



BACK BAY observer

The Official Newsletter of the Back Bay Amateur Astronomers
P.O. Box 9877, Virginia Beach, VA 23450-9877

EPHEMERALS october 2016

10/06, 7:30 PM
BBAA Monthly Meeting
TCC Campus, VA Beach
Building J, Rm JC-13

10/7, Dusk to Dawn
Cornwatch
Cornland Park

10/11, 7:30 PM
Garden Stars
Norfolk Botanical Gardens

10/15, 10:00 AM
"Sun" Day
Elizabeth River Park

10/20-23
East Coast Star Party
Hampton Lodge
Coinjock, NC

10/29, 5:30 PM
Nightwatch
Chippokes Plantation



Looking Up!

Since the last Looking-Up column I managed to have a pretty dismal star party in Green Bank, WV. The July 6-10 trip to the annual Star Quest star party was pretty much a bust. My wife and I enjoyed rain, clouds and a nice flat tire on the trailer. We did get to hear Seth Shostak who is the Senior Astronomer and Director, Center for SETI Research speak as well as our own Michelle Shinn who is the Program Manager for Science Applications of Nuclear Physics Research. Both talks were excellent.

Our Blue Moon Festival at Hunt Club Farms on July 29 was well attended and we had excellent weather. The July and August Boardwalk Astronomy enjoyed great weather and high attendance. The movie night at Mount Trashmore on Aug. 12 was a success as well. The BBAA observation of the August Perseid meteors in Cornland Park enjoyed good weather, lots of bugs but fewer than anticipated meteors.

The Aug. 27 Skywatch at the NWRP in Chesapeake was one of the most highly attended by both BBAA members and guests. It seemed as though both parking lots were full and we spent the evening leisurely showing many people many different views of many objects.

Our "Sun day on Saturday" events were cancelled for July and August due to heat advisories. The city of Chesapeake has agreed to move

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Looking Up, continued from [page 1](#)

the venue to another park starting in September. The new location is the [Elizabeth River Park](#) located at 1400 Elizabeth River Way in Chesapeake. Get on I-464 and take the Poindexter exit toward the Jordan Bridge, the park is JUST before the Jordan Bridge.

Tuesday Sept. 13 marked the end of our Boardwalk Astronomy season, we had five successful events and only one cancelled for bad weather this summer. This included observing the transit of Mercury in early May. The September Boardwalk Astronomy was less attended due to being after labor day, but we still had lines at most of the scopes. I targeted the moon until it was dark enough to

capture Saturn, and stayed on Saturn until after ten O'clock. You just can't beat Saturn when it is clear.

The seeing was not as good as previous BA events but for folks enjoying their first looks ever through a telescope, I am sure it did not matter to them. My inquiries yielded visitors from Ohio, Quebec, Moscow, Ukraine, Italy, Fairfax County, Washington State, Colorado, Illinois, Hawaii, Mexico, Oregon, Isytebskjeyleftekistan (I can't remember the exact name but this is kind of close) and Texas!

Thank you everyone and I hope to see you all at other outreach events.

Chuck Jagow

Aug. 4, 2016 Meeting Summary

The August meeting was called to order at the 7:30 PM by President Chuck Jagow at the Kiva Room in Plaza Middle School.

Astronomical League Report:

- Club ALCOR, Bill McLean addressed the new folks, if you're a member of BBAA, then you're also a member of the A.L. You get the Reflector Magazine. They have 40 programs and awards: Lunar, Messier, and others to peak anyone's interest. Learn how to log and observe. It makes you a better observer. Nearly everyone in the club has at least one pin. Most club members have at least one pin.
- Bill McLean presented Mercury Transit (distance to the sun calculations) Awards & Pins to: Annette McLean, Chuck Jagow, Leigh Anne Lagoe, Jeff Goldstein, Mike Webster, George Reynolds, Bill McLean, Dino & Mary, and others were sent directly to member's homes via email.
- Jeff Goldstein volunteered to head the committee for the 2017 Solar Eclipse Observation.

Old Business:

- Constitution still in the works. Positions are being updated to reflect the current year. Should be ready by the end of the year for everyone to review.

New Business:

- Chuck suggested using some club funds to raffle off items such as eyepiece, telescope

equipment at the annual summer picnic, perhaps as a "Christmas in July" type present to help raise money for the scholarship funds. Perhaps we could raffle off a really nice eyepiece (or two). Send email to one of the club officers if you have suggestion.

Presentation of 2016 Scholarship Awards

- The 2016 Georgie June \$500 Scholarship was awarded to Dylan Campbell who read a very eloquent essay on his Astronomy aspirations concerning Project Jove and Measuring the Effects on IO on Jupiter's Signal.
- The 2016 BBAA Club \$1,500 Scholarship was awarded to Matthew Pieczynski who also read his eloquent Astronomy Essay.

Meeting adjourned at 8:42 PM.



Recipients of the Astronomical League's 2016 Mercury Transit Award.

Image Credit: Bird Taylor

The Back Bay Amateur Astronomers

Observer

The BBAA Observer is published monthly; the monochrome version is mailed to members who do not have internet access. Members who do have Internet access can acquire the full color version on the Internet at <http://www.backbayastro.org/observer/newsletter.shtml>

Please submit articles and items of interest no later than the date of the monthly meeting in order to be in the next month's edition.

Please submit all items to:
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BBAA Meetings

The BBAA meet the first Thursday of every month except for July. While school is in session, we meet at the VA Beach TCC Campus. The Nov. 3, 2016 meeting will be held at TCC in Virginia Beach, Building J, Rm JC-13 (or nearby room) at 7:30 PM. Directions are on our [Night Sky Network page](#).

BBAA Internet Links

BBAA Website
www.backbayastro.org

Yahoo! Groups
tech.groups.yahoo.com/group/backbayastro

BBAA Observer Newsletter
www.backbayastro.org/observer/newsletter.shtml

Observer's Corner

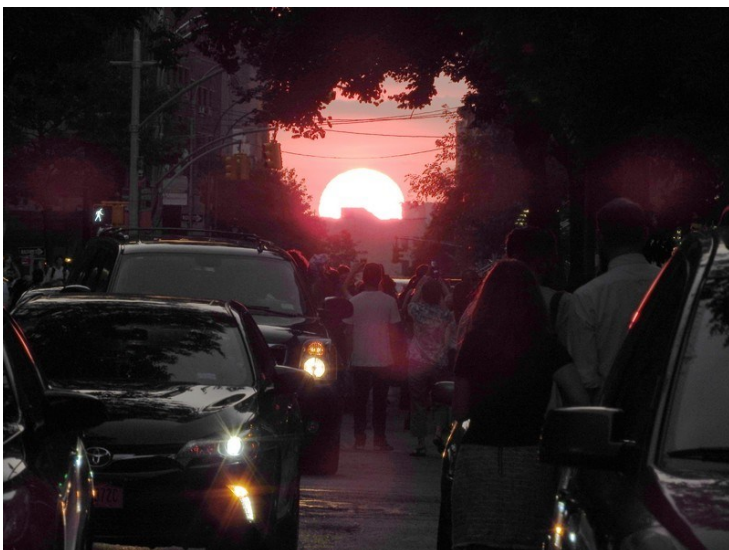


Image by Kent Blackwell

Manhattanhenge

While in NYC this past week there was a really unique occurrence, even for New York. New York City is laid out in a perfect grid system. Twice per year, the sun rises directly in line down every street in Manhattan. I saw a couple of things odder than "[The Heel Stone](#)" down some of the streets, but that's another matter.

It's referred to as "Manhattanhenge" or "The New York City Stonehenge."

As I always say, ONLY IN NEW YORK. What a town!!

- Kent Blackwell

Drift Method Analysis for Telescope Alignment

By William Rust

Producing astronomical images is both an art and a science. Accurate polar alignment is very helpful because good alignment can lengthen exposure time. The digital mount I use has an alignment protocol that works most of the time, but some site conditions make even this method problematic. The classic drift method is sometimes necessary. However, the drift method can be frustrating and time consuming due to the “try-and-see” approach. Observing time should not be wasted, so the goal of this analysis is to improve the efficiency of this technique. A mathematical model was constructed that gives the relative velocity of a star as a function of alignment error in altitude and azimuth. Subsequent parametric studies clarified the best way to employ the relationships. Field testing validated the assertions stated here. To use this method effectively, the OTA optics and mount must be characterized. Suggestions for accurate characterization will be discussed later.

There are three factors that affect alignment:

- **Linear motion (drift):** This is caused by mount misalignment with the celestial pole. For imaging purposes, deviation of the telescope polar axis automatically induces star trails. The trailing effect can be considered linear for relatively small alignment deviation.
- **Periodic motion:** Caused by minute imperfections in the mount drive. This effect can be minimized by observing star motion for 5 or 6 minutes.
- **Refraction:** This is caused by the bending of light as it passes through the atmosphere making objects appear higher than they are. Refraction is a function of altitude, elevation, and ambient sky temperature and varies continuously over the sky dome.

Drift. The relationship of drift rate with angular errors in altitude and azimuth was found as well as the effect of altitude on light refraction by the atmosphere. A parametric study was performed to find the most accurate, straightforward method to follow for good results. The star will drift vertically upwards or downwards depending on the direction of misalignment and the optical arrangement of the telescope. The model considers drift in the true North or West direction to be positive. In practice,



The author at his home observatory.

it is easy to tell if the applied correction is in the right direction. It is a simple matter to back out the adjustment and go the opposite way.

The form of the error function is linear: $E = CF \cdot DR$, where, E is error (arcmin), CF is calculated correction factor (arcmin*min/arcsec) (Table 1). It represents the slope of the drift velocity at a particular observing point on the celestial equator, and DR is measured drift rate of star (arcsec/min).

For Azimuth error, the correction factor, CF , on the **CELESTIAL EQUATOR at the MERIDIAN** is exactly equal to $-12/\pi$ (or -3.82), with an error of 5% when within $\pm 1/2$ hour of the meridian. Positive drift gives a negative result, which shows the azimuth must be moved West by the error amount, $E = -3.82 \cdot DR$.

For Altitude error, measurements are made at the **CELESTIAL EQUATOR**, look east between $4.5 < LHA < 3$, where LHA is the local hour angle. The correction factor and refraction correction for LAT (latitude) 36.83 deg (my location) has been tabulated for every five minutes by finding the best quadratic fit of data between the hour angle limits as shown in Table 1. The LHA, the observer's precise LAT-LONG, or sidereal time is not always easy to determine. For these situations and convenience, the altitude is also tabulated. Bill will provide data for latitudes 25-47 deg upon request (willrust@hotmail.com).

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Hour Angle		Altitude	Correction Factor	Final Refraction Correction - Reduce Altitude by:
Hours	Minutes	Deg.	min*arcmin /arcsec	arcmin
4	30	17.84	6.9	14.06
4	25	18.81	6.96	13.09
4	20	19.77	7.02	12.17
4	15	20.73	7.09	11.3
4	10	21.69	7.17	10.49
4	5	22.64	7.25	9.74
4	0	23.59	7.34	9.04
3	55	24.53	7.44	8.4
3	50	25.47	7.55	7.82
3	45	26.4	7.66	7.29
3	40	27.33	7.78	6.82
3	35	28.25	7.91	6.4
3	30	29.16	8.04	6.04
3	25	30.07	8.19	5.73
3	20	30.96	8.34	5.48
3	15	31.85	8.49	5.29
3	10	32.74	8.66	5.16
3	5	33.61	8.83	5.07
3	0	34.47	9.01	5.05

Table 1. Correction Factor (CF) and Final Refraction Correction with LHA and Altitude for Latitude +/- 36.83 degrees.

The validation observations are based on Table 1. Several interesting points were noted during the parametric study:

- **For Altitude** measurements, the drift correction factor in N-S or E-W direction; the CF is within 15% at +/- 60 arcmin error. However, the N-S measurement is affected by the azimuth error, while the E-W direction is independent of azimuth error. In other words, +/- 60 arcmin azimuth error will cause +/- 12 arcmin error in altitude when drift is stopped in the N-S direction. Therefore, the tabulations are compiled using the East-West direction. East-West direction can be determined by using the right ascension control, or simply stopping the drive motor. West is the direction the star moves when the power is off and is considered positive. Refraction corrections should be applied while correcting for altitude.
- **For Azimuth**, the CF of -3.82 is good across the entire meridian at transit. Furthermore, I noted that when altitude error was present, the star drifted N-S and E-W. It is impossible to determine altitude error based on E-W

sightings at the meridian. This motion should be ignored.

- **For Refraction**, the tabulated values were computed at 50° F and sea level. Differing conditions create small effects and may be neglected.

Preliminary Validation. This method was tested on 14 June 2016 LAT 36.83N. The azimuthal and altitude drift motion was “frozen” in less than five attempts. This was due to a tabulated error I did not notice before the test began, so I had to correct that in the field. After the test, I ran a 6-star fix with the resident digital mount protocol, which resulted in +2.67 arcmin altitude error and -1 azimuth error. The (-1, +2.67) error was used to find the calculated azimuthal drift, which was 0.262 arcsec/min. Applying Equation (1) gives:

$E = 0.262 \times -3.82 = -1.001$ arcmin, which agrees with the mount solution.

Repeating this for the altitude drift, the calculated error at (-1, 2.67) was 0.365 arcsec/min. The correction factor for the mount position at the last sighting is +7.331. Again,

$E = 0.365 \times 7.33 = 2.68$ arcmin, which agrees with the mount solution.

Refraction. This is excellent agreement between the mount and drift solutions neglecting refraction. By inference, it seems that the mount alignment protocol neglects refraction effects when it clearly is a factor. After due consideration, I realized that the sight picture was not complete without the refraction rate included with the drift rate. When this was done, it became obvious that a significant positive displacement (for altitude correction only) occurred when the star’s apparent drift was zeroed out. However, this value could be computed and applied to the drift adjustment, even though it varies continuously for altitude. The displacement of 5 arcmin is illustrated in Fig.1. Data for Fig. 1 was computed at LHA 3.25, Dec 0, and further discussed below. Again, refraction correction should not be applied during azimuth adjustment.

Second Validation. On 21 July 2016, a second experiment was conducted to test the refraction phase of alignment, LAT: 36.83N, sky clear, T = 72° F. Performed usual setup and began trial drift adjustments. I checked my measurements using the mount protocol and found alignment error to be: **AZM, +00d01m59s, ALT, -00d02m12s.**

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Is there a super Earth in the Solar System out beyond Neptune?

By Dr. Ethan Siegel

When the advent of large telescopes brought us the discoveries of Uranus and then Neptune, they also brought the great hope of a Solar System even richer in terms of large, massive worlds. While the asteroid belt and the Kuiper belt were each found to possess a large number of substantial icy-and-rocky worlds, none of them approached even Earth in size or mass, much less the true giant worlds. Meanwhile, all-sky infrared surveys, sensitive to red dwarfs, brown dwarfs and Jupiter-mass gas giants, were unable to detect anything new that was closer than Proxima Centauri. At the same time, Kepler taught us that super-Earths, planets between Earth and Neptune in size, were the galaxy's most common, despite our Solar System having none.

The discovery of Sedna in 2003 turned out to be even more groundbreaking than astronomers realized. Although many Trans-Neptunian Objects (TNOs) were discovered beginning in the 1990s, Sedna had properties all the others didn't. With an extremely eccentric orbit and an aphelion taking it farther from the Sun than any other world known at the time, it represented our first glimpse of the hypothetical Oort cloud: a spherical distribution of bodies ranging from hundreds to tens of thousands of A.U. from the Sun. Since the discovery of Sedna, five other long-period, very eccentric TNOs were found prior to 2016 as well. While you'd expect their orbital parameters to be randomly distributed if they occurred by chance, their orbital orientations with respect to the Sun are clustered extremely narrowly: with less than a 1-in-10,000 chance of such an effect appearing randomly.

Whenever we see a new phenomenon with a surprisingly non-random appearance, our scientific intuition calls out for a physical



A possible super-Earth/mini-Neptune world hundreds of times more distant than Earth is from the Sun. Image credit: R. Hurt / Caltech (IPAC).

explanation. Astronomers Konstantin Batygin and Mike Brown provided a compelling possibility earlier this year: perhaps a massive perturbing body very distant from the Sun provided the gravitational "kick" to hurl these objects towards the Sun. A single addition to the Solar System would explain the orbits of all of these long-period TNOs, a planet about 10 times the mass of Earth approximately 200 A.U. from the Sun, referred to as **Planet Nine**. More Sedna-like TNOs with similarly aligned orbits are predicted, and since January of 2016, another was found, with its orbit aligning perfectly with these predictions.

Ten meter class telescopes like Keck and Subaru, plus NASA's NEOWISE mission, are currently searching for this hypothetical, massive world. If it exists, it invites the question of its origin: did it form along with our Solar System, or was it captured from another star's vicinity much more recently? Regardless, if Batygin and Brown are right and this object is real, our Solar System may contain a super-Earth after all!

This article is provided by NASA Space Place.

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Drift Method Analysis, continued from [page 5](#)

I re-measured the drift and applied the tabulated refraction correction. I concluded the evening and before disassembly, I measured the altitude with a level and found the altitude of the scope to be $36.8\text{deg} \pm .05$, the accuracy of the level. This was a good result.

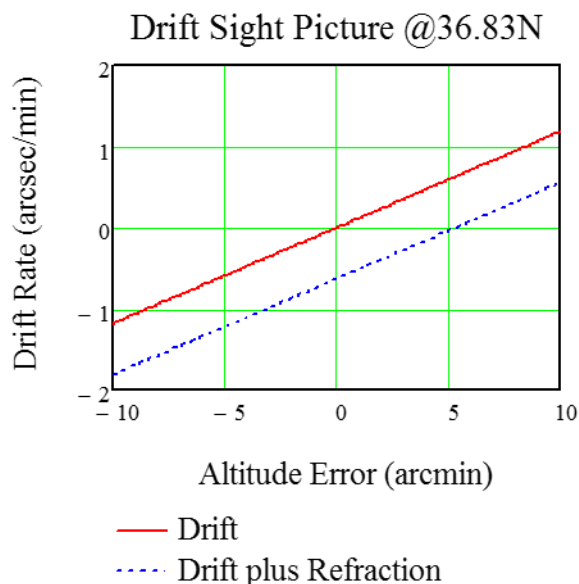


Figure 1. Induced Drift compared to Induced Drift plus Refraction. Values match observing conditions, (LHA = 3.25, Dec. =0, and 72 F).

Characterizing the Scope and Mount. This process is important because the observer must understand how much the mount should be adjusted in altitude and azimuth, and must be able to measure the motion of the star in the reticle. For this work, a digital level, stop watch, a set of dials, and a bullseye style reticle are needed. In general, a GPS device is helpful.

1. Make a dial for each knob. Any material such as metal, plastic, paper or cardboard will do. Lighter materials can be taped to the knobs, but care must be taken not to dislodge them during service. I chose $\frac{1}{2}$ " thick Ultra High Molecular Weight polyethylene to make both dials. I drilled $\frac{1}{16}$ " holes every 18 deg., which is 5% of the circumference and filled the holes with aluminum rod. Provision was made for each dial to be mounted securely to the adjustment knobs. Of course, a fixed reference point is necessary during adjustments, so I attached a six-inch steel rule to the mount. This can be used and removed with the dials when alignment is finished.
2. Erect the tripod and mount in a convenient place. Use the digital level to measure the

change in altitude with turns of the altitude knob. Record the data, and find the average change in altitude per turn. In my case, this is 54.8 arcmin/turn.

3. Repeat this for the azimuth knob. Measure the radial from the mount centerline to the axis of the adjustment screw. Measure the number of screw threads per unit length. Find the distance the screw travels in one turn and divide by the radial distance. This is the tangent of the angle of travel. Find the angle by taking the inverse tangent. For my mount, this is 26.0 arcmin/turn. This value is good for small angles. The total adjustment available on my mount is ± 7.5 deg., or $\pm \frac{1}{2}$ hour in time. I find the loss of accuracy at the extreme azimuth travel to be unimportant.
4. Set up the telescope with bullseye reticle and view a convenient star in the southern sky, preferably near the meridian. Adjust the reticle so the star tracks East and West when using the right ascension control. Place the star on centerline crosshair. The star moves at 15 arcsec/sec at the sidereal rate or 7.5 arcsec/sec at 50% sidereal. Select the mounts 50 or 100% rate (or any known rate) and use the stopwatch to time the transit across the diameter of the bullseye. The bullseye diameter is therefore the rate*time. Do several trials until you are getting good repeatability. Divide by the number of subdivisions for more precision. My reticle is 1.55 arcsec/division.



This beautiful image of M101 taken by the author demonstrates the rewards that can be gained by lengthening exposure time, which requires accurate polar alignment. Using the techniques in this article can improve the classic drift method of alignment.



October 2016

BBAA Events	Special Outreach	Astronomical Events
10/06 BBAA Monthly Meeting		10/09 First Quarter Moon
10/07 Cornwatch @ Cornland Park	10/15 "Sun" Day Elizabeth River Park	10/16 Full Moon
10/11 Garden Stars @ Norfolk Botanical Gardens	10/20-23 East Coast Star Party, Hampton Lodge, Coinjock, NC	10/20,21 Orionids Meteor Shower
		10/22 Last Quarter Moon
10/29 Nightwatch @ Chippokes Plantation		10/30 New Moon

Sneak Peek into November

Thu 11/03/2016 Monthly Meeting, Tidewater Community College, 7:30 pm
 Fri 11/04/2016 & 11/25/2016 Observing sessions at Cornland Park
 Thu 11/08/2016 Space & Science Outreach Night, Slover Library Norfolk, 6:00-8:00 pm
 Wed 11/09/2016 Garden Stars at Norfolk Botanical Gardens, 7:00 pm
 Sat 11/19/2016 Skywatch at Northwest River Park, 3:30 pm
 Sat 11/26/2016 Nightwatch at Chippokes Plantation