The Denver
# OBSERVER
JUNE 2016

**Mercury transits the Sun on May 9, 2016. The planet, *seen at the lower left of the Sun's face,* has a diameter of about 3,000 miles, but the Sun's 870,000 mile cross-section dwarfs the planet—even though the Sun is seen here at twice Mercury's distance from us. (Note the planet-sized sunspots above-left of solar center.)** ***Image © Ron Pearson.***

## JUNE SKIES

*The Solar System*

*by Zachary Singer*

If you haven't been observing **Mars,** the "unusually bright orange object in Libra," *now* is a really good time: As June begins, the planet is just past opposition, and even more recently past its closest approach to Earth, when the planet's disk spanned a full 18.6 arcseconds. It looms large in a telescope now, and even instruments of moderate power bring satisfying images at 100 or 150X. By midmonth, Mars will be highest around 11 PM, with the disk slightly smaller, at 17.9"; by June 30th, though, the planet will have already crossed the Meridian at 10 PM, before the sky is fully dark, and the disk will have shrunk somewhat, to 16.3".

As I noted last month, the Achilles' heel of this pass by the red planet is that Mars appears low in our local sky, exacerbating the effects of Denver's turbulent air. Still, by waiting for the planet to cross the Meridian on a night of decent seeing, detail on the Martian surface reveals itself. On observing runs over the last few weeks, with good seeing, early views did indeed yield so-so results, but improved noticeably as the planet neared its highest point in the south. I was able to make out the Syrtis Major region easily, even though moonlight was a factor in the initial sessions.

One great tool for improving your view is a "Moon filter." By bringing the sheer brightness of Mars' magnitude -2 disk down a notch, the moon filter brings richer color and improved detail. (That brightness can be striking, even in a 6-inch 'scope.) Long observation helps, too, as the eye becomes accustomed to where the detail is and more used to picking it out.

**Jupiter** remains a wonderful target in the beginning of June, appearing more than 40° above the southwest horizon at 10:30 PM, with a disk some 37" across. By July 1st, the planet's distance from us increases by about half an Astronomical Unit (AU), to 5.77 AU from 5.3 on June 1st. That will naturally reduce Jupiter's angular dimensions (to about 34"), but the real problem is that Jupiter's angular separation

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### In the Observer



### Sky Calendar

| | |
|---|---|
| 4 | New Moon |
| 12 | First-Quarter Moon |
| 20 | Full Moon |
| 27 | Last-Quarter Moon |

## Society Directory

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*The Executive Board conducts the business of the DAS at 7:30 PM, at Chamberlin Observatory.*
*Please see the Schedule of Events for meeting dates. All members are welcome.*
*http://www.denverastro.org*

# PRESIDENT'S MESSAGE

*by Ron Hranac*

*Tools and Tips for Solar Observing*

What comes to mind when you think of astronomical observing? Stepping outside on a clear evening for naked-eye views of visible constellations and asterisms? Grabbing your binoculars and taking a low-power, wide-angle peek at the night sky? Setting up a telescope and enjoying the Moon, planets, double stars, open and globular clusters, and various dim fuzzies?

The common thread to these is the dark of night, but there is another facet of astronomical observing that doesn't require a nice, dark sky. Indeed, the brighter the better! I'm talking about daytime solar observing. Yes, a number of Denver Astronomical Society members observe and even photograph the Sun. If you've never tried solar observing, ol' Sol can deliver some spectacular views. The odds are that you can use your existing telescope, too. The key is to do so safely.

Arguably the most common solar observing by amateur astronomers is what is commonly called white-light observing. White-light filters reduce the brightness of the Sun's light to a level that is safe to look at, which is somewhere around 1/1000$^{th}$ of 1% of its naked-eye brightness. Not doing so risks permanent eye damage.

White light observing allows one to see sunspots, and depending on the observing equipment, other features such as granulation and faculae on the Sun's photosphere. Projection methods can also be used to see the Sun, and one method using binoculars is described at *http://spaceweather.com/sunspots/doityourself.html*. A telescope also can be used to project the Sun's image for observing; see *http://www.skyandtelescope.com/observing/celestial-objects-to-watch/observing-the-sun/*.

If you'd like to use your telescope for direct viewing of the Sun, you'll need a suitable filter that is in most cases placed over the front of the 'scope (don't use those cheap screw-on-the end-of-the-eyepiece filters that used to come with department store 'scopes—they can crack from heat buildup, and should be tossed in the trash). I have both glass and Mylar-type film full-aperture filters; they're low cost and work well. I've used a glass filter on my 85mm refractor for more than 10 years. It screws on the front end of the 'scope with the dew shield retracted. One thing I noticed with the glass filter on my particular telescope is that under some circumstances, a reflection occurs between the front of the telescope's objective lens and the rear of the filter. I found that not tightening the filter completely allows it to tilt very slightly with respect to the surface of the objective and move the reflection out of the field of view, while still being mounted securely on the front of the 'scope.

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# DAS SCHEDULE

## JUNE 2016

| | |
|---|---|
| 3-5 | Dark Sky Weekend—EGK Dark Site & Brooks Observatory |
| 11 | Open House—DU's Historic Chamberlin Observatory—Starts at 8:30 PM |
| 17 | General Meeting at DU's Olin Hall, Rm. 105, 7:30 PM |
| 24 | E-Board Meeting—At DU's Historic Chamberlin Observatory, 7:30 PM |
| 29 | Rocky Mountain Star Stare, Gardner, Colorado |

During Open House, volunteer members of the DAS bring their telescopes to the Chamberlin Observatory's front (south) lawn, so the public can enjoy views of the stars and planets, try out different telescope designs, and get advice from DAS members. The Observatory is open, too (costs listed below), and its historic 20-inch telescope is open for observing with no reservations necessary.

Open House costs (non-members): If the skies are clear, $2/person ($5/family), $1/person in inclement weather. DU students with ID, and DAS members free.

Public Nights feature a presentation on astronomical subjects and a small-group observing session on the historic 20-inch telescope (weather permitting), at Chamberlin Observatory on Tuesday and Thursday evenings (except holidays), beginning at the following times:

March 10 - September 30 at 8:30 PM

October 1 - March 9 at 7:30 PM

Public Night costs (non-members): $4/adult, $3/child and students with ID. DAS members and DU students with ID: free.

Members of the public (non-DAS/DU, as above), please make reservations via our website (*www.denverastro.org*) or call (303) 871-5172.

# DAS NEWS

## Volunteer Opportunities

**June 17, 6:00PM-6:00AM** (volunteers can arrive and leave as desired)**. Relay for Life, American Cancer Society, Green Mountain High School, Lakewood (stargazing).**

**June 24, 8:00PM:** Star Party for **Boy Scouts, Astronomy Merit Badge, Cherry Creek State Park.**

**July 12th, 8:00 PM**: Star Party and astronomy lecture for members and their children, **The Club at Pradera** golf course, **Parker, CO.**

**July 15th, 8:00 PM: Moonlight Extravaganza and Science Night, Philip S. Miller Park, Castle Rock, CO.**

**July 25th, 8:00 PM: Troop 506 (Arvada),** Boy Scout Merit Badge, **Camp at Easter Seals Facility, Empire, CO.**

To volunteer, please contact Julie Candia at *external@denverastro.org* —and thanks!

## DAS Picnic

**Save the Date:** The DAS Annual Club Picnic is coming up on **Saturday, July 9th at 4 PM**, before the July Open House.

Details will follow in next month's *Observer*.

## Van Nattan-Hansen Scholarship

The Van Nattan-Hansen Scholarship Committee of the Denver Astronomical Society is now accepting applications for scholarships to be awarded for the 2016-2017 academic year. Details can be found online at *http://www.denverastro.org/das/das-scholarships/*. **Please note that the application deadline is June 15.** We apologize for giving such short notice, but the recently reorganized committee members would like to make the scholarship available this year.

Please direct any questions you may have to *vnh@denverastro.org*.

The committee would also like to ask members of the Denver Astronomical Society to consider making contributions to the Van Nattan-Hansen Scholarship Fund.

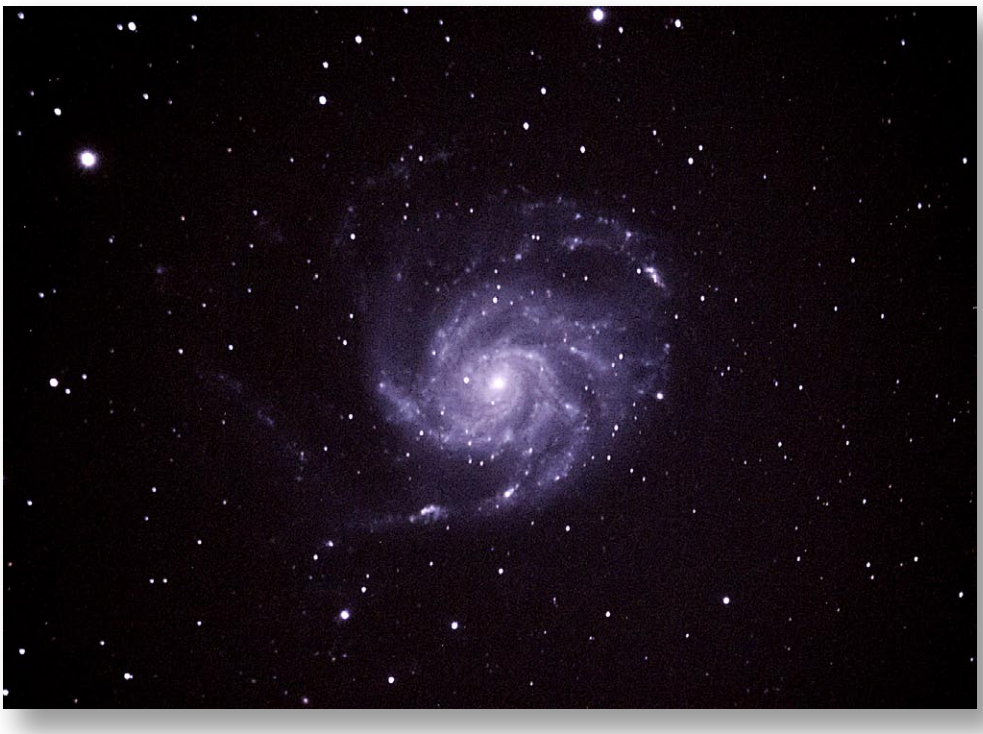
One of the main goals of the DAS is community outreach, and in order to facilitate that for future generations, it's important that we support the education of the next generation of professionals in the field: astrophysicists, astronomers, and astronomical engineers, among others. You can help us build the principal of the scholarship fund by making a donation via PayPal through our membership and donation page, *http://www.denverastro.org/membership.html*. The link to the scholarship fund is at the bottom of the page. If you prefer, you may mail a check or money order to:

Van Nattan-Hansen Scholarship Fund
P. O. Box 100621
Denver, CO 80250-0621

## DAS Astrophotographers Wanted

One of the functions of the *Observer* is to share our members' astrophotos with each other and the general public—*they could be yours!*

Taking this a step further, combining the images with other content, like our "Monthly Skies" column, makes their informational value that much stronger—if you would like to plan some of your future targets with the Observer editor, that would be warmly received, indeed. Either way, interested parties, please contact the editor at *editor@denverastro.org* or *singer@zachsingerphotography.com* —and thank you!



**M 101 in Ursa Major.**
***Image © Ron Pearson.***

# NOAA'S JOINT POLAR SATELLITE SYSTEM (JPSS) TO REVOLUTIONIZE EARTH-WATCHING

*by Ethan Siegel*

*NASA Space Place*

If you want to collect data with a variety of instruments over an entire planet as quickly as possible, there are two trade-offs you have to consider: how far away you are from the world in question, and what orientation and direction you choose to orbit it. For a single satellite, the best of all worlds comes from a low-Earth polar orbit, which does all of the following:

* orbits the Earth very quickly: once every 101 minutes,

* is close enough at 824 km high to take incredibly high-resolution imagery,

* has five separate instruments each probing various weather and climate phenomena,

* and is capable of obtaining full-planet coverage every 12 hours.

The type of data this new satellite – the Joint Polar Satellite System-1 (JPSS-1) -- will take will be essential to extreme weather prediction and in early warning systems, which could have severely mitigated the impact of natural disasters like Hurricane Katrina. Each of the five instruments on board are fundamentally different and complementary to one another. They are:

1. The Cross-track Infrared Sounder (CrIS), which will measure the 3D structure of the atmosphere, water vapor and temperature in over 1,000 infrared spectral channels. This instrument is vital for weather forecasting up to seven days in advance of major weather events.

2. The Advanced Technology Microwave Sounder (ATMS), which assists CrIS by adding 22 microwave channels to improve temperature and moisture readings down to 1 Kelvin accu-

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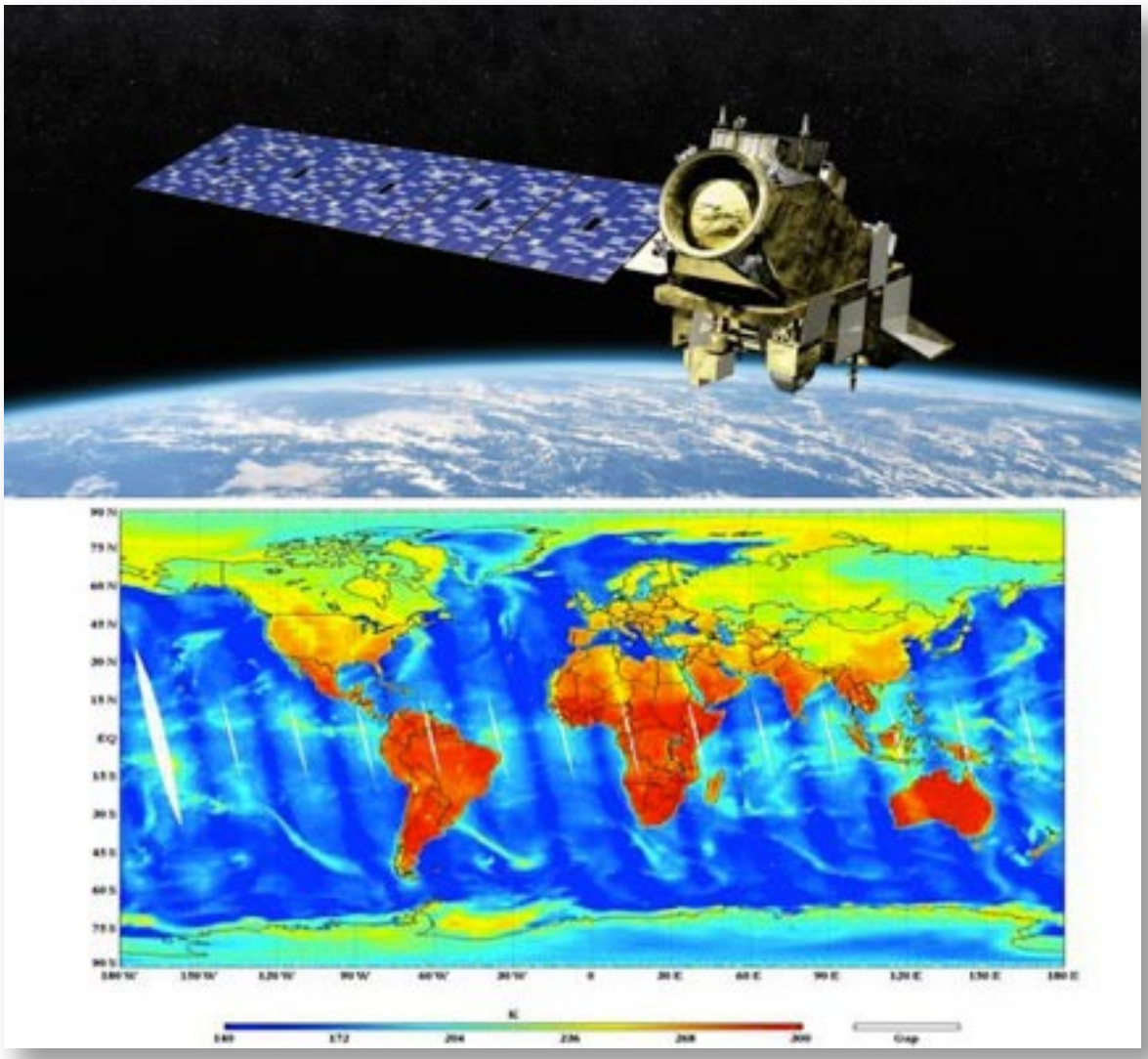

**Images credit: An artist's concept of the JPSS-2 Satellite for NOAA and NASA by Orbital ATK (top); complete temperature map of the world from NOAA's National Weather Service (bottom).**

## President's Message

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Baader AstroSolar safety film is used in some commercially produced filters that fit various telescope apertures. I have a Baader safety film filter that fits 5- and 6-inch aperture telescopes. Film-type filters provide somewhat improved contrast compared to glass filters (most casual observers likely won't notice the difference). The film is also available by itself for those who prefer to make their own filters. If you're uncomfortable making a solar filter, go the commercial route.

I've heard it said that the best filter for white-light solar observing is a Herschel wedge, which replaces a refractor's star diagonal. One downside is that Herschel wedges cannot be used with reflectors. I've been using a Herschel wedge for the past few years on a refractor, and am inclined to agree that it produces superb white-light solar images.

A step up from white-light observing takes one to the world of hydrogen-alpha (H-alpha), for observing the Sun's chromosphere and features such as prominences, filaments, spicules, and flares. In order to see these things, one needs either a dedicated H-alpha telescope or a special H-alpha filter set for an existing 'scope. H-alpha light is emitted by hydrogen atoms, and is a specific shade of red (656.28 nanometers, or 6562.8 angstroms). Sources of H-alpha solar 'scopes and filters include Meade (which acquired Coronado a few years back), Lunt Solar, and Daystar. H-alpha scopes can be pricey, but the views are *oh-so-cool*. One word of caution: ***H-alpha filters intended for nighttime observing of nebula cannot be used for solar observing***.

More information about H-alpha solar observing can be found at *http://www.skyandtelescope.com/observing/guide-to-observing-the-sun-in-h-alpha092321050923/.*

One other tip: When you're outside enjoying views of the Sun, don't forget a good hat, sunscreen, and other protection from sunburns.

## NOAA's Joint Polar Satellite

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racy for tropospheric layers.

3. The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument, which takes visible and infrared pictures at a resolution of just 400 meters (1312 feet), enables us to track not just weather patterns but fires, sea temperatures, nighttime light pollution as well as ocean-color observations.

4. The Ozone Mapping and Profiler Suite (OMPS), which measures how the ozone concentration varies with altitude and in time over every location on Earth's surface. This instrument is a vital tool for understanding how effectively ultraviolet light penetrates the atmosphere.

5. Finally, the Clouds and the Earth's Radiant System (CERES) will help understand the effect of clouds on Earth's energy balance, presently one of the largest sources of uncertainty in climate modeling.

The JPSS-1 satellite is a sophisticated weather monitoring tool, and paves the way for its' sister satellites JPSS-2, 3 and 4. It promises to not only provide early and detailed warnings for disasters like hurricanes, volcanoes and storms, but for longer-term effects like droughts and climate changes. Emergency responders, airline pilots, cargo ships, farmers and coastal residents all rely on NOAA and the National Weather Service for informative short-and-long-term data. The JPSS constellation of satellites will extend and enhance our monitoring capabilities far into the future.

**This article is provided by NASA Space Place.**

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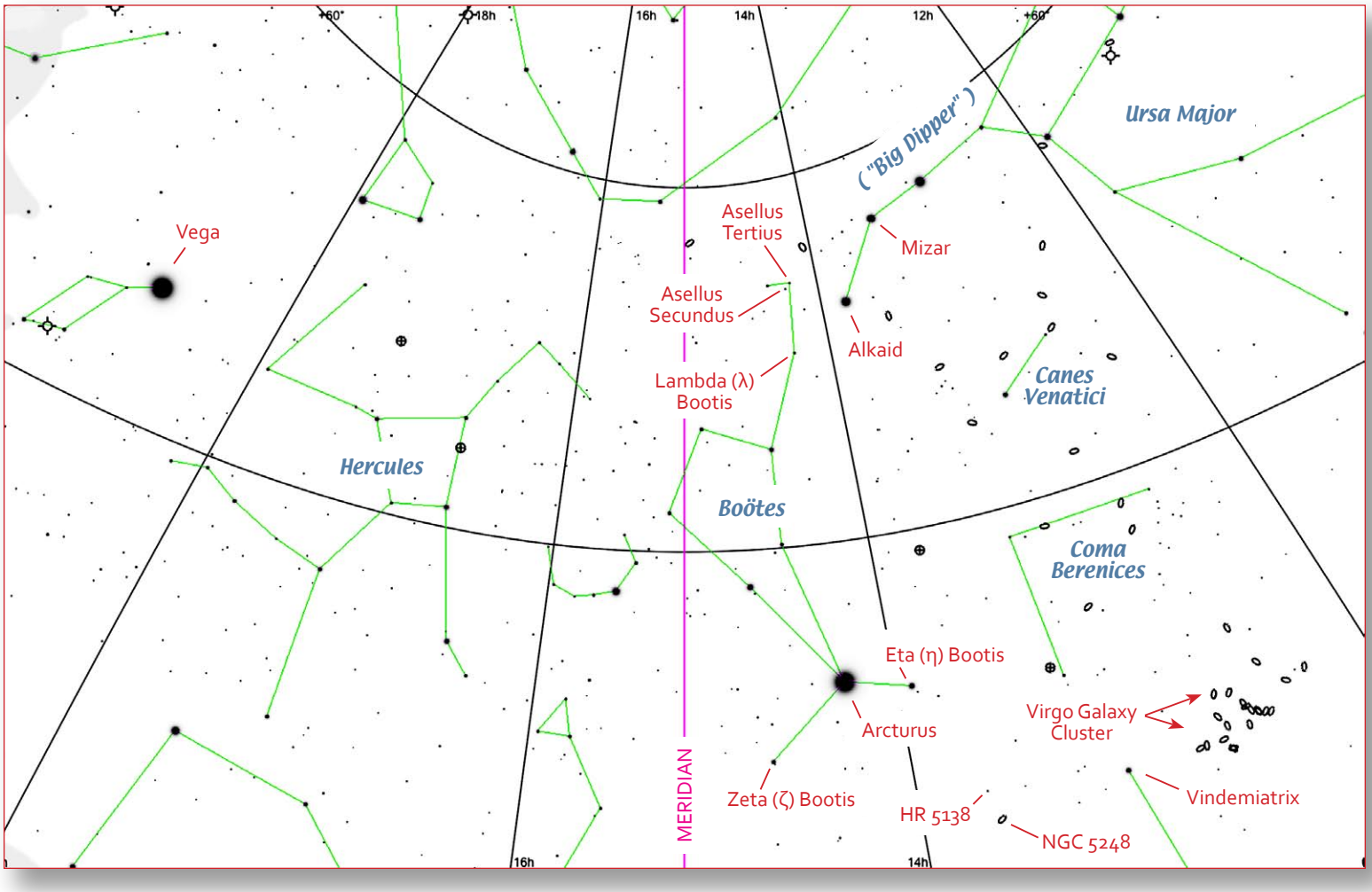


**Denver skies at 10:30 PM in mid-June; center of chart is at zenith (i.e., looking straight up), and south is at bottom. (Objects not mentioned in "June Skies" are included for reference.)** ***Heze, or Zeta (ζ) Virginis, mentioned in article, was excluded for space; it would be below the chart, towards the right.***

*Object positions, constellation and meridian lines charted in SkySafari, and then enhanced.*

## *June Skies*

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from the Sun will be decreasing, too: By next month, the result will be that Jupiter will be only 22° up in the west as the sky turns dark—and it will get lower and lower as it sinks into the Sun's glare.

As it was last month, **Saturn** is a lovely object following Mars across the evening sky. Since its opposition was on the night of June 2-3, it will be visible all night, crossing the Meridian around 1 AM at the beginning of the month (if you're thinking that should have been midnight, you'd be right but for Daylight Time). By the end of June, though, Earth's orbit takes us to a different line of sight, and Saturn will then be highest around 11 PM.

At opposition, Saturn's disk will measure 18.4"—about the same as Mars early this month—but narrows slightly to 17.5" at the beginning of July. Since that's the angular measure of *the planet,* not the rings, the size of the whole object will remain quite large regardless. As was also the case last month, though, Saturn is low in our skies like Mars, so the same approach applies: It's best to observe Saturn when it's at its highest.

### *Stars and Deep Sky*

This month, we'll explore the constellation Boötes, the Herdsman, which hugs the zenith at 10:30 PM this month. Though the traditional outline was meant to convey the Herdsman's tapering torso, most folks tend to see the shape as a "kite," with Arcturus at the skinny end and two stars, Eta (η) and Zeta (ζ) Bootis, making up the tail. (For the newbies, Arcturus, the brightest star in this part of the sky, is easily found by following the curve of the Big Dipper's handle away from the Dipper, towards the south—see the chart above.)

Whether you see a torso or a kite, though, the shape that's drawn on most star charts very often excludes a line of stars heading upward from the Herdsman's "shoulder," toward the Dipper—that's unfortunate, because some of those stars are pretty interesting! Our first target, the duo of stars known as **Asellus Secundus** and **Asellus Tertius**, or **Iota** (ι) and **Kappa** (ϰ) **Bootis**, are so high up this "arm" of Boötes that they're much closer to the Big Dipper's handle than the Herdsman's body. You'll find them at **14h 19m, +51° 00'**, and **14h 16m, +51° 25'**, respectively.

Separately, both "Aselli" ("Donkeys" in Latin) are worthwhile objects—binary stars in their own right, each is unrelated to the other. At the same time, although they're separated in space by more than 60 light-years, their lines of sight nearly overlap from our point of view, so they appear to lie just little over a ½° apart—close enough to be seen together in a moderately powered telescopic view. Viewing them together, while thinking about the nature of each system and imagining them circling independently is an unusual twist, compared to most of the binary stars we see.

The closer star, Iota (ι) Boo, lies about

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## June Skies

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95 light-years from us, and with a wide separation of nearly 39", should split in a pair of binoculars. (For comparison, if someone there were looking back at *us*, Earth would lie *less than 0.04"from the Sun*, and Pluto just 1.4" past that!) Considering the binary's distance, its separation means that the pair are at least 1100 AU apart, or more than 27 times Pluto's average distance from the Sun. According to Prof. James Kaler of the University of Illinois, their orbital period is at least 24,000 years.

The farther pair, Tertius, or Kappa (κ) Boo, at about 155 light-years, is much tighter in the eyepiece, with a separation that SkySafari posits at 14.5"; it should split under moderate telescopic power. According to Prof. Kaler, the brighter of the two is ending its time on the main sequence and will begin expanding into a helium-fusing red giant. Its visible companion has less mass (and therefore, a longer lifespan) and will continue burning hydrogen in its core for a long time to come. These two, the professor says, orbit each other about every 8,700 years; the pair are currently about 735 AU apart.

But wait—there's more: The brighter star, the will-be red giant, has an unseen companion as well. Professor Kaler suggests that this third component, detected spectroscopically and with a period of about 5 years, orbits at an average distance of about 2.5 AU with a close approach of about half that—something more to imagine while your mind creates circles-within-circles for all these faraway objects that share an eyepiece view.

To find Asellus Secundus and Tertius, first keep in mind that though they're both of naked-eye brightness, neither is of sufficient magnitude to be seen under city lights without optical aid. In the country, you can find them quickly enough by following the arc of stars upward along the western side of the "kite" from Arcturus and continuing through Lambda (λ) Bootis to Secundus and Tertius. The duo will stand out a little less than 5° east of Alkaid (the last star in the Big Dipper's handle), with Asellus Primus close by on the side opposite Alkaid. (You can also "eyeball" the location with the next approach.)

In the city, use a Telrad to make a rough 90° angle encompassing the Secundus and Tertius duo, Alkaid, and Mizar (the star at the "bend" of the Dipper's handle). While you won't see the Aselli directly in the Telrad, you can place the viewfinder's center over its *expected* location—in this case, a little more than a Telrad's width from Alkaid. Even crude aim should get you close enough to see Secundus and Tertius in a finderscope, with which you can very easily center them. *See the detailed chart on this page.*

There are a great number of well-known and spectacular galaxies not far from Boötes—M 101, for example, lies just 3° from Asellus Tertius. With a nod, though, to our advanced observers, who've probably already seen this region's big showboats, there's **NGC 5248**. It's an interesting, but more challenging 10th-magnitude "grand design" spiral roughly 4.5x6-arcminutes across, and located at **13h 39m, +8° 48'**, about 14° south-southeast of Arcturus.

Astronomers continue to argue over the size of the galaxy's central bar, but there is little dispute over its existence—the bar's influence over the structure of the galaxy's spiral arms has been the object of intense study. As in similar galaxies, the spinning bar creates shock waves that resonate throughout the galaxy, compressing the gas and dust. Deep astrophotographs of NGC 5248 reveal unusually intense regions of starburst activity, with vast numbers of hot new blue stars, and plenty of pink HII regions, the nebulae stars form in. Two especially distinct arms appear in photographs; though 5248's glow can

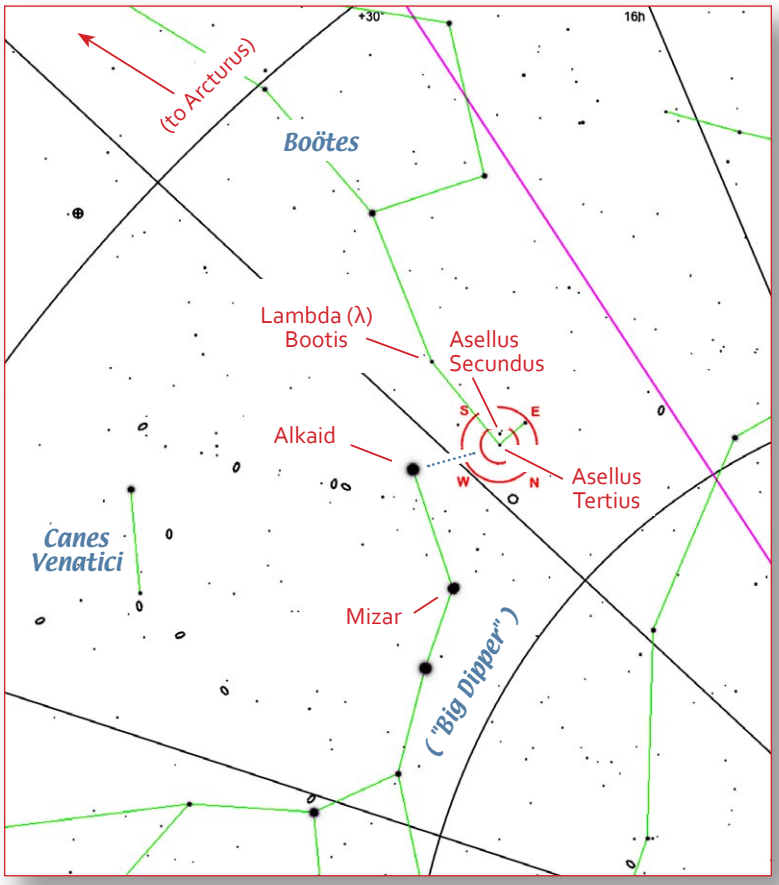


**Chart shows "right-angle" relationship between Mizar, Alkaid, and (following dotted line) Asellus Secundus and Tertius. *View is about 75° up, looking southwest.***

***Objects, constellation and meridian lines charted in SkySafari, and then enhanced.***

be seen in a 6-inch telescope, it will take a 12- or 16-inch to begin to glimpse detail, and a rather larger instrument will likely be necessary to see these arms well. For you astrophotographers, here's a chance to shoot something different!

Finally, experienced observers might notice the similarity of 5248's brightness and dimensions to galaxies in the Virgo Cluster. That's for good reason—although NGC 5248 is more than 15° across the sky from Markarian's Chain (near the Cluster's center), it's indeed a member.

Except for those with go-to telescopes, finding NGC 5248 is also a task for a more-experienced observer; the nearest "bright" star, *5th-magnitude* HR 5138, lies 2° to the north. On a better note, though, the galaxy lies almost exactly halfway between Eta (η) Boo and Heze, or Zeta (ζ) Virginis—and just 1° westward of the line between them—a good guesstimate of the halfway point should bring you close enough to HR 5138 to get the star in your finderscope, and from there, the galaxy is almost directly south, at a bearing of 195°.

If you have an equatorial mount, try centering Heze, and slewing north from there; NGC 5248's right ascension is only 3 minutes greater. Even better, use your setting circles to slew eastward that amount, and the galaxy should be centered after a 9.5° slew directly north—your setting circles will be a great help! If your mount isn't marked clearly, though, try slewing *a little less* than the full amount northward, say 6 or 7 degrees, and use your slow-motion controls to go the remaining distance while you watch for the galaxy through the telescope in a wide, low-power eyepiece.

—See you next month.

# ABOUT THE DAS

Membership in the Denver Astronomical Society is open to anyone wishing to join. The DAS provides trained volunteers who host educational and public outreach events at the University of Denver's Historic Chamberlin Observatory, which the DAS helped place on the National Register of Historic Places. First light at Chamberlin in 1894 was a public night of viewing, a tradition the DAS has helped maintain since its founding in 1952.

The DAS's mission is to provide its members a forum for increasing and sharing their knowledge of astronomy, to promote astronomical education to the public, and to preserve Historic Chamberlin Observatory and its telescope in cooperation with the University of Denver. The DAS is a long-time member in good standing of the Astronomical League and the International Dark Sky Association.

The DAS is a 501 (c)(3) tax-exempt corporation and has established three tax-deductible funds: the Van Nattan-Hansen Scholarship Fund, the DAS General Fund, and the Edmund G. Kline Dark Site Fund.

*****JOIN US!** More information about DAS activities and membership benefits is available on the DAS website at *www.denverastro.org*.



The Denver Astronomical Society
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Denver, Colorado 80250