Chapter 1

Looking Up

Brandon Stroupe - BMAC Chair
Hello BMACers,

Welcome to July, everyone. Welcome to the hot, muggy summer. I really do enjoy the summer time, I just do not enjoy the hot, humid weather. I go on about that enough, so I will refrain from doing it again this month. I hope everyone is enjoying their summer. That is, if you get one. A lot of families tend to go on vacation during the summer months, if that is yours, I hope you have a great time and get to relax and enjoy a break from all your hard work. For the rest of us, hang in there, our vacation will be here before we know it.

Now for something much more serious. Many of you may have already known about this, but regretfully, we had to say goodbye to one of our very own members last month, Terry Alford. Terry was one the founding members of BMAC and a very strong advocate for astronomy outreach. He enjoyed everything about astronomy and our club. He rarely missed a meeting and you could always count on him being there to have a great conversation. If you didn’t have a chance to sit down and talk with him at least once, I really wish you could have. He was a great member and a great friend. He will truly be missed.

For our meeting this month, we will not be having a speaker and our meeting will not be on the first Friday of the month. It is our annual picnic month. We will again be having our picnic at Natural Tunnel State Park in Duffield, VA. The picnic will be on July 15 and begin at 6 p.m. The picnic will be located at the gazebo in the back of the park. We will also be hosting a public night viewing for the campers in the park after the picnic. This is a potluck style picnic, so please bring your favorite dish to share and don’t forget to bring a chair since there is no seating at the gazebo. Also, if you would like to bring your scope or binoculars, please feel free to since we will need some for the public viewing. If the sky is clear, there are guaranteed to be a lot of campers come up to have us show them the night sky. Many have kids with them and it is a great way to help them get started in our wonderful hobby. We always have a great time at the picnic and I hope to see everyone there.

At our meeting last month, we welcomed a fellow club member, William Troxel. His presentation was entitled, “What Type of Scope is Best for You.” He talked about how to work down through the vast information about the different scopes and how
to narrow down what he felt he would like to look at to start. He also bought up the Astronomical League and how they can help the amateur astronomer. A big point about purchasing a telescope was explained. Just because you see a good deal at Wal-Mart, it does not mean it is the right scope for you and your needs. He shared how getting out and becoming part of club (like BMAC) and not being afraid of asking questions. He then spoke about really getting hands on with different scopes at least once to see which is right for you. A great way to do that at no cost is to attend one of our public StarWatches and see all the different types of scopes being used. I hope everyone enjoyed Will’s presentation and found it very beneficial to you. Thank you, Will, for taking the reins for me since I was unable to be there and thanks for giving a great presentation.

Our constellation this month will be Hercules. This constellation is well-known to most of us. However, when it comes to the origin of the constellation, many of us do not know. That includes me. What I have found about the Hercules constellation is that in Greek mythology, the constellation Hercules is typically associated with the penultimate labour of Heracles. This involved the killing of the dragon Ladon, who guarded the garden of the Hesperides. The dragon is represented by the constellation Draco. Other myths about Hercules involve what I always heard growing up and that is that Hercules is the son of the Greek god Zeus and Alcmene, who was a mortal woman. I think both myths probably fit together in one way or another. Some of the notable objects that we find in Hercules are M13 (The Great Hercules Cluster) and M92, which is another good globular cluster in this constellation. Something else that is interesting about Hercules is that we know of at least 15 different planetary systems in that direction. That means that it has 15 stars that are orbited by extrasolar planets. That is pretty awesome. As always, please take the time to go out this month and enjoy the beauty of the Hercules constellation and the rest of our beautiful night sky.

That will be it for this month. Before I go, I would like to thank Wayne Manly for donating a PST to the Park to help with solar viewing. The Park is designing and building a dual-head mount for it and including a small white light scope to put on a heavy tripod. This will make it easier for staff and volunteers to bring it out for solar viewing on weekends when it is clear. Thank you, Wayne, for your great donation. Speaking of solar viewing, please remember that the SunWatches are continuing as usual on Saturday and Sunday if it is clear. If you would like to volunteer to help with the SunWatches, please arrive a little before 3 p.m. to help with setup. The scopes are typically setup at the dam.

I would also like to thank everyone for re-electing me as your club chairman. I hope everyone feels that I am doing a decent job at this. It is my primary goal to help the club grow as much as possible and get as many people, especially kids, interested in astronomy as possible. This is a very daunting task so I will still
need the help of others as well. It is an honor to stand in front of you all every month and I will continue to do my very best. Until next month... Clear Skies.
Chapter 2

BMAC

Notes

More on this image. See FN4.
Passing of Founding BMAC member Terry Alford

It is sad news to announce the passing of one of our founding members of the BMAC, Terry Alford.

He was very active in the club. He attended most every meeting, was the club chair a number of times, was the author of articles about ATM (amateur telescope making) for many, many years, helped with many projects, he was host to summer picnics, and the list goes on.

He always had a bad joke at hand (many of which cannot be repeated) and that sly smile.

I learned a lot from him and I thank him. He will be missed.

Adam

(If you are new to the club, Terry is the second from the right in this image from Brandon Stroupe)
BMACer Wayne Manly Donates PST

Wayne Manly with the PST H-alpha scope he generously donated to help with the Park’s public SunWatch viewing for educational outreach. This telescope is designed to only show the Sun’s Chromosphere. That is the layer that displays prominence’s, flares, and plages.

This telescope will be paired with another small white-light scope to show the Sun’s Photosphere. That is the layer that you can see sunspots, faculae, and granulation.

Photo by Adam Thanz
Opportunities & Rules Posted on the BMAC Part of the Park’s Website

Opportunities
How you would like to learn how to run one of our telescopes in one of our observatories? If so, that’s great! You need to be a BMAC member in good standing (see rules below) and qualified to do so. In order to run any of our equipment, you’ll need to learn on your own the basics of pointing and using a telescope. A great opportunity for that is during our public StarWatch night viewing programs. A fellow club member can show you the basics with a scope they are using. Over time, you’ll learn these basics. You’ll also learn how to help the public understand what they are seeing in the telescope. Then, you can contact the planetarium staff to set up a one-on-one training session during the daytime to learn the specifics of the Park’s observatories.

Rules
In order to enjoy the full benefits of being a member of the Bays Mountain Astronomy Club, like earning the opportunity to run a scope in one of our observatories or even help at a public event, one needs to understand that being a member is akin to volunteerism to Bays Mountain Park. As such, a member needs to be in good standing, of good character, and doesn’t abuse this privilege.

The Park is enforcing some long held basic, good behavior guidelines regarding volunteers. If a volunteer (i.e. club member) does not play well with others, then they will not be a part of this volunteer effort. Again, it is a privilege, not a right, to be a member of the club and volunteer.

Not to put a negative tone to this page, but it is important to establish guidelines that we can all work by. Here is a short list of unacceptable behaviors:

• Being rude and/or abusive to another member/public/staff person. This includes verbal, unspoken, online and physical methods. Abuse also includes micromanaging, passive/aggressive behavior, high type-A behavior, and more.

• Theft.

• Damage to equipment/property through gross negligence or on purpose.

• Shirking responsibilities to something volunteered on a repeated basis.

• Being at a club meeting, StarWatch, SunWatch, StarFest, Astronomy Day or any other public event while intoxicated, even by the smallest amount, by alcohol or drugs.

This is not an absolute list, but it should get the point across. [Ed.: Unfortunately, I have personally experienced every point listed above.]
Report of Astronomy Property Stolen
from Ted Saker

I’m a member of the Columbus Astronomical Society. I attended the recent Texas Star Party. On my way home, on the morning of May 29, I stopped at a hotel in Jackson TN where thieves broke into my truck and stole some of my gear. Among the stolen items are a go-bag filled with recent TSP T-shirts, my ST-8XME and accessories, and two old laptops loaded with astronomy software. Here is a link to a Craig’s List ad I posted in the hope that I could recover the items.

https://nashville.craigslist.org/wan/6153366425.html

I have not received a response to the ad. I and a number of my friends are watching internet sites. I write in the hope that any member of your organization would alert me in case someone tries to sell or donate my gear to one of your members or your organization. I would appreciate it if your organization would let me know if it turns up. A reward is offered for the return of my stolen gear complete and in working condition.

The full list of equipment is: ST-8XME with the Particle Wave Dessicant Plug, CFW10SA with LRGB Ha SII OIII filters, Astrodon MOAG-ST with RGH, and an AO-8, power supply, extra desiccant, allen wrench in a black pelican case. I have the serial numbers in case there’s any question.

Also, the thieves did not get the data cables for the RGH or ST-8XME, so anybody looking for them my be suspect as well.

Ted Saker <tsakerjr@gmail.com>
With this month’s article, I complete my first year of submitting something for your reading pleasure. I hope that you have enjoyed my insights into the skies above. I look forward to continuing this endeavor in the months ahead. Next month, I will focus more on the upcoming celestial event that I know we are all looking forward to with childlike anticipation.

For July, we continue with several opportunities to view the planets, our Moon and Comet Johnson.

On a slightly different note, I was very sad to hear of the passing of Terry Alford. I know many of our members will feel the loss of a wonderful mentor and friend. Terry was very welcoming to me when I joined back in 2006 and, though we rarely saw one another outside of club related activities, I always looked forward to seeing Terry at our meetings and StarWatch programs. I especially enjoyed the quiet whisperings of his often non-PC humor.

Planets

The somewhat elusive world, Mercury, makes it’s return to our evening skies this month. It will, however, be a challenging observation for most of the month as it remains close to the horizon after sunset. On the 24th/25th it will be just 1° from Regulus, the brightest star in Leo. Your best opportunity to see this world will be at the end of the month when Mercury reaches its greatest Eastern elongation. On the 29th, the planet will appear 27° from the Sun, but it will be just 8° above the horizon a half hour after sunset, making it a bit of a challenge with the extended twilight skies of summer.

Jupiter is now moving back towards Spica in the constellation Virgo. It’s still bright at magnitude -2.0 and will only dim slightly to mag. -1.9 over the month. The size of the disk starts out at 37” and ends the month at 34”. The optimal viewing of Jupiter was earlier this Spring when Jupiter was at opposition. Jupiter is now getting lower in the Southwest an hour after sundown. Take a look on the 18th and you’ll see the 4 visible moons aligned on one side of Jupiter.

The other gas giant planet in the solar system, Saturn, is also visible and shines at magnitude 0.2. Sitting between the head of
Scorpius and the top of the Teapot, it crosses the meridian around midnight at about 30° altitude. The ring plane is very open to us at 26.5° and very close to its maximum tilt. Saturn spans about 18” and the ring plane about 41”.

Another challenging observation this month is the distant and surprisingly unique world Pluto. Pluto reaches opposition this month on the 9th/10th. If you’ve ever wanted to view this former planet, now’s the time. At magnitude 14.2, you’ll need at least an 8 inch or preferably larger scope, a few nights of clear dark skies and lots of patience. Both Sky & Telescope and Astronomy magazines have a short section on Pluto this month which include some finding charts.

Pluto passed through perihelion back in 1989. Since then, it has begun to move farther from the Sun. With its highly elliptical orbit, this movement towards aphelion becomes quite significant for observers as Pluto’s aphelion distance takes it almost 3 billion miles further from the Sun! With a 248 year orbit, it won’t be long until Pluto is but a distant memory.

To complete your planet observations this month, look to the morning skies for our sister planet, Venus. Rising about 3 a.m. in early July, it will reach a 20° altitude an hour before sunup. Venus is currently moving through the constellation of Taurus. On the 5th, it will pass about 7° south of the Pleiades as it moves on north of the Hyades cluster passing about 3° north of Aldebaran on the 13th. By month’s end, it will be shifting into Gemini as it continues its eastern movement back towards the Sun.

Luna

As the month opens, we find a waxing gibbous Moon creating a small triangle with Spica and Jupiter. The full Moon comes a week later on the evening of the 8th. On the 6th, a nearly full Moon will pass just 3° North of Saturn. When your attempting to find Mercury on the 24th, you’ll find a thin crescent just below and to the right of Mercury and Regulus. The next night it will be above and to the left. On the 28th, while making your observations of Jupiter, you’ll find a large crescent just 3° above the giant world. Be sure to head out on the morning of the 20th for that observation of Venus. A thin, waning crescent will be just below and to the right of this bright beauty.

Comets

Comet Johnson (C/2015 V2) made its closest approach to the Earth and Sun last month. It is now making its way out of the Solar System. But before it leaves, we may get some good observations of it this month. It is currently moving southward through the lower half a Virgo, East of Spica, and is about magnitude 8.3, which could reach 6th or 7th magnitude as we
begin the month. A perfect binocular object, it was already exhibiting a faint dust and ion tail back in May.

That’s all for this month. I hope to see you at the club picnic this month. I’ll be driving back from Louisville that day, but plan on stopping by.

Clear Skies!
Chapter 4

The Queen Speaks

Robin Byrne
This month, we celebrate the life of a man who started in astronomy, but eventually found himself to be an expert on tree rings, instead. Andrew Ellicott Douglass was born in Windsor, Vermont on July 5, 1867. At the age of 18, he began attending Trinity College in Hartford, Connecticut, where he majored in astronomy, math and physics.

After graduating in 1889, Douglass was part of an expedition by the Harvard College Observatory to Arequipa, Peru. They helped establish the site for a new observatory that would be used for southern hemisphere photographic surveys. It became known as Boyden Station. The data taken of stars was analyzed primarily by Pickering’s Women back at Harvard. So the work of Henrietta Leavitt on Cepheid variable stars, and Annie Cannon’s development of the spectral classification system can be linked to this observatory.

In 1894, Douglass moved to Flagstaff, Arizona to work at the Lowell Observatory. Douglass was essentially considered second in command, filling the role of acting director whenever Percival Lowell was out of town. However, Douglass and Lowell had a falling out when Douglass expressed his doubts about features Lowell claimed were canals on Mars. In 1901, Douglass was fired. [Ed.: This sounds familiar…]

For a few years, Douglass worked as a probate judge before being hired by the University of Arizona in 1909. He was made an Assistant Professor of Physics and Geography. During this time, he spent eight years unsuccessfully trying to raise funds for a large telescope in Tucson. Meanwhile, Douglass was the Head of the Physics and Astronomy Department, served as the university’s interim president during the 1910-1911 academic year, and was finally made Dean of the College of Letters, Arts, & Sciences.

In 1916, Douglass’ dream of a large telescope in Tucson started to come true. An anonymous loan gave the university $60,000 to build such a telescope. Eventually, the donor was identified as Lavinia Steward, who had an interest in astronomy and wanted to commemorate her late husband, Henry. World War I interfered with its construction, since the best manufacturers of large mirrors were in Europe, so an American company had to be found. Ultimately, the Spenser Lens Co. in Buffalo, New York was given the contract for the 36 inch Newtonian telescope. Six years
Prof. A. E. Douglass and the original Steward Observatory 36-inch Telescope (moved to Kitt Peak in 1963)

Image from Wikipedia from the University of Arizona Library Special Collections
after the project began, the Steward Observatory was officially dedicated and ready for business.

It was during this time that Douglass continued his study of tree rings that had begun at Lowell Observatory. One of the first patterns he established is that tree rings correlate with rainfall. Not too surprising, years with more rain were indicated by more growth. Douglass even taught a class on dendrochronology - the use of tree rings to determine the date of an event. His expertise on tree rings brought Douglass to the attention of the American Museum of Natural History. Douglass was contacted to help determine the sequence of events associated with prehistoric ruins in the American Southwest. After three years of study, Douglass was able to establish that samples from an Aztec Ruin in New Mexico all came from the same two-year period, while samples from another site were 25 years older, which, after more study, was later modified to 40-45 years older.

Unfortunately, the museum cut off funding for further research of this subject in 1920, but Douglass was able to get backing through the National Geographic Society in 1922. The resulting project became known as the Beam Expeditions. From 1923 to 1929, Douglass studied samples throughout the Southwest, ultimately establishing a timeline correlating to tree rings dating all the way back to the year 700 CE. This relationship allowed for accurate dating of archeological ruins throughout the region.

Douglass connected his interest in tree rings with his career in astronomy by studying the link between tree rings and the sunspot cycle. Using a precursor to Fast Fourier Transfer Series, which pull out repeating patterns, Douglass analyzed tree rings for repeating patterns and cycles. He did the same analysis to sunspot frequency. Douglass studied over 52,000 rings on 305 trees from the region between the Rocky Mountains and the coast. Relating the patterns to specific years, Douglass found that the tree ring data showed no cycle between the years of 1650 and 1725. That was of great concern. However, three years later, Maunder published his description of the almost complete lack of sunspots from 1645 to 1715, which is now known as the Maunder Minimum. That correlation added a tremendous boost to Douglass’ work. Overall, Douglass found that trees in Europe experienced more growth during sunspot maximum, but also a lesser boost of growth at minimum. Meanwhile, the sequoias in the western United States had a stronger growth correlation with the Sun’s 22-year sunspot cycle. Ultimately, all of this pointed to a connection between tree growth, climate, and the sunspot cycle that is still not fully understood.

In 1937, Douglass established the Laboratory of Tree-Ring Research at the University of Arizona. He served as its director until his retirement in 1958.

A. E. Douglass died March 20, 1962 in Tucson, Arizona. His legacy lives on in the use of tree rings to study the history of:
forest fires, volcanic activity, hurricane activity, the movement of glaciers, rainfall, geologic events, and floods. There are even craters on both the Moon and Mars named after him. While you peer at the Sun during our current solar minimum, bemoaning the lack of sunspots, think about their connection to climate and tree growth, and the man who figured it all out - A. E. Douglass.

References:

Chrono-Biographical Sketches Douglass, Andrew Ellicott (United States 1867 - 1962) by Charles H. Smith 2005

http://people.wku.edu/charles.smith/chronob/DOUG1867.htm

The Douglas Archives: A collection of historical and genealogical records A.E. Douglass

http://www.douglashistory.co.uk/history/a_e_douglass.htm#.WTarBlKZOis

A. E. Douglass - Wikipedia


Evidences of Cycles in Tree Ring Records by A. E. Douglass

Proceedings of the National Academy of Sciences March 1933

http://ltrr.arizona.edu/sites/ltrr.arizona.edu/files/bibliodocs/Douglass,20AE_Evidences20of20Cycles20in20Tree20Ring20Records_1933.pdf

Harvard College Observatory Expedition: Boyden Station, Arequipa, Peru, 1889-1927

http://ocp.hul.harvard.edu/expeditions/boyden.html
When Stamatios (Tom) Krimigis was selected for the Voyager mission in 1971, he became the team’s youngest principal investigator of an instrument, responsible for the Low Energy Charged Particles (LECP) instrument. It would measure the ions coursing around and between the planets, as well as those beyond. Little did he know, though, that more than 40 years later, both Voyager 1 and 2 still would be speeding through space, continuing to literally reshape our view of the Solar System.

The Solar System is enclosed in a vast bubble, carved out by the solar wind blowing against the gas of the interstellar medium. For more than half a century, scientists thought that as the Sun moved through the galaxy, the interstellar medium would push back on the heliosphere, elongating the bubble and giving it a pointy, comet-like tail similar to the magnetospheres—bubbles formed by magnetic fields—surrounding Earth and most of the other planets.

“We in the heliophysics community have lived with this picture for 55 years,” said Krimigis, of The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland. “And we did that because we didn’t have any data. It was all theory.”

But now, he and his colleagues have the data. New measurements from Voyager and the Cassini spacecraft suggest that the bubble isn’t pointy after all. It’s spherical.

Their analysis relies on measuring high-speed particles from the heliosphere boundary. There, the heated ions from the solar wind can strike neutral atoms coming from the interstellar medium and snatch away an electron. Those ions become neutral atoms, and ricochet back toward the Sun and the planets, uninhibited by the interplanetary magnetic field.

Voyager is now at the edge of the heliosphere, where its LECP instrument can detect those solar-wind ions. The researchers found that the number of measured ions rise and fall with increased and decreased solar activity, matching the 11-year solar cycle, showing that the particles are indeed originating from the Sun.

Meanwhile, Cassini, which launched 20 years after Voyager in 1997, has been measuring those neutral atoms bouncing back, using another instrument led by Krimigis, the Magnetosphere Imaging Instrument (MIMI). Between 2003 and 2014, the number of measured atoms soared and dropped in the same way as the ions, revealing that the latter begat the former. The neutral atoms...
must therefore come from the edge of the heliosphere.

If the heliosphere were comet-shaped, atoms from the tail would take longer to arrive at MIMI than those from the head. But the measurements from MIMI, which can detect incoming atoms from all directions, were the same everywhere. This suggests the distance to the heliosphere is the same every which way. The heliosphere, then, must be round, upending most scientists’ prior assumptions.

It’s a discovery more than four decades in the making. As Cassini ends its mission this year, the Voyager spacecraft will continue blazing through interstellar space, their remarkable longevity having been essential for revealing the heliosphere’s shape.

“Without them,” Krimigis says, “we wouldn’t be able to do any of this.”

To teach kids about the Voyager mission, visit the NASA Space Place: https://spaceplace.nasa.gov/voyager-to-planets

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

See FN7
# BMAC Calendar and more

<table>
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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 4, 2017</td>
<td>7 p.m.</td>
<td>Nature Center</td>
<td>Program: Topic TBA; Free.</td>
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<td>Discovery Theater</td>
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<tr>
<td>Friday, September 1, 2017</td>
<td>7 p.m.</td>
<td>Nature Center</td>
<td>Program: Topic TBA; Free.</td>
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<td>Discovery Theater</td>
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<tr>
<td>Friday, October 6, 2017</td>
<td>6 p.m.</td>
<td><strong>Observatory</strong></td>
<td>Program: Observatory cleaning and topic TBA; Free.</td>
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<tr>
<td><strong>SunWatch</strong></td>
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<tr>
<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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<tr>
<td>Oct. 7 &amp; 14, 2017</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>
</tr>
<tr>
<td>Oct. 21 &amp; 28 &amp; Nov. 4, 2017</td>
<td>7:00 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>
</tr>
<tr>
<td>Nov. 11, 18, &amp; 25, 2017</td>
<td>6:00 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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<tr>
<td><strong>Special Events</strong></td>
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<tr>
<td>Saturday, July 15, 2017</td>
<td>6 p.m.</td>
<td>Gazebo, Natural Tunnel State Park</td>
<td>Annual club picnic and public star gaze. BMACers and their families are most welcome to enjoy the evening along with a potluck dinner. Please bring a dish to share. You’ll need to bring your own chair and telescope to share the night sky.</td>
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<tr>
<td>Oct. 27-29, 2017</td>
<td>-</td>
<td>Farmstead</td>
<td>StarFest 2017. 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 Oct. 6, 2017 with full payment is mandatory for attendance. Sorry, no walk-ins nor “visits.”</strong> Registration opens in August.</td>
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</table>
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/

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.
**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.


   Image Credit: NASA/JPL/Space Science Institute

2. **Duke on the Craters Edge**
   Astronaut Charles M. Duke Jr., Lunar Module pilot of the Apollo 16 mission, is photographed collecting lunar samples at Station no. 1 during the first Apollo 16 extravehicular activity at the Descartes landing site. This picture, looking eastward, was taken by Astronaut John W. Young, commander. Duke is standing at the rim of Plum crater, which is 40 meters in diameter and 10 meters deep. The parked Lunar Roving Vehicle can be seen in the left background.

   Image AS16-114-18423

   Creator/Photographer: NASA John W. Young

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**

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**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.

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   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 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’s 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 if 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 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 e
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. New data from NASA's Cassini and Voyager show that the heliosphere — the bubble of the
Sun's magnetic influence that surrounds the Solar System — may be much more compact and
rounded than previously thought. The image on the left shows a compact model of the
heliosphere, supported by this latest data, while the image on the right shows an alternate model
with an extended tail. The main difference is the new model's lack of a trailing, comet-like tail on
one side of the heliosphere. This tail is shown in the old model in light blue.
Image credits: Dialynas, et al. (left); NASA (right)