

In This Issue...

2 [Sky Watch Review](#)

*Franconia Notch State Park
Webster Free Public Library
Center for Conscious Studies
Bedford High School
Auburn Village School*

2 [Society Activities](#)

*The Ghost Hunt
LTP Powers of Ten*

4 [Acadia Night Sky Festival](#)

7 [NEFAF 2014](#)

10 [Object of the Month](#)

November: NGC 40

11 [Images of the Month](#)

Aloha, Lunar Eclipse!

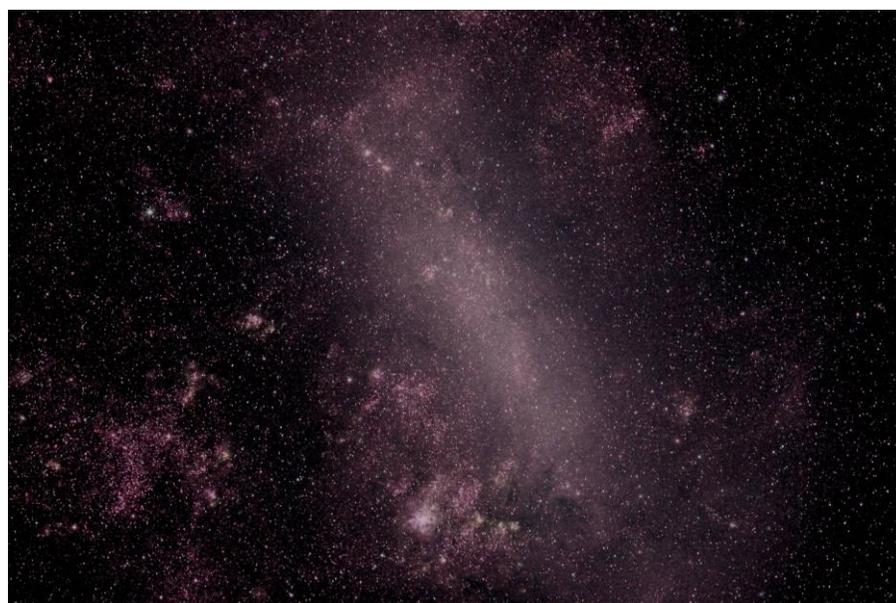
12 [Featured Articles](#)

*The Cassini Flyby of Earth
Two Eclipses and Two Comets*

19 [The Regular Items](#)

*Business Meeting Report
Treasurer's Report
Contact Information
Club Loaner Scopes
Astronomy Resource Guide
Upcoming Events
Credits*

LMC



The Large Magellanic Cloud in Dorado and Mensa

(Image: John Gianforte)

He helped organize the very successful third edition of NEFAF last year and unwound by joining an Astronomy tour of the large telescopes and the Atacama desert in Chile. From 0605 UT on November 9, 2013, at a site 18kms from Vicuna, John Gianforte took 22 one-minute exposures of the LMC with his Canon 60Da DSLR at f/5.6 with a Canon 200mm lens, mounted on an iOptron Smart EQ mount. He stacked and registered the images using Deep Sky Stacker. Behold the result!

Although named after Ferdinand Magellan, who sighted them on his voyage of 1519, the LMC/SMC pair was known to ancient Persian astronomers. Al-Sufi recorded them in his 'Book of Fixed Stars' in the 10th century. Later, Dutch sailors called them Cape Clouds.

Rich in dust and gas, the LMC is home to the Tarantula Nebula (NGC 2070, designated also as 30 Doradus), the most active star-forming region in the Local Group. It is the large dense splotch at the bottom of this image, slightly left of the middle. The closest supernova in the past 400 years (SN 1987A) occurred at the outskirts of the Tarantula Nebula.

Franconia Notch State Park, Franconia NH, October 2

The sky did not clear up as forecast, but it did get clear enough to get views of the Moon, Mizar, Albireo, M57, M13, Andromeda Galaxy, 61 Cygni, NGC 457, the Pleiades, and the Double Cluster in Perseus. Only four people showed up: two park rangers and two campers. I suspect the cloudy skies kept everyone else away.

- *Paul Winalski*

Webster Free Public Library, Webster NH, October 2

The event took place on the backup date. I gave the indoor presentation and **Curt Rude** joined me later with his 4" f/9 refractor as we showed off the FQ moon, Alberio, M13, M31, M57, NGC 457 and the Double Cluster to 12-15 library patrons. I showed the Library staff how to find M31 with the Library telescope as well. They would love to have us back in the spring. Webster is rural, so the sky would be very good with no moon. They have a better location in mind for the next skywatch, with no light pollution either.

- *Gardner Gerry*

Center for Conscious Studies, Stratham NH, October 11

I gave a talk on "Identified Flying Objects--Unusual Night Sky Phenomena" to about 10 Center participants, followed by a Q&A discussion on UFOs in which **Tom Cocchiaro** also took part. Participants then went to the top of *Stratham Hill Park* for the observing session.

Unfortunately we were in a large cloud band most of the time, with occasional clear spots. I set up my TeleVue 85mm refractor and Tom his 6" refractor. We managed to observe the Moon, Mizar, Albireo, M57, M31, and the Pleiades.

The site is very dark, is located well away from any artificial lighting, and has good horizon views. It was a shame the weather didn't cooperate more.

- *Paul Winalski*

Bedford High School, Bedford NH, October 14

The event took place at Benedictine Park. The teacher in charge was **Tiffany Nardino**, formerly of MSDC, and an NHAS member. This was the best attended BHS event in recent memory. There must have been at least 35 students as well as some parents. Tiffany had each student sign in and stay for at least an hour to get lab credit. At this point in their school term, the students had covered the solar system and some aspects of the celestial sphere. The kids seemed very interested and asked some great questions.

- *Steve Rand*

Auburn Village School, Auburn NH, October 30

Alternating clouds and clear patches kept us hunting for targets; I showed the FQ Moon, Alberio, NGC 457 and M45. NHAS members in attendance included **Bob Veilleux, Ed Ting, John Pappas, Herb Bubert** and **Steve Rand**.

- *Gardner Gerry*

Society Activities

The Ghost Hunt, Lyndeborough NH, October 25

The event went off at **Sue and Scott Wickett's** residence on the backup date, but became mostly a pot-luck party as the weather continued to be uncooperative. Lightning didn't strike twice after the very successful *Messier Marathon* last month. In attendance this time were **Ken Charles, Rich DeMidio, Steve Forbes, Linda and Larry Lopez, Sue McPhee and Rick Marshall, John Rose, Mike Townsend** and **Ed Ting**. There was perhaps more food inside than clouds outside, but the clearing near sunset did not carry through and a post-sunset cloud cover rang early dinner bells. About an hour's clearing did occur later (sucker holes mostly) that allowed some observing, but haze crept back in and drew curtains on the Ghost Hunt by about 9pm. A great time was had by all over plates of great food, with the pumpkin bread getting special mention. Afterwards Steve Forbes, ever the gentleman, assumed the blame – the ghosts probably wanted a sniff at the nuclear chili he usually brings to these events, but failed to on this day.

LTP Powers of Ten

Last month the **100th Library Telescope** to be deployed by NHAS in the State of New Hampshire was acquired by the **Concord Public Library** in Concord. Their kick-off was not with the usual public skywatch a few months after the presentation, but with a special 1-hour talk in their auditorium on October 23 by **Paul Winalski** to explain the fundamentals of telescopes and also cover the functionality and operation of the new scope and all its accessories. Paul continues the narrative:

*This particular telescope has been named **Stella** by the librarians. One library patron showed up with a beat-up 60mm Tasco OTA that he'd paid \$1 for. It had problems with various set screws coming loose over time. I showed him how to get it all working again. Another asked for help with purchasing a first scope. I gave him my standard advice: visit [Ed Ting's scopereviews.com website](http://EdTing's Scopereviews.com) and follow his advice to beginners to buy an Orion XT6 classic dob.*



Paul explaining use of the Starblast scope and an important accessory: the Audubon guide in the pouch. (Photos: Deb Baker, CPL)



Also last month, as part of the research for the LTP Story article, I had visited the **Mary E. Bartlett Library** in Brentwood to have a look at the **10th Library Telescope** to have been deployed by NHAS (back in April 2010). It has not been checked out in almost a year, and the last person to do so had reported problems with it. A quick look revealed that the finder was not functioning because its CR2032 battery had drained. Not having a spare battery on hand, and being unfamiliar with the gun-sight, I took the scope home and contacted **Pete Smith**.



(Above and far right): Aply supervised by his grand-kids, Pete Smith refurbished the scope in record time. Sue Stowbridge would have applauded the effort.

(Below and right): Betsy Solon simply couldn't believe the new look and the Moon map, and examined the red light with Joyce Miller & Kiki Donis-Wahl.

On a Saturday morning, Pete fixed the finder, applied all the new decals, re-did the lanyards, and added the Moon-hole; I supplied an Audubon guide, aligned the scope and **Steve Rand** checked the collimation before I took it back to the library. I gave **Betsy Solon** the standard tutorial about the scope's functionality and helped her plan a skywatch in late January. Mission accomplished?



- **Ramaswamy**

By all accounts, this year's festival was the most successful edition of ANSF. The weather was superb, the seeing was incredible, there was very little dew and the public turnout broke all previous records. As the expression goes, you just had to be there!



Sunset over Cadillac mountain sees astronomers setting up their equipment, with their own cars being used as screen against the headlights of buses transporting people to the site, pulling up along the drive in front. (Photo: Dwight Lanpher)



A wider angle view of the scene, with boulders obscuring the roadway in front of the screen of cars. (Photo: Bonnie Derek)

NHAS was well represented at the festival and every participant had a wonderful time and many stories to tell, but the representative account here is from **Bonnie Derek**:

The weather could not have been more perfect for a weekend of astronomy – mid- autumn temperatures and only a sliver of a Moon that went to bed early each night. There were many activities going on throughout the weekend but I will only refer to the ones we participated in.

Friday evening's event was at Seawall Picnic Area in Southwest Harbor, and there were many more scopes present this year than last year, several representing NHAS. The crowd was also larger than last year; park rangers estimated 450+ spectators. Joe set up his 17" Dobsonian and his 20x80 binoculars.

Saturday meant solar viewing at the Jackson Laboratory site; Joe and I went as spectators as we were not set up for solar viewing with our equipment. The day was a bit on the warm side and many people at the solar viewing were looking for a spot of shade to cool off!



The Derek Dob at Seawall (Photo: Bonnie Derek)

Late in the afternoon we drove to the summit of Cadillac Mountain to set up before the sun went down. There were already quite a few astronomers setting up when we got there, of whom about a dozen represented NHAS. For this event, Joe set up his 12-1/2" Newtonian reflector with the equatorial mount and his 20x80 binoculars. Former NHAS member **Mark Warend** manned the binoculars so that Joe could focus on the visitors at his telescope.

The buses bringing spectators started rolling up the mountain almost an hour early and continued an hour past the advertised viewing time. The local high school honor students acted as guides to passengers on the buses, letting them know some of the things they might see once they arrived at their destination. They also cautioned passengers to be careful with the equipment and not to touch unless instructed to do so. We heard there were so many interested parties at the visitor center that they had to turn about sixty vehicles away; the average wait time for a bus was upwards of an hour and a half.



Joe Derek with four new friends

(All Photos: Bonnie Derek)

The evening sky was magnificent! The Milky Way was stunning! All the astronomers were very helpful and informative. The spectators were very respectful of the equipment, asked great questions and were delighted and amazed with all that they could see.

• **Bonnie Derek**



Linda and Larry Lopez as Alberio.



Ken Charles with Soulshine.

Ken Charles adds:

The Acadia Night Sky Festival was a resounding success. Saturday night had beautiful skies, no dew, 60-65 degrees, 48 scopes and 5 pairs of binoculars. Easily over 1000 people showed up for the skywatch on top of Cadillac Mountain. Some of the best New England skies I've ever seen. NHAS was represented by, among others, Joe and Bonnie Derek, Larry and Linda Lopez, Marc Stowbridge and yours truly. Many thanks to Dwight Lanpher for inviting us to participate.

while **Larry Lopez** chimes in with this take on Alberio over Acadia:

Most people did see a small blue star, bright white star or orange, but 7 or 8 people didn't see any color.

Dwight Lanpher of *Penobscot Valley Star Gazers (PVSG)* and at least nine more hats that include NHAS, was one of the main organizers of the Festival (though he would claim it was the effort of others), and along with ANP Ranger **Michael Marion** and others pulled off a great event over the 5 days of September 25-29. There were many lectures and other activities on the schedule, beginning with the Keynote address on Thursday evening by author Paul Bogard (“The End of Night”) about losing the dark. Some excerpts from Dwight’s review of the long weekend:

*The opening star party at Seawall Picnic Area with its darker skies was excellent but by around 10:30pm the normal layer of a low level ground fog had started to appear. By then we had had a record showing of 450 people thoroughly entertained by our 35+ scopes and binoculars, including **Joe Derek’s 17” Dob.***

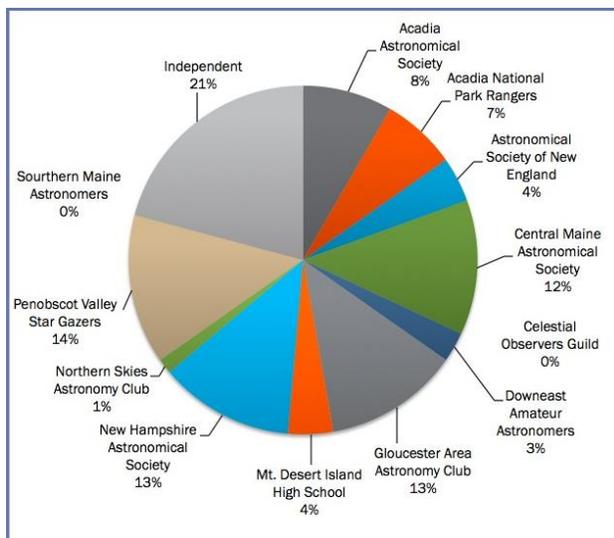
*The following night, perfectly clear skies greeted us on Cadillac. For those of you that were here last year, the weather was better still with temperatures on Cadillac in the 60s. Clear Sky Chart had accurately predicted the excellent transparency and seeing. There was a light wind of 1 to 2 mph with a wet bulb temperature high enough to keep dew off the scopes. The crowds were orderly and the lines were long with an estimated 1900 people this year... a substantial increase and another record for the festival. I was set up beside **Michael Deneen** of GAAC with his 14” Celestron SCT. Setting up such a large scope in the field in no small feat. It was fascinating to watch his technique of attaching the GE mount to the stationary OTA.*

*Saturday morning featured solar viewing just outside the main auditorium at the Jackson Laboratory. The public was treated to a combination of a dozen white light and H-alpha solar scopes and a solar spectroscope. This was followed by a well-received presentation by **Dr. Richard Wolfson**: “Wild Sun, a Drama in Three Acts”. To me this was one of the highlights of the festival and I learned more than a couple of things about our “magnetic sun.”*

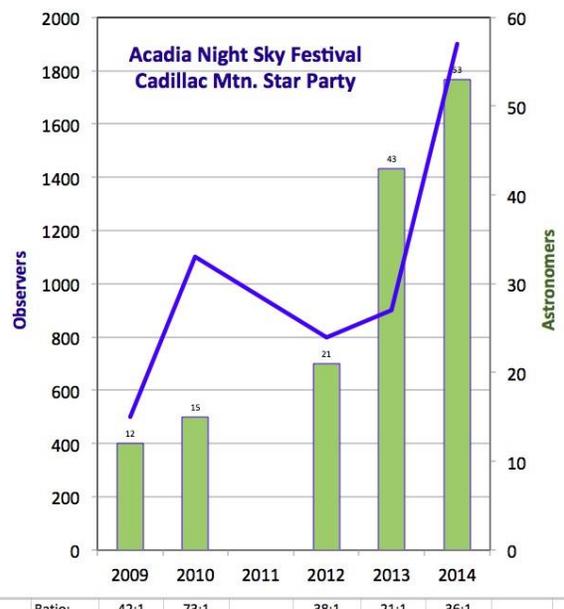
***Marc Fisher** of DEAA, who had arrived late on Saturday, showed up early the next morning and brought his long focal length refractor with a Hershel wedge, a triple stacked Hydrogen-alpha scope and a Calcium-K scope with video display so that all of us could see the near UV band images. **Marc Stowbridge** showed off his H-alpha setup with a solar blocking screen and a NASA lenticular picture of the sun on the back that he said was there for people to look at when clouds pass overhead.*

Next year’s edition of the Acadia Night Sky Festival will be held earlier in the month, on September 10-14, to keep in step with the New Moon. It would mean that twilight will be about 30 minutes later. Keep those schedules clear!

And what report would be complete without a review Pie Chart and a Bar/Line Chart? These should do!



Participating astronomers by club affiliation in 2014.



Participating observers without affiliation, over the years.

The Fourth Annual *New England Fall Astronomy Festival (NEFAF)* was held on the grounds of the University of New Hampshire Observatory on October 17-18. Friday evening featured a Keynote address by **Dr. Carolyn Porco**, the Imaging Science Team Leader of the *Cassini* mission to Saturn. This was followed by an evening of star-gazing and GLP constellation tours for the public. The weather was quite cooperative that day.



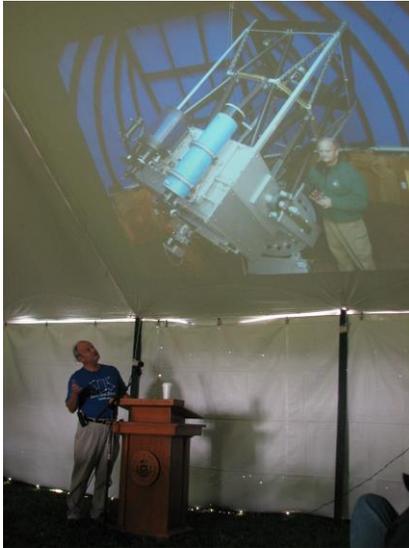
Curt Rude sets up his refractor in picturesque settings, right next to the NHAS tent (above right), while on the other side of the Observatory Dome, Pat Amoroso sets up along with his GAAC colleagues. It was the prelude to a good session after 9pm.



At 7pm, attention shifted back to the Main Tent for the Keynote address by Dr. Carolyn Porco (left) about Cassini's "A Decade at Saturn." It was a one-hour talk, followed by Q&A. Ted Blank presented her with a framed copy of the "A Decade of Saturn" collage by Herb Bubert. Interestingly enough, Herb started imaging Saturn in 2004 as well.

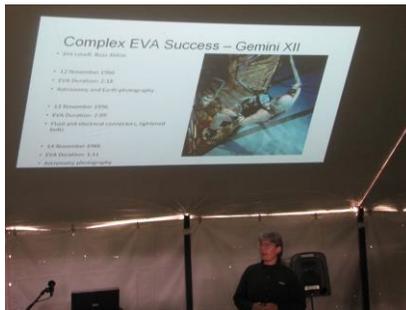
The next day featured a full day of activities for kids and adults alike, but it was cloudy all day and all evening. No more than 10 minutes of daytime solar observing was possible, and skywatch that evening was cancelled by 9pm. But there was plenty of fun to be had, with rocket launches, walking the solar system all the way out to Neptune, and listening to the Mad Science presentation of “Sounds like Science.”

NHAS members ran a Scope Clinic answering questions regarding telescopes and astronomy in general; given the conditions of the day, it was practically the only thing to do! Under the Main Tent, area astronomy clubs had set up tables and were engaging the public on all matters space and astronomy related. Meanwhile, in the Speaker’s Tent, a slate of 5 exceptional talks (of about an hour each) engaged the visitors all afternoon:

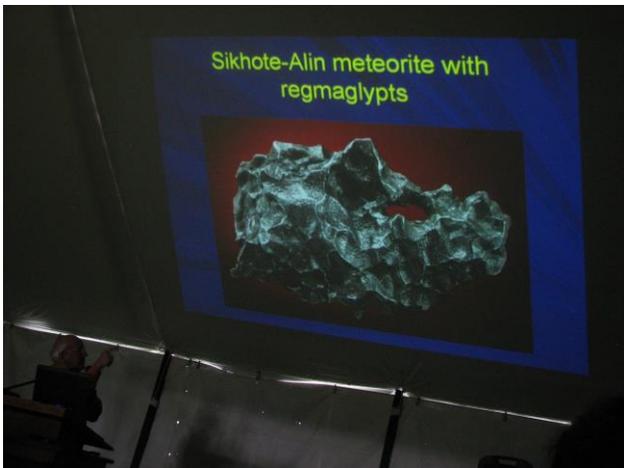


- * **Dr. Mario Motta** on “Light Pollution and How to Build a Telescope”
- * **Sandy Fletcher** of NASA on “US Spacewalks – Past, Present and Future”
- * **Ted Blank** on the Cassini mission “Saturn Revealed!”
- * **Bob Veilleux** on “Meteorites and Meteorwongs”
- * **John Gianforte** on “Photographing the Night Sky”

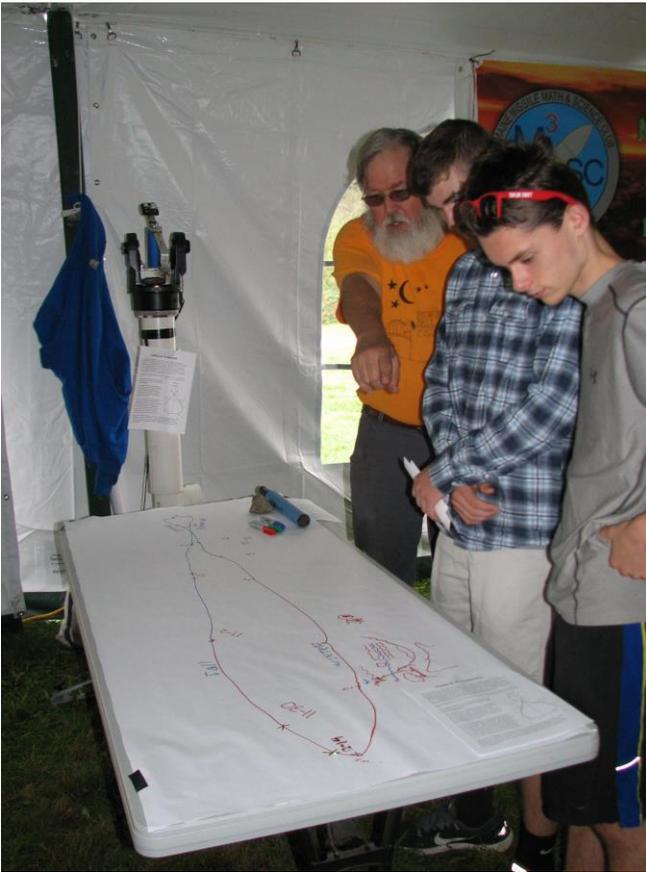
- **Ramaswamy**



The second half of Dr. Motta’s talk was all about the construction of his telescope (left), while the first described not so well-known side-effects of light pollution. Sandy Fletcher talked about spacewalks from the Gemini IV mission onward (in the 1960s) through Skylab and Apollo to the Shuttle and ISS. The TED (Blank) Talk was on the Cassini mission, describing the spacecraft’s capabilities, its flight trajectory to Saturn and the imaging and science done at Saturn in the past decade (right).



The afternoon concluded with Bob Veilleux talking about the geology of meteorites and showcasing some of the most interesting specimens found in past century (left), and John Gianforte conducting a beginner’s tutorial on astrophotography.



Marc Stowbridge explains the analemma (left), Rex Gallagher fires away on rockets (above) and Rich Schueller and Mike Townsend talk about telescopes while waiting out the overcast (below).



Ian Cohen pumps up the rocket launcher; off it goes and is retrieved by an eager volunteer almost as quick as the rocket.



Consider the trio of thumbnails to the left a quiz:

Identify the NHAS Members!

NGC 40 – Planetary Nebula in Cepheus

by Glenn Chaple

Our November deep-sky target, NGC 40, could be featured any month of the year. Just 17.5 degrees from the North Celestial Pole, it's circumpolar from mid-northern latitudes. But it's during mid-autumn that NGC 40's parent constellation Cepheus rides highest above the northern horizon after sunset.

NGC 40 was discovered by Sir William Herschel on November 25, 1788, and bears the Herschel Catalog designation H IV-58 (his 58th Class IV [Planetary Nebulae] entry). A more recent designation, C2, reflects its inclusion in Sir Patrick Caldwell-Moore's 1995 Caldwell Catalog – his compilation of the finest 109 non-Messier deep-sky objects. NGC 40 is also nicknamed the Bow-Tie Nebula, a moniker shared with the planetary nebula NGC 2440 in Puppis and the Hubble-imaged proto-planetary nebula PGC 3074547 in Centaurus.

Finding NGC 40 is quite problematic, as it lies in a star-poor region of Cepheus. The accompanying Telrad chart shows its location about one-third of the way from gamma (γ) Cephei (labeled Errai) to kappa (κ) Cassiopeiae. Center your finderscope on the area and begin a low-power search (about 50X should suffice) until you come to what looks like an out-of-focus 12th magnitude star midway between and slightly west of a pair of 9th magnitude stars. NGC 40 can be glimpsed with a 4-inch scope under dark skies, but you'll need twice that aperture to capture significant detail. Magnifications of 150X and up will reveal a slightly oval 35 X 38 arc-second haze surrounding a star of 11.6 magnitude.

If you gaze at NGC 40's central star, the surrounding nebulosity seems to disappear. Look to the side and the nebulosity pops into view. The effect mirrors that of NGC 6826 (better known as the "Blinking Planetary" in Cygnus). At a distance of 3,500 light years, NGC 40 is about one light year in diameter.

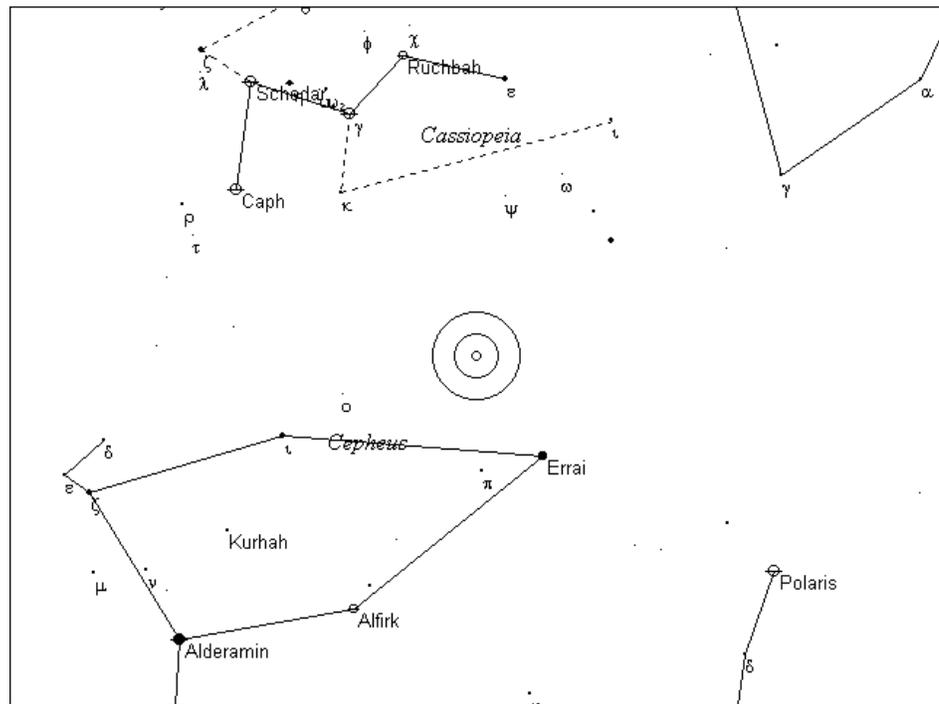
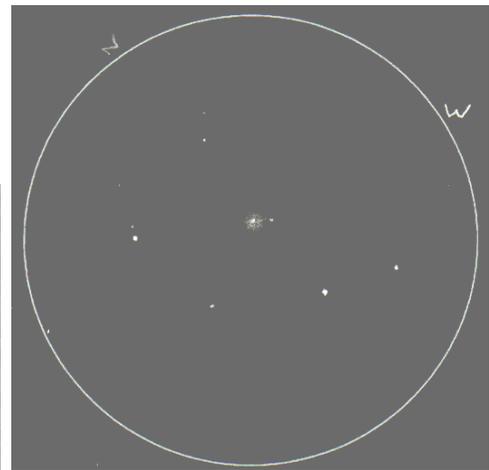


Chart prepared by D. Parkin (www.astrosurf.com/dgilbert/outils/divers/Caldwell)



NGC 40 as imaged by the HST
(Credit: NASA)



Sketch by the author on 12/3/2012, using his
10" f/5 reflector at 208X

Aloha, Lunar Eclipse!

Back in February, the monthly NHAS Business Meeting was postponed by a week since as routinely scheduled on the second Friday of the month, it clashed with Valentine's Day. Love conquers all.

Earlier this month, **Rich and Susan Schueller** were vacationing in Hawaii, when the Heavens put on a show to commemorate their wedding anniversary. A Total Lunar Eclipse no less, one they would have been unable to see or image from their backyard observatory. Rich continues:

We were invited to go to one of the Maui Astronomy club's sites, one on the Haleakala summit, one over at the Hyatt Regency roof-top located in Ka'anapali, and locally at the Laperouse Bay site, which by the way was just down the street from us. We decided to stay at the hotel since we had just woken up and were groggy. We got outside when the eclipse was about an eighth of the way in and stayed outside for most of the event. Forgive the images, but we were taking these without tracking equipment.



Going in



Totality

(Images: Susan and Rich Schueller)



Earth Shadow

Did you know that ...

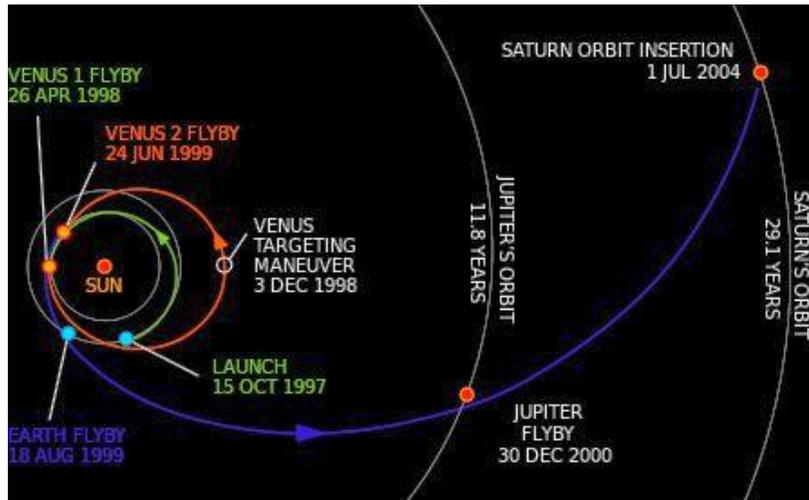
- While eclipses always come in pairs on adjacent Full and New Moons, they also come in Triplets? In such cases, a Total Lunar eclipse is book-ended by a pair of Solar eclipses, or an Annular or Total Solar eclipse is sandwiched between a pair of Lunar eclipses. In triplets, the middle eclipse is always a Total eclipse. Once in a while, a triplet can amount to three eclipses in a month, causing much comment, though the Sun, the Earth and the Moon have no specific knowledge of the Gregorian Calendar. The last triplet was in April-May 2013; the next one will be in July-August 2018.
- The current Total Lunar Eclipse is part of a so-called Tetrad? It is the second of four consecutive Total Lunar eclipses. This is the second Tetrad in the 21st century, and there are six more instances to come, the next one being in 2032-33. There were 5 Tetrads in the 20th century, but none in the three previous ones.
- The current Total eclipse was also called a 'Selenelion' in eastern United States? That is because it was a moonset event and just as the Moon was entering the Earth's shadow in the west, the Sun was rising in the east. Both the Sun and the eclipsed Moon would have been visible together (provided both horizons were free and clear) because of the refraction due to Earth's atmosphere.
- The next Total Lunar eclipse of April 4, 2015 will only barely be a Total eclipse? Whereas Total Solar eclipses are usually 1 to 4 minutes in duration, the Lunar variety is often an hour long, the maximum being 107 minutes. The next Lunar eclipse will feature just 5 minutes of totality.
- While we on Earth are watching a Total Lunar eclipse, an astronaut on the Moon would be watching a Total Solar eclipse? It won't be like any Total Solar eclipse seen from Earth because the apparent size of the Earth in the sky above the Moon would be quadruple that of the Sun, and also the duration of totality. The Sun's corona won't be visible for the most part since Earth would act like a LASCO C4 coronagraph on SOHO (which doesn't exist).

The Cassini Flyby of Earth

When launched by a Titan IV B-Centaur booster at 08:43 UT on October 15, 1997 from Cape Canaveral, Florida, the 5.6-tonne payload of *Cassini-Huygens* could not have directly reached the orbit of Mars, let alone Saturn's.

It needed a sequence of 'gravity-assists' involving Venus (twice), the Earth and finally Jupiter to reach its destination. These maneuvers increased the speed of the relatively-insignificant-in-mass spacecraft when it approached the enormously-more-significant-mass of a planet "from behind" and "stole" some of its orbital momentum each time, with no expenditure of the fuel on board.

For it to work, the pair of Venusian flybys (about 14 months apart) were punctuated by a re-targeting maneuver on Dec. 3, 1998 that actually *slowed* *Cassini* by about 1000 mph relative to the Sun. But after the second flyby of Venus, *Cassini* had enough speed to travel all the way to the asteroid belt.



The gravitational-assist trajectory of Cassini-Huygens. The Earth Flyby on August 18, 1999 is depicted lower-left, in blue. (Credit: Wikimedia Commons)

But just eight weeks later, its course led *Cassini* to encounter Earth. At 03:28 UT on August 18, 1999, it flew past Earth at a distance of about 728 miles, passing most closely above the eastern South Pacific (23.5°S 128.5°W). It received an approximately 12,000 miles-per-hour boost. The new trajectory put it on course to encounter Jupiter on Dec. 30, 2000, where yet another gravity-assist enabled *Cassini* to reach Saturn three and a half years later.

August 18, 1999

Cassini's closest approach to Earth was in daylight somewhere near Pitcairn Island. It was late winter and nightfall was still a few hours away on the eastern coast of Australia. From his observatory in Loomberah NSW, **Gordon J. Garradd** started imaging the region of the sky where *Cassini* was to be, now speeding away from Earth, some 9 hours after closest approach.

His first image of the area was exposed at 12:25 UT and he took 10 more shots (of about 20-30 seconds duration) at regular intervals over the next 2 hours with his 450mm f/5.4 Newtonian and an Apogee AP7 CCD camera. The images were 512x512 pixels in size.



A composite of 11 images charting the progress (left to right in the middle of the frame) of Cassini near Earth on August 18-19, 1999. The bright star below the track is 2UCAC30121207 at magnitude 9.6. (Credit: Gordon J. Garradd)

They show *Cassini* as 11 blips of magnitude 16-17 starting center- left in the composite frame. The following night Gordon took more images of the region from 17:25 UT on. In the intervening hours, *Cassini* dimmed to magnitude 19. Astrometry data from 6 of the first set of 11 exposures of the Near Earth Object (NEO) that *Cassini* represented were submitted to **Bill Gray** at the [Project Pluto](#) site, along with 5 from the next day (see table below left).

Date.Time	RA	Dec.	Mag.
C1999 08 18.51899	23 28 23.37	-05 04 56.9	16.2
C1999 08 18.52503	23 28 21.35	-05 04 57.3	16.7
C1999 08 18.54081	23 28 15.69	-05 04 56.6	16.5
C1999 08 18.57286	23 28 03.14	-05 04 51.7	17.0
C1999 08 18.58419	23 27 58.51	-05 04 48.9	16.4
C1999 08 18.59442	23 27 54.32	-05 04 45.8	16.7
C1999 08 19.72619	23 29 03.21	-05 01 06.4	19.0
C1999 08 19.73325	23 29 02.24	-05 01 04.8	19.2
C1999 08 19.74565	23 29 00.47	-05 01 02.1	19.0
C1999 08 19.77046	23 28 57.46	-05 00 56.8	19.1
C1999 08 19.77853	23 28 56.63	-05 00 55.2	19.1

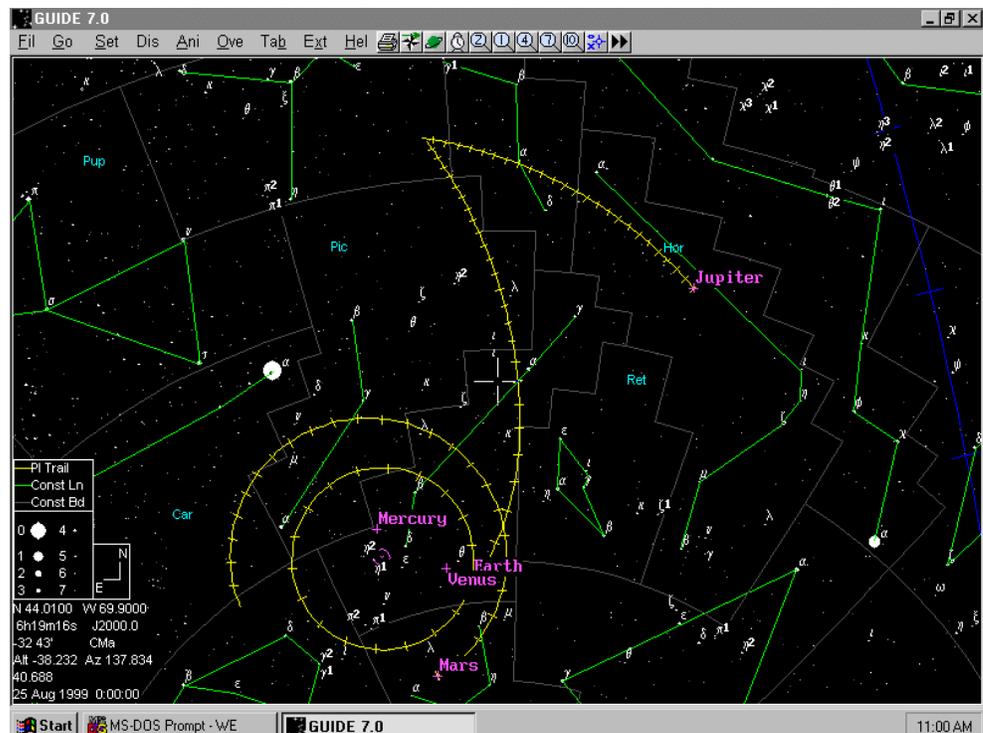
The set of numbers for August 19 exhibit a curious ‘wobble’ in Right Ascension values. Gordon explains the matter:

The jump in the RA from one set to the next is due to reflex motion. As the Earth rotates and Cassini was moving away from us, its path appears to be an ever decreasing spiral in the sky. But since my imaging only covered a short period each night, the path appears almost straight but is in fact a curve, part of the spiral. The path of comets coming in from the outer solar system will exhibit the same spiraling effect on an annual basis as we orbit the Sun. Comet Hale-Bopp was a good example of that [illustrated on next page]. NEOs passing close by us also show a large wobble in their path across the sky due to Earth's rotation.

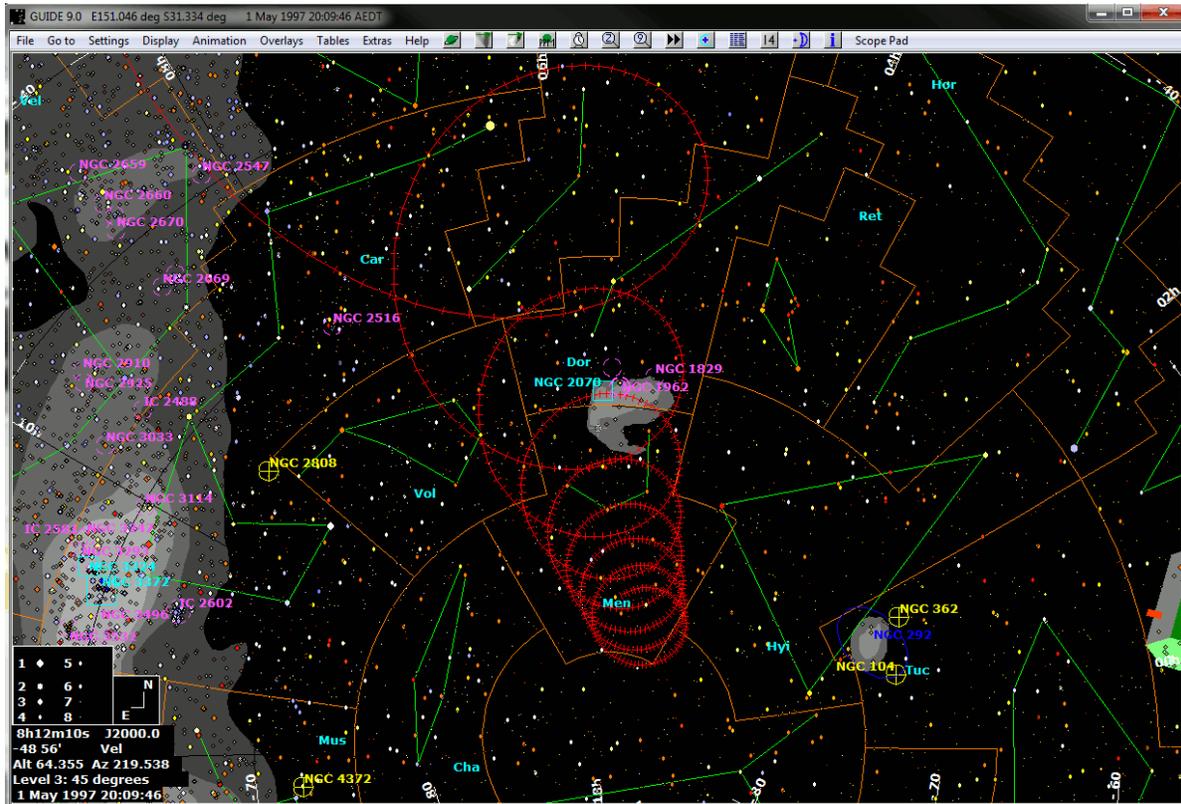
In the 15 years since flying by Earth, *Cassini* has sent mankind thousands of images of the Moon, of Jupiter and of course of the Saturnian system. On July 19 last year it even looked back and took a shot of Earthlings waving at it from 900 million miles away. But in August 1999 **Gordon J. Garradd** took among mankind’s last looks at *Cassini* that became [APOD of August 26, 1999](#). For good measure, he plotted its course from Earth to Jupiter (below).

On August 20, 1999, **Robert McNaught** imaged the receding *Cassini* and supplied 4 more astrometry data points (that show more ‘wobble’ in the Right Ascension numbers).

[The FIND_ORB Orbit Determination Program](#) at Project Pluto churned the combined set of numbers to calculate the new aphelion of *Cassini*’s orbit, which had been boosted from 2.53AU (on the day before the flyby) to 7.17AU now, i.e. from the edge of the asteroid belt to beyond the orbit of Jupiter. A 12,000mph jump in speed will do that! *Cassini* was now headed for its flyby encounter with Jupiter.



From near Earth to Jupiter in 16 short months. The screen shot is a view from 10 AU "above" the plane of the ecliptic; the orbit of Mars has been added merely to aid perspective (Cassini came nowhere near Mars). (Credit: Gordon J. Garradd)



Comet Hale-Bopp (C/1995 O1) was discovered (near M70) by amateurs Alan Hale and Thomas Bopp on July 23, 1995, considerably before its perihelion on April 1, 1997. Dubbed the Great Comet of 1997, it was visible to the naked-eye for almost 18 months. Its orbit is almost perpendicular to the ecliptic and as the comet speeds away from the Sun, the ever decreasing spiral of its track as seen from Earth is depicted above. (Credit: Gordon J. Garradd and Bill Gray)

Looking back at the orbit of *Cassini* on August 18 itself, the FIND_ORB numbers reported that the spacecraft had got as close as 7554km to Earth's center. Given Earth's 6378km radius, *Cassini* was just 1176km over the Pacific Ocean at its closest approach. JPL calculated the number to be 1171km; they'd have had more data to work off of. It is worth noting however that FIND_ORB was working off a set of observations taken over only 3 nights.

How does Gravity-assist Work?

It appears to run counter to the intuitive notion that the total energy (kinetic + potential) of a body in motion is constant as it moves through the gravitational field of a far more massive body. The speed of said body will increase during the encounter and the direction of its velocity vector will change; but as it recedes from the encounter, its speed will gradually decrease to the same value as that during approach. And yet a gravitational field of a massive body like a planet does boost the speed of a spacecraft that encounters it.

The key, [as Prof. James Van Allen explains](#), is that the massive body is not at rest; it is in motion. His paper used the December 4, 1973 encounter of *Pioneer 10* with Jupiter as a real-life example of gravitational assist that enabled the probe to change course from an elliptical orbit around the Sun to a hyperbolic one escaping the Sun. Orbits of comets were known to change after a close approach to Jupiter, but it was not until [the work on the 3-body problem \(in 1961\) by a graduate student named Michael Minovitch](#) at JPL that the [utility of gravity-assist in interplanetary travel was proven and adopted](#) (*Mariner 10* used it to get to Mercury in 1973-75). In 1964, **Gary Flandro** at JPL discovered an upcoming once-in-176-years alignment of the large outer planets and conceived of a [Planetary Grand Tour](#), utilizing gravity-assists from them in succession. The technique reduced the mission duration from 40 years to about a dozen years, and was discovered in the nick of time – the next launch windows were in the years 1976-1978.

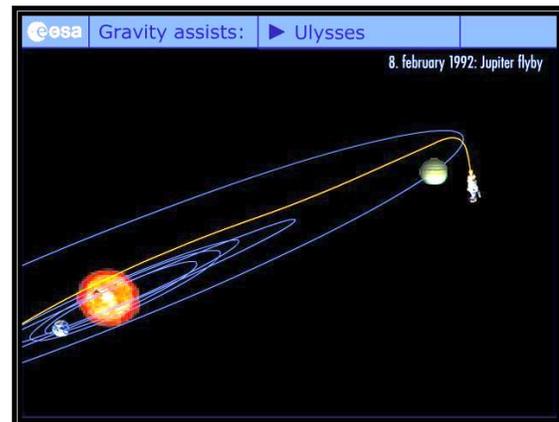
As an intern at the Charles Hayden Planetarium in the late 60's and early 70's, NHAS member **Steve Rand** got to know **Mike Mattei**, the resident astronomer at Harvard-Smithsonian's *George R. Agassiz Station* in Harvard, MA (it was established in 1933, later known as the *Oak Ridge Observatory*, and was largely decommissioned by August, 2005). The association afforded Steve the opportunity to observe, take astro-photographs, and generally look into projects at a working observatory, whose primary research focus was on tracking minor planets and asteroids. Steve recalls that one of the projects at that time involved the compilation of interferometry data on the positions of the known moons of the outer planets. This was for the benefit of the *Pioneer* and Grand Tour missions to come.

To Boldly Go

Over the past 4 decades, a number of spacecraft have used gravitational assists to accomplish their missions – *Pioneer 11*, as well as *Voyagers 1* and *2*, used the gravity of Jupiter (and Saturn) to ‘slingshot’ their way around the solar system and then out of it. *Pioneer 11* made an almost 180° turn at its Jovian flyby and cross the inner solar system to reach the vicinity of Saturn. *Voyager 1* managed to leave the ecliptic and go ‘up’ because of the way its Titan encounter at Saturn had to be managed. *Voyager 2* went ‘down’ from the ecliptic for a closer look at Triton after its Neptune encounter. But these maneuvers appear straightforward compared to more recent space missions.

Galileo was one of the first spacecraft to utilize the gravitational fields of the *inner* planets to get all the way to Jupiter. It was originally designed to be launched by the Shuttle using a powerful liquid-fueled Centaur-G upper stage, powerful enough for a direct flight to Jupiter. The *Challenger* disaster precluded such use, so the switch to a lower powered solid-fuel booster forced the mission to rely on a VEEGA maneuver following its October 18, 1989 launch – *Galileo* was launched on a **Venus-Earth-Earth Gravity Assisted** trajectory.

Ulysses was an entirely different story. It was designed to investigate the polar regions of the Sun. Originally drawn up as twin spacecraft operating in mirror orbits (much as *STEREO A* and *STEREO B* do today in the plane of the ecliptic), *Ulysses* was scaled back to a solitary spacecraft in polar orbit around the Sun. The enormous cost of a booster capable of launching it into a high-inclination solar orbit was neatly avoided by the use of Jovian gravity. Launched on October 6, 1990, [Ulysses had its transformative encounter with Jupiter](#) on February 8, 1992. It settled into an orbit with a period of about 6 years that took it over the Sun's south and north poles. The aphelion remained about 5 AU (which is approximately Jupiter's distance from the Sun), while the perihelion was a bit more than 1 AU. The mission lasted 15 years (1994-2009), four times its designed lifespan.



Animation of the gravity-assist maneuvers of *Cassini* and *Ulysses* to achieve their missions. [Click to view.](#) (Credit: ESA)

Observed Earth Flyby Speed Anomalies

A number of spacecraft had showed a change in speed following an Earth flyby that differed from expected values. The largest variation (a 13.5mm/second increase) was noticed after the *NEAR Shoemaker* spacecraft's flyby on January 23, 1998 on the way to the asteroid Eros. *Galileo* was similarly seen to have sped up by 3.9mm/second more after its first flyby of Earth in December 1990. The speed of a spacecraft is measured by Doppler shifts in the radio telemetry from the probe as monitored by NASA's Deep Space Network antennae.

JPL engineers could not explain the anomaly; the difference was too large to be addressed by known effects relating to Einstein's General Theory of Relativity. But in 2009 [a solution was proposed by Jean Paul Mbelek of CEA-Saclay, France](#) that considered effects of Special Relativity (SR). Mbelek found that the SR time dilation, the SR transverse Doppler shift and the addition of velocities to account for Earth's rotation, taken all together, yield the correct (larger) values for the speed. In effect, the software used by JPL was relativistic, but not fully relativistic.

- [Ramaswamy](#)

Two Eclipses and Two Comets

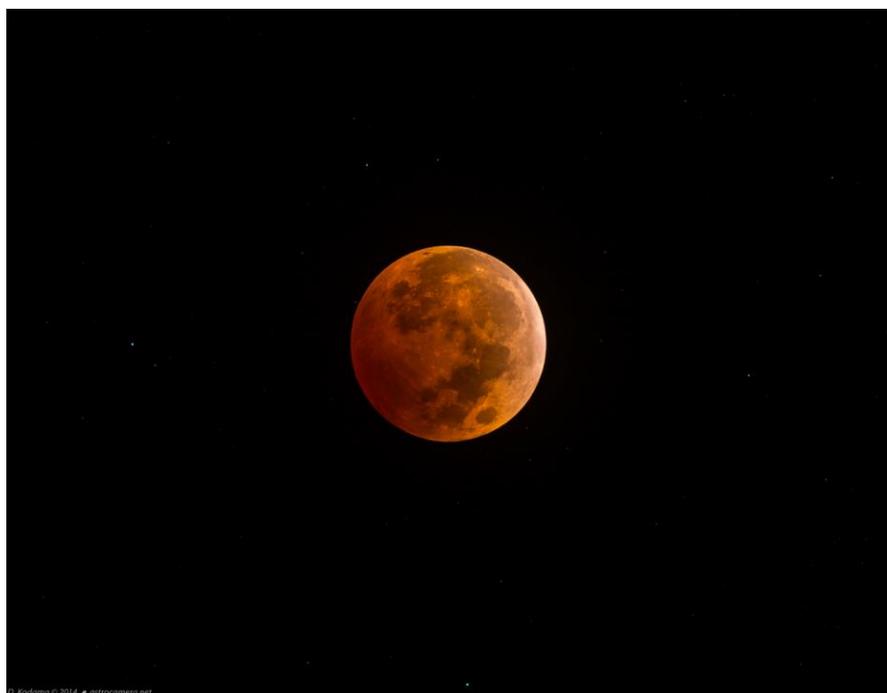
Lunar and Solar eclipses are like Siamese-twins; they *always* come together at adjoining Full and New moons. The order depends on the orbital circumstances of a different 3-body ‘problem’ of the Moon, the Earth and the Sun. But the places on Earth from which the two events are visible are usually widely separated, as are the types.

One such pair occurred this month and was visible from North America. For New Englanders, both began low on the western horizon (or just below it) – the Total Lunar eclipse of October 8 was at moonset beginning at about 6:25am EDT, and the Partial Solar eclipse of October 23 was likewise at sunset beginning at about 5:50pm EDT.

Act One – A Red Moon

West of the Mississippi, many North Americans and even a few travelling NHAS members had a good look at the Lunar eclipse, as weather permitted. The experiences of **Rich and Susan Schueller** are documented on page 11.

From his observatory at the site of the Orange County Astronomers in southern California, **Dave Kodama** imaged the Moon, and the small green disk of **Uranus** next to it to the left. Beyond the faint specks to the right (and out of view here) would be the trio of bright stars – 60, 62 and 63 Piscium in a straight-line, the last being reddish **δ Piscium** that serves as a 4.4 magnitude signpost for locating Uranus these days. The tiny speck at the bottom of the frame is HIP 3765, a 5.7 magnitude star quite close to the ecliptic. Of the two stars above the moon, HIP 4231 (mag. 7.3) is the brighter one to the left; it is closer still to the ecliptic.



The eclipsed Moon with Uranus alongside to the left.

(Credit: Dave Kodama)

I was in Fairbanks, Alaska for what promised to be an hour of totality from about 2:30am local time, and for a different take on Uranus that (unfortunately) did not work out. The overcast was thick enough to prevent even a hint of a Full Moon throughout that night. Above the clouds, Uranus would have been about 5’ off the southern limb at mid-eclipse.

Uranus would not have been visible prior to or after the eclipse, thanks to the Full Moon. It would have been interesting to see if a naked-eye view (under promised dark skies) or more likely a binocular view would have shown it appear and then disappear – I didn’t bring a scope with me. It could have been the lunar equivalent of a Total Solar Eclipse tradition – the emergence of Mercury during totality. Except this episode would have lasted considerably longer!

Further north near Barrow and Prudhoe Bay, a grazing occultation was expected.



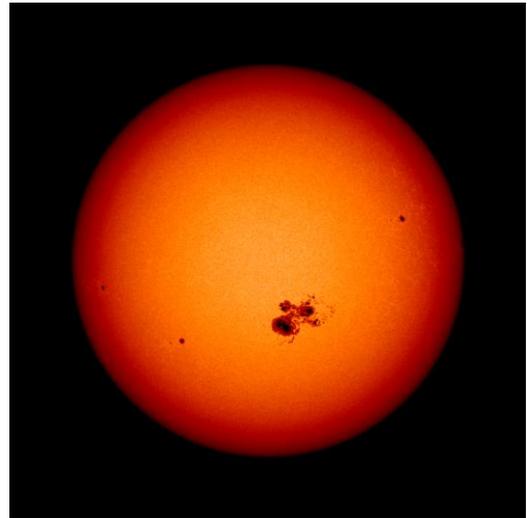
*Eclipsed Moon over Fairbanks
(Courtesy: Stellarium)*

Act Two – A Bite out of the Sun

The Partial Solar Eclipse was a non-event in New England (since it didn't really get going until a bit after sunset), but maximum eclipse was at hand in the Mid-west just as the Sun set. Further west, the entire eclipse was visible as the Moon chomped off the northern half of the solar disk, from right to left. **Dave Kodama** was at the *National Solar Observatory* in New Mexico this time (attending a conference) and found favorable conditions to watch and image the eclipse. The National Solar Observatory hosting the Dunn Solar Telescope is located on Sacramento Peak near, and I am *not* making this up, Sunspot NM 88349. The nearest 'large' town is Alamogordo, forever associated with the Trinity test of July 16, 1945.



The Sun at maximum eclipse above New Mexico, marked squarely by its prominent Active Region.
(Credit: Dave Kodama)



The Sun in its splendor on October 23, 2014: AR2192 staring right back at Earth (or close to it).
(Courtesy: SDO/NASA)

Active Region 2192 (more correctly AR 12192) made its appearance 5 days before the eclipse and managed to shoot off 6 X-flares and 4 M-flares in just 10 days, the largest of which was an X-3.1 the day after the eclipse. Fortunately none of the X-flares generated a major CME, but aurora activity certainly picked up on Earth – kp-index of 6 was being advertised. AR2192 was not only the largest active region of the current sunspot cycle that began in 2008, but the largest in about 25 years (the large sunspot at the base is Jupiter-sized). It will probably return with a new name.

Act Three – A Close Encounter at Mars

On January 3, 2013, **Robert McNaught** discovered comet *C/2013 AI*, the first discovery of that year, using the Uppsala Southern Schmidt telescope at *Siding Spring Observatory* at Coonabarabran, NSW. Initial speculations about the comet, then about 7.2AU away from the Sun, had it on a collision course with Mars, a notion soon dispelled. Comet *Siding Spring* would come no closer than 86,000 miles of the planet.

On October 19, it did just that. It would have been a Great Comet, a spectacular magnitude -6 object in the Martian skies. Given that Mars was about 11,000 times brighter than the diffuse-looking comet, Earth's best look at the pair was courtesy of the *Hubble Space Telescope* (right).



Mars greets a Comet on Oct. 19. (Credit: NASA/ESA)

There are five spacecraft orbiting Mars at this time: NASA's *Mars Reconnaissance Orbiter*, 2001 *Mars Odyssey* and *MAVEN*, ESA's *Mars Express* and India's *Mangalyaan (Mars Orbiter Mission)*. All NASA orbiters were 'parked' on the opposite side of Mars at the time of highest risk from potentially damaging particles that would reach Mars about a couple of hours after the nucleus's closest approach; Comet *Siding Spring* shot past Mars at about 125,000mph. For good measure, the most vulnerable parts of the orbiters were oriented away from the dust trail. Damage done by the comet's close pass will not be known for some time, but is expected to be minimal, if any at all.

The rover *Opportunity*, which had been exploring the western rim of Endeavour crater, was not ideally situated to image the passing comet at closest approach, since the sky above would by then have been bright. But 2.5 hours earlier from its station at Ulysses crater, with dawn still to break, *Opportunity* took a series of exposures of 10 to 50 seconds with its panoramic camera (with an obviously unguided mount). It is worth noting the smears caused by the rotation of Mars, and also that the star trail of omicron Ceti at the top of the image is of **Mira** "the wonderful."

Unsmearred points are due to cosmic rays, while the smear of the comet itself is in a slightly different orientation than those of the stars, due to the comet's own motion across the Martian sky.

Act Four – A Closer Encounter is Imminent

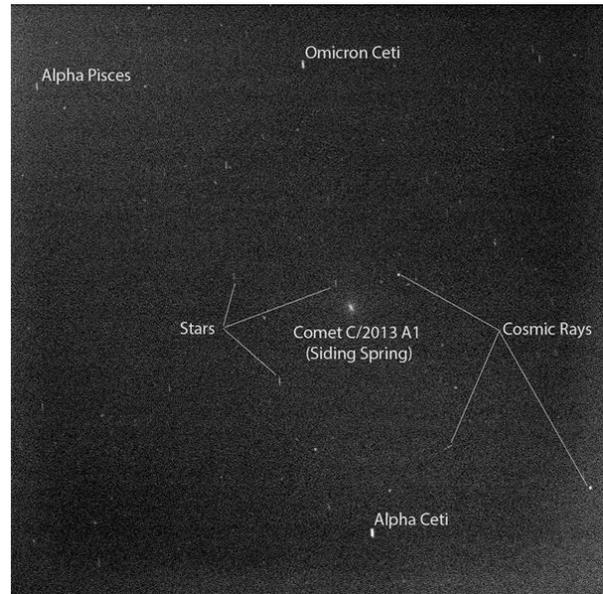
The summer of 2014 was spent by the *Rosetta* spacecraft in successfully achieving a low orbit at Comet **67/P (Churyumov–Gerasimenko)** and examining its tortured surface for potential landing sites for the probe **Philae**.

That landing event is now set for November 12, but in the meantime the CIVA camera on board the lander *Philae* (still attached to the mother craft) took this image on October 7 beyond a solar panel of *Rosetta*. The twin lobes of the comet are at the top of the image, some 10 miles away, with out-gassing from the larger lobe already evident in a 'downward' direction. The landing site on the smaller lobe is also facing the camera at this moment. (67/P rotates every 12.4 hours).

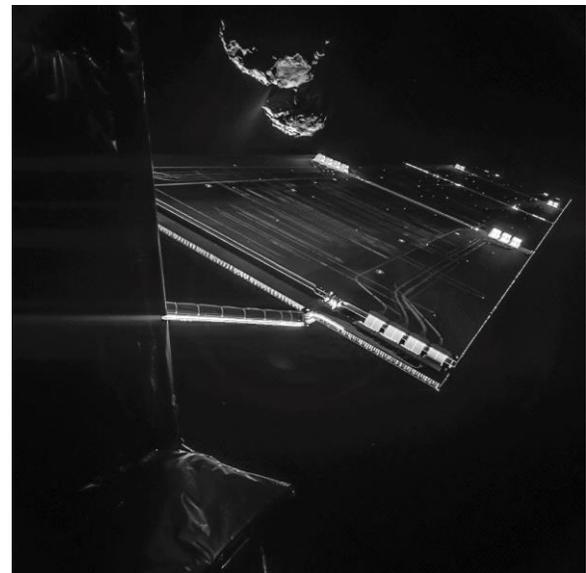
Shortly after separation on November 12, *Philae* will take another image looking back toward the *Rosetta* orbiter, and then begin its descent to the nucleus of the comet. A system of screws will push the 100Kg probe away from the mother craft and send it drifting down to the comet surface. If the screws fail, a spring mechanism will propel the lander away. The descent will be a free-fall of 20Km in 7 hours; harpoons will secure the landing. It will be a stern test of nerves.

Rosetta was originally set to meet the mundane comet **46/P Wirtanen**, but delays in launch turned the mission to 67/P.

- [Ramaswamy](#)



Opportunity grabs Comet Siding Spring just before closest approach on October 19, 2014. (Credit: JPL/NASA)



Comet 67/P awaiting the Philae lander. (Credit: ESA)

NHAS October 2014 Business Meeting Report

The monthly business meeting was held at MSDC, Concord NH on October 10th, with our Vice-President **Tom Cocchiaro** presiding. The Treasurer's report by "**Rags**" follows on the next page.

Vice-President's Report

The past month's activities were reviewed, including many public skywatches, the club's Fall Messier Marathon and an LTP Mod Party in NH, and the excellent participation at Acadia Night Sky Festival in Maine.

Next on the agenda was the NEFAF 2014 event held by UNH on Oct. 17-18, with NHAS participation. The not-to-miss keynote address will be by **Dr. Carolyn Porco**. Volunteers were needed for the indoor NHAS table, the scope clinic and the "Walk the Solar System" tour on Saturday, and for the GLP tours on both nights.

The Top 3 News items of the past month, in reverse order:

* Evidence has emerged that the Moon has a "soft center" due to its gravitational interaction with Earth.

* An Earth-sized exoplanet has been found in the habitable zone – **Kepler-186f** is orbiting a brown dwarf:



* **Comet Siding Spring (C/2013 A1)** will soon be passing close to Mars.

Case of the Month

Paul Winalski showed the custom-built case for his Tele Vue 85mm refractor made by Case Technology, Inc. of Ipswich MA. Costing only \$269, it is classy, extremely rugged, the workmanship is superb, and it fits the scope perfectly.

Astronomy Shorts

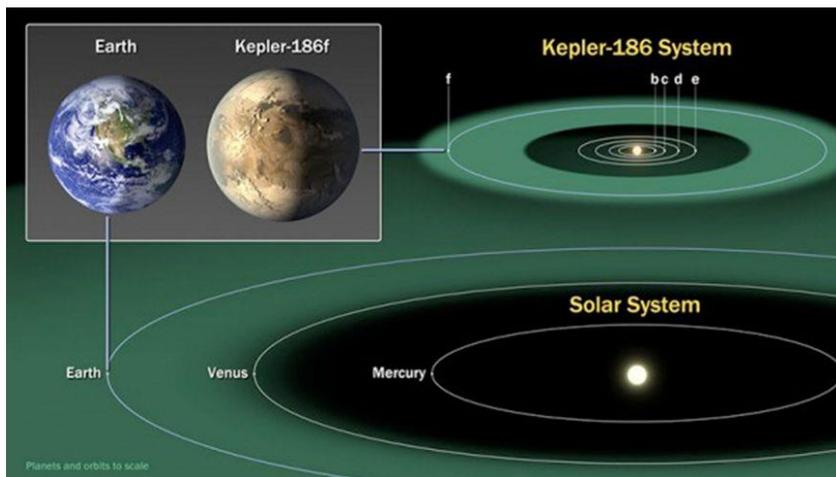
Pete Smith: Working with the **St. Louis Astronomical Society** to get their LTP program started. They went through 4 gallons of chili to build 18 scopes, and NHAS is attributed on each of their scopes!

Gardner Gerry: Thanked **Curt Rude** for being the only other to show up for the Webster skywatch.

Marc Stowbridge: Acadia has three libraries; each has a scope.

The Evening Presentations

In a members-only program, **Ken Charles** shared info on his astro Android apps and reviewed his updated Ghost Hunt plan for the upcoming event. **Paul Winalski** shared his knowledge of faint red beacons of light known as Carbon Stars. Finally **Barrie Sawyer** showed his Denkmeier Binotron-27, a night-vision binoviewer that really pulls in the faint fuzzies.



NHAS Treasurer's Report

(as of October 9, 2014)

Starting Checking Balance:	\$8,583.12	Membership:	7	
			Single + Family	
Deposits:		Cash Renewals:	23x30.00+6x10.00	750.00
Membership	1038.30	Cash New Members	0x30.00+0x10.00	0.00
Donations	370.00	PayPal Renewals:	10x28.83+0x 9.61	288.30
Interest	0.35	PayPal New Members:	0x28.83+0x 9.61	0.00
Calendar sales	161.00	Total:	33	\$1038.30
EP & T-shirt sales at Stellafane	58.00	Current Members:	40	
Ramaswamy payment for OTA	500.00			
Total:	\$2,127.65	New Members:		
		Nori Odoi		Greenfield NH
Expenses Paid:		Donations:		
NEFAF Donation	750.00	John Russell	GEN	20.00
Rymes Heating & Oil (propane)	110.41	John Bishop	GEN	20.00
Rackspace Cloud (Web site)	22.69	Mike O'Shaughnessy	GEN	5.00
GoDaddy server	9.99	Friends of Minot-Sleeper Library	LTP	325.00
Total:	\$893.09	Total:		\$370.00
Current Checking Balance:	\$9,817.68			
Petty Cash:	\$100.00			
Current Cash Balance:	\$9,917.68			
EOC Share:	\$6,760.02			

Contact Information

How to join NHAS

Write to us: **NHAS**
P. O. Box 5823
Manchester, NH 03108-5823

Send Email to: info@nhastro.com

Visit our web site: <http://www.nhastro.com>

How to contribute to the Observer

Email articles and snapshots to the Editor:
ramax.astro@yahoo.com

NHAS Officers:

President: [Ted Blank](#)
Vice-President: [Tom Cocchiaro](#)
Secretary: [Paul Winalski](#)
Treasurer: [David "Rags" Gilmore](#)

Board of Directors:

[Ken Charles](#)
[Pete Smith](#)
[Steve Rand](#)



Orion Starblast 4.5 – LTP-style Scope

Custodian: *Pete Smith*
Contact: psastro60@gmail.com

Equipped with:
 Commercial red-dot finder with a special Joel Harris mount.

Celestron 8mm-24mm zoom EP, plus 17mm and 6mm EPs.
 Instruction booklet and an Audubon constellations guide.
 A red/white Headlamp and a Lens Cleaning Pen in the pouch.
 A simple Collimation Cap to learn to collimate the old way.
 A Planisphere and a Moon Map.
 Richard Berry’s “Discover the Stars”

How to Borrow a Loaner Scope in 3 Simple Steps

- Contact the custodian of scope you’re interested in
- Arrange to meet for the transfer (usually at a monthly Business Meeting)
- Sign the requisite papers and leave with the scope

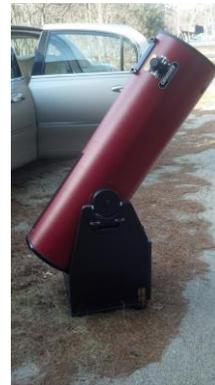
It is a benefit of your membership in NHAS. The loan will be for 2 months; an extension might be granted if no one else is waiting for the unit. The objective is to help new members get to know what will suit them personally, to experiment with options and to understand **what will work** in the time available to them to pursue their new hobby, and equally, **what may not**. A suitable (beginner’s) telescope is invariably one that is easy to transport to the observing site and easy to setup, and not necessarily the one with the most aperture or sophistication.



Orion XT6 – 6” Newtonian on a Dobson mount

Custodian: *Ted Blank*
Contact: tedblank@gmail.com

Equipped with:
 Telrad finder with a dew shield
 32mm, 25mm & 10mm Plössl EPs in a case
 A Planisphere, a Moon map and a red light
 Orion XT6 user manual
 Richard Berry’s “Discover the Stars”



Coulter Odyssey 10” Newtonian on a Dobson mount

Custodian: *“Rags” Gilmore*
Contact: nhas@ragnorok.net

Equipped with:
 Telrad finder with a dew shield
 26mm TeleVue Plössl and 15mm Celestron Plössl in a case
 A Planisphere and a Moon map
 Richard Berry’s “Discover the Stars”
Also available, independently of the telescope and in a separate slip-case:

Sky Atlas 2000.0 by Wil Tirion and Roger Sinnott
 Sky Atlas 2000.0 Companion: Robert Strong & Roger Sinnott



Meade 8” Newtonian on a Dobson mount

Custodian: *Ken Charles*
Contact: starnek2550@gmail.com

Equipped with:
 Telrad finder with a dew shield
 25mm and 10mm EPs
 A custom-built base (made by Joe Derek and Chase McNiss)



Orion XT10 Newtonian on a Dobson mount

Custodian: *Pete Smith*
Contact: psastro60@gmail.com

Equipped with:
 Telrad finder
 Assorted EPs: 35mm, 25mm wide-angle, 17mm and a mystery one (25mm?).
 An EP case
 Richard Berry’s “Discover the Stars”

Regional Astronomy Clubs

New Hampshire Astronomical Society
 [NHAS] *Skywatches around the State*
Sidewalk Astronomy in Portsmouth
www.nhastro.com

Amateur Astronomical Society of Rhode Island (North Scituate, RI)
www.theskyscrapers.org

Amateur Telescope Makers of Boston
 (Westford, Mass.)
www.atmob.org

Astronomy Society of Northern New England (Kennebunk, Maine)
www.asne.org

Gloucester Area Astronomy Club
 (Gloucester, Mass.)
www.gaac.us

McAuliffe-Shepard Discovery Center
 [MSDC] (Concord, NH)
First Friday Observing Event
www.starhop.com

Northeast Kingdom Astronomy Foundation (Peacham, VT)
www.nkaf.org

North Shore Astronomy Club
 (Groveland, Mass.)
www.nsaac.org

Penobscot Valley Star Gazers
 (Bangor, Maine)
www.gazers.org

Online Live Observatories

Astronomy Live (broadcasts)
www.astronomylive.com

SLOOH (Tenerife, Canary Is.)
www.slooh.com/about.php

Worldwide Telescope
www.worldwidetelescope.org

Magazines

Astronomy
www.astronomy.com

Sky & Telescope
www.skyandtelescope.com

Astronomy Gear

Adorama
www.adorama.com

Agena AstroProducts
www.agenaastro.com

Astromart
 (Used equipment and advice)
www.astromart.com

Astronomy-Shoppe
(in Plaistow, NH 03865)
www.astronomy-shoppe.com

Celestron
www.celestron.com

Cloudynights
 (Used equipment, Articles, Forums and Reviews)
www.cloudynights.com

Explore Scientific
www.explorescientific.com

High Point Scientific
www.highpointscientific.com

Kendrick Astro Instruments
www.kendrickastro.com

Lunt Solar Systems
www.luntsolarsystems.com

Meade Instruments
www.meade.com

Oceanside Photo & Telescope
www.optcorp.com

Orion Telescopes
www.telescope.com

ScopeStuff
www.scopestuff.com

TeleVue
www.televue.com

Vixen Optics
www.vixenoptics.com

William Optics
www.williamoptics.com

Astronomy Web Sites

CalSky
 (Sky Calendar to plan Observing)
www.calsky.com

Free Star Charts
 (Star Charts for MM, Planets etc.)
www.freestarcharts.com

Heavens Above
 (on Satellites, Spacecraft, Planets)
www.heavens-above.com

NASA
www.nasa.gov

Dark skies Observing Sites
 (Horizons and Clear Sky information)
www.observingsites.com

ScopeReviews
(Reviews by Ed Ting, NHAS)
www.scopereviews.com

Sloan Digital Sky Survey DR10
<http://skyserver.sdss3.org/>

SpaceWeather
 (Solar activity, Asteroid passes)
www.spaceweather.com

Computer Software

Cartes du Ciel (*aka Skychart*) (Free)
www.ap-i.net/skychart/

Celestia
www.shatters.net/celestia

Computer Aided Astronomy (Free)
www.astrosurf.com/c2a/english/

Earth Sky Tonight
www.earthsky.org/tonight

SkyMap Online
www.skymaponline.net

Starry Night
 (many versions, Novice to Expert)
www.starrynight.com

Stellarium (Free)
www.stellarium.org

WinStars (Free)
www.winstars.net/english/

Event	Date	Time	Location
NH Techfest Solar Skywatch	Saturday, November 1	9:00am	Nashua High School North, 10 Chuck Druding Dr, Nashua NH
Sidewalk Astronomy Skywatch	Saturday, November 1	6:00pm	Market Square, Portsmouth NH
North Hampton Public Library Skywatch	Monday, November 3	7:00pm	237a Atlantic Avenue, North Hampton NH
Minot-Sleeper Library Skywatch	Tuesday, November 4	7:00pm	35 Pleasant Street, Bristol NH
Minot-Sleeper Library Skywatch (backup date)	Wednesday, November 5	7:00pm	35 Pleasant Street, Bristol NH
First Friday Skywatch for MSDC	Friday, November 7	7:00pm	MSDC, Concord NH
Reeds Ferry Skywatch	Monday, November 10	6:30pm	Lyons Road, Merrimack NH
EOC Meeting	Thursday, November 13	6:30pm	Manchester City Library, Manchester NH
Salem High School Skywatch	Thursday, November 13	7:00pm	44 Geremonty Drive, Salem NH
NHAS Business Meeting	Friday, November 14	7:30pm	St. Anselm College, Manchester NH
Salem High School Skywatch (backup date)	Thursday, November 20	7:00pm	44 Geremonty Drive, Salem NH
Heronfield Academy Skywatch	Friday, November 21	6:30pm	Heronfield Academy, Hampton Falls, NH
Coffee House Night at YFOS	Saturday, November 22	5:00pm	YFOS
Rey Center Skywatch	Saturday, November 22	6:30pm	Waterville Valley NH
Heronfield Academy Skywatch (backup date)	Saturday, November 22	6:30pm	Heronfield Academy, Hampton Falls, NH
Crestwood Center Presentation	Monday, November 24	6:00pm	40 Crosby Street, Milford NH
Josiah Carpenter Library Skywatch	Tuesday, November 25	7:00pm	41 Main Street, Pittsfield NH
Josiah Carpenter Library Skywatch (backup date)	Wednesday, November 26	7:00pm	41 Main Street, Pittsfield NH
Nashua Winter Holiday Stroll Skywatch	Saturday, November 29	5:00pm	Main Street, Nashua NH
Sidewalk Astronomy Skywatch	Saturday, November 29	6:00pm	Market Square, Portsmouth NH
Blaisdell Memorial Library (Library Telescope Training)	Monday, December 1	7:00pm	129 Stage Rd, Nottingham, NH
Epping Middle School Skywatch	Wednesday, December 3	7:00pm	33 Prescott Road, Epping NH
First Friday Skywatch for MSDC	Friday, December 5	7:00pm	MSDC, Concord NH
EOC Meeting	Thursday, December 11	6:30pm	Manchester City Library, Manchester NH
Concord High School Skywatch (backup date)	Thursday, December 11	7:00pm	White Farm, Rt. 13, Concord NH
NHAS Business Meeting (Election)	Friday, December 12	7:30pm	MSDC, Concord NH
Coffee House Night at YFOS	Saturday, December 20	5:00pm	YFOS
Rey Center Skywatch	Saturday, December 20	6:30pm	Waterville Valley NH
Nesmith Library Skywatch	Monday, December 22	6:00pm	8 Fellows Rd, Windham NH
Sidewalk Astronomy Skywatch	Saturday, December 27	6:00pm	Market Square, Portsmouth NH
Nesmith Library Skywatch (backup date)	Monday, December 29	6:00pm	8 Fellows Rd, Windham NH
Nesmith Library Skywatch (2nd backup date)	Tuesday, December 30	6:00pm	8 Fellows Rd, Windham NH
Portsmouth First Night Skywatch	Wednesday, December 31	6:00pm	Market Square, Portsmouth NH

Note: Please check [\[Calendar\]](#) at www.nhastro.com for up-to-date information on upcoming events.

Date	Lunar Phase
Thursday, November 6	 Full moon 10:23pm
Friday, November 14	 Last quarter 3:16pm
Saturday, November 22	 New moon 12:32pm
Saturday, November 29	 First quarter 10:06am
Saturday, December 6	 Full moon 12:27pm
Sunday, December 14	 Last quarter 12:51pm
Monday, December 22	 New moon 1:36am
Sunday, December 28	 First quarter 6:31pm

Credits

Contributors to this month's **Observer:**

Deb Baker, Ted Blank, Glenn Chaple, Ken Charles, Tom Cocchiaro, Bonnie and Joe Derek, Steve Forbes, Gordon Garradd, Gardner Gerry, John Gianforte, Bill Gray, "Rags" Gilmore, Dave Kodama, Dwight Lanpher, Larry Lopez, Lachlan MacDonald, Mario Motta, Steve Rand, John Rose, Susan and Rich Schueller, Pete Smith, Mike Townsend, Bob Veilleux and Paul Winalski.