The Denver
OBSERVER
NOVEMBER 2018

NGC 281, the "Pacman Nebula," in Cassiopeia. This image originally graced our December 2016 issue, and is re-shown because this challenging visual object is one of our targets in "November Skies."

Image © Darrell Dodge

NOVEMBER SKIES

by Zachary Singer

The Solar System

November will bring interesting observing opportunities for some of the planets (stay tuned!), but if you need one word to describe viewing **Mercury** this month, it's "Meh." The planet will be a difficult binocular target as the month begins—determined folks can look for it *very* low in the southwest, about a half-hour after sunset. Mercury's angular separation from the Sun increases until the 6th, improving the situation slightly (and for a few days that follow); after that, though, it appears closer and closer to the Sun until it's lost in glare.

Happily, **Venus** is a different story—it's now a pre-dawn object—though just barely so on November 1st. As the month begins, Venus will span 60"—*a full arc-minute*—across, and would appear as a pencil-thin crescent. That is, if you can see it sharply—it will be only 1° above the eastern horizon, half an hour before sun-up. On a more realistic basis, the planet will display a *thin* crescent and almost as large a disk (58") a week later—and by then, it will be a much more reasonable 10° up, 30 minutes before sunrise.

As November progresses, Venus will sit higher and higher before dawn; by month's end, its disk will have brightened to nearly -5 magnitude (!), with a more usual 40" disk and a thicker-looking crescent phase. If we have good weather this month, Venus should be a real treat.

As for **Mars**, views of the Martian surface as October ended still showed traces of detail, especially in pronounced features like

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Sky Calendar

7	New Moon
15	First-Quarter Moon
22	Full Moon
29	Last-Quarter Moon

In the Observer

The Observer is available in color PDF format from the DAS website: https://www.denverastro.org/das/?page_id=13

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PRESIDENT'S MESSAGE

by Ron Hranac

The New DAS Member Portal

Denver Astronomical Society has enjoyed phenomenal membership growth over the past few years, and we now have more than 500 members (and counting!). As you might imagine, trying to manage that many members the way we've been doing it just doesn't scale. Several months ago, our E-Board created an ad hoc committee (Dena McClung, Scott Perrin, Darrell Dodge, Ed Ladner, Sorin, and Connor Bray) to research several commercial solutions that cater to non-profit organizations, as well as rolling our own software. They decided on a recommended solution from a company called Wild Apricot.

Following the committee's recommendation, a group of roughly 35 DAS member volunteers spent time evaluating and testing the use of a membership management portal from Wild Apricot. The E-Board gave final approval to the recommended solution, and we launched the new membership portal in the latter part of October. By now you should have received e-mail notifications with updates on the status of the portal, its roll-out, answers to questions, and general information.

The following is excerpted from some of the committee's communication to DAS members.

Why is this change being made?

Various aspects of your DAS membership were being handled by volunteers who were doing it the old-fashioned way: by hand. These volunteers rely on memory and imperfect communications to share their changing information with one another; as DAS grew, this process became increasingly impractical, and frankly, subject to human error. With over 500 members, it became necessary for us to move to a more automated process. This portal will permit YOU to update your information and edit your privacy preferences.

How will these changes affect the DAS website?

The existing DAS website, www.denverastro.org (our public-facing site), will stay as-is. You may not even realize when you're moving between it and the membership portal.

You'll control your membership information: By now, you should have received an

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DAS SCHEDULE

November 2018

2	E-Board Meeting—DU's Historic Chamberlin Observatory, 7:30 PM. All members welcome.
10	Dark Sky Weekend—EGK Dark Site & Brooks Observatory
17	Open House—DU's Historic Chamberlin Observatory—Starts at 5:30 PM
30	DAS General Meeting—*Show & Tell*—DU's Olin Hall, Rm. 105—Starts at 7:30 PM

(December 2018)

8	Dark Sky Weekend—EGK Dark Site & Brooks Observatory
15	Open House—DU's Historic Chamberlin Observatory—Starts at 5:00 PM
16	DAS Holiday Party—Embassy Suites Denver Tech Center—Starts at 6:00 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.

President's Message

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e-mail from the membership portal asking you to log in and edit your membership information. Hopefully you've done so already; but if not, the first time you log in, please ensure that your contact information is correct and make any needed changes. (Then, take a look around and see what else is included in the member portal.)

Easier Renewal Process: Your annual membership renewal advisories will come from this system instead of through Constant Contact. Online and snail-mail renewals will still both be options. (The portal will also accept online donations to the various DAS funds. We plan to make automatic renewals an option in 2019.)

Will DAS see my credit card information?

No. The membership portal (Wild Apricot) has built-in credit-card processing and all the requisite security and controls to ensure that no one can access your credit information.

What happens to the DAS Member Directory?

The Member Directory will be online, and YOU control your privacy. The online Member Directory *will replace the print version*. The privacy controls will allow you to choose which details of your personal information are included. Two new optional features are supported: an avatar (photo or image, which you can upload) and an "About Me" section, where you can create a brief bio about yourself and your astronomy hobby. We encourage you to use the features to permit DAS members to learn more about each other.

Will we still be using Yahoo Groups for the club listserv?

No. The Wild Apricot platform includes a membership forum that will replace the under-supported Yahoo Groups. While the forums have a different look and feel than Yahoo Groups, we're confident you'll be able to make the transition and enjoy the reliability that it offers. We recommend that you subscribe to the forums that interest you, so you can easily stay up-to-date. We will discontinue use of Yahoo Groups at some point, and provide information for accessing the files that have been stored there. (We'll let you know about the discontinuation beforehand.)

What about Special Events?

The portal will enable you to sign up for the annual Holiday Party and the annual Spring Banquet, choose your dinner entrée, and pay for it (beginning with this December's Holiday Party). *We strongly recommend that all members who wish to attend use the portal for this*. For the handful of members who do not use e-mail or go online, we will advise them separately via snail-mail, and they'll have to be sure they mail their payment in before a specified deadline.

Eventually, we may add other events that do not require payment or signing up in advance. This will be done for the purpose of gauging interest and determining how many volunteers we can count on for our free-to-member events.

What else can we expect in the future?

A News Blog, a Classified Ads Forum, and a FAQ page already exist on the member portal. We plan to add the following pages as well:

* Regular event announcements for internal and external events
* Event calendar
* Scope loan information
* Astronomy features (image gallery, etc.)
* Links to a DAS store for ordering badges, making donations, etc.

And?

The feedback from the previously mentioned test group became the basis for the membership portal's FAQ page. If, however, you see something in the member portal that you feel MUST be covered now, or have questions about the member portal, please send an e-mail us at membership@denverastro.org.

ABOUT THE DENVER ASTRONOMICAL SOCIETY

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 DU's 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.

ASTRO UPDATE

Selected Summaries of Space News

by Don Lynn

Exploring an Asteroid

Hayabusa2 deployed three of its four landers onto the surface of asteroid Ryugu. They are known as MINERVA II-1a, MINERVA II-1b and MASCOT. (The fourth lander is scheduled to be deployed next summer.)

The first two were developed by the Japanese space agency, and the last by German and French scientists. Unlike the MINERVAs, MASCOT is battery powered; though planned to last 16 hours, it has exceeded this, with all instruments performing perfectly. Those instruments took images, and measured radiation, spectra, temperature, and magnetic fields. MASCOT spent three asteroid-days and two nights observing on the surface (a day on Ryugu lasts seven hours, 36 minutes).

All three landers are "hoppers;" they move to various locations on the surface by hopping, snapping a weight to accomplish that. Both MINERVAs are solar powered, and are expected to continue operation as long as the main spacecraft is orbiting nearby to relay data to Earth—about 18 months. The MINERVAs are cylindrical, only seven inches across, and weigh only 2.4 pounds, but they're equipped with stereo cameras, thermometers, and radios. The landers took 22 hours to drop gently to the surface, even though they were dropped from only about 60 yards away.

By the time you read this, the main spacecraft will have made its first landing and collected surface samples. These and additional samples are scheduled to return to Earth in December 2020.

The Goblin

Another dwarf planet has been discovered in the far outer reaches of our solar system. It is now about 80 astronomical units out (one AU = Earth's distance from the Sun), or about twice as far as Pluto. Officially named 2015 TG387, it has been nicknamed The Goblin for the "TG" in its assigned name, and because it was first seen around Halloween in 2015.

It took until now to determine the Goblin's orbit because it's very wide—more than 2,000 AU at its farthest—so the minor planet moves slowly, taking about 40,000 Earth years to complete each cycle. (It reaches no closer than 65 AU on the near end.) Its orbit is consistent with the Planet 9 theory, which says a very distant massive undiscovered planet is gravitationally pushing small bodies in the outer Solar System into just a few orbital alignments. Based on its brightness and distance, Goblin's likely diameter is about 180 miles, putting it toward the small end of the range that is considered a dwarf planet.

FRBs

You have probably seen videos of radio telescope arrays all moving in unison, pointing at the same spot in the sky. But what would happen if operators pointed every dish at a different part of the sky? A huge part of the sky would be imaged at once, albeit with reduced sensitivity. Astronomers who wanted to capture fast radio bursts (FRBs) used this "wide-angle" approach with the Australian radiotelescope array named ASKAP.

Because FRBs last only milliseconds and can occur randomly anywhere in the sky, only about three dozen had been caught previously, but the new technique has already discovered 19 more. The new discoveries include the closest FRB yet and the most intrinsically bright one. (Distances to FRBs are determined by how much the interstellar gas has spread the arrival times of different frequencies within the burst.) Even with the new discoveries, only one FRB has ever been seen to repeat from the same location. Many astronomers now believe that the singles and the repeater are caused by different phenomena. The causes are still a heavily debated mystery.

Not a Nova

The star designated as CK Vulpeculae was seen to brighten dramatically for a period in 1670, and so was classed as a nova. There are various types of novae, caused either by material dropping onto a white dwarf star or by certain types of stars merging. New observations, however, of CK made by the ALMA radio telescope array show that it is none of these types of nova—it was instead a brown dwarf merging with a white dwarf. (A brown dwarf is a body without quite enough mass to sustain nuclear fusion, and so is not a true star.)

This is the first time such a merger has been firmly established. The new observations were made of more distant starlight shining through the remnant of the "nova." The remnant showed lithium, unusual ratios of isotopes of carbon, nitrogen, and oxygen; and organic molecules including formaldehyde. None of these should be present in any type of star, but would be common in a brown dwarf. The merger blasted material outward into an hourglass-shaped remnant, seen in these observations.

Supernova Discovered

How to discover a supernova: Make numerous new images of galaxies and compare them to standard images of the same galaxies, looking for a star that isn't in those standard pictures. An amateur astronomer in Brazil did this with his 12-inch telescope, but unexpectedly, the "extra" star was on the *standard* image for galaxy NGC 1892, not his new image.

When he reported this to professional astronomers, they examined all the archived images they could find of this galaxy and determined that there was indeed a supernova on the standard image, taken 14 years ago by professional astronomers as part of the Carnegie-Irvine Galaxy Survey. No one had noticed the supernova at the time.

TESS

TESS (Transiting Exoplanet Survey Satellite), the replacement for Kepler, recently began operation, and has discovered its first exo-planet (confirmed by ground-based follow-up observations). It is orbiting the star Pi (π) Mensae, which is 60 light-years away. The planet's mass is in the range 4-5.7 times that of Earth, so is likely a mini-Neptune, with a solid core and huge atmosphere. Its year is only 6.27 Earth days. This is the second planet known to orbit this star. Expect thousands more exo-planets from TESS.

DAS NEWS

DAS Auction Update

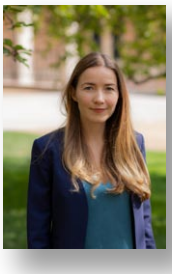
A week after our DAS Auction, we have a good estimate of our net proceeds from the event—about $1,800. The money will be used for our Van Nattan-Hansen Scholarship Fund and other important DAS functions. A grand *Thank You* to all who participated!

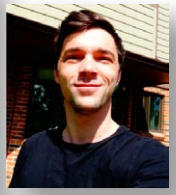
November General Meeting: "Show and Tell"

Our November General Meeting, on **Friday, November 30th at 7:30 PM**, will be our traditional "Show and Tell" event. If you have a five-minute presentation you'd like to share with fellow DASers, contact Lindsey Shaw at: vpresident@denverastro.org.

The meeting will be held at **DU's Olin Hall, Room 105**, and all present will be invited to a reception following the meeting at DU's Historic Chamberlin Observatory. Coffee and light refreshments will be served.

DAS Holiday Banquet





Our 2018 Holiday Banquet is set for **Sunday, December 16th**, at the Embassy Suites Denver Tech Center. **Cocktail hour starts at 6:00 PM**, with dinner at 7:00 PM.

Our presenters, **Dr. Ann Marie Madigan**, of the Department of Astrophysical and Planetary Sciences at the University of Colorado, Boulder, and **Jacob Fleisig**, an astrophysics undergraduate currently finishing his senior year at that university, will discuss how and why the orbits of minor planets beyond Neptune are behaving strangely: They tilt and cluster together in bizarre ways that don't conform with our story of the Solar System's formation and evolution. In this talk, they will present the latest theoretical ideas to explain what's going on—is there a new planet in the dark, outer regions of the Solar System, or could the collective gravity between minor planets be more important than we thought?

The DAS Holiday Party is a members-and-guests-only event that replaces the December general meeting.

Though we have greater capacity than last year, seating is still limited. Tickets are $25. For full details, and to purchase tickets online, go to https://members.denverastro.org/event-3106082

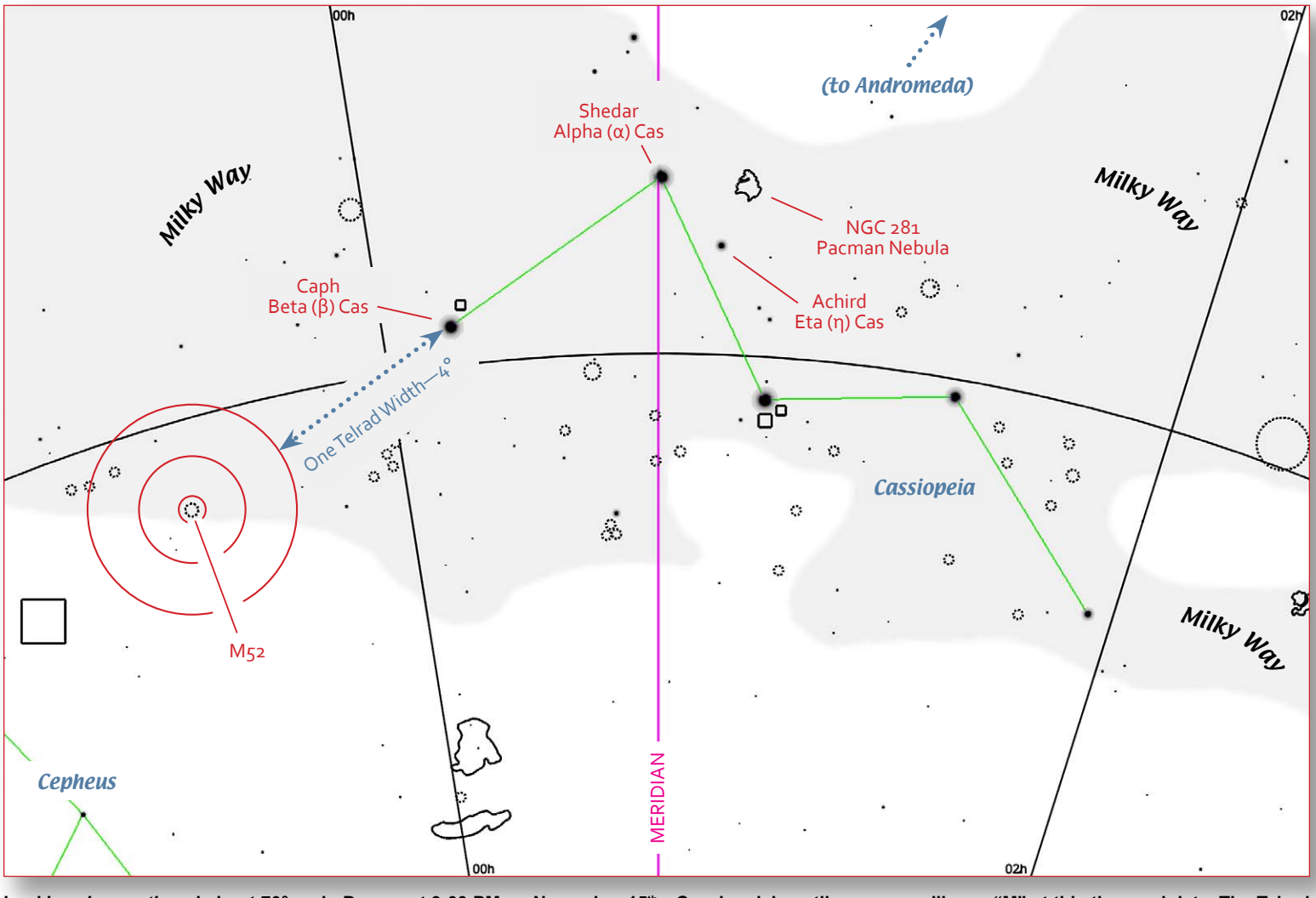
The Observer Will Move Online

As a DAS member, you're likely to have heard about our new Member Portal, which brings many DAS services online (if not, make sure to read this month's President's Message!). After much ongoing discussion, the E-Board has also approved a significant change to the *Denver Observer*: **After the December 2018 issue, the *Observer* will move to an *online* platform, while phasing out both the black-and-white paper copies and the related color PDF files you're used to receiving.** Instead, you'll find the *Observer's* content in a section of the DAS website.

The initial decision to move forward was reached at the October 19th E-Board meeting, and enough of the plan's details were worked out at the November 2nd meeting to bring you this update. Here's why the *Observer* will be evolving:

* The new format will allow more frequent updates than the monthly format the *Observer* has now. For numerous reasons, many of the *Observer's* functions, like the Volunteer Updates, have come to require quicker turnaround than is possible with the old format, and the *Observer's* "news" function was increasingly impaired. In the new format, we'll be able to add more timely information on the *Observer's* webpage, without having to wait for an all-in-one publication to be distributed.
* The online *Observer's* text will be "reflowable." That is, like other webpages or the pages in your e-reader, the text margins will automatically readjust to the size of your viewing window, making the new approach far more readable and user-friendly to those using a computer, tablet or smartphone. In the online version, there won't be any more "continued on page XYZ" interruptions, and no more getting lost while scrolling around on a PDF page! The difference will be especially noticeable on smartphones, but desktop computer users will have an easier time, too. The recent DAS survey on the newsletter showed that 80% of respondents are already using electronic devices—*not paper*—and we've aimed our approach with this reality in mind.
* We won't be constrained by physical limits on the amount of content, as we currently are with an eight-page publication. If there's more to share, we'll be able to. (That doesn't mean we're going to start flooding you unnecessarily, but it does give us the option to go a little longer—or a little shorter—as determined by editorial judgment, rather than an inflexible template.)
* In the future, we can include other types of media, like sound or video files, that a paper copy, or its PDF twin, just can't deliver.
* Our content will be more search-engine friendly, making it easier for both DAS members and the general public to find the material they're looking for. Since public education is a key part of the DAS mission, having our science material available to more people is an important consideration—and the increased visibility may help us gain new members, as well.

As with the Member Portal, we'll keep you posted and help you along. In the meantime, you can send your comments and questions to me at editor@denverastro.org. —Zach Singer, Editor



Looking *due north* and about 70° up in Denver at 9:00 PM on November 15th—Cassiopeia's outline appears like an "M" at this time and date. The Telrad circle is shown centered on M52; note how the distance between the edge of the Telrad's outer circle and Beta (β) Cassiopeiae is the same as the Telrad's outer circle itself—about 4°. Stars are plotted to magnitude +6.5, about the limit of the unaided eye in a dark sky; deep-sky objects are shown down to magnitude +10.0.

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

November Skies

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Syrtis Major. Early November should offer similar opportunities, as the planet's disk remains about 12" across. By the 20th or so though, the disk shrinks to 10"—a measurement often cited as the cutoff for seeing detail on the red planet. By month's end, the disk shrinks further, to just over 9".

After that, Mars will remain an obvious disk in a telescope for months yet, so it will retain some interest for those who have yet to view this planet telescopically. (For a striking contrast, try looking at the color of Mars and comparing it to that of Uranus.) For those more accustomed to great views of the Martian surface, November marks the end of the show for now. Take heart, though; our next chance is in 2020—and we'll get much sharper views then, as the planet will appear much higher in Denver's sky than it did this time around.

Two more quick notes: Look for a pairing with the Moon on the 15th—they're closest, about 1½° apart, around 11 PM. And set a date for a *very* close conjunction with Neptune next month, on the night of the 6th.

Technically, **Jupiter** should be visible, a few degrees above the southwestern horizon, in early November, but for all practical purposes, it's lost in sunlight for most of the month. Jupiter will reappear as a pre-dawn object in late December (look for a close conjunction with Mercury on the morning of December 21st.)

For **Saturn** lovers, look while you can—in early November, the planet remains high enough for a brief telescopic view right when the sky gets dark enough. By month's end, though, it will be too low for a sharp image, and it will be lost in solar glare by mid-December.

Just past opposition as November begins, **Uranus** transits (is highest in the south) just after midnight. It's close enough to Omicron (o) Piscium to *almost* share the same 4° Telrad (or finderscope) field. To ensure the planet appears in your finderscope, center Omicron and then slew your 'scope eastward until the star is on the outer (4°) Telrad circle—that should put Uranus near the northern end of your finderscope's view.

By the end of November, Uranus transits much earlier, at just after 9 PM. By then, simply centering Omicron Piscium will put the planet in your finderscope, easy-peasy.

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November Skies

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Neptune more or less maintains its position in our sky all month, just 2° east of 4th-magnitude Hydor, aka Lambda (λ) Aquarii. Center Hydor in your Telrad, slew your 'scope eastward until the star is on the western edge of the outermost Telrad circle (as above for Uranus), and Neptune should be in or near your finderscope's crosshairs—this is a good opportunity to find this planet easily.

Neptune is high in the southern sky at 9 PM in early November, and beginning to sink low in the southwest at that hour by month's end. Remember to use high power to see this planet as a disk—even at 200x, it will appear quite small.

Stars and Deep Sky

This month, we have two objects in Cassiopeia—one that should be easy to see in most amateur telescopes, and one that will be more challenging.

Our first target, **M52**, at **23h 26m, +61° 41'**, is a beautiful and reasonably bright open cluster. (For the uninitiated, an open cluster is a grouping of stars born from a large cloud of gas and dust like the Orion Nebula—or, as we'll see, our next target. After the stars form, the surrounding nebula gets blown away, revealing the cluster.) With about 200 members, M52 isn't the biggest cluster, and at magnitude 6.9, it's not as bright as some others, like M11—or the Pleiades, for that matter. But M52 has its own tricks up its sleeve.

For one thing, M52 is tightly packed—many sources report a central density of three stars per cubic parsec. (In comparison, if we could look at our Sun centered in its own cubic parsec of space, we'd see it's the only star there.) M52 is also young, as far as clusters go, so it still has a good number of hot—and *bright*—class-B blue stars among its members. In practice, these qualities mean that M52 is a wonderful target, even in small 'scopes, because its light is concentrated both by its density and by the high output of the stars within it.

A recent observation underlined this quality—M52 remained a good target in an 8-inch 'scope, in spite of the combined effects of an almost-full Moon, moderate light pollution, and atmospheric haze. Under those conditions, my observing partner and I saw gorgeous views at both 80x and 200x. The former showed the whole cluster, in a roughly ½° field, and bordered by a "chain" of stars when we slewed slightly to the southeast. (The stars have different distances from each other and the cluster, so they're a line-of-sight coincidence—but they're beautiful, and they make a great landmark for confirming you're in the right place.)

The 200x view was stunning, even though its smaller field doesn't show the full cluster at one time—it does certainly show the center. The extra magnification allowed us to see more deeply into the cluster than in the lower-powered view, and we noted a beautiful curving arc of stars, like a "C," with one star (or a grouping of them) in the center. (My notes from a much earlier observation with a 12-inch Newtonian under city lights, mentioned a noticeably yellow star among the cluster—it's a former blue star, now swelled up in the process of dying. With the 8-inch under "iffy" skies, that star was visible, but its color wasn't noticeable.)

Don't worry if your 'scope has a small aperture—M52 will look fine under a dark country sky in a 4-inch 'scope. Even binoculars or a finderscope should show it, though they won't resolve the stars.

To find M52 around 9 PM mid-month, look high up and due north for Cassiopeia—its famous "W" shape will look more like an "M," but it should be quickly recognizable. (Early in November, the constellation will appear somewhat eastward of north, and later in the month, it will lie somewhat westward.)

Now look for the two bright stars that make up the M's left side—they're Shedar, aka Alpha (α) Cassiopeiae, and Caph, aka Beta (β) Cassiopeiae. Imagine a line from Shedar to Caph, and extend it about 6° beyond Caph to M52. To measure that distance easily, remember that the Telrad's outermost circle is 4° in diameter, and look at it for a moment to get a feel for its size across the sky. Then slide your Telrad down the Shedar-Caph line until the Telrad's *trailing edge* winds up that same Telrad-circle width past Caph, and you should be very close to M52. (The 4° gap you create, added to the 2° from that trailing edge to the Telrad's center, will give you the 6° separation you need—*see chart*.)

On a good night, M52 should show up as a smudge in your finderscope, allowing you to center it easily—but if not, you should still be close to having it in your telescope eyepiece, so spiral gently around the area if it's not initially visible.

Our next object, **NGC 281**, is often referred to as the **Pacman Nebula**. Located at **00h 54m**, **+56° 42'**, in Cassiopeia, this underappreciated object is an H II region—a cloud of ionized, glowing gas and dust, like the Lagoon Nebula (M8) in Sagittarius or the famous Orion Nebula (M42). These clouds are often referred to as "stellar nurseries" because the density of the clouds' material allows "clumps" to form—these clumps eventually collapse in on themselves, compressing their interiors enough to become stars.

In a sense then, these aren't so much *stellar* nurseries, as "open-cluster nurseries," because such clouds give birth to large numbers of stars, *grouped in clusters*, just as we saw at M52, above. This also helps explain another term for glowing gas clouds like this, "emission nebulae"—the energy from all the hot new stars in and around the cloud excites the gas, causing the nebula to *emit* light. (This is much the same idea as running electric current through a fluorescent tube to make it glow.)

Unlike the Lagoon or Orion nebulae, though, the Pacman might be a bit more of a challenge to see. In that respect, it reminds me of the North America Nebula (NGC 7000) in northern Cygnus, another vast, glowing cloud of gas. Many sources express frustration with the North America, saying it's difficult or "impossible" to see it in a telescope, and often suggesting binoculars instead—but stay with me for another moment, and you'll see what we're up to!

Like the North America Nebula, the Pacman has low surface brightness, and can be difficult to separate from its background in a telescope eyepiece. *However*, as with the North America, it's an interesting object, and it *really* benefits from a UHC or O III filter—*with either, the Pacman pops nicely into view in a dark country sky*.

It's also essential to back off your magnification with this object and *use low power*, at least until you have it located. Ironically, reports of seeing NGC 281 in *50mm finderscopes* or 80mm telescopes are fairly common, but some folks with big aperture give it up. That might seem counterintuitive, but the small

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instruments' low magnification helps concentrate the nebula's light in a small area, so it can be detected by the eye.

I suspect that some users of big-bore 'scopes are mistakenly tempted to boost initial magnification. (With compact light sources, like stars or smaller deep-sky objects, higher magnification can indeed help detection—we just saw this with M52's stars.) Along with dissipating the Pacman's light, though, moderate to high magnification might also enlarge this nebula's image enough for it to extend outside the field of view—just as with the "difficult" North America Nebula, failing to *see the edges* can make this target difficult to spot.

Keep in mind that the Pacman *spans almost half a degree* photographically, and only a little less visually (users of standard Plössl eyepieces, for example, are pushing their luck by 80x). In my 12-inch Newtonian, keeping the power down works very well—a 60x view (with a *wide-field* 25mm eyepiece) gave me a viewing angle of just over 1°, and I saw the nebula clearly with a UHC filter—on a lousy night with bad haze, when my eyepieces were fogging up in the cold. If you don't have a fancy 25mm, try a 32mm Plössl on the Pacman—it's an inexpensive solution for folks with Maksutov and Schmidt-Cassegrain 'scopes, even with focal lengths as long as 2,000mm.

In the eyepiece, the Pacman somewhat resembles its video-game counterpart—but the nebula's "mouth" isn't the empty space it appears to be—quite the opposite! It's actually an area of dense material, similar to the dark lane in the Lagoon Nebula (or for that matter, the dark area in Orion's Flame Nebula, NGC 2024, which we explored in January 2018). It's filled with activity, including water masers, all hidden within the cloud. To bring a sense of scale to your observation, consider that the Pacman appears dimmer than its famous counterparts mostly because we're looking at it from 9,000-10,000 light-years away (that's roughly double our distance to the Lagoon, and six or seven times the distance to the Orion Nebula).

Getting to the Pacman Nebula, NGC 281, shouldn't be difficult. First look for Achird, aka Eta (η) Cassiopeiae, which is the next reasonably bright star from Shedar as you head towards the middle of Cass's "M" shape (see chart). Now imagine a line between Shedar and Achird as the base of an equilateral triangle, with the top of that triangle to the southeast, in the direction of Andromeda. Centering your Telrad on that point should put the Pacman in your eyepiece—if you have your position right, you'll notice both Shedar and Achird appear about halfway between your Telrad's biggest (4°) and mid-sized (2°) circles.

Happily, this arrangement should put the nebula *off-center* in your eyepiece, minimizing the chance you'll fill the whole field with the nebula, and maximizing your ability to detect its edge.

—See you next month.

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