Chapter 1

Looking Up

Brandon Stroupe - BMAC Chair
Hello BMACers,

August is finally here. To me it felt like July seemed to last forever. Here we are now in August which is usually one of the hottest months of the year. I really hope it will not be that way. I am not a fan of hot, humid weather. The good news is that summer will be winding down soon now and I will be more than happy to welcome in Autumn. Our days are now slowly beginning to shorten and our nights are slowing getting longer. The perfect combination for our wonderful little hobby. I may be one of the only ones that feel that way, but that is okay. I really hope we will have a lot of good clear nights the rest of this year.

For our meeting this month, I will be the presenter and my presentation will be titled, “Astrophotography: Budget Friendly Ways to Image the Night Sky.” This presentation will be about the basics of astrophotography and the equipment used. I will also talk about how to image the night sky for a beginner on a budget and still produce breath-taking images. Most of you know that my favorite thing to do in astronomy is imaging. I absolutely love taking pictures to show the awesome beauty of our night sky. I have been imaging for about the past five years. I have discovered that there really is no reason to break the bank to produce great images, unless you really want to. It is really up to the person whether they want fancy equipment or just equipment that is sufficient enough to get the job done. This will all be covered in my presentation. I really enjoy getting out to image as much as our iffy Tennessee weather will allow and I think others will too. If you are at all interested or know someone that is interested in getting into astrophotography, please feel free to join us at our meeting on Aug. 5th at 7 p.m. Feel free to bring your camera and I will be happy to answer questions and show everyone what they can do with their camera. I hope to see everyone there.

For the month of July, we did not have a meeting because of our annual picnic. The picnic was at our usual location of Natural Tunnel State Park in Duffield, VA. We had eleven members show up for the picnic. The weather was questionable from the very beginning. Prior to the meeting, there was a heavy rain that knocked out the power to the whole Park for a few hours. The power returned during the picnic. Rain was also coming down at the start of the picnic and quickly left the area. The skies
Sagittarius

M20
M8

Sagittarius the Archer
image from Stellarium
layout by Adam Thanz

Kaus Australis
Julietta
remained overcast for the majority of the evening. Finally, right about the time the campers would usually come up, the skies started clearing. At about 9 p.m., the skies were almost completely clear, and just in time too, because here came the campers. We had about 20-30 campers come up to look through the scope that Wayne Manley brought up. There were a few pairs of binoculars going around as well. All and all it turned out to be a pretty good picnic with great food and great company. Thank you for everyone that came out and I look forward to next year as well. [Ed.: Brandon did not mention that he brought his new toy, a drone complete with tiny camera. See his very cool images accompanying this newsletter.]

Our constellation for the month of August will be one of my favorites. It is Sagittarius which is translated to “the archer.” There are a couple of competing myths for this constellation. The one I looked at is in Greek mythology. It says that Sagittarius is identified as the archer Crotus, son of Pan, who the Greeks say invented archery. According to this myth, Crotus went hunting on horseback regularly and lived among the Muses. The Muses asked that Zeus place Sagittarius in the sky, where he could be seen demonstrating his archery. The arrow in the bow of this constellation points towards the star Antares, which is known as the heart of the scorpion, Scorpions, and Sagittarius stands ready to attack should Scorpions ever attack nearby Hercules, or he is ready to avenge Orion who was slain by Scorpions.

One of the reasons that I love this constellation is that it has an abundance of deep-sky objects. Here are just a few of the objects that can be found in Sagittarius: M8 (The Lagoon Nebula), M17 (The Omega and Swan Nebulae), and M20 (The Trifid Nebula). These are just a few of the objects in this constellation. There are at least 6 more Messier objects. Most are globular clusters. Another interesting part of this constellation is that it is home to the center of our galaxy. Astronomers refer to this area as Sagittarius A. There is also a supermassive black hole there. When you are out this month, remember to check out all the interesting objects in this great constellation low, in our southern sky.

That will do it for this month. Please remember that the SunWatches will still happen every Saturday and Sunday from 3:00-3:30 p.m. if it is clear and we are always happy to have volunteers from the club to help out with this too. If you would like to help out, please arrive about 30 minutes early to help set up the equipment. I hope to see everyone at our meeting this month. Until next month…. Clear Skies.
Thank You Terry Alford!
Last month’s issue included Terry’s last regular column known as “Star Stuff.” Terry has been writing for the Bays Mountain Astronomy Club for decades. His articles have been mostly ATM (Amateur Telescope Maker) topics, but has been writing about the month’s night sky and what to see in the last few years. I want to thank Terry for his diligent work, very informative articles, his good nature, and being part of a team, the BMAC. He still wants to do the occasional article and I can’t wait to hear about some cool technique or gadget to make!

Continuing the theme of writing about the current night sky will be none other than Jason Dorfman. His monthly column is called “Celestial Happenings.” He’s been wanting to do a regular writing assignment and this is a perfect fit. He’ll apply his astronomy training and planetarium experience in a deftly manner. I think you’ll agree.

Adam Thanz, Ed.

BMAC Youtube!
The BMAC has a YouTube channel. Click here to see what’s on!

(https://www.youtube.com/channel/UCwIQM6nUs9gxJtDQe4AaAWQ)

The presentation by Steve Conard, who spoke about the telescope instrument on the New Horizons spacecraft, is now online. More to come!

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BMACers get droned. Photo by Brandon Stroupe.
BMACers stand at attention for a group photo. Can you see us?
Photo by Brandon Stroupe.
The skies cleared for a nice night of public observing. This aerial photo says it all. Photo by Brandon Stroupe.
Chapter 3

Celestial Happenings

Jason Dorfman
An Introduction

Many of you already know me, but for those of you who don’t, I have been a member of the club since the Fall of 2006, soon after I moved to Kingsport. I’m not sure when my love of the night sky really began. I know the summers I spent visiting family in the clear, dark skies of Alberta, Canada definitely had an effect. But, the real awe and wonder probably began while watching a lunar eclipse in the early ’80’s. My father had a good pair of binoculars then that turned the ‘flat’ Moon into a three-dimensional giant. I still remember how the shadows gave depth to the craters along the edge of the Moon, completely altering my perception of the starry skies above.

Though I took my first Intro to Astronomy class back in 1989, I didn’t really start observing the heavens until 2001 when I went back to school. I studied Physics and Astronomy at San Francisco State University where I received a BS in Physics with a concentration Astrophysics in 2004. While there, I worked in the observatory and planetarium.

Currently, I am one of the astronomy staff members at Bays Mountain Park where I spend a lot of my time creating programs for the planetarium theater. I also do my best to keep the technical aspects of the theater working properly.

My hopes for this article are mainly to present an overview of what’s happening in the night sky for the current month. I may also, from time to time, throw in a bit related to recent discoveries and explorations in astronomy. This is the first time that I have contributed a regular article to a newsletter or anything else. I hope you enjoy, but please bear with me as I find my footing with this new endeavor.

On to the Article…

Despite the Summer heat, thunderstorms and hazy skies, August still holds some great delights for observation. All of the visible planets will make an appearance in our evening skies this month, though some will be more easily observed than others. There are several different alignments occurring, as well. One of the highlights of August are the Perseid meteors. They are expected to be quite good this year due to a periodic interaction between Jupiter and the comet debris stream of Swift-Tuttle.
Planets

Looking to the west at dusk, we find Jupiter getting low along the horizon. On the 5th, a waxing crescent Moon will appear just below Jupiter. On this same evening, Venus will be about 1 degree North of Regulus, though you’ll be competing with the bright glow of the setting Sun to catch this alignment. Mercury has returned to our evening skies and will reach it's greatest eastern elongation on August 16. It will have about a 27 degree separation from the Sun. Near the end of the month, on August 27, Jupiter and Venus will appear less than a half a degree apart with Mercury about 5 degrees south of the pair. Unfortunately at this time of year, the ecliptic makes a low arc across the sky, so the elevation of Mercury and Venus will remain quite low, as will Jupiter in the later half of the month. You'll need to find a good location with a clear view towards the true western horizon for your best opportunity to catch a glimpse of these events.

Mars and Saturn, however, are still easily viewed within the constellation of Scorpius. Both are dimming slightly and growing a bit smaller in the sky, but remain big and bright enough for some wonderful views. Saturn’s rings are still seen far open in telescopes. On August 23, Mars will make a line with Saturn about 4° above and Antares less than 2° below. Both are transiting close to sunset, so be sure to catch them early before they descend lower.

Perseid Meteor Shower

Predictions for this year’s Perseids are looking good. Though Perseid meteors can be seen from mid July to about August 24, the peak is officially on the night of August 11/12. In a normal year, the Zenithal Hourly Rate (ZHR), or number of meteor events seen per hour, is about 60-90 on the peak night between midnight and dawn. This is based upon counts submitted to the International Meteor Organization (IMO) by observers worldwide. This year the predictions are estimating a ZHR between 150-160. The increase is due to a 12 year periodic interaction of Jupiter with the broad debris trail of Comet 109P/Swift-Tuttle. Each time, Jupiter’s gravity pulls a bit of the comet debris closer to a crossing path with Earth’s orbit, which results in a slight increase in activity every 12 years. The Moon will be at first quarter on the 10th, so best views of the shower will be after midnight on the evening of the peak. With full Moon on the 18th, the nights leading up to the peak may be a bit better than after.

Exploration

The Juno spacecraft, launched this month five years ago, successfully entered into orbit about Jupiter on July 4. Juno is tasked with exploring the atmosphere, aurora and gravitational and magnetic fields of the gas giant. To help protect the most
sensitive electronic equipment from Jupiter’s deadly radiation, they were placed inside a vault made of titanium. To learn more about the Juno mission, check out https://www.missionjuno.swri.edu.

References

Sky & Telescope, 132, no.2

2016 Meteor Shower Calendar; IMO_INFO(2-15), International Meteor Organization, 2015
Chapter 4

The Queen Speaks

Robin Byrne
Let us once again explore a science-themed book. “The First War of Physics: The Secret History of the Atom Bomb 1939-1949” by Jim Baggott explores many facets that went into the development of the atom bomb. Baggott has a background in chemistry and science writing and does an excellent job of discussing not only the science of the bomb, but also the human stories involved.

The book begins with an excellent description of the physics involved in both fission and fusion. He shares the original thoughts about how to induce fusion and creating a self-sustaining chain reaction. We see the early experiments that provided tantalizing clues about how to proceed.

With the rise of the Nazi party in Germany, we experience the first wave of scientists leaving Europe for England, Canada, and the United States. As Germany begins its expansion into neighboring countries and the start of World War II, the exodus of scientists grows exponentially. As these new arrivals try to work with their colleagues, they encounter a major roadblock - security clearance. Many of these same scientists were behind the push for America to develop a bomb before Germany. As the programs to develop the atom bomb are established, the countries were faced with an unusual problem - some of the best scientists were foreign nationals. If the program falls under the jurisdiction of national security, how can people from other countries be involved in the research? Some were given complete clearance, while others were pushed to the periphery. Various sites were established to focus on different aspects of the work, with most of the people involved being kept in isolation as a security measure. We follow the work being done at all of the sites throughout the book.

Baggott looks not just at the program in the United States, but also in England, Canada, Germany, and Russia. This approach provides a much broader view of the struggles involved, the discoveries made, and the setbacks encountered around the globe. We see the German program, which was the initial threat that had spurred America’s rush to develop a bomb. Ironically, the German scientists, under the leadership of Heisenberg, met enough obstacles to decide to only pursue development of a reactor, but not a bomb. One reason for this was the concerted effort by the Allies to target facilities that provided needed
THE FIRST WAR OF PHYSICS
THE SECRET HISTORY OF THE ATOM BOMB
1939-1949
JIM BAGGOTT
materiel, especially heavy water. After the fall of Germany, the Allies took into custody many of the German scientists to question. They were kept in a safe house, and their conversations were bugged. This was when it was discovered how little progress had been made on a bomb. Some of the German scientists later claimed that they intentionally stalled developing a bomb as a silent protest against the Nazi party and Hitler. The author was not entirely convinced that this was true.

Baggott also explores the world of espionage involved on all sides. This was especially true for people sympathetic to communism. Since Russia was our ally, they saw nothing wrong with sharing their information. Three agents stationed at Los Alamos released enough information to Russia to ensure they would be able to build a bomb soon after the war. Meanwhile, on the other side of the intelligence game were efforts to break codes and decipher messages. The work by intelligence agents in England made a huge difference in this area.

Then we see the development of the different types of bombs, with different approaches to how to trigger a chain reaction. The dropping of the bombs on Hiroshima and Nagasaki were the culmination of many years of effort. While some of the scientists took the aftermath in stride, others would regret their role for the remainder of their lives.

Baggott ends with the beginning of the Cold War and the development of a bomb by Russia. Combined with this was the hunt for the spies who had released information to Russia. Many of those involved with the program, especially those who were not native to America, were under suspicion, including Oppenheimer. Most of the spy rings were eventually discovered and the individuals arrested, but by that time it was too late.

“The First War of Physics” was a very interesting read both from a physics angle, as well as from an historical angle. The only part of the book I had trouble with was keeping track of all the different people involved in each country. When there’s an appendix of key individuals that runs 20 pages, you know you are encountering a cast of characters worthy of Tolkien. So I didn’t try to remember every person, but just let the context provide the information I needed to follow the story. And what a fascinating story it was.

References:
The First War of Physics: The Secret History of the Atom Bomb 1939-1949 by Jim Baggott; Pegasus Books 2010
As Earth speeds along in its annual journey around the Sun, it consistently overtakes the slower-orbiting outer planets, while the inner worlds catch up to and pass Earth periodically. Sometime after an outer world—particularly a slow-moving gas giant—gets passed by Earth, it appears to migrate closer and closer to the Sun, eventually appearing to slip behind it from our perspective. If you’ve been watching Jupiter this year, it’s been doing exactly that, moving consistently from east to west and closer to the Sun ever since May 9th.

On the other hand, the inner worlds pass by Earth. They speed away from us, then slip behind the Sun from west to east, re-emerging in Earth’s evening skies to the east of the Sun. Of all the planets visible from Earth, the two brightest are Venus and Jupiter, which experience a conjunction from our perspective only about once per year. Normally, Venus and Jupiter will appear separated by approximately 0.5° to 3° at closest approach. This is due to the fact that the Solar System’s planets don’t all orbit in the same perfect, two-dimensional plane.

But this summer, as Venus emerges from behind the Sun and begins catching up to Earth, Jupiter falls back toward the Sun, from Earth’s perspective, at the same time. On August 27th, all three planets—Earth, Venus and Jupiter—will make nearly a perfectly straight line.

As a result, Venus and Jupiter, at 9:48 PM Universal time, will appear separated by only 4 arc-minutes, the closest conjunction of naked eye planets since the Venus/Saturn conjunction in 2006. Seen right next to one another, it’s startling how much brighter Venus appears than Jupiter; at magnitude -3.80, Venus appears some eight times brighter than Jupiter, which is at magnitude -1.53.

Look to the western skies immediately after sunset on August 27th, and the two brightest planets of all—brighter than all the stars—will make a dazzling duo in the twilight sky. As soon as the Sun is below the horizon, the pair will be about two fists (at arm’s length) to the left of the Sun’s disappearance and about one fist above a flat horizon. You may need binoculars to find them initially and to separate them. Through a telescope, a large, gibbous Venus will appear no more distant from Jupiter than Callisto, its farthest Galilean satellite.

As a bonus, Mercury is nearby as well. At just 5° below and left of the Venus/Jupiter pair, Mercury achieved a distant conjunction with Venus less than 24 hours prior. In 2065, Venus will actually
occult Jupiter, passing in front of the planet’s disk. Until then, the only comparably close conjunctions between these two worlds occur in 2039 and 2056, meaning this one is worth some special effort—including traveling to get clear skies and a good horizon—to see!

To teach kids more about Venus and Jupiter, visit the NASA Space Place webpages titled “All About Venus” [http://spaceplace.nasa.gov/all-about-venus/en/] and “All About Jupiter” [http://spaceplace.nasa.gov/all-about-jupiter/en/].

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!
Chapter 6

BMAC

Calendar

and more
## BMAC Calendar and more

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<tr>
<th>Date</th>
<th>Time</th>
<th>Location</th>
<th>Notes</th>
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<tbody>
<tr>
<td><strong>BMAC Meetings</strong></td>
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<tr>
<td>Friday, August 5, 2016</td>
<td>7 p.m.</td>
<td>Nature Center</td>
<td>Program: Brandon Stroupe will speak on “Astrophotography: Budget Friendly Ways to Image the Night Sky.” The presentation will be about the basics of astrophotography and equipment. How to image the night sky for a beginner on a budget and still produce breath-taking images.; free.</td>
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<td>Discovery Theater</td>
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<td>Friday, September 2, 2016</td>
<td>7 p.m.</td>
<td>Nature Center</td>
<td>Program: TBA; free.</td>
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<td>Discovery Theater</td>
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<td>Friday, October 7, 2016</td>
<td>6 p.m.</td>
<td>Observatory</td>
<td>Program: Observatory cleaning and topic TBA; Free.</td>
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<td><strong>SunWatch</strong></td>
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<td>Every Saturday &amp; Sunday March - October</td>
<td>3-3:30 p.m. if clear</td>
<td>At the dam</td>
<td>View the Sun safely with a white-light view if clear.; Free.</td>
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<tr>
<td><strong>StarWatch</strong></td>
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<td>October 1, 8, 15, 2016</td>
<td>7:30 p.m.</td>
<td>Observatory</td>
<td>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.</td>
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<td>Oct. 22, 29, Nov. 5, 2016</td>
<td>7:00 p.m.</td>
<td>Observatory</td>
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<tr>
<td>November 12, 19, 26, 2016</td>
<td>6:00 p.m.</td>
<td>Observatory</td>
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<td><strong>Special Events</strong></td>
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<td>October 21-23, 2016</td>
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<td>Farmstead Museum, BMP</td>
<td>StarFest. Our 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. <strong>Pre-registration by Sept. 30, 2016 with full payment is mandatory for attendance. Sorry, no walk-ins nor “visits.”</strong> Registration opens in August.</td>
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Regular Contributors:

Brandon Stroupe
Brandon is the current chair of the club. He is a photographer for his home business, Broader Horizons Photography and an avid astrophotographer. He has been a member since 2007.

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.

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:

www.baysmountain.com/astronomy/astronomy-club/
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.


Creator/Photographer: NASA John W. Young
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 counterpart 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 stars.

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 theorists say that the heavy-element composition of a star may be enhanced after 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 August 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. Image credit: E. Siegel, created with Stellarium, of a small section of the western skies as they will appear this August 27th just after sunset from the United States, with Venus and Jupiter separated by less than 6 arc-minutes as shown. Inset shows Venus and Jupiter as they’ll appear through a very good amateur telescope, in the same field of view.