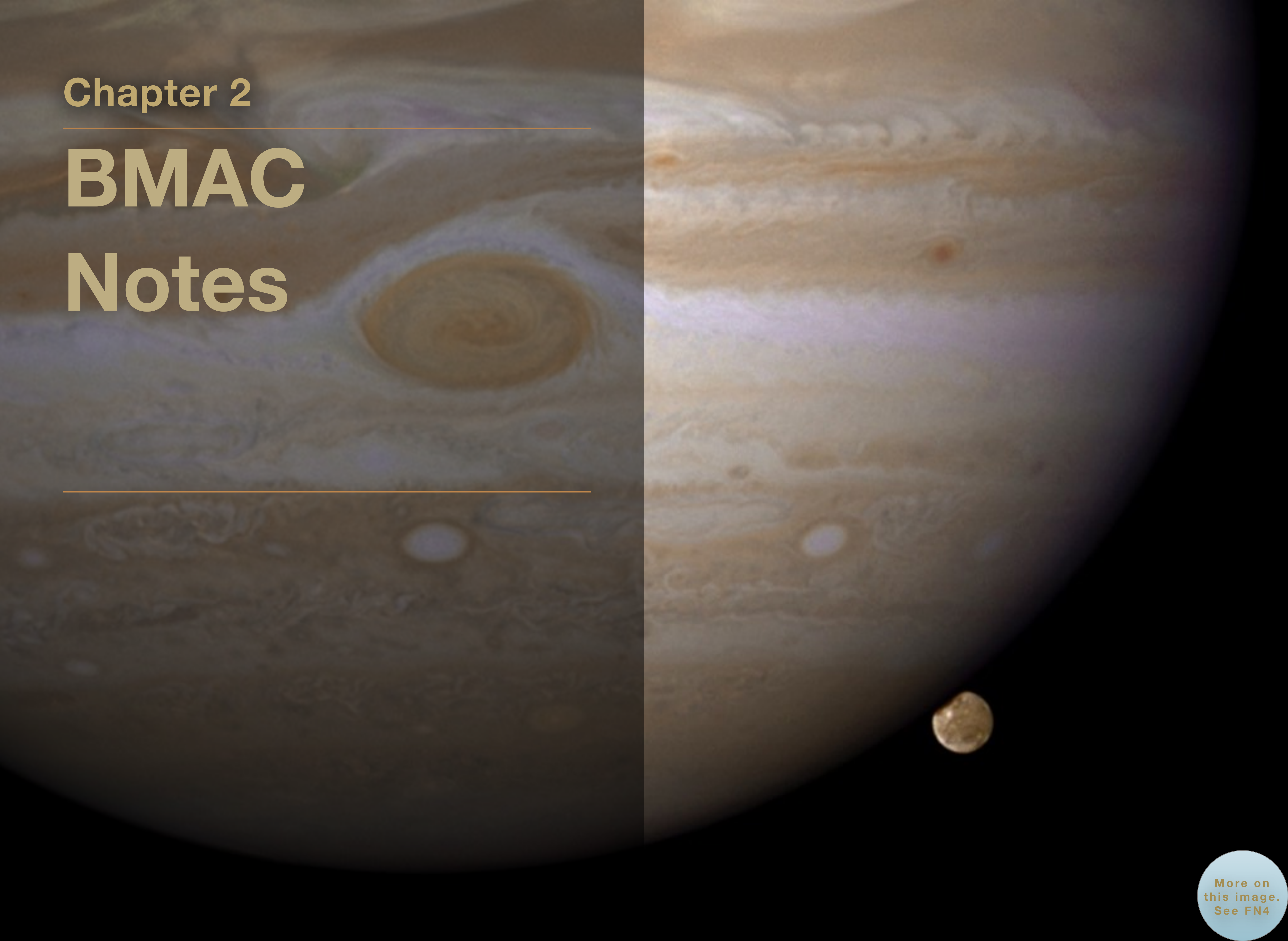
ETSU has one of the largest groupings of astronomy faculty in the state of Tennessee. The research being conducted is broad. One area of expertise includes massive stars. Stars born with more than eight times the Sun’s mass live impressively dramatic lives: they are powerful emitters of ultraviolet radiation; they propel fast and dense outflows into space; they explode dramatically as supernovae; and they leave behind bizarre and exotic “compact objects” of neutron stars and black holes. This presentation will review efforts by the speaker to help clarify the “stories of drama” surrounding these curious stars. Acquisition from a variety of telescope facilities will serve as a focus, including the speaker’s involvement with projects that have obtained or will obtain observations from the Hubble Space Telescope, NASA’s Chandra X-ray Telescope, the BRITE nanosatellites mission, Europe’s XMM-Newton mission, radio data from the Very Large Array (VLA), and even public archival data. The emphasis will be on what can be learned by exploring massive stars from different ways of viewing them.

I hope you will come and help welcome Professor Ignace on September 6th starting at 7 p.m.

Until next time, Clear Skies!

Chapter 2

BMAC Notes



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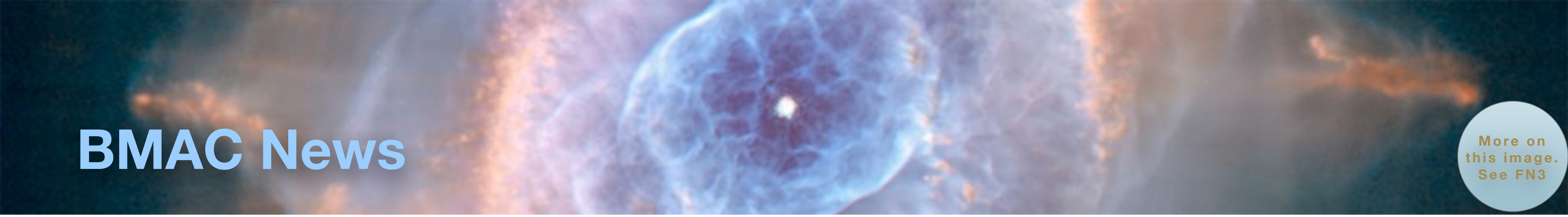
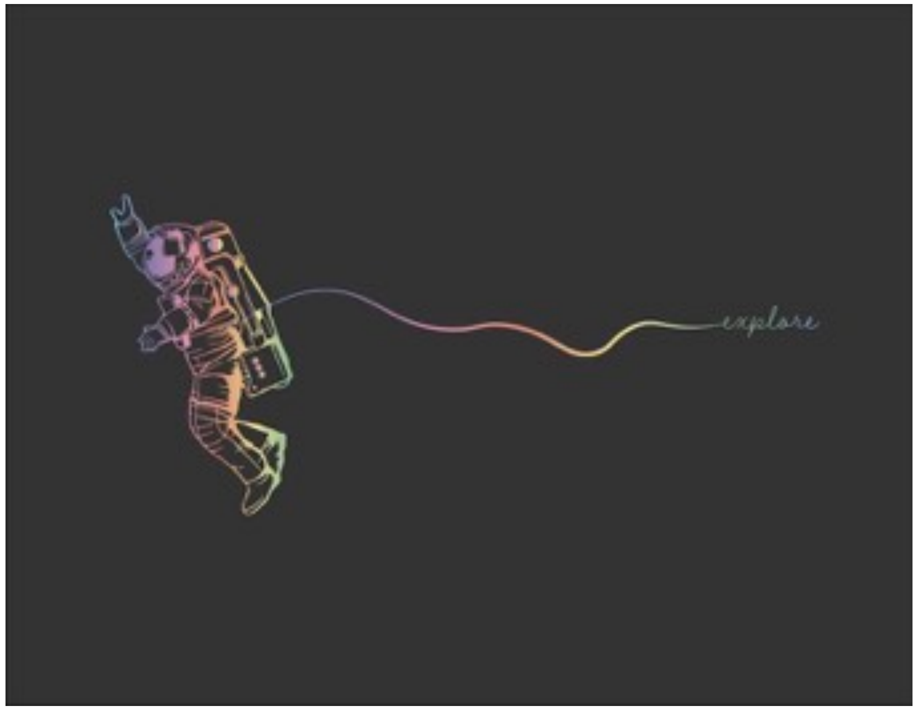


BMAC News



StarFest Reminder

If you haven't registered for StarFest, you still have some time until September 27. We have quite a shindig planned with 5 fabulous meals, 4 super keynote speakers, 3 days of excitement and learning, 2 nights observing, and 1 exceptional commemorative T-shirt!

The complete registration information can be found here.

The one-page registration sheet can be found here.

Dark Sky Celebration Weekend in August

The Pickett State Park is hosting a weekend event August 30 - September 1 with more of a focus on observing.

This weekend is for amateur astronomers and astronomers. We will have speakers and a star gazing both Friday and Saturday night in the field behind the group camp. We will have lectures and programs throughout the day on Saturday and end the night with a dinner from Cumberland Mountain State Park's Homestead Harvest Restaurant. You must have your telescopes set-up on the field before dark on Friday and Saturday.

Check in will be 3-5 p.m. on Friday and Check out is noon Sunday.

https://tnstateparks.com/parks/event_details/pickett/#/?event=dark-sky-celebration-weekend-2019

See the BMAC Picnic from Above!

BMACer Shawn Beamish took some drone footage of the event. Here's the link to see it: https://youtu.be/fDsjUuRmVFw.

Mercury Transit Public Viewing Press Release

Monday, November 11, 2019

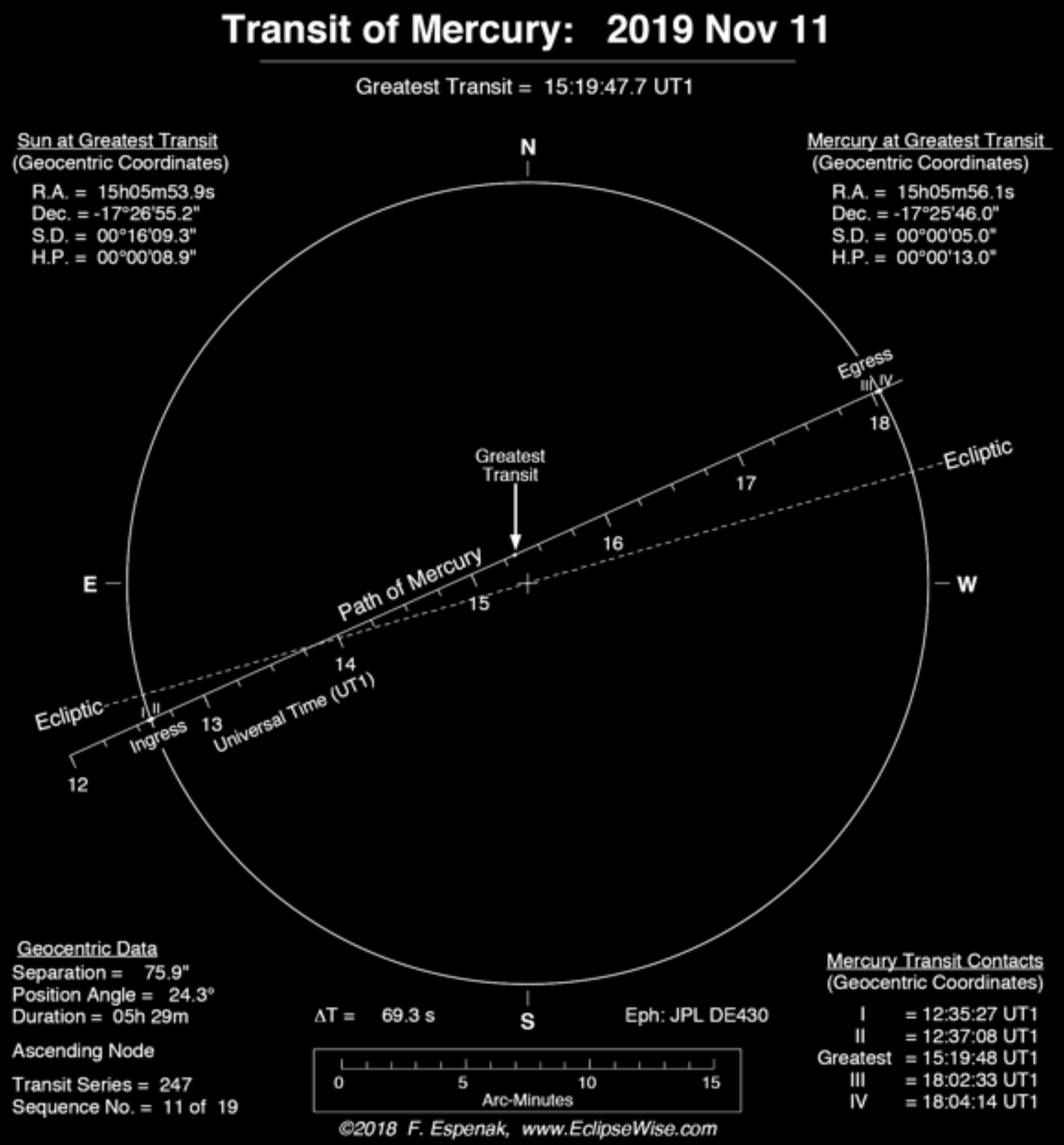
Join the Bays Mountain Astronomy Club in viewing the transit of the planet Mercury across the face of the Sun!

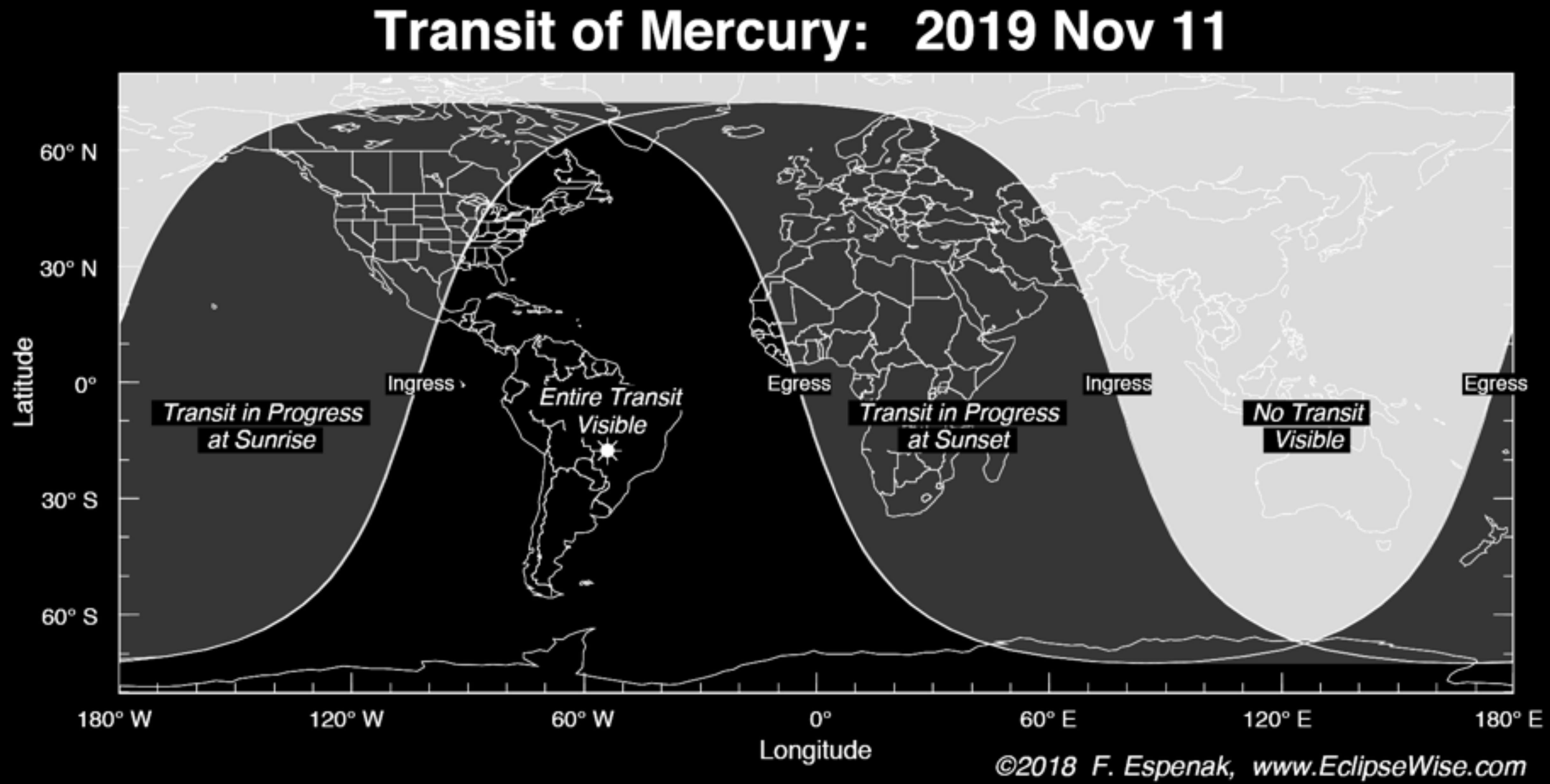
Public viewing will be 10 a.m.-1 p.m. at the Park's Observatories and is free. Please note that the Park's admission fee still does apply. The event is cancelled if poor weather.

You can see by the accompanying images that the transit actually starts at 7:35 a.m., but we need the Sun to clear the trees!

A transit is when a celestial object, like an inferior planet (Mercury and Venus), pass directly in front of the Sun. If you are on the correct side of the Earth to see this event, and have proper solar filters, then you'll see a tiny dot slowly travel across the face of the Sun. If you still have your solar glasses from the solar eclipse of 2017, then use them to see if you can spy Mercury's tiny disk against the Sun.

Remember, it is unsafe to view the Sun without proper eye protection!


Transit of Mercury: 2019 Nov 11
Greatest Transit = 15:19:47.7 UT1
Sun at Greatest Transit
(Geocentric Coordinates)
R.A. = 15h05m53.9s
Dec. = -17°26'55.2"
S.D. = 00°16'09.3"
H.P. = 00°00'08.9"
Mercury at Greatest Transit
(Geocentric Coordinates)
R.A. = 15h05m56.1s
Dec. = -17°25'46.0"
S.D. = 00°00'05.0"
H.P. = 00°00'13.0"
N
E
W
S
Greatest
Transit
Path of Mercury
Ecliptic
Ecliptic
Egress
III IV
I II
Ingress
12
13
14
15
16
17
18
Universal Time (UT1)
Geocentric Data
Separation = 75.9"
Position Angle = 24.3°
Duration = 05h 29m
Ascending Node
Transit Series = 247
Sequence No. = 11 of 19
ΔT = 69.3 s
Eph: JPL DE430
0
5
10
15
Arc-Minutes
©2018 F. Espenak, www.EclipseWise.com
Mercury Transit Contacts
(Geocentric Coordinates)
I = 12:35:27 UT1
II = 12:37:08 UT1
Greatest = 15:19:48 UT1
III = 18:02:33 UT1
IV = 18:04:14 UT1


Transit of Mercury: 2019 Nov 11
60° N
30° N
0°
30° S
60° S
Latitude
Transit in Progress
at Sunrise
Ingress
Entire Transit
Visible
Egress
Transit in Progress
at Sunset
Ingress
No Transit
Visible
Egress
180° W
120° W
60° W
0°
60° E
120° E
180° E
Longitude
©2018 F. Espenak, www.EclipseWise.com

New Videos Added to the BMAC YouTube Channel!

Thanks to Brandon Stroupe for all his hard work! We just added the three last presentations by Steve Conard including the August meeting.

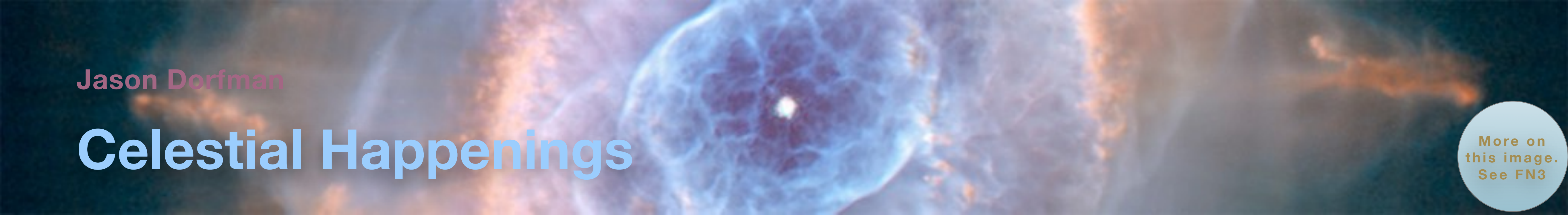
https://www.youtube.com/channel/UCwIQM6nUs9qxJtDQe4AaAWQ

Chapter 3

Celestial Happenings

Jason Dorfman

More on this image. See FN5



Jason Dorfman

Celestial Happenings

Understanding Nebulae

The space between the stars, what is known as the interstellar medium, is not truly empty space. Although it is more devoid of matter than any artificial vacuum created in a lab, interstellar space consists of gas and dust. Of this, the interstellar gas makes up about 99% of the interstellar medium. Similar to the make up of stars, it is about 75% hydrogen (either molecular or atomic) and 25% helium. The average density is about 1 atom per cubic centimeter, making it essentially transparent over a wide spectral range. The remaining 1% is interstellar dust. However, don't expect to find any dust bunnies in space. These dust particles are extremely small and irregularly shaped. The dust is composed of silicates, carbon, ice, and/or iron compounds. Though the amount of gas far exceeds the dust, a given mass of dust will block more light than the same mass of gas.

We see this gas and dust as various diffuse nebulae and dark clouds when it is interacting with the light from stars. The nebula we observe are all connected to the life of stars. From the large molecular clouds from which stars form to the planetary nebula and supernova remnants of stellar death, each nebula gives us a unique glimpse into the life cycle of stars. Though no two nebula are exactly alike, their unique appearance is the result of just three different interactions of light with the gas and dust. The three types are emission, reflection and dark nebulae.

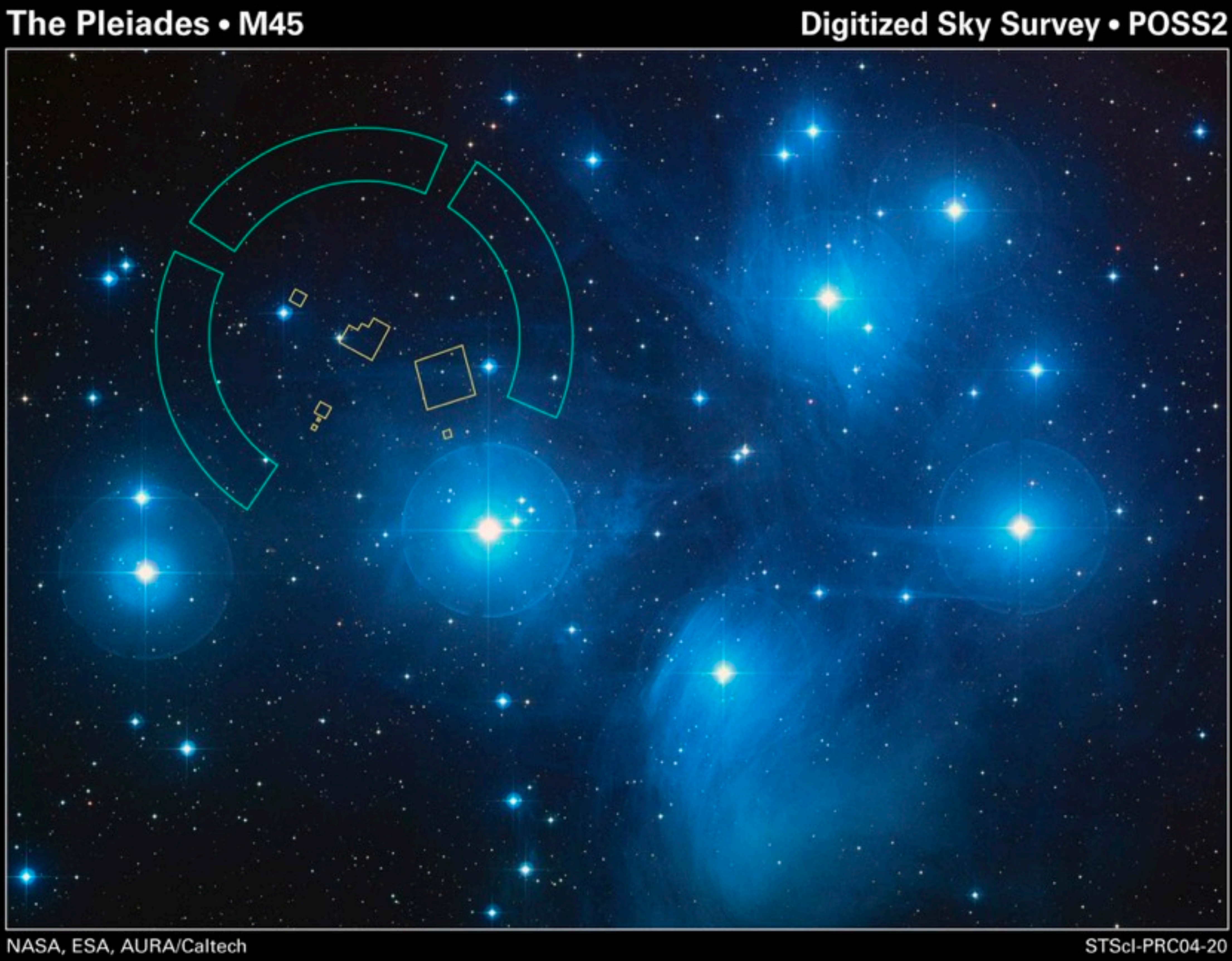
The term nebula originated as a description of any diffuse and extended astronomical object that wasn't a planet or comet. This originally included galaxies and star clusters. Before telescopes could resolve individual stars in other galaxies, these objects were referred to as nebulae and were thought to be part of the Milky Way. It was largely due to the work of Edwin Hubble, who measured somewhat accurate distances to these "nebulae," when it became clear that these were enormous collections of stars far beyond the extent of our own galaxy. Today, the term nebula simply refers to a cloud of gas and dust.

Emission Nebulae

Much of the interstellar gas is neutral hydrogen (HI) and molecular gas (mostly H_2). In regions where the density of gas and dust is greater, we get giant molecular clouds which is where stars can form. It is in these regions of recent star formation that

The Orion Nebula (M42) and cluster from the VLT Survey Telescope. - ESO/G. Beccari

The Horsehead Nebula (IC434) - Jean-Charles Cuillandre (CFHT) & Giovanni Anselmi (Coelum) / Canada-France-Hawaii Telescope / Coelum



The Pleiades (M45) - NASA, ESA, AURA/ Caltech we find the most spectacular nebulae. Massive O and B stars, such as the Trapezium stars at the heart of the Orion Nebula, give off large amounts of ultraviolet radiation which strips the electrons off of the hydrogen atoms, creating ionized hydrogen or HII regions. As electrons recombine with the ionized atoms, they descend through different energy levels emitting photons of light along the way. Emission nebulae are often red because the predominant emission line of hydrogen is in the red part of the spectrum. We also see green due to collisions between electrons and ions that excite the ions to higher energy levels producing emission features of Oxygen.

Dark Nebulae

As mentioned earlier, interstellar dust is much better at blocking light than the gas. The light blocking effects of dust were significant enough that early astronomers, such as Harlow Shapely, ended up overestimating distances because they were not aware of the effect the dust was having on their observations. This phenomenon is known as "extinction." The dust blocks and scatters the light. Similar to our atmosphere, the shorter wavelengths of blue light are scattered more easily than the longer red wavelengths. Therefore, the light that reaches us appears redder than it would have been, if not for the dust. This is called "Interstellar Reddening."

Dark nebulae are areas where the density of the interstellar dust is greater, creating clouds which are simply blocking the light from whatever is behind. The Horsehead Nebula is a great example of a dark nebula. The dark patches seen within the band of the Milky Way are additional areas where dust is blocking the light of more distant stars.

Reflection Nebulae

With dark nebulae, the dust cloud lies between us and the light source. If the cloud of dust is to one side of a star, then we see some of the scattered light reflected toward us. These are reflection nebula which tend to be blue because the scattering is more efficient for blue light. A fine example is the Pleiades star cluster in Taurus. The blue light from the young, hot B-stars is reflecting off the surrounding dust.

Reflection nebulae and emission nebulae are often seen together and are sometimes both referred to as diffuse nebulae. Planetary nebulae, like the Ring Nebula, are emission nebulae. The intense ultraviolet radiation from the central white dwarf is ionizing the surrounding cloud of gas that was once part of the now dead star. The Orion and Trifid Nebulae are great examples where we see all three types of nebula in action. We can see the reddish hue from the ionized gas and blue light scattering off the surrounding dust combined with denser regions where the dust is blocking the light beyond. Next time you're out observing, I hope you'll notice some of these different types of nebulae.

The Ring Nebula (M57) - NASA, ESA and the Hubble Heritage (STScI/ AURA)-ESA/Hubble Collaboration

Trifid Nebula (M20) - NASA/ JPL-Caltech/ NOAO

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Chapter 4

The Queen Speaks

Robin Byrne

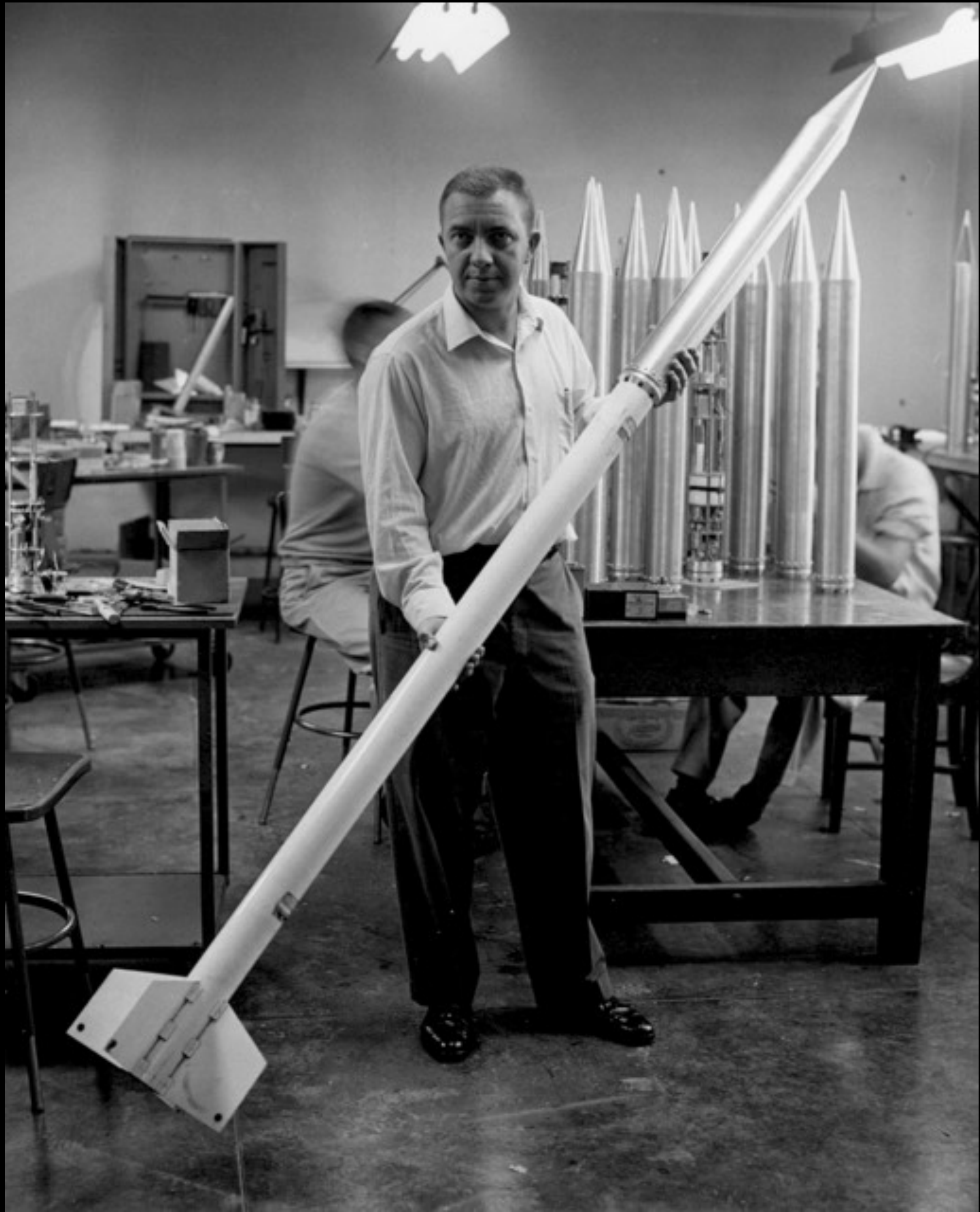
Robin Byrne

Happy Birthday James Van Allen

This month we celebrate the life of a man whose name is attached to part of our magnetic field, but who did so much more. James Van Allen was born September 7, 1914 on the family farm outside of Mount Pleasant, Iowa. His parents, Alfred and Alma, had four sons, with James being the second oldest. It seems that science was James' fate, growing up with an interest in electronics and mechanical devices, with subscriptions to magazines, such as Popular Mechanics and Popular Science. James even once built his own Tesla coil that produced sparks a foot long. During his years at Mount Pleasant High School, one of his science instructors played a key role in encouraging James to pursue science. James must have been a good student during those years, because he graduated valedictorian.

Van Allen always had an interest in boats and the sea, so he applied to the U.S. Naval Academy for college. Despite doing well on the entrance exam and having wonderful grades, he was denied entrance due to failing the physical exam on three counts: flat feet, poor eyesight, and not being able to swim. On to Plan B - Iowa Wesleyan College in his home town. The summer after his Freshman year, James had a summer research position, which gave him his first glimpse at geophysics. Working with Thomas C. Poulter, James not only became hooked on the study of physics, but he also established an important relationship with the man who would become his first mentor. By June of 1935, James had a bachelors degree in Physics, graduating summa cum laude.

Van Allen's mentor, Poulter, was the chief scientist with the Second Byrd Antarctic Expedition from 1933 to 1935. Poulter was in charge of the geophysical studies conducted on the mission. Van Allen had assisted him in preparing for the expedition, including help in developing equipment to be used, such as a seismograph and a tilt-meter for measuring the motion of glaciers. Van Allen also had the job of testing out the magnetometer that was to be used. He tested it by measuring the magnetic field around the county, creating a field map. His measurements would be published as part of the national grid made by the Department of Terrestrial Magnetism. While Van Allen got plenty of experience at home working with a wide range of equipment and other skills, his parents would not let James accompany Poulter on the expedition. Listening to the



James Van Allen of the University of Iowa poses in workshop with a rocket and scientific instrument package (Rockoon). 1955. Frederick W. Kent Collection, University of Iowa Archives

Image from NASA.

accounts from the expedition on the radio, Van Allen heard about how his mentor, Poulter, rescued Admiral Byrd from the South Pole Station in 1934. Byrd had been alone, monitoring the meteorological equipment at the station for several months, sending radio messages that became increasingly incoherent. Poulter and two others, who were stationed closer to the coast, tried three times to get to Byrd, finally reaching him on the third attempt. Byrd was suffering from carbon monoxide poisoning from a stove.

After leaving Iowa Wesleyan, Van Allen chose the State University of Iowa for graduate school, continuing his studies of physics. Van Allen's Masters Degree thesis was about solid state physics, which he completed in 1936. Thanks to a fellowship, Van Allen had the opportunity to study nuclear physics in Washington, D.C. at the Carnegie Institution. His doctoral thesis concerned the particle accelerator that Van Allen and others built. Van Allen received his PhD in nuclear physics in June of 1939.

After graduation, Van Allen went to work at the Department of Terrestrial Magnetism (DTM) at the Carnegie Institution. Here his work focused on nuclear physics, studying the breaking apart of deuterium using gamma rays, and measuring the size of atomic nuclei. With Europe already engaged in World War II, war research began to dominate the activities at DTM. Beginning in 1940, Van Allen worked on proximity fuses, which were used to increase the effectiveness of anti-aircraft weapons used by ships. This work moved James to the Applied Physics Lab (APL) at Johns Hopkins University in April of 1942. In November of 1942, James joined the Navy, spending 16 months visiting various destroyers in the South Pacific, training the men in how to use and test the fuses. On one of his assignments, Van Allen was stationed as an assistant staff gunnery officer, helping to defend the ship from a Japanese attack. Van Allen was awarded four battle stars for his service, and left the Navy with the rank of Lieutenant Commander.

On October 13, 1945, James married Abigail Halsey, whom he met at the Applied Physics Laboratory during the war years. They would have five children: three girls and two boys.

After the war, Van Allen returned to APL. This was when he began conducting high altitude experiments using V-2 rockets that had been captured from Germany. He wanted to study the upper atmosphere. Van Allen and his colleagues would become known as the High Altitude Research Group. After using the V-2's, Van Allen worked on the development of the Aerobee rockets for continued use in high altitude atmospheric research.

In 1951, Van Allen joined the faculty of the University of Iowa and was named the head of the Physics and Astronomy Department. Van Allen would remain in this position until 1985, when he retired. It was here that Van Allen began work with "rockoons" - balloons that would carry rockets to a high altitude, and then the rocket would fire, carrying it even higher, so they could detect cosmic rays in the upper reaches of the atmosphere. Van Allen

The three men responsible for the success of Explorer 1, America's first satellite, launched Jan. 31, 1958. From left, William H. Pickering, James Van Allen and Wernher von Braun.

Image from NASA.

and his students would launch the balloons from the school's football practice field. In one of their flights, they discovered that aurorae were caused by energetic electrons. This was the first hint of Earth having a radiation belt.

In 1950, Van Allen hosted a gathering of various geoscientists at his home. During the course of the evening, someone had mentioned that, with the development of rocketry and advanced equipment, the geosciences should have an "International Year" to encourage new discoveries in the same way that the International Polar Years had spurred expeditions to the North and South Poles. Everyone was excited by the idea, and soon government officials were being contacted to get the go-ahead. The plan was to designate 1957-1958 as the International Geophysical Year (IGY), coinciding with solar maximum. The idea was to launch satellites equipped with devices designed for studying the Earth and its magnetic field. The Soviet Union got to space first in October of 1957 with their Sputnik satellite, but it did not contain any scientific equipment. In preparation for the United States' attempt to put a satellite in orbit, Wernher von Braun believed they needed a "real, honest-to-goodness scientist" as part of the team. Van Allen's reputation was already well established, and his name was the first to be suggested. Van Allen was excited at the prospect of sending his equipment into space. On January 31, 1958, the United States launched its first successful satellite, Explorer 1. On board was a detector for micrometeorites, and a cosmic ray detector built by Van Allen. During its orbit around Earth, the detector found that Earth was surrounded by a donut-shaped region of charged particles trapped by Earth's magnetic field. A second launch as part of the IGY sent a probe to the Moon. Although the probe never reached the Moon, it did achieve a high enough altitude to discover a second region of radiation trapped in the magnetic field. These regions are now known as the Van Allen Belts.

Van Allen continued to teach at the University of Iowa, where he and his many students would work on most of the major unmanned space program missions: Pioneer, Mariner, Voyager, Galileo, and Cassini. Van Allen himself was involved in a total of 24 missions, either studying Earth or other planets, and studying the magnetic fields of every planet in our Solar System. Van Allen would mentor 34 doctoral students and 47 master's students, not to mention the myriads who took his undergraduate General Astronomy class.

In 1985, Van Allen retired, but he didn't stop working. Now as an Emeritus Professor, Van Allen continued his research and work as an advisor to students. In 1987, President Reagan awarded Van Allen with the highest scientific honor in the country, the National Medal of Science. On August 9, 2006, Van Allen experienced heart failure and died in Iowa City, Iowa. He was ninety-one years old.

Van Allen's name lives on, not only with "his" radiation belts, but also on two space probes. Originally named the Radiation Belt

Storm Probes, the Van Allen Probes were renamed by NASA in his honor in 2012. Slated to last for two years, the probes orbit Earth in the heart of the Van Allen Belts, studying their structure. Not expected to last much past two years due to the harsh environment of the radiation belts, the probes have proven to be as robust as their namesake. Still functioning perfectly, the probes have just this past year had their orbits altered to allow for a controlled reentry into Earth's atmosphere. But don't worry. The reentry won't occur until 2034. In the meantime, as long as their fuel lasts, the probes will continue to send back information about the radiation belts and Earth's upper atmosphere. It seems fitting that these spacecraft named after James Van Allen would work perfectly well for so long. After all, that's what James did!

References:

James Van Allen - Wikipedia

https://en.wikipedia.org/wiki/James_Van_Allen

International Space Hall of Fame at the New Mexico Museum of Space History - James Van Allen

http://www.nmspacemuseum.org/halloffame/detail.php?id=86

American Astronomical Society - James Alfred Van Allen (1914-2006) by George H. Ludwig and Carl Edwin McIlwain

NASA's Van Allen Probes Begin Final Phase of Exploration in Earth's Radiation Belts by Geoff Brown

https://www.nasa.gov/feature/goddard/2019/nasa-s-van-allen-probes-begin-final-phase-of-exploration-in-earths-radiation-belts

Chapter 5

Space Place

More on this image. See FN6

David Prosper

Spot the Stars of the Summer Triangle

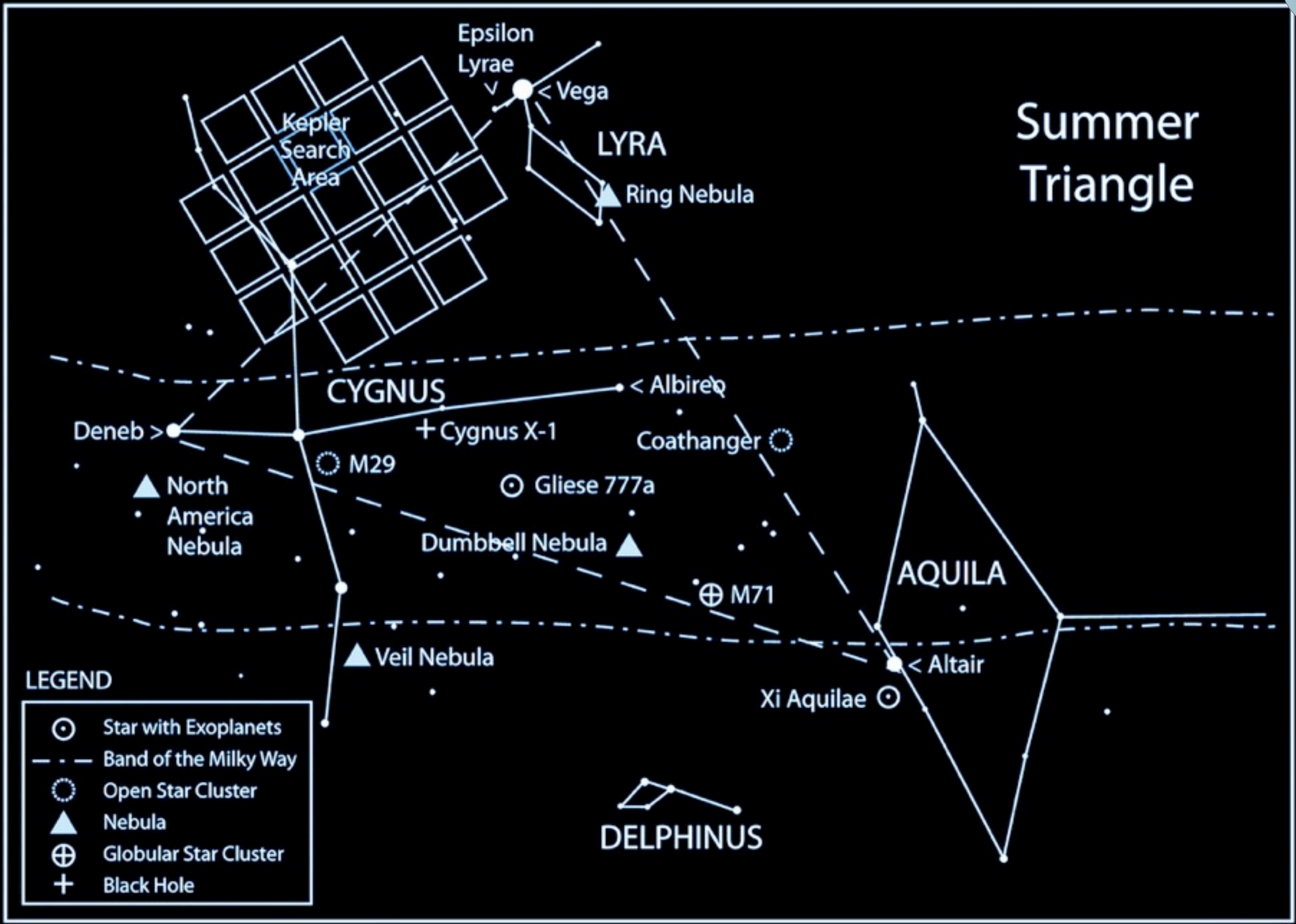
September skies are a showcase for the Summer Triangle, its three stars gleaming directly overhead after sunset. The equinox ushers in the official change of seasons on September 23. Jupiter and Saturn maintain their vigil over the southern horizon, but set earlier each evening, while the terrestrial planets remain hidden.

The bright three points of the Summer Triangle are among the first stars you can see after sunset: Deneb, Vega, and Altair. The Summer Triangle is called an asterism, as it's not an official constellation, but still a striking group of stars. However, the Triangle is the key to spotting multiple constellations! Its three stars are themselves the brightest in their respective constellations: Deneb, in Cygnus the Swan; Vega, in Lyra the Harp; and Altair, in Aquila the Eagle. That alone would be impressive, but the Summer Triangle also contains two small constellations inside its lines, Vulpecula the Fox and Sagitta the Arrow. There is even another small constellation just outside its borders: diminutive Delphinus the Dolphin. The Summer Triangle is huge!

The equinox occurs on September 23, officially ushering in autumn for folks in the Northern Hemisphere and bringing with it longer nights and shorter days, a change many stargazers appreciate. Right before sunrise on the 23rd, look for Deneb - the Summer Triangle's last visible point - flickering right above the western horizon, almost as if saying goodbye to summer.

The Summer Triangle region is home to many important astronomical discoveries. Cygnus X-1, the first confirmed black hole, was initially detected here by x-ray equipment on board a sounding rocket launched in 1964. NASA's Kepler Mission, which revolutionized our understanding of exoplanets, discovered thousands of planet candidates within its initial field of view in Cygnus. The Dumbbell Nebula (M27), the first planetary nebula discovered, was spotted by Charles Messier in the diminutive constellation Vulpecula way back in 1764!

Planet watchers can easily find Jupiter and Saturn shining in the south after sunset, with Jupiter to the right and brighter than Saturn. At the beginning of September, Jupiter sets shortly after midnight, with Saturn following a couple of hours later, around 2 a.m. By month's end, the gas giant duo are setting noticeably earlier: Jupiter sets right before 10:30 p.m., with Saturn following just after midnight. Thankfully for planet watchers, earlier fall sunsets help these giant worlds remain in view for a bit longer.



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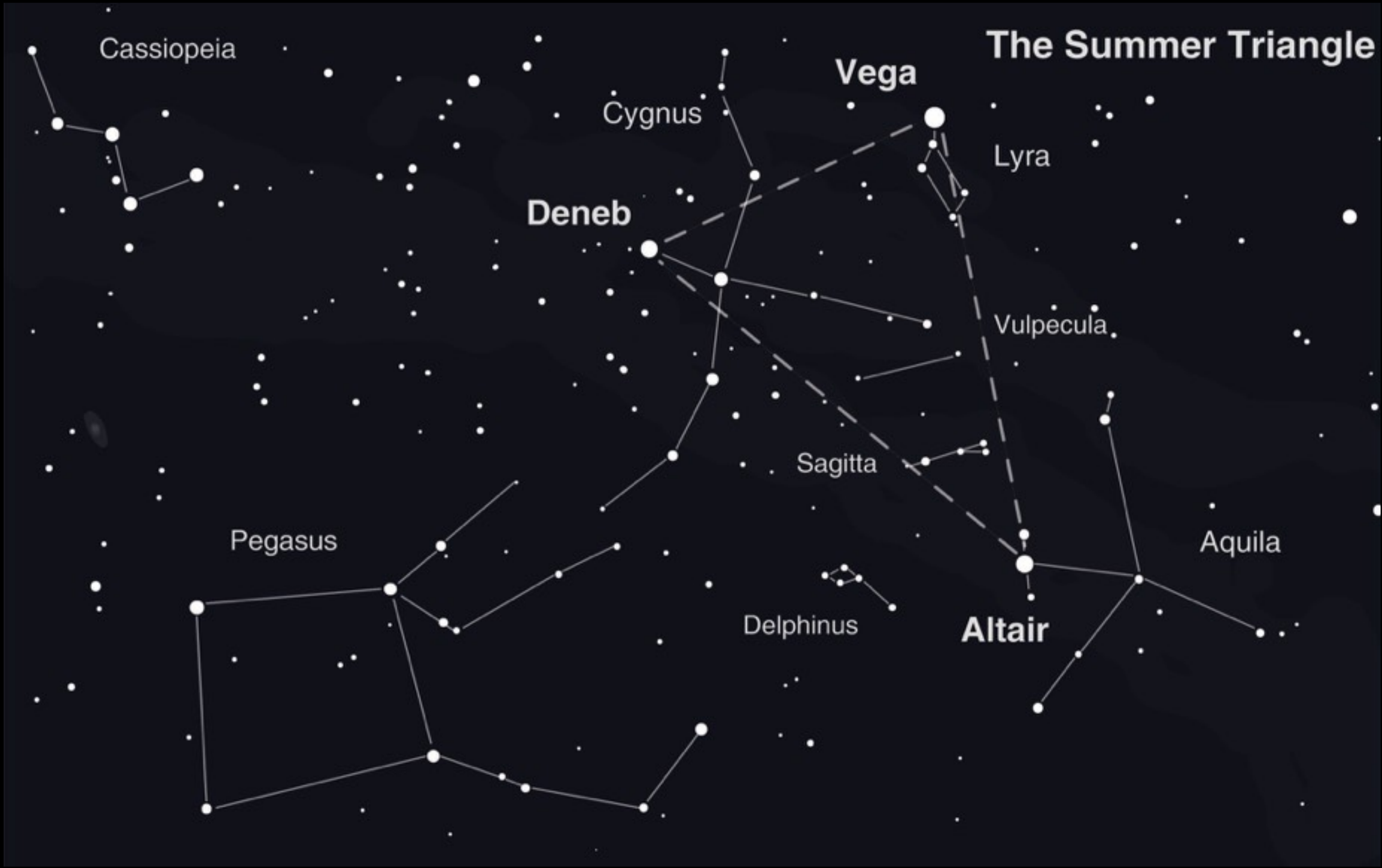
More on this image. See FN9



The terrestrial planets, Mars, Venus, and Mercury, remain hidden in the Sun's glare for the entire month.

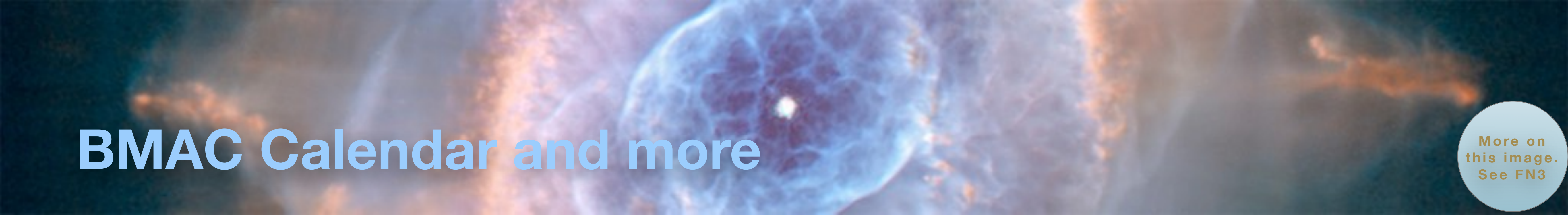
Discover the latest in space science from the NASA missions studying our universe at nasa.gov.

This article is distributed by the NASA Night Sky Network. NASA's 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!

Chapter 6

BMAC Calendar and more

More on this image. See FN7



BMAC Calendar and more

More on this image. See FN3

Date	Time	Location	Notes
BMAC Meetings			
Friday, September 6, 2019	7 p.m.	Nature Center Discovery Theater	Program: Dr. Richard Ignace, Astrophysicist and Professor in the ETSU Astronomy & Physics Department will speak on "Massive Stars: All About the Drama!" Abstract – ETSU has one of the largest groupings of astronomy faculty in the state of Tennessee. The research being conducted is broad. One area of expertise includes massive stars. Stars born with more than eight times the Sun's mass live impressively dramatic lives: they are powerful emitters of ultraviolet radiation; they propel fast and dense outflows into space; they explode dramatically as supernovae; and they leave behind bizarre and exotic "compact objects" of neutron stars and black holes. This presentation will review efforts by the speaker to help clarify the "stories of drama" surrounding these curious stars. Acquisition from a variety of telescope facilities will serve as a focus, including the speaker's involvement with projects that have obtained or will obtain observations from the Hubble Space Telescope, NASA's Chandra X-ray Telescope, the BRITE nanosatellites mission, Europe's XMM-Newton mission, radio data from the Very Large Array (VLA), and even public archival data. The emphasis will be on what can be learned by exploring massive stars from different ways of viewing them.; Free.
Friday, October 4, 2019	6 p.m.	Nature Center Discovery Theater	Program: Observatory Cleaning & Observing. As we wait for dark, we'll have some fun with The Four Tens. What is that you ask? We'll have four club members talk for just 10 minutes each on an astronomical topic. Our club chair will be contacting four of you to be part of this fun activity. Creativity is part of the short presentation. If the weather is poor, we'll be in the Discovery Theater instead. Please remember to bring cleaning supplies like rags, shop-vac, broom, elbow grease, et al. to help. And, remember, it starts at 6 p.m.; Free.
SunWatch			
Every Saturday & Sunday March - October	3-3:30 p.m. if clear	At the dam	View the Sun safely with a white-light view if clear.; Free.
StarWatch			
Oct. 5, 12, 2019	7:30 p.m.	Observatory	View the night sky with large telescopes. If poor weather, an alternate live tour of the night sky will be held in the planetarium theater.; Free.
Oct. 19, 26, Nov. 2, 2019	7 p.m.		
Nov. 9, 16, 23, 30, 2019	6 p.m.		
Special Events			
Oct. 18-20, 2019	-	Bays Mountain Park	StarFest 2019. Our 36th annual astronomy convention/star gathering for the Southeast United States. Three days of astronomy fun, 5 meals, 4 keynote speakers, unique T-shirt, and more. ***Pre-registration by Sept. 27, 2019 with full payment is mandatory for attendance. Sorry, no walk-ins nor "visits."*** Registration is open.
Monday, November 11, 2019	10 a.m.-1 p.m.	Observatory	Mercury Transit Public Viewing. Come help with using solar telescopes to view the Sun and the planet Mercury transiting across its surface. If poor weather, the event is cancelled.

Bays Mountain Astronomy Club

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Annual Dues:

Dues are supplemented by the Bays Mountain Park Association and volunteerism by the club. As such, our dues can be kept at a very low cost.

$16 /person/year

$6 /additional family member

Note: if you are a Park Association member (which incurs an additional fee), then a 50% reduction in BMAC dues are applied.

The club's website can be found here:

https://www.baysmountain.com/astronomy/astronomy-club/#newsletters

Regular Contributors:

William Troxel

William is the current chair of the club. He enjoys everything to do with astronomy, including sharing this exciting and interesting hobby with anyone that will listen! He has been a member since 2010.

Robin Byrne

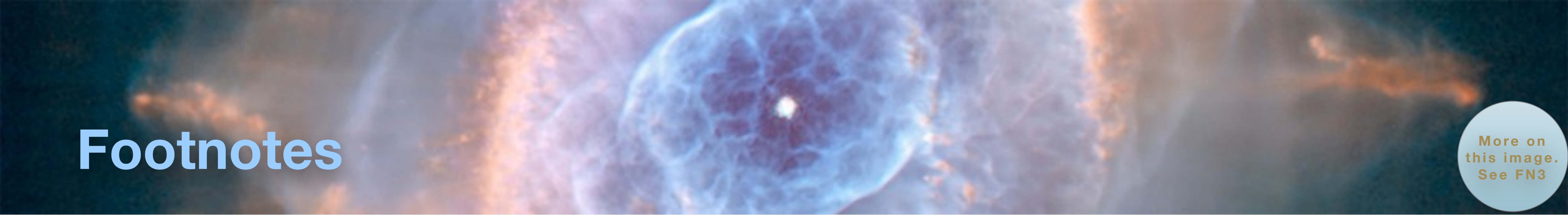
Robin has been writing the science history column since 1992 and was chair in 1997. She is an Associate Professor of Astronomy & Physics at Northeast State Community College (NSCC).

Jason Dorfman

Jason works as a planetarium creative and technical genius at Bays Mountain Park. He has been a member since 2006.

Adam Thanz

Adam has been the Editor for all but a number of months since 1992. He is the Planetarium Director at Bays Mountain Park as well as an astronomy adjunct for NSCC.



Footnotes

Footnotes:

1. The Rite of Spring

Of the countless equinoxes Saturn has seen since the birth of the solar system, this one, captured here in a mosaic of light and dark, is the first witnessed up close by an emissary from Earth … none other than our faithful robotic explorer, Cassini.

Seen from our planet, the view of Saturn's rings during equinox is extremely foreshortened and limited. But in orbit around Saturn, Cassini had no such problems. From 20 degrees above the ring plane, Cassini's wide angle camera shot 75 exposures in succession for this mosaic showing Saturn, its rings, and a few of its moons a day and a half after exact Saturn equinox, when the sun's disk was exactly overhead at the planet's equator.

The novel illumination geometry that accompanies equinox lowers the sun's angle to the ring plane, significantly darkens the rings, and causes out-of-plane structures to look anomalously bright and to cast shadows across the rings. These scenes are possible only during the few months before and after Saturn's equinox which occurs only once in about 15 Earth years. Before and after equinox, Cassini's cameras have spotted not only the predictable shadows of some of Saturn's moons (see PIA11657), but also the shadows of newly revealed vertical structures in the rings themselves (see PIA11665).

Also at equinox, the shadows of the planet's expansive rings are compressed into a single, narrow band cast onto the planet as seen in this mosaic. (For an earlier view of the rings' wide shadows draped high on the northern hemisphere, see PIA09793.)

The images comprising the mosaic, taken over about eight hours, were extensively processed before being joined together. First, each was re-projected into the same viewing geometry and then digitally processed to make the image "joints" seamless and to remove lens flares, radially extended bright artifacts resulting from light being scattered within the camera optics.

At this time so close to equinox, illumination of the rings by sunlight reflected off the planet vastly dominates any meager sunlight falling on the rings. Hence, the half of the rings on the left illuminated by planetshine is, before processing, much brighter than the half of the rings on the right. On the right, it is only the vertically extended parts of the rings that catch any substantial sunlight.

With no enhancement, the rings would be essentially invisible in this mosaic. To improve their visibility, the dark (right) half of the rings has been brightened relative to the brighter (left) half by a factor of three, and then the whole ring system has been brightened by a factor of 20 relative to the planet. So the dark half of the rings is 60 times brighter, and the bright half 20 times brighter, than they would have appeared if the entire system, planet included, could have been captured in a single image.

The moon Janus (179 kilometers, 111 miles across) is on the lower left of this image. Epimetheus (113 kilometers, 70 miles across) appears near the middle bottom. Pandora (81 kilometers, 50 miles across) orbits outside the rings on the right of the image. The small moon Atlas (30 kilometers, 19 miles across) orbits inside the thin F ring on the right of the image. The brightnesses of all the moons, relative to the planet, have been enhanced between 30 and 60 times to make them more easily visible. Other bright specks are background stars. Spokes -- ghostly radial markings on the B ring -- are visible on the right of the image.

This view looks toward the northern side of the rings from about 20 degrees above the ring plane.

The images were taken on Aug. 12, 2009, beginning about 1.25 days after exact equinox, using the red, green and blue spectral filters of the wide angle camera and were combined to create this natural color view. The images were obtained at a distance of approximately 847,000 kilometers (526,000 miles) from Saturn and at a Sun-Saturn-spacecraft, or phase, angle of 74 degrees. Image scale is 50 kilometers (31 miles) per pixel.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the mission for NASA's Science Mission Directorate, Washington, D.C. The Cassini orbiter and its two onboard cameras were designed, developed and assembled at JPL. The imaging operations center is based at the Space Science Institute in Boulder, Colo.

For more information about the Cassini-Huygens mission visit http://saturn.jpl.nasa.gov/. The Cassini imaging team homepage is at http://ciclops.org.

Image Credit: NASA/JPL/Space Science Institute

2. Leo Rising

A sky filled with stars and a thin veil of clouds.

Image by Adam Thanz

3. The Cat's Eye Nebula, one of the first planetary nebulae discovered, also has one of the most complex forms known to this kind of nebula. Eleven rings, or shells, of gas make up the Cat's Eye.

Credit: NASA, ESA, HEIC, and The Hubble Heritage Team (STScI/AURA)

Acknowledgment: R. Corradi (Isaac Newton Group of Telescopes, Spain) and Z. Tsvetanov (NASA)

4. Jupiter & Ganymede

NASA's Hubble Space Telescope has caught Jupiter's moon Ganymede playing a game of "peek-a-boo." In this crisp Hubble image, Ganymede is shown just before it ducks behind the giant planet.

Ganymede completes an orbit around Jupiter every seven days. Because Ganymede's orbit is tilted nearly edge-on to Earth, it routinely can be seen passing in front of and disappearing behind its giant host, only to reemerge later.

Composed of rock and ice, Ganymede is the largest moon in our solar system. It is even larger than the planet Mercury. But Ganymede looks like a dirty snowball next to Jupiter, the largest planet in our solar system. Jupiter is so big that only part of its Southern Hemisphere can be seen in this image.

Hubble's view is so sharp that astronomers can see features on Ganymede's surface, most notably the white impact crater, Tros, and its system of rays, bright streaks of material blasted from the crater. Tros and its ray system are roughly the width of Arizona.

The image also shows Jupiter's Great Red Spot, the large eye-shaped feature at upper left. A storm the size of two Earths, the Great Red Spot has been raging for more than 300 years. Hubble's sharp view of the gas giant planet also reveals the texture of the clouds in the Jovian atmosphere as well as various other storms and vortices.

Astronomers use these images to study Jupiter's upper atmosphere. As Ganymede passes behind the giant planet, it reflects sunlight, which then passes through Jupiter's atmosphere. Imprinted on that light is information about the gas giant's atmosphere, which yields clues about the properties of Jupiter's high-altitude haze above the cloud tops.

This color image was made from three images taken on April 9, 2007, with the Wide Field Planetary Camera 2 in red, green, and blue filters. The image shows Jupiter and Ganymede in close to natural colors.

Credit: NASA, ESA, and E. Karkoschka (University of Arizona)

5. 47 Tucanae

In the first attempt to systematically search for "extrasolar" planets far beyond our local stellar neighborhood, astronomers probed the heart of a distant globular star cluster and were surprised to come up with a score of "zero".

To the fascination and puzzlement of planet-searching astronomers, the results offer a sobering counterpoint to the flurry of planet discoveries announced over the previous months.

"This could be the first tantalizing evidence that conditions for planet formation and evolution may be fundamentally different elsewhere in the galaxy," says Mario Livio of the Space Telescope Science Institute (STScI) in Baltimore, MD.

The bold and innovative observation pushed NASA Hubble Space Telescope's capabilities to its limits, simultaneously scanning for small changes in the light from 35,000 stars in the globular star cluster 47 Tucanae, located 15,000 light-years (4 kiloparsecs) away in the southern constellation Tucana.

Hubble researchers caution that the finding must be tempered by the fact that some astronomers always considered the ancient globular cluster an unlikely abode for planets for a variety of reasons. Specifically, the cluster has a deficiency of heavier elements that may be needed for building planets. If this is the case, then planets may have formed later in the universe's evolution, when stars were richer in heavier elements. Correspondingly, life as we know it may have appeared later rather than sooner in the universe.

Another caveat is that Hubble searched for a specific type of planet called a "hot Jupiter," which is considered an oddball among some planet experts. The results do not rule out the possibility that 47 Tucanae could contain normal solar systems like ours, which Hubble could not have detected. But even if that's the case, the "null" result implies there is still something fundamentally different between the way planets are made in our own neighborhood and how they are made in the cluster.

Hubble couldn't directly view the planets, but instead employed a powerful search technique where the telescope measures the slight dimming of a star due to the passage of a planet in front of it, an event called a transit. The planet would have to be a bit larger than Jupiter to block enough light — about one percent — to be measurable by Hubble; Earth-like planets are too small.

However, an outside observer would have to watch our Sun for as long as 12 years before ever having a chance of seeing Jupiter briefly transit the Sun's face. The Hubble observation was capable of only catching those planetary transits that happen every few days. This would happen if the planet were in an orbit less than 1/20 Earth's distance from the Sun, placing it even closer to the star than the scorched planet Mercury — hence the name "hot Jupiter."

Why expect to find such a weird planet in the first place?

Based on radial-velocity surveys from ground-based telescopes, which measure the slight wobble in a star due to the small tug of an unseen companion, astronomers have found nine hot Jupiters in our local stellar neighborhood. Statistically this means one percent of all stars should have such planets. It's estimated that the orbits of 10 percent of these planets are tilted edge-on to Earth and so transit the face of their star.

In 1999, the first observation of a transiting planet was made by ground-based telescopes. The planet, with a 3.5-day period, had previously been detected by radial-velocity surveys, but this was a unique, independent confirmation. In a separate program to study a planet in these revealing circumstances, Ron Gilliland (STScI) and lead investigator Tim Brown (National Center for Atmospheric Research, Boulder, CO) demonstrated Hubble's exquisite ability to do precise photometry — the measurement of brightness and brightness changes in a star's light — by also looking at the planet. The Hubble data were so good they could look for evidence of rings or Earth-sized moons, if they existed.

But to discover new planets by transits, Gilliland had to crowd a lot of stars into Hubble's narrow field of view. The ideal target was the magnificent southern globular star cluster 47 Tucanae, one of the closest clusters to Earth. Within a single Hubble picture Gilliland could observe 35,000 stars at once. Like making a time-lapse movie, he had to take sequential snapshots of the cluster, looking for a telltale dimming of a star and recording any light curve that would be the true signature of a planet.

Based on statistics from a sampling of planets in our local stellar neighborhood, Gilliland and his co-investigators reasoned that 1 out of 1,000 stars in the globular cluster should have planets that transit once every few days. They predicted that Hubble should discover 17 hot Jupiter-class planets.

To catch a planet in a several-day orbit, Gilliland had Hubble's "eagle eye" trained on the cluster for eight consecutive days. The result was the most data-intensive observation ever done by Hubble. STScI archived over 1,300 exposures during the observation. Gilliland and Brown sifted through the results and came up with 100 variable stars, some of them eclipsing binaries where the companion is a star and not a planet. But none of them had the characteristic light curve that would be the signature of an extrasolar planet.

There are a variety of reasons the globular cluster environment may inhibit planet formation. 47 Tucanae is old and so is deficient in the heavier elements, which were formed later in the universe through the nucleosynthesis of heavier elements in the cores of first-generation stars. Planet surveys show that within 100 light-years of the Sun, heavy-element-rich stars are far more likely to harbor a hot Jupiter than heavy-element-poor stars. However, this is a chicken and egg puzzle because some theoreticians say that the heavy-element composition of a star may be enhanced after if it makes Jupiter-like planets and then swallows them as the planet orbit spirals into the star.

The stars are so tightly compacted in the core of the cluster – being separated by 1/100th the distance between our Sun and the next nearest star — that gravitational tidal effects may strip nascent planets from their parent stars. Also, the high stellar density could disturb the subsequent migration of the planet inward, which parks the hot Jupiters close to the star.

Another possibility is that a torrent of ultraviolet light from the earliest and biggest stars, which formed in the cluster billions of years ago may have boiled away fragile embryonic dust disks out of which planets would have formed.

These results will be published in The Astrophysical Journal Letters in December. Follow-up observations are needed to determine whether it is the initial conditions associated with planet birth or subsequent influences on evolution in this heavy-element-poor, crowded environment that led to an absence of planets.

Credits for Hubble image: NASA and Ron Gilliland (Space Telescope Science Institute)

6. Space Place is a fantastic source of scientific educational materials for children of all ages. Visit them at:

http://spaceplace.nasa.gov

7. NGC 3982

Though the universe is chock full of spiral-shaped galaxies, no two look exactly the same. This face-on spiral galaxy, called NGC 3982, is striking for its rich tapestry of star birth, along with its winding arms. The arms are lined with pink star-forming regions of glowing hydrogen, newborn blue star clusters, and obscuring dust lanes that provide the raw material for future generations of stars. The bright nucleus is home to an older population of stars, which grow ever more densely packed toward the center.

NGC 3982 is located about 68 million light-years away in the constellation Ursa Major. The galaxy spans about 30,000 light-years, one-third of the size of our Milky Way galaxy. This color image is composed of exposures taken by the Hubble Space Telescope's Wide Field Planetary Camera 2 (WFPC2), the Advanced Camera for Surveys (ACS), and the Wide Field Camera 3 (WFC3). The observations were taken between March 2000 and September 2009. The rich color range comes from the fact that the galaxy was photographed invisible and near-infrared light. Also used was a filter that isolates hydrogen emission that emanates from bright star-forming regions dotting the spiral arms.

Credit: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

Acknowledgment: A. Riess (STScI)

8. Once you spot the Summer Triangle, you can explore the cosmic treasures found in this busy region of the Milky Way. Make sure to “Take a Trip Around the Triangle” before it sets this fall! Find the full handout at bit.ly/TriangleTrip

9. This wider view of the area around the Summer Triangle includes another nearby asterism: the Great Square of Pegasus.