Skylights

Newsletter of the Astronomical Society of Northern New England

SEPT 2015

Member of NASA's

Astronomical League

ASNNE MISSION

ASNNE is an incorporated, non-profit, scientific and educational organization with three primary goals:

1) To have fun sharing our knowledge and interest with others.

2) To provide basic education in astronomy and related sciences to all who are interested.

3) To promote the science of Astronomy.

What's Up In September

By Bernie Reim

The month of September was the seventh month of the year when March was the first month. Fall always begins for us in the northern hemisphere this month and this will happen on Wednesday the 23rd at 4:21 a.m. EDT. The autumnal equinox is farther defined by the sun on the ecliptic crossing over the celestial equator on a downward path, meaning the days are getting shorter and shorter.

The weather is usually at its best at this time of year, and the nights will be getting longer and cooler, so this will be a great month to get out and enjoy some of the natural wonders of the sky above us and the earth beneath us.

That is one of only two days each year that the sun rises due east and sets due west for everyone on earth except at the poles. The other day is the beginning of spring. Within a few days of that date is also the only time that the days and nights are exactly 12 hours long for everyone on Earth except at the poles. They are always 12 hours long at the equator.

The main highlight this month is a total eclipse of the Harvest Moon. This lunar eclipse will be the last in the current tetrad, which are four total lunar eclipses in a row with no partial eclipses in between. It will start on Sunday evening the 27th at 9 07 pm and the total phase will start at 10:11 pm, about an hour later. The moon will begin to reemerge out of our shadow at 11 23 pm and the partial eclipse phase will end at 12 27 am on Monday morning the 28th. The entire total lunar eclipse will last about three and a half hours.

Not only will this be the most famous of the moons being eclipsed, but it will also be the closest Harvest moon in a lifetime, since the eclipse will occur when the moon is less than one hour from perigee, which is its closest point to the earth for the month. So you don't need to stay up particularly late or get up really early to see this one from right here in the northeast. The entire eclipse will not be visible for the western half of our country. We were not as lucky for the first three total lunar eclipses in this current tetrad.

Every lunar eclipse is unique. Watch closely and also try to photograph it to capture its great beauty and to get a better sense of what is really happening when this takes place. The shadow cone of the earth, which always extends about one million miles into space, will be sweeping across the moon at this time, which is about 4 times smaller than we are.

Our atmosphere bends or refracts the sunlight around the earth and back onto the moon, allowing us to see it in many subtle shades of red and orange during the total phase. What you are really seeing is the combined effect of all the sunrises and sunsets on the earth simultaneously reflected back at us from the stark lunar surface. The more dust is in our atmosphere at the time, the darker the lunar eclipse would be.

I just returned from the Stellafane convention in Springfield, VT. This is an annual pilgrimage for many amateur astronomers and always an exciting time to learn more about many aspects of astronomy, make new friends, reconnect with old friends, and most importantly, really experience and soak in the beauty of a pristine night sky a quarter of a

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Club Contacts

Officers:

President:
Ron Burk
rdavidburk@yahoo.com

Vice President:
Joan Chamberlin
starladyjoan@yahoo.com

Secretary:
Carl Gurtman
carlgurt@msn.com

Treasurer:
Ian Durham
idurham@anselm.edu

Board of Directors:

Nan Musgrave
mzgrvz@outlook.com

Tim Brown
cote54@icloud.com

Sara Carter
scarterdin@hotmail.com

Star Party Co-ordinator:

TBD

Skylights Editor:

Paul Kursewicz
pkursewicz@myfairpoint.net

Website Manager:

Jim Hatch
nerdfulthings@earthlink.net

NASA Night Sky Network Co-ordinator:

Joan Chamberlin
starladyjoan@yahoo.com

JPL Solar System Ambassador:
Joan Chamberlin
starladyjoan@yahoo.com

What's Up "*Continued from page 1*"

mile above sea level while magnifying tiny parts of it with larger telescopes than you could have access to anywhere else.

The bonus this year was catching many remaining Perseid meteors, though it was a couple of nights after their peak. There is nothing like witnessing the pitch dark sky sprinkled with its random arrangement of softly glowing stars and other celestial objects suddenly being silently split apart by a brilliant streak of light that leaves a twisting trail of matter high in our atmosphere. You can get a better sense of the real nature of our life-sustaining atmosphere as you attentively watch exactly how our protective envelope of precious air absorbs and extinguishes these tiny sand grain size objects safely as you see this silent streak.

I gained a much better appreciation for Pluto and all the work and some luck that went into making this a successful mission that will continue for many more years by listening to Alan Stern, the chief investigator for the New Horizons mission that just got to Pluto on July 14 after nine and a half years of high speed travel.

This dwarf planet is turning out to be quite an active place with moving nitrogen and methane ice mountains and an atmosphere that is four times thicker than we first thought. It looks more like Mars with its orange and reddish colors. There are many mysteries still to be uncovered here as we try to develop plausible mechanisms that could explain some of what these great high resolution images are showing us in stunning detail.

Saturn is now setting about 3 hours after sunset into the western sky even as it is drifting farther away from us as the earth leaves it behind in our faster orbit around the sun. The ringed planet is still an impressive sight in the constellation of Scorpius. Watch as the waxing crescent moon passes close to it on the evening of Friday the 18th.

Venus, Mars, and Jupiter are all in the morning sky now. Look for them about evenly spaced one hour before sunrise in the eastern morning sky towards the end of the month. Before that you will only see Mars and Venus in the morning sky. Watch and try to photograph as a slender waning crescent moon passes right between Venus and Mars on the morning of Thursday the 10th.

Venus starts the month as a large and slender crescent and finishes the month much smaller and one third lit by the sun as our sister planet is racing ahead of us in our continual orbits around the sun.

Sept.3. On this day in 1976 Viking 2 landed on Mars.

Sept.4. The waning gibbous moon will occult Aldebaran in Taurus at midnight tonight. The star will then reemerge about an hour later from behind the dark limb of the moon. Try to watch this carefully with binoculars so that you will get a sense of the continual motion of the moon around the earth. Also try to photograph this event.

Sept. 5. Last quarter moon is at 5:54 a.m. EDT.

Sept.11. On this day in 1985 the International Cometary Explorer made its first flyby of a comet and it also flew by Halley's Comet the next year. It was placed in a Lagrangian orbit where the gravitational forces of the earth, sun, and moon are perfectly balanced so that gravity seems to be suspended in those areas. We lost communication with this satellite in Feb. of 2014.

Sept. 13. New moon is at 2:41 a.m. There will also be a partial solar eclipse today, visible only over Antarctica and part of South Africa.

Sept. 17. On this day in 1789 William Herschel discovered Mimas, the smallest and innermost of Saturn's 7 largest moons. Mimas is 250 miles in diameter and it has a giant crater than covers one third of its surface and has a 4-mile-high central peak.

Sept. 23. Autumn begins at 4:21 a.m. for us in the Northern Hemisphere. On this day in 1846 Johan Galle discovered Neptune very close to where Urbain LaVerrier predicted it would be mathematically. Two other astronomers were also involved in this interesting story of discovery. Neptune just completed its first orbit around the sun four years ago after its discovery. Its 165-year orbit has a perfect 2 to 3 resonance with Pluto's 248-year orbit. There are about 12 other Kuiper Belt Objects with this resonance and they are all called Plutinos.

Sept. 27. A total lunar eclipse will take place tonight starting at 9:07 this Sunday evening and ending at 12:27 the next morning.

Moon Phases

Sept 5
Last Quarter

Sept 13
New

Sept 21
First Quarter

Sept 27
Full

Moon Data

Sept 5
Aldebaran 0.5° south of Moon

Sept 10
Venus 3° south of Moon

Mars 5° north of Moon

Sept 14
Moon at apogee

Sept 15
Mercury 5° south of Moon

Sept 18
Saturn 3° south of Moon

Sept 26
Neptune 3° south of Moon

Sept 27
Moon at perigee

Sept 28
Uranus 1.0° north of Moon

Sky Object of the Month – September 2015
S Cepheii – Carbon Star in Cepheus
by Glenn Chaple

This past August 15th, I presented a talk on carbon stars at the Stellafane Convention. The library at the McGregor Observatory, which served as the setting, hosts a typical audience of 12 to 20. This time, more than 30 Stellafaners showed up. The topic was obviously one of intense interest!

The reason is obvious to anyone who has ever looked at a carbon star like R Leporis ("Hind's Crimson Star"), T Lyrae, or V Aquilae. At certain times, they can appear red – drop-of- blood red!

Popular fare for backyard astronomers over a century ago, carbon stars have enjoyed a resurgence in popularity, particularly with individuals seeking a change from the usual deep-sky fare of nebulae. clusters, and galaxies. They have become so popular that the Astronomical League recently initiated a carbon star observing program that lists 100 of these cosmic rubies.

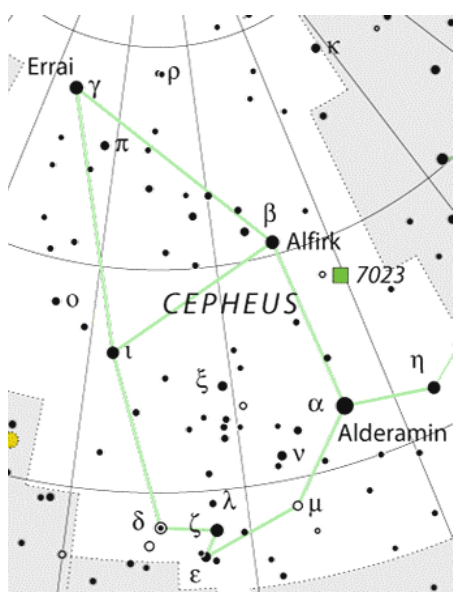
Like its kindred carbon stars, of which nearly 7000 have been catalogued, S Cephei is a red supergiant with a 'sooty" carbon-laced outer atmosphere that enhances its ruddy appearance. Typical of its stellar class, it varies in brightness, ranging from 7th to 11th magnitude in a period averaging 485 days.

Lest I be accused of false advertisement, I should point out that not all carbon stars are ruby red. The color you see will depend on your vision, the nature of binocular or telescope used, sky conditions, and the star's magnitude (carbon stars tend to be reddest when near minimum brightness). At the very least, a carbon star will shine with a rich golden yellow hue.

The accompanying finder charts point the way to S Cephei. A line from gamma (g)

to the wide pair rho (ρ) and 28 Cephei and extended an equal distance beyond brings you to a triangle of 7th magnitude stars perched atop a 6th magnitude star labeled 59 (its magnitude without decimals) on Chart B. Chart C will help you star-hop from the triangle to S Cephei. Magnitudes of surrounding stars are added (decimals omitted).

You'll find more information on S Cephei at www.aavso.org/lcotw/s-cephei. The Astronomical League's Carbon Star Program is described at www.astroleague.org/content/carbon-star-observing-program.



Finder Chart A.
(www.constellation-guide.com)

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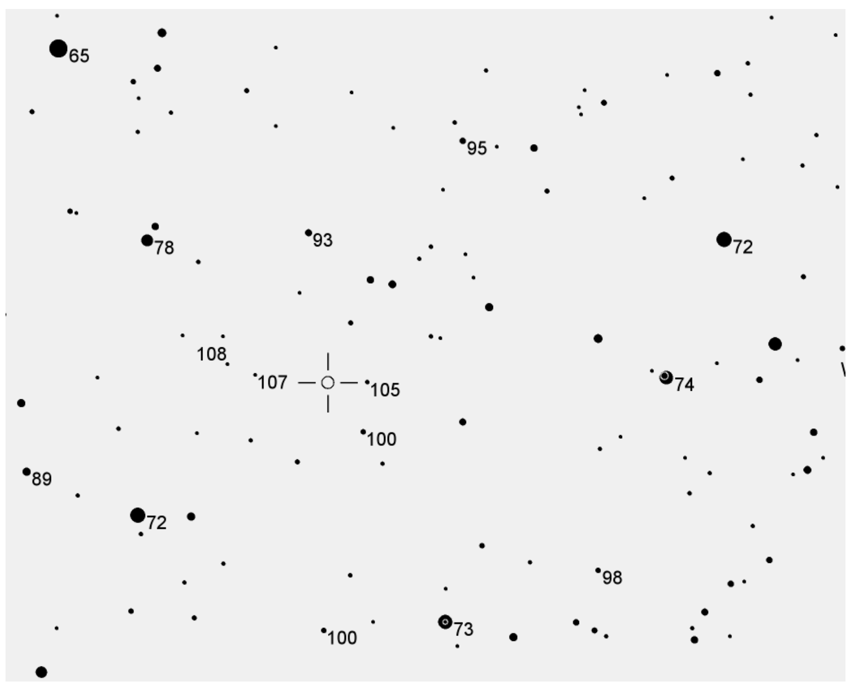
Finder Chart B. (AAVSO)



Finder Chart C. (AAVSO)

Principal Meteor Showers in 2015

January 4
Quadrantids

April 22
Lyrids

May 6
Eta Aquarids

July 30
Delta Aquarids

August 12
Perseids

October 9
Draconid

October 21
Orionids

November 9
Taurids

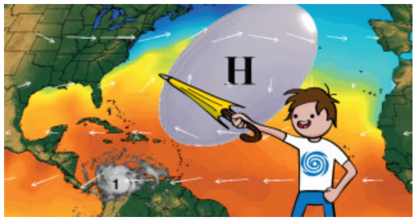
November 18
Leonids

November 26
Andromedids

December 14
Geminids

December 22
Ursids

Note: Dates are for maximum



Explore the relationship between sea surface temperatures and hurricane strength in this hurricane simulator.

Visit [http://**scijinks.gov**](http://scijinks.gov) to learn more about tropical storms.

It affects weather patterns, it affects ocean currents, and it even affects air travel. As important as the Coriolis Effect is, many have not heard about it, and even fewer understand it.

The latest issue of the <u>Space Place Newsletter: News and Notes for Formal and Informal Educators</u> can be found at:

http://spaceplace.nasa.gov/educator-newsletter

Check out our great sites for kids:

The Space Place website (http://spaceplace.nasa.gov)

The *SciJinks Weather Laboratory* at http://**scijinks.gov**

NASA Climate Kids at http://**climate.nasa.gov/kids**

Our club has merchandise for sale at:

www.cafepress.com/asnne

All money raised goes to our operating fund.
Any design can be put on any item.

NASA Space Place

Solar Wind Creates—and Whips—a Magnetic Tail Around Earth

By Dr. Ethan Siegel

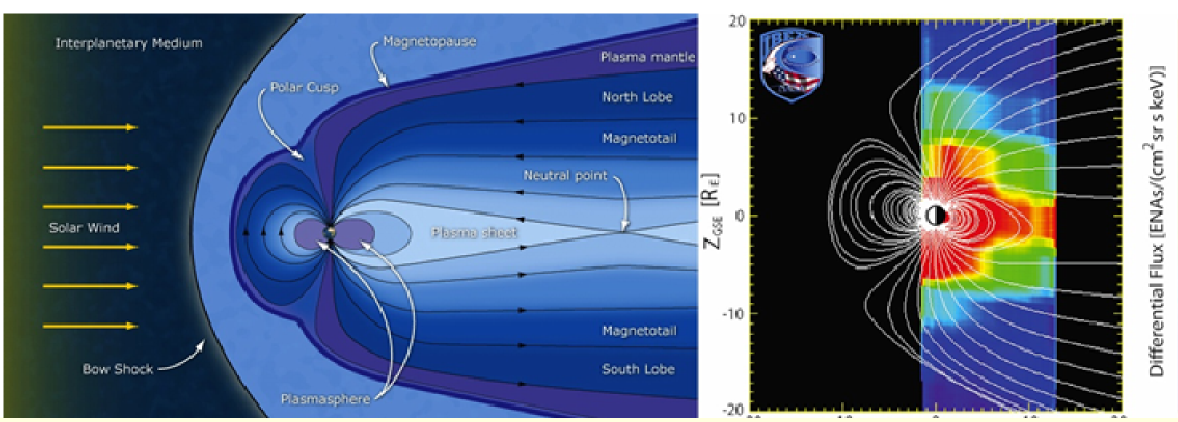
As Earth spins on its axis, our planet's interior spins as well. Deep inside our world, Earth's metal-rich core produces a magnetic field that spans the entire globe, with the magnetic poles offset only slightly from our rotational axis. If you fly up to great distances, well above Earth's surface, you'll find that this magnetic web, called the magnetosphere, is no longer spherical. It not only bends away from the direction of the sun at high altitudes, but it exhibits some very strange features, all thanks to the effects of our parent star.

The sun isn't just the primary source of light and heat for our world; it also emits an intense stream of charged particles, the solar wind, and has its own intense magnetic field that extends much farther into space than our own planet's does. The solar wind travels fast, making the 150 million km (93 million mile) journey to our world in around three days, and is greatly affected by Earth. Under normal circumstances, our world's magnetic field acts like a shield for these particles, bending them out of the way of our planet and protecting plant and animal life from this harmful radiation.

But for every action, there's an equal and opposite reaction: as our magnetosphere bends the solar wind's ions, these particles also distort our magnetosphere, creating a long magnetotail that not only flattens and narrows, but whips back-and-forth in the onrushing solar wind. The particles are so diffuse that collisions between them practically never occur, but the electromagnetic interactions create waves in Earth's magnetosphere, which grow in magnitude and then transfer energy to other particles. The charged particles travel within the magnetic field toward both poles, and when they hit the ionosphere region of Earth’s upper atmosphere, they collide with ions of oxygen and nitrogen causing aurora. Missions such as the European Space Agency and NASA Cluster mission have just led to the first accurate model and understanding of equatorial magnetosonic waves, one such example of the interactions that cause Earth's magnetotail to whip around in the wind like so.

The shape of Earth's magnetic field not only affects aurorae, but can also impact satellite electronics. Understanding its shape and how the magnetosphere interacts with the solar wind can also lead to more accurate predictions of energetic electrons in near-Earth space that can disrupt our technological infrastructure. As our knowledge increases, we may someday be able to reach one of the holy grails of connecting heliophysics to Earth: forecasting and accurately predicting space weather and its effects. Thanks to the Cluster Inner Magnetosphere Campaign, Van Allen Probes, Mars Odyssey Thermal Emission Imaging System, Magnetospheric Multiscale, and Heliophysics System Observatory missions, we're closer to this than ever before.

Kids can learn about how solar wind defines the edges of our solar system at NASA Space Place. http://spaceplace.nasa.gov/interstellar



Caption:

Image credit: ESA / C. T. Russell (L), of Earth's magnetic tail and its cause: the solar wind; Southwest Research Institute / IBEX Science Team (R), of the first image of the plasma sheet and plasma sphere created around Earth by the solar wind.

The University of California High-Performance AstroComputing Center

Planets Amidst the Noise

Tau Ceti's planets were not supposed to be there.

They revealed themselves when Steven S. Vogt, astrophysics professor at UC Santa Cruz, and his collaborators were testing a new noise-analysis method on spectrometer data to calibrate their technique. Indeed, the team of 15 astronomers from seven institutions on four continents had picked Tau Ceti specifically because meticulous observations strongly suggested the star had no planetary system.

From the earliest days of the hunt for exoplanets almost 20 years ago, astronomers suspected that evidence of Earth-like planets might be buried in the noise of spectroscopic measurements of stellar radial velocities (stars' velocities in space toward or away from us). Such noise arises from flares and other activity on a star's surface.

The tiny signal…

Earth-like planets are low mass compared to stars. Even so, planets revolve not around a host star's center (axis of rotation); instead, both star and planets revolve around the planetary system's barycenter (center of mass). Like a smaller boy gamely wrestling a bigger one, the gravitational mass of a planet throws a star's weight around just a little, even though the bigger mass is in control.

The barycenter for our own solar system, for example, slowly wanders from near the center of the Sun to farther than a solar radius above the Sun's surface: when all the planets are on the same side of the solar system as Jupiter, the barycenter is farther from the center of the Sun toward Jupiter than it is when all the planets are on the opposite side of the solar system from Jupiter. In other words, the Sun itself is doing a slow dance like a meandering box step of hundreds of thousands of kilometers around the solar system's barycenter.

In the 1980s, exoplanet hunters began to wonder whether the barycentric wandering of a distant star could betray the existence of planets. Would it be even detectable? Most stars speed toward or away from Earth by 10,000 or more meters per second. A star's barycentric wandering due to the pull from an orbiting Earth-sized planet, however, would speed or slow that RV by under a meter per second, Vogt noted.

But it might be measurable by a precision spectrometer, such as the High Resolution Echelle Spectrograph (HIRES) Vogt had designed, built, and used at Keck Observatory for 20 years. Its 25-megapixel CCD detector measures Doppler shifts of spectral lines finer than 1 part in 300,000,000, a precision of stellar RV to under 1 meter per second.

…amidst stellar "jitter"

Detecting the barycentric wandering of a distant star is a colossal challenge for both measurement and computational analysis. Vogt and his collaborators needed a nearby Sun-like star whose RV had been meticulously measured for years, with no evidence of a planetary system. They needed a bright star to eliminate so-called Poisson noise due to statistical variations in the rate of photons detected. By studying noise signatures from the planetless star, they hoped to learn precise characteristics of noise produced by stellar surface activity—so as to remove its masking of extremely weak variations in a star's RV from the gravitational effect of Earth-sized planets.

Seeming to fit the bill was Tau Ceti, a 3.5-magnitude G8 star about three-quarters the size of the Sun closer than 12 light-years, speeding toward us at 16.4 kilometers per second. Some 6000 precision radial velocities existed in three independent sets of high-precision RV measurements by three different teams, in runs ranging from 6 to 13 years.

"Continued on page 8"

Planets Amidst the Noise "Continued from page 7"

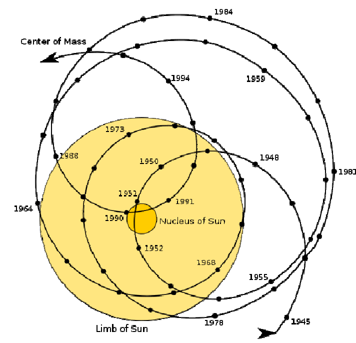
Vogt's mathematician collaborator Mikko Tuomi at the University of Hertfordshire developed statistical techniques for analyzing and comparing the three data sets, identifying and removing noise. The goal: to identify variations in signals appearing periodically and simultaneously in all three sets of data (and therefore due to real planetary-induced changes in Tau Ceti's RV) versus variations in only one set of data due to stellar surface activity and/or instrumental errors. Tuomi also developed methods for analyzing the long-term pattern of a star's barycentric motion to calculate number of possible planets, their masses and orbits.

When the group applied the computational techniques to Tau Ceti's runs of spectrometry data as a dry run for the stellar surface noise calibration, "five statistically significant planet-like signals popped out!" Vogt exclaimed. "It was a surprise!" The signals suggested the planets were not much bigger than Earth, with the outermost two *e* and *f* being in the habitable zone where water could be liquid.

The team is now applying their new techniques to runs of RV data for other nearby stars. *–Trudy E. Bell, M.A.*

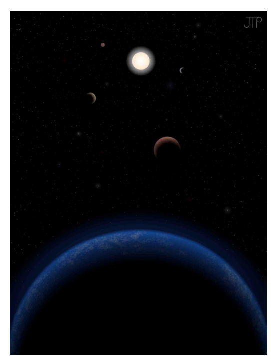
Further reading: "Signals embedded in the radial velocity noise: Periodic variations in the τ Ceti velocities" *Astronomy & Astrophysics* 551: 79, March 2013, http://arxiv.org/abs/1212.4277 .

The University of California High-Performance AstroComputing Center (UC-HIPACC), based at the University of California, Santa Cruz, is a consortium of nine University of California campuses and three Department of Energy laboratories (Lawrence Berkeley Laboratory, Lawrence Livermore Laboratory, and Los Alamos National Laboratory). UC-HiPACC fosters collaborations among researchers at the various sites by offering travel and other grants, co-sponsoring conferences, and drawing attention to the world-class resources for computational astronomy within the University of California system. More information appears at http://hipacc.ucsc.edu .



The Sun moves around the barycenter (center of mass) of our solar system, depending on the positions of the planets. Detecting barycentric movement of other stars from precision radial velocity (RV) measurements can reveal the presence of Earth-mass planets; the pattern of movement can reveal number, masses, and orbits.

Credit: Carl Smith, Rubik-wuerfel http://en.wikipedia.org/wiki/Barycentric_coordinates_%28astronomy%29



Rendering of the Tau Ceti planetary system shows the five planets b, c, d, e, and f, from closest to farthest from the star. All range in mass from 2.0 to 6.6 times the mass of Earth with orbital periods ranging from 13.9 to 642 days. The two outermost planets e and f are at 0.5 and 1.5 A.U. from Tau Ceti.

Credit: J. Pinfield for the RoPACS network at University of Hertfordshire, 2012.

Club Meeting & Star Party Dates

Date	Subject	Location
Sept 4	**No ASNNE Club Meeting on the 4th. Only a business meeting.**	Starfield Observatory, West Kennebunk, Me.
Sept 18-20	**Starfest** Our regular club meeting will be on Saturday, the 19th at the observatory. The particulars and details for "Starfest" will be talked about at our business meeting on the 4th. Guest speaker/topic - **Dr. Nicole Gugliucci** Assistant Professor of Physics, Saint Anselm College. Ian will find out what her topic will be. Nicole is an astronomer and science outreach specialist whose primary work has been in radio astronomy.	
TBD	Club/Public Star Party (*Visit website for updates and or cancellations*)	Starfield Observatory, West Kennebunk, Me.

Directions to ASNNE event locations

Directions to The New School in Kennebunck [38 York Street (Rt1) Kennebunk, ME]

For directions to The New School you can use this link to the ASNNE NSN page and then click on "get directions" from the meeting location. Enter your starting location to generate a road map with complete directions. It works great. http://nightsky.jpl.nasa.gov/club-view.cfm?Club_ID=137

Directions to Starfield Observatory [Alewive Road, Kennebunk, ME]

From North:
Get off turnpike at exit 32, (Biddeford) turn right on Rt 111. Go 5 miles and turn left on Rt 35. Go 2 miles on Rt 35 over Kennebunk River to very sharp 90 degree left turn. The entrance to the Starfield Observatory site is at the telephone pole at the beginning of the large field on the left. Look for the ASNNE sign on the pole.

From South:
Get off the turnpike at exit 25 in Kennebunk. After toll both turn right on Rt 35. Go up over the turnpike and immediately turn right on Rt 35. About 4 miles along you will crest a hill and see a large field on your right. Continue until you reach the end of the field. Turn right into the Starfield Observatory site at the last telephone pole along the field. Look for the ASNNE sign on the pole. If you come to a very sharp 90 degree right turn you have just passed the field.

To join **ASNNE**, please fill out the below membership form. *Checks should be made payable to: Astronomical Society of Northern New England (A.S.N.N.E).* For more details, please visit our website: **http://www.asnne.org**

Astronomical Society of Northern New England
P.O. Box 1338
Kennebunk, ME 04043-1338

2015 Membership Registration Form

(Print, fill out and mail to address above)

Name(s for family): ____

Address: ____
City/State: ______________________________ Zip code: ________________________

Telephone # ____

E-mail: ____

Membership (check one):
Individual $35 _____ Family $ 40 _____ Student under 21 years of age $10 _____ Donation________

Total Enclosed____________

Tell us about yourself:
1. Experience level: Beginner____ Some Experience ____ Advanced______

2. Do you own any equipment? (Y/N) And if so, what types?

____

3. Do you have any special interests in Astronomy?

____

4. What do you hope to gain by joining ASNNE?

____

5. How could ASNNE best help you pursue your interest in Astronomy?

____

6. ASNNE's principal mission is public education. We hold many star parties for schools and the general public for which we need volunteers for a variety of tasks, from operating telescopes to registering guests to parking cars. Would you be interested in helping?
Yes_____ No_____

7. ASNNE maintains a members-only section of its web site for names, addresses and interests of members as a way for members to contact each other. Your information will not be used for any other purpose. Can we add your information to that portion of our web site?

Yes_____ No_____