

OBSERVER



The Andromeda Galaxy, M31, and its two satellite galaxies, M32 (left of M31's nucleus) and M110 (lower right).

Image © Alan Erickson

NOVEMBER SKIES

by Zachary Singer

Before we get started, a quick note: To make this column more user-friendly, directions for navigation will now appear in this typeface. This will make them easier to find—or easier to skip, for those who can find the way on their own. —Ed.

Our Local Sky

This November's skies start their show right away, as **Venus, Mars, and Jupiter appear very close together in the early morning.** When Venus rises a bit after 2:30 a.m. on November 2nd through the 4th, Mars shares a 1° field, and Jupiter will be about 6½° above the pair. Later in the month, they'll begin to separate, and though they'll no

longer be close together enough to be seen as a group through optical instruments, they should make quite an impression on naked-eye observers.

On the morning of the 7th, **Venus will be about 1½° from a very thin crescent Moon**, as our satellite rises after 2:40 a.m. By 4 a.m., the pair will be about 14° above the horizon, and slightly closer; at

5 a.m., their separation will be similar, though widening—but the pair will be 25° up. As the hours progress, they'll grow visibly farther apart, becoming more a target for binoculars than rich-field telescopes—but they should remain visible together well through morning twilight.

The "Northern Stream" of the **Taurid Meteor Shower peaks on the night of the 12th.** This shower is known for both its unpredictability and (sometimes) intense meteor storms—some sources also suggest that this might be a good year for fireballs. The shower's radiant, near the Pleiades, will be up all night, and highest between midnight and 1 a.m. (If there is something to see this year, the Moon won't be a problem.)

The **Leonid Shower** peaks less than a week later, on the night of the 17th. Though the meteoroids' hourly rate will be unremarkable, they can be bright and tend to leave trails behind them. The Moon will set as Leo, the radiant, rises.

Wrapping up the events for the solar system this month, the **Moon occults Aldebaran** (or narrowly misses) at roughly 3:50 a.m., on the morning of the 26th (Thanksgiving Day). Before you get too excited, though, the Moon will be full, which will make observation difficult at best. Given both that and the hour, I might have passed this one by—

Sky Calendar

3	Last-Quarter Moon
11	New Moon
18	First-Quarter Moon
25	Full Moon

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The Executive Board conducts the business of the DAS at 7:30 p.m., 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

Eclipses, Hyperbole, and Real Public Outreach

A little more than a month ago, Denver Astronomical Society held what was our most successful outreach activity of 2015, the Sunday, September 27th, total lunar eclipse observing event at DU's historic Chamberlin Observatory. Some 40 to 50 scopes and binoculars were set up on the park lawn by DAS members in anticipation of a large turnout, and the public didn't disappoint: More than 1,000 people showed up to look at the Moon. The observatory was open, too, and nearly 400 paid to take a peek through the 20-inch Alvan Clark-Saegmuller refractor. Two local TV stations also showed up: News crews from CBS4 and 7News were on hand providing coverage.

Why so much interest in a lunar eclipse? For better or worse, part of the interest can be chalked up to the combination of this eclipse's full Moon being a so-called "supermoon," (that is, the Moon appears about 10% larger because it's at perigee) and the popular media's use of the phrase "blood moon" (from lunar eclipses' typically reddish color, as well as implied supernatural involvement).

Some of us cringe at that sort of publicity. After all, neither "supermoon" nor "blood moon" is a scientific term. The media also made a big deal out of the fact that the next supermoon total lunar eclipse won't happen again until 2033—never mind that one can't easily discern a supermoon from a run-of-the-mill full Moon, at least naked-eye.

What else generated interest in the lunar eclipse, at least locally? It certainly helped that the eclipse was early in the evening, and that Mother Nature cooperated with decent weather.

I think, though, that our PR efforts also played a significant role. DAS promoted the September 27th eclipse observing event at recent General Membership Meetings, Open Houses and Public Nights; via press releases to local media; on our web page and in our newsletter; and on social media. Indeed, several hundred of our Facebook followers indicated that they planned to attend the observing event. We also promoted the event during the solar observing we did as part of the Scientific & Cultural Facilities District Community Free Day at the Denver Museum of Nature and Science on the same day as the eclipse, and while doing some of our external outreach programs at local schools and other venues. All-in-all, DAS members did a superb job of getting the word out.

I'd like to pass along a heartfelt thank-you to everyone who helped make the observing event the success that it was. We couldn't have done it without the volunteers who brought their instruments to Observatory Park and shared views of the eclipse with the public. Thanks, too, to those who staffed

Continued on Page 5

DAS SCHEDULE

NOVEMBER 2015

- 13-15 Dark Sky Weekend—EGK Dark Site & Brooks Observatory
 20 General Meeting at DU's Olin Hall, 7:30 PM —*Member Show & Tell*
 21 Open House—DU's Historic Chamberlin Observatory—Starts at 6:30 PM

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

November 10, 8:10AM-10:00AM: Space presentation at Ranch View Middle School in Highlands Ranch for 145 middle school age students. One of the school's 8th grade science teachers is teaching a unit on Space Science and would like us to supplement her curriculum with a presentation. I will put whoever signs up for this event in touch with the teacher to hash out details and logistics.

November 21, 9AM-3PM: STEAM-A-PALOOZA event at Grandview

High School in Aurora. Ryan Remien, a STEM teacher at Red Hawk Ridge Elementary School, has asked us to set up a table and solar scopes (and spectrometer if possible) at this event. For information about the event, please visit <https://sites.google.com/a/cherrycreekschools.org/steam-a-palooza/>. I will send more specifics on logistics n' such to those who sign up.

To volunteer, please contact Lindsey Shaw at external@denverastro.org —and thanks! ∞

DAS Auction

With Ivan Geisler acting as auctioneer, this year's DAS Auction, held on October 24th, raised more than \$1200 for the Van Nattan-Hansen Scholarship Fund—better than 60% of the gross proceeds. Thanks to all who participated!



∞

Farewell Reception for S&S Optika



Cathie and Tim Havens arrive at the Farewell Reception at the Chamberlin Observatory.

On Saturday, October 24, DAS hosted a Farewell Reception for Cathie and Tim Havens of S&S Optika at Chamberlin Observatory—and 80 members showed up for the sendoff.... Cathie has written us a note about her time with S&S and her involvement with the DAS and the Denver astro community. **It appears on Page 8.** ∞

Writers Wanted

The Denver Astronomical Society is looking for good, volunteer writers to contribute articles for *The Observer's* "This Month's Skies."

Are you brimming with ideas about how to describe celestial events? If you are, please contact the editor, Zachary Singer, at editor@denverastro.org ∞

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 is a long-time member in good standing of the Astronomical League and

the International Dark Sky Association. 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 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 Ed-

mund G. Kline Dark Site Fund.

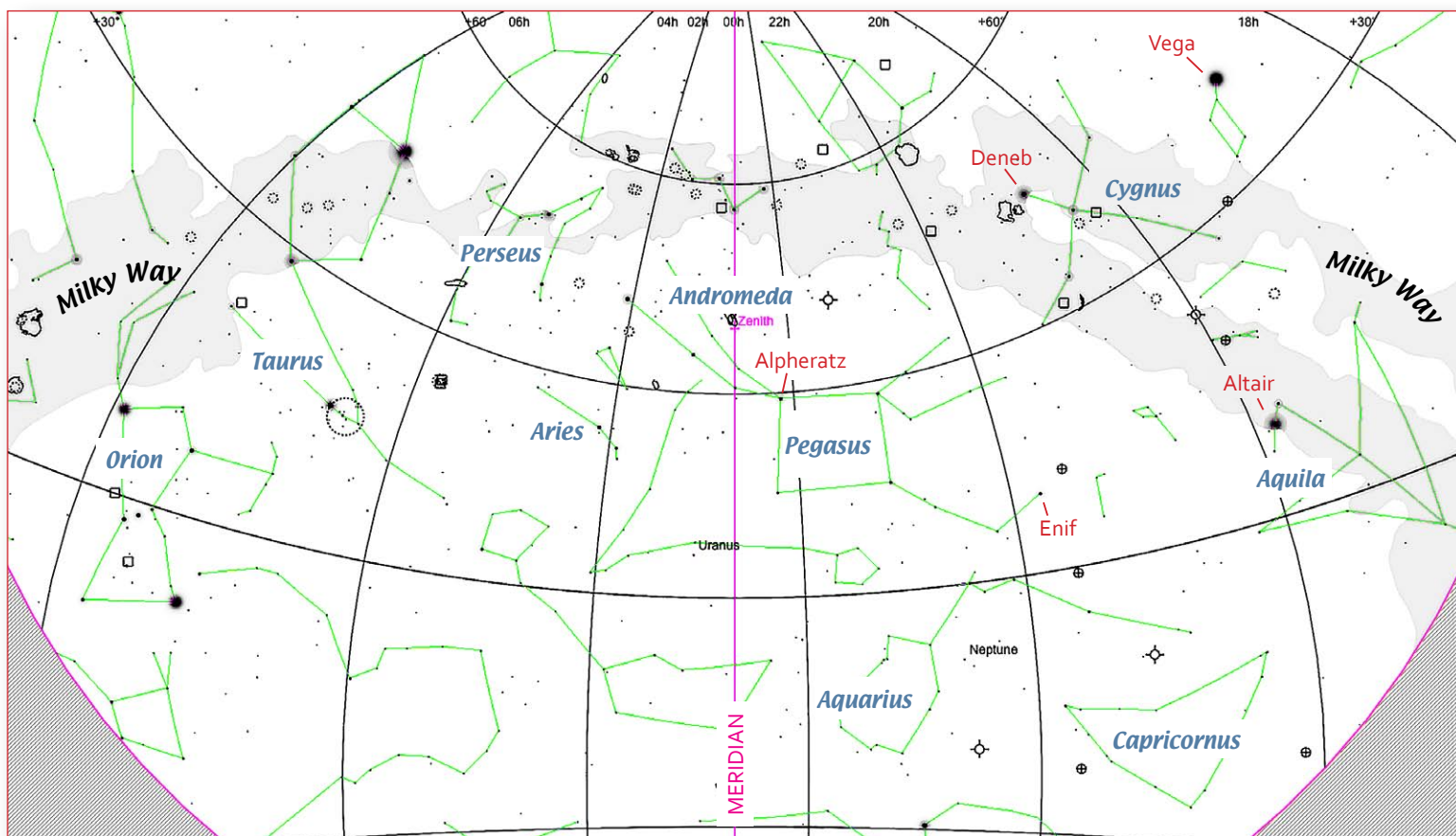
More information about DAS activities and membership benefits is available on the DAS website at www.denverastro.org. ∞



GETTING YOUR BEARINGS

... from the editor

Pegasus and Andromeda



Ultra-wide view of Denver's southern sky at 9:00 p.m. in mid-November. Note the zenith marker, near the center of the chart, showing the point in the sky that is directly overhead. (Other stars and constellations are marked for reference.)

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

Looking at the southern sky around 9 p.m. this month, you may notice that the Summer Triangle, our starting point for the past few months, has moved off into the west. While it's still useful, it's time to move on. Our new landmark, conveniently straight-up at the beginning of the month, is Pegasus.


Pegasus, the Winged Horse, is a fascinating constellation on its own, both for its mythology and for the variety of objects in and near it. For our purposes here, though, its most important characteristic is its outline, the central part of which we will use as a signpost to other constellations (Andromeda, this month). Happily, both Andromeda and Pegasus have brighter stars than we had to deal with last month in Capricornus and Aquarius—nearly all of our “signpost” stars are 2nd-magnitude, and all of the notable stars here are 4th-magnitude or brighter.

Briefly, the overall shape of Pegasus is meant to convey the body, head, and front legs of the horse. The outline doesn't much resemble that idea, though, until you find out that *the figure you see on star maps shows the horse “upside down.”*

Look at the star chart above, and find the square area surrounding the “Pegasus” label near the chart's center—this is the “Great Square of Pegasus,” the horse's body. If you follow the line of stars downward and to the right, you'll see the star Enif—the horse's *nose*—and that curved line of stars you just traveled along is the horse's neck and head. (See? I told you it was upside-down!) Similarly, the two lines of stars flowing from the *top-right* of the square represent the gal-

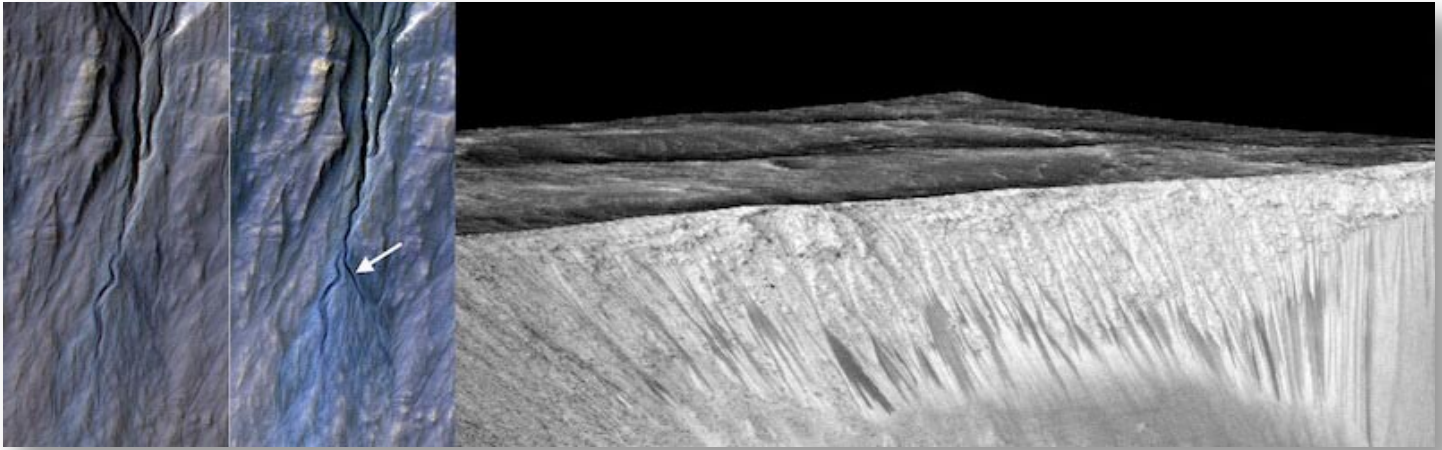
loping horse's outstretched front legs. (Presumably, the horse's *hind* legs—and wings—just faded into the background, because they're not traditionally drawn.) Most of the stars outlining these areas are bright enough to make easy guideposts away from the square, and can be quite useful for finding deep-sky objects there.

Before we head for Andromeda, observe that Pegasus can also be an eastern guidepost to areas we covered here in previous issues—it sits directly above Aquarius and northeast of Capricornus, and it's great for finding Cygnus in the west, when you've lost your way. (Alpheratz, mentioned below, *is also a common alignment star for go-to scopes.*) One last thing about Pegasus—while the “Great Square” does indeed look like a square when it's *straight up*, the figure is badly tilted when it's rising or setting—so remember that you may encounter it as a *diamond* shape when it's not overhead.

Even if you're not into ancient mythology, remembering just a little can help you remember the outlines—and relative placements—of the constellations. That's true for both Pegasus and Andromeda: The latter's outline represents the figure, in a flowing gown, of Princess Andromeda, who was threatened by a sea monster. She is said to have been saved by Perseus (the constellation to the east)—and *Pegasus*, who flew her to safety. And so, in looking for Andromeda, you will always find her hanging on for dear life to the body of Pegasus—in fact, the top-left (northeastern) star in the Great Square of Pegasus (Alpheratz) is formally considered to belong to the constellation Andromeda, and is also known as Alpha (α) Andromedae. 

HOW WE KNOW MARS HAS LIQUID WATER ON ITS SURFACE

By Ethan Siegel
NASA Space Place



Images credit: NASA/JPL-Caltech/Univ. of Arizona, of a newly-formed gully on the Martian surface (L) and of the series of gullies where the salt deposits were found (R).

Of all the planets in the solar system other than our own, Mars is the one place with the most Earth-like past. Geological features on the surface such as dried up riverbeds, sedimentary patterns, mineral spherules nicknamed “blueberries,” and evidence of liquid-based erosion all tell the same story: that of a wet, watery past. But although we’ve found plenty of evidence for molecular water on Mars in the solid (ice) and gaseous (vapor) states, including in icecaps, clouds and subsurface ices exposed (and sublimated) by digging, that in no way meant there’d be water in its liquid phase today.

Sure, water flowed on the surface of Mars during the first billion years of the solar system, perhaps producing an ocean a mile deep, though the ocean presence is still much debated. Given that life on Earth took hold well within that time, it’s conceivable that Mars was once a rich, living planet as well. But unlike Earth, Mars is small: small enough that its interior cooled and lost its protective magnetic field, enabling the sun’s solar wind to strip its atmosphere away. Without a significant atmosphere, the liquid phase of water became a virtual impossibility, and Mars became the arid world we know it to be today.

But certain ions—potassium, calcium, sodium, magnesium, chloride and fluoride, among others—get left behind when the liquid water

disappears, leaving a “salt” residue of mineral salts (that may include table salt, sodium chloride) on the surface. While pure liquid water may not persist at standard Martian pressures and temperatures, extremely salty, briny water can indeed stay in a liquid state for extended periods under the conditions on the Red Planet. It’s more of a “sandy crust” like you’d experience on the shore when the tide goes out than the flowing waters we’re used to in rivers on Earth, but it means that under the right temperature conditions, liquid water does exist on Mars today, at least in small amounts.

The measured presence and concentration of these salts, found in the dark streaks that come and go on steep crater walls, combined with our knowledge of how water behaves under certain physical and chemical conditions and the observations of changing features on the Martian surface supports the idea that this is the action of liquid water. Short of taking a sample and analyzing it in situ on Mars, this is the best current evidence we have for liquid water on our red neighbor. Next up? Finding out if there are any single-celled organisms hardy enough to survive and thrive under those conditions, possibly even native to Mars itself!



President’s Message

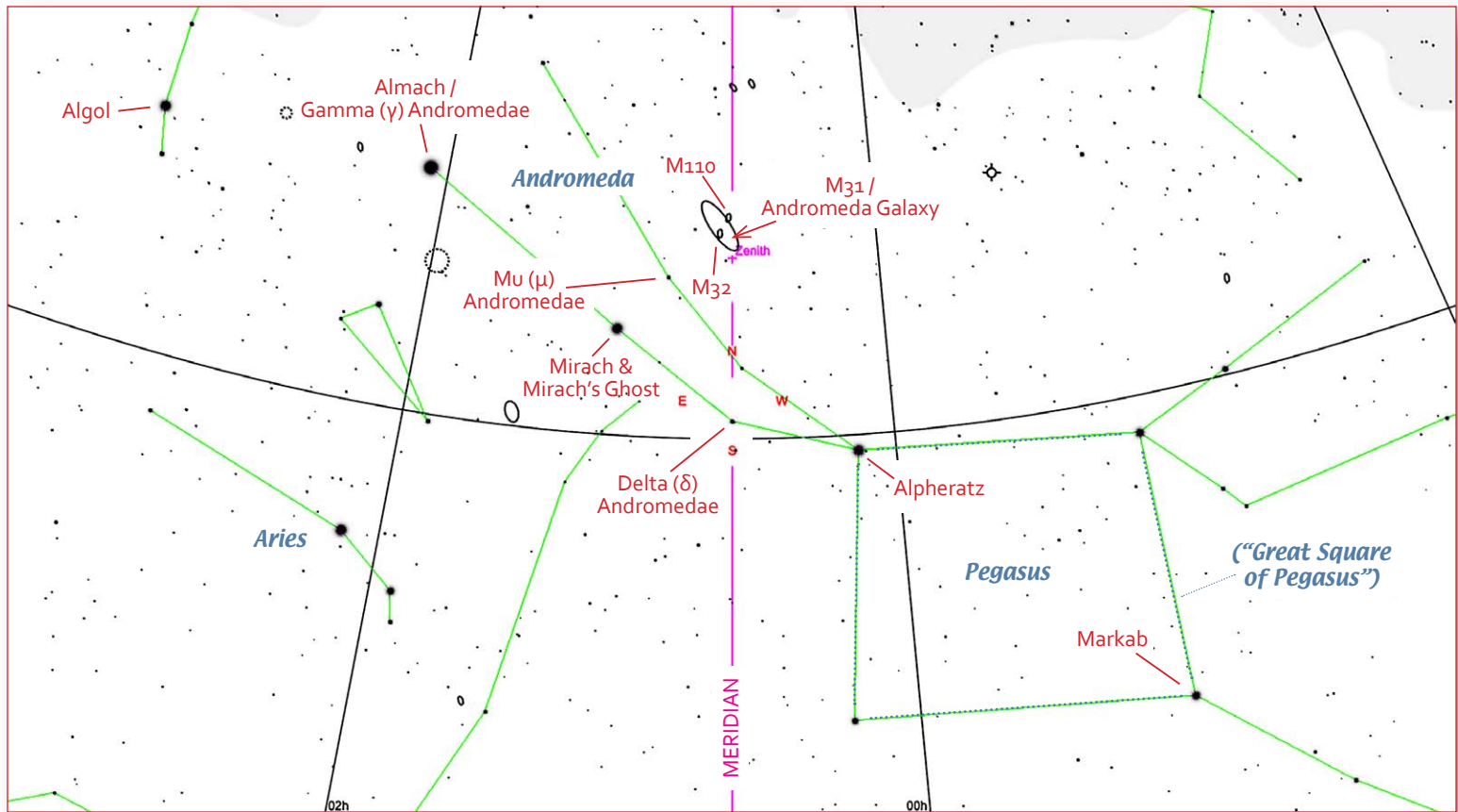
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DU’s Chamberlin Observatory during the event. A big tip o’ the hat to the folks who wrote and distributed the press releases, created our promotional materials (the stickers were a great idea!), plugged the event on Facebook and other social media, wrote the Constant Contact messages, created a special web page, and even spread the word the old fashioned way by telling friends and families what we had planned.

Can we continue the momentum for future Denver Astronomical Society activities and special events? While most upcoming items on the calendar may not generate widespread interest in the same way that a supermoon or blood moon does, there is no reason why we can’t apply the lessons learned from the lunar eclipse observing event.

We have cultivated local media contacts and can take advantage of those relationships down the road. Our exposure on social media continues to grow, with nearly 1,100 followers on Facebook. Videos on our YouTube page have been viewed more than 20,000 times (<https://www.youtube.com/user/denverastro>). A variety of new ideas for expanding our PR efforts are being discussed. Of course, we’re open to suggestions, which can be sent to: president@denverastro.org.





Section of the Denver sky in mid-November at 9 p.m., as viewed when facing south; the center of the chart is about 80° upward.

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

NOVEMBER SKIES

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except that here in the Denver area, this could be interesting.

For the adventurous, here's the deal: Denver is right on the edge of the zone where the occultation will occur—so if the Moon doesn't miss the star from your viewing location, the time between appearance and reappearance will be unusually short. The timing depends on where you live: From my place, just north of the DTC at latitude 39° 39', the moon should miss the star by mere arcseconds (and the event's "duration" will be zero). In contrast, about 20 miles north of here, at 40° 00', Aldebaran will definitely be occulted, and will reappear some 13 minutes later.

Those farther north will experience a longer occultation—in Fort Collins, *the event will start several minutes earlier* and last 22 minutes. Conversely, those south of the 40° line will experience a shorter period (about 8 minutes at latitude 39° 50'). Somewhere south of there lies a narrow band that will witness a grazing occultation, with Aldebaran appearing to flicker on and off as it is in turn hidden by lunar mountains and revealed by adjacent valleys. (And of course, south of that band, the moon will "just miss" the star, as it will where I live.)

To increase Aldebaran's visibility in the face of all the lunar glare, use high power to restrict how much of the moon you see. If you have one, try an orange filter—it will retard much of the Moon's light while letting a relatively larger amount of (orange) Aldebaran's light pass, reducing the contrast between the two objects.

For those shrugging their shoulders, there will be many more occultations of this star over the next few years, as the Moon's orbital dynamics bring it repeatedly into the same line of sight as Aldebaran's. Our next opportunity in Denver will be during a better phase and at a far more convenient hour—just after 6 p.m. on January 19th!

Deep Sky

Out among the stars this month, we'll find one well-known "classic," our first stop; a somewhat-known but fascinating binary star system; and a less-well-known galaxy hiding in plain sight. All are easily navigated to, but even advanced observers may not have seen the last one. We'll tour the constellation of Andromeda and start our trip in adjacent Pegasus, so if you're unfamiliar with the outline or location of these, see this month's "Getting Your Bearings."

The "classic" is the **Andromeda Galaxy, M31**, at 0h 44m, +41° 21'. It's often said that M31 is the farthest object that can be viewed with the naked eye, at a distance currently estimated at 2.5 million light-years. In dark skies, it's easily seen and a wonder to behold—a milky, oval glow about two fingers' width across. Its spiral structure is similar to our own galaxy's, though M31 is larger. From Earth, we see it in an inclined perspective, producing the foreshortened appearance.

A great thing about M31 is that pretty much any optical instrument will give you an interesting view: Binoculars show you the galaxy's flat disk in the context of the sky around it, and a 6-inch rich-field scope can still get you a wide enough field to take in much of the galaxy and its closest satellite galaxies, **M32** and **M110**, both bright and interesting elliptical (or spheroidal) galaxies in their own right. Larger telescopes will gather enough light to "zoom in" on M31's spiral arms and show their dust lanes to careful observers. (I've found the northwestern section, which lies next to M31's nucleus in the direction of M110, the easiest to see.)

To find M31, a simple approach is to start at the Great Square of Pegasus, which is just about due south and 70° up at 9 p.m. at the beginning of the month, and somewhat west-

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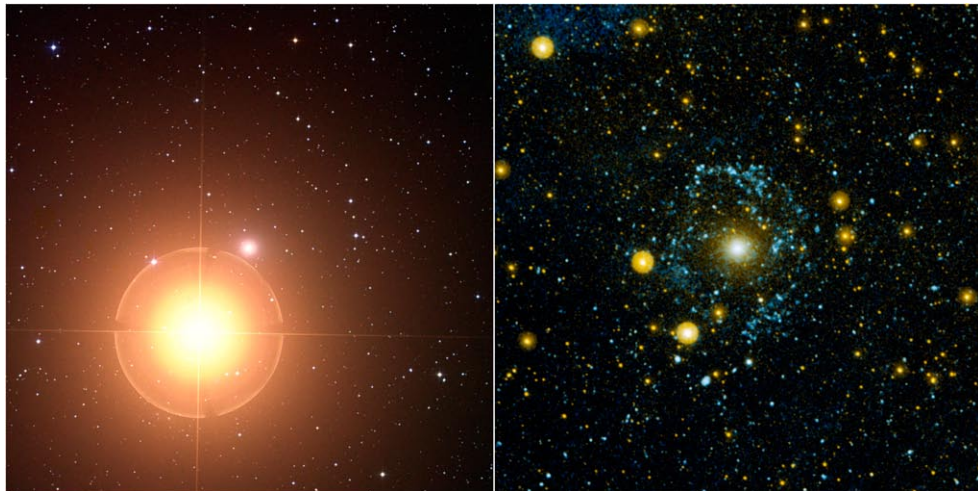
ward at month's end. Imagine a diagonal running from the southwest corner's star, Markab, to the northeastern one, Alpheratz. If you extend that line about the same distance northeastward, you'll find Mirach, a warm-hued star of about the same magnitude as our "diagonal" stars. (See star chart in this article.)

Two quick hints for finding Mirach:

1. You're in the right place if there's another star of equal brightness a similar distance northeast of Mirach along the diagonal. (The star is Almach, which we'll tour shortly.)
2. Be careful not to get lost at Delta (δ) Andromedae, a dimmer star along the curving section of this diagonal, about halfway between Mirach and Alpheratz.

From Mirach, look for Mu (μ) Andromedae, a 4th-magnitude star just less than 4° from Mirach—it's a 90° turn to the right from the Alpheratz-Mirach line. (If you look closely, you'll see that Mu Andromedae is part of a "twin" curve of stars that roughly duplicates the sweep from Alpheratz to Almach.) Once you have Mu in sight, imagine a line from Mirach to Mu—it points straight at M31, with Mu as the halfway point. If you're dark-adapted in good skies, M31 will suddenly become obvious; if your vision or the skies are compromised, though, center your Telrad in that spot, and M31 will appear in your finderscope.

If our next object, **Mirach's Ghost, NGC 404**, has a familiar name, it's for good reason—at its position of 01h 10m, +35° 48', it's less than 7' from Mirach (the first star we "jumped" to from Pegasus). This 10th-



Visible light (left) and UV (right) images of Mirach and the galaxy NGC 404 (aka "Mirach's Ghost").
—Image © NASA/JPL-Caltech/DSS

magnitude lenticular galaxy makes for an interesting comparison with the two satellites of M31 we just visited—it's four times farther away than they are, and glows only at magnitude 10.3 (M32 and M110 are 8th-mag.).

NGC 404 was long thought to be a typical elliptical galaxy, filled with old reddish stars, like M32—but more recent observations in UV light show that it has an extensive ring of hot new stars surrounding it. (Interestingly, M110 harbors some hot new stars, too. The origin of these stars in both galaxies is their hosts' close interaction with a galactic neighbor—a small dwarf galaxy in NGC 404's case, and giant Andromeda in M110's.)

What makes the Ghost remarkable for visual observing, though, is its positioning—it forms one corner of an equilateral triangle with Mirach and an 8.6-magnitude star, making an oddly striking trio

through the eyepiece. All three objects fit nicely in a ¼° field, though I found the galaxy easiest to see in my 6-inch at just 34X (and so, with a very wide field of view). The galaxy's dimness in the telescope made it seem more mysterious and remote, especially in comparison to its much brighter (and closer) stellar companions, and there was a distinct sense of grace and beauty in seeing the trio together. To see NGC 404 more clearly on its own, though, try repositioning your telescope to exclude Mirach and the other star from the field.

If you use lower powers at first, like I did, all you have to do to find Mirach's Ghost is to center Mirach in the telescope. Don't worry if your big scope can't provide a wide view—even a ½° field is more than enough room.

Our last target, **Almach**—also known as **Gamma (γ) Andromedae**—is a beautiful, 2nd-magnitude binary star, located at 02h 05m, +42° 24'. Visually, this chrome-orange and blue pair would remind you of Albireo, but the orange giant here is a magnitude brighter, making a greater contrast to its blue companion. The pair here is also closer together, with a separation of 10"—while Almach might require more magnification than Albireo to split, it's still easy even for small scopes.

Unlike Albireo, Almach's components are known to be a true binary pair, with a separation in the range of 1200 AUs and a very long orbital period. While advanced observers may already be aware of this, few may know that the blue companion is *itself* a multiple star, with *three* members in a hierarchical arrangement. That is, it's an optical binary with a very tight separation of 0.3-0.5"—but one of

the stars in this pair is *also* a spectroscopic binary, with an unseen dwarf companion! While Gamma Andromedae has always been lovely to look at, I find that wondering about the unseen components and imagining what's really going on over there, some 350-390 light-years away, makes it even more fascinating. (Users of "go-to" and "push-to" scopes, see my note about Almach just after the following directions for navigation.)

To find Almach, remember that this was the "one jump farther" star we used as reference for finding Mirach. (Recall that the trick to finding Mirach was to make a diagonal jump across the Square of Pegasus from southwest to northeast, and then make a similar jump in direction and distance to Mirach—Almach, you may now remember, was one further jump from Mirach.) At 9 p.m. at the beginning of the month, Almach is nearly 65° up in the northeast sky—but by month's end at the same hour, it's within 4° of the zenith, where it will be easy to find, but a bear for Dobsonian users, so take note.

And finally, for the go-to and push-to folks, Almach makes a great alignment star: With just a little familiarization, it's easy to find; it's as bright as the other alignment stars in the region (except Capella, which rises hours later); and it's in a good strategic location for precise alignments in this area of sky. Unlike most of the other would-be alignment stars, though, *Almach's identity is easy to ensure*—just pop a moderate eyepiece into your scope to confirm its signature binary appearance.

—See you next month. ∞

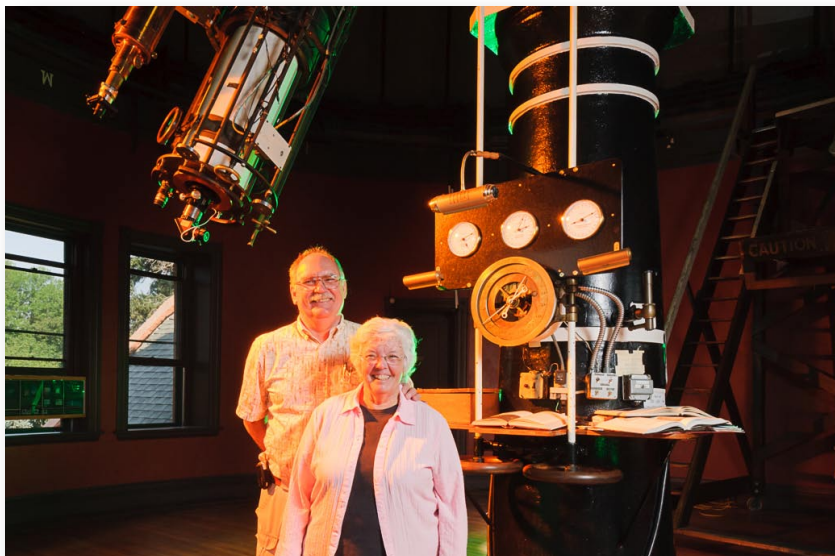
From Cathie and Tim Havens

When I got my Colorado Sales Tax License for S&S Optika in October of 1972, I could never have imagined how the store would change and enrich my life. My interest in Astronomy became much more than a "Hobby Out of Control," and I grew to love the opportunity to inspire and assist others to marvel at the wonders of the Universe. Through the store, I met Tim and we have shared our love of Astronomy and each other for 35 wonderful years.

Our customers have become close friends and we have enjoyed sharing in the DAS Open Houses, and our "Backyard Star Parties" and "Solar SunDays." We will miss these events and truly thank all those that helped us and shared them with us.

We thank all of our loyal customers for their years of support. It has been an honor and pleasure to serve you and we thank you for that opportunity.

But all things change, and now it's time for us to change, too. We want to keep active in Astronomy—but we are looking forward to doing it from DARK SKIES! We plan to attend more of the larger regional star parties and hope to see many of you there. We are also planning to come back to Denver 3 or 4 times a year and hope to see you at the DAS Open Houses at Chamberlin



Cathie and Tim at the Chamberlin's 120th Anniversary in 2014.

© Z. Singer

corresponding with those visits.

Thank you for your outpouring of friendship at our farewell reception. We were overwhelmed! We will miss all of you!

We wish you clear skies.

With much love,

Tim and Cathie Havens

