The Denver
OBSERVER
OCTOBER 2018

Messier 30, in the constellation Capricornus, as imaged by the Hubble Space Telescope's Advanced Camera for Surveys. The cluster lies about 28,000 light-years from Earth, and spans 90-100 lght-years. M30 is one of the targets featured in this month's "Skies" column.

Image Credit: NASA / ESA

OCTOBER SKIES

by Zachary Singer

Wellllllll... We had a planet-rich summer, but many of the planetary observational opportunities are going away or will do soon. At the same time, we're in a great position for deep-sky targets, with late-summer objects still in play, and winter targets, like Orion, becoming visible to observers in the wee hours. The earlier onset of night helps, too. Here's what's up for October:

The Solar System

Mercury is in solar glare this month, but may be a binocular target, very low in the west, at month's end. (If you're going to try, look for it about 3½° above the horizon half an hour after sunset. It's directly below Jupiter on the 28th and "down and left" of Jupiter on the 31st.)

At the beginning of October, **Venus** is also *very* low in the west—just 2.2° up—half an hour after sunset, and it will get even lower as the days pass. The planet will then be lost in sunlight, re-emerging in early November as a bright, pre-dawn crescent.

As for **Mars**, there's Murphy's Law: Now that Mars is well past opposition and the planet's apparent size shrinks by the day, the Martian dust storm is at an end. On the bright side, the planet is still nearly 16" across at the beginning of October, large enough to show off detail. At that point, Mars is also highest in the south at 9 PM, a very convenient hour for observing. By month's end, Mars transits an hour earlier, at 8 PM, but its disk will shrink to just 12". *Enjoy this planet while you can.*

Jupiter starts off October just 14° above

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Sky Calendar

2	Last-Quarter Moon
8	New Moon
16	First-Quarter Moon
24	Full 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*

Critical Changes to Loading/Unloading at Chamberlin Observatory

For longer than I've been a member, Denver Astronomical Society's monthly Open Houses (http://www.denverastro.org/?page_id=114) have included observing and other activities inside of DU's historic Chamberlin Observatory, along with on-the-lawn observing through a variety of telescopes set up by DAS members. Our outreach at Chamberlin has been an incredible resource and benefit for members of the public, going back several decades!

As those of you who attended August's Open House and/or General Meeting know, we were visited during our August Open House by a Denver Parks ranger. The ranger advised us that we weren't authorized to set up telescopes on the park lawn without a Public Event & Special Occasion Permit (The lawn is part of Observatory Park, which is owned by the City and County of Denver, although the observatory itself is owned by DU.) After some negotiation by member Stacie Booker with the ranger's supervisor, we got a temporary OK to continue setting up 'scopes for that night. We were asked to contact the Parks Permit Office as soon as possible to secure the necessary permit.

Shortly after the Open House, I phoned the Parks Permit Office to get the application process underway. I provided a brief overview of DAS and our Open House program, and explained our history and partnership with DU and the observatory. I also highlighted activities we've been doing in the park (going back decades!). So far, so good. Then the clerk dropped a bombshell: She said that from a permit perspective, Observatory Park is classified for *athletic events only* (and picnics). It wasn't possible for us to even apply for a Public Event & Special Occasion Permit. Definitely a "Yikes!" moment. The clerk suggested we take this unfortunate conundrum up the chain of command to see what might be able to be done.

The good news is that our request made it all the way to the head of Denver Parks and Recreation, who agreed to grant us special permission to continue our on-the-lawn activities during our Open Houses. A big thanks to Dena McClung for heading up those discussions. We got verbal approval in time for the September Open House, and should have

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DAS SCHEDULE

October 2018

6	Dark Sky Weekend—EGK Dark Site & Brooks Observatory
6-14	Okie-Tex Star Party (near Kenton, Oklahoma)
13	Open House—DU's Historic Chamberlin Observatory—Starts at 6:00 PM
19	E-Board Meeting—DU's Historic Chamberlin Observatory, 7:30 PM. All members welcome.
20	In-Reach— DU's Historic Chamberlin Observatory, 7:30 PM. (Members and guests only.)
27	DAS Auction—DU's Historic Chamberlin Observatory—11 AM - 3 PM (see DAS News).

(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

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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something in writing by the time you read this (the City was still finalizing the written document's language). Denver Parks rangers are supposed to have been notified that we have special authorization for 'scopes on the lawn. The written document is intended to be kept on file at Chamberlin and used for clarification in the event of questions.

During our August Open House, the Denver Parks ranger restricted the number of vehicles allowed on the driveway for unloading/loading. Think safety, avoiding sprinkler head damage, and keeping the lawn in good shape.

The bottom line: We have to do a much better job of keeping vehicles off of the lawn than we have in the past. Here are the new rules concerning DAS vehicle access to Observatory Park for equipment setup and teardown:

DO NOT park or drive on the lawn under ANY circumstances. DO NOT park (even temporarily) with tires off of the asphalt, even part way. All vehicles MUST remain entirely on the asphalt.

DO NOT park on the driveway or the round area near the observatory's south doors for more time than it takes to unload/load equipment. The paved driveway is for unloading and loading of equipment ONLY.

DO NOT try to drive around another vehicle that is blocking the driveway. Wait until the other vehicle moves out of the way.

DO NOT unload your gear and then set it up while your vehicle is still parked on the driveway. Stop your vehicle, unload your gear onto the lawn, park your vehicle out on the street, then walk back and set up your equipment. Do the same in reverse at the end of the event: Tear down and pack up your gear so it is ready to load, go get your vehicle, load your gear, and depart the park.

NOTE: Only *two* vehicles should use the access driveway at one time. This will allow vehicles to turn around at the circle and leave the site driving forward.

The above rules are especially important, and failure to comply could jeopardize our ability to continue setting up 'scopes outside during Open Houses.

Do the new rules work? Telescope set-up and teardown during our September Open House went well. Minimizing the number of vehicles on the driveway was uneventful and worked better than expected. Some members chose to get prime parking spots on the street and haul equipment in small wagons to and from observing sites on the lawn.

Indeed, September's Open House was one of the better ones in a while. The weather cooperated, with comfortable temperatures and a clear sky, although the seeing was only so-so. The official head count for the observatory was 203, and the public enjoyed looking through several 'scopes that members set up on the park lawn. Learner's Land was a popular attraction, too.

A big thanks to all of you who helped make last month's Open House a success!

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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.

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ASTRO UPDATE

Selected Summaries of Space News

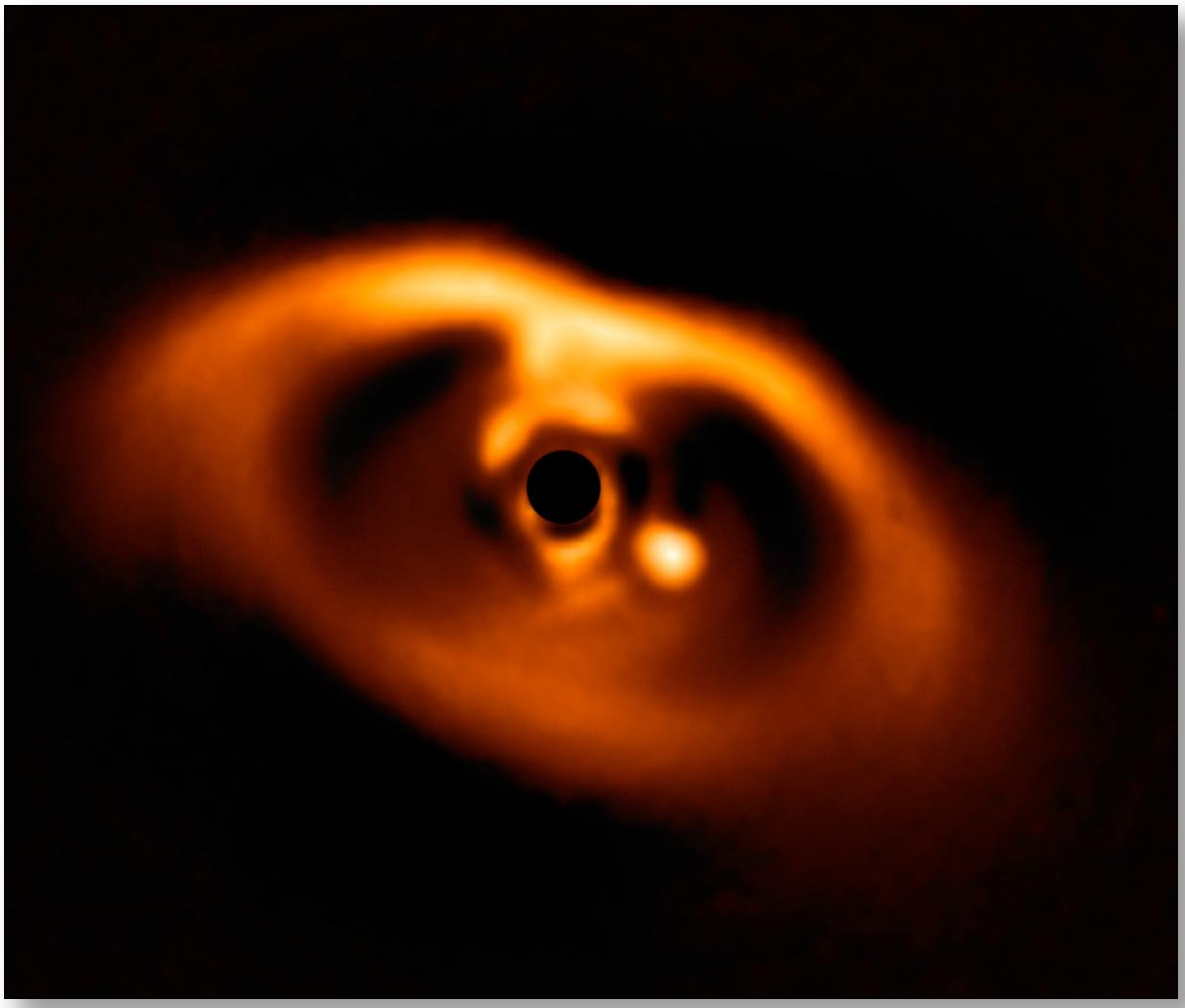
by Don Lynn

Exo-Planet Mass

Since the discovery of a young planet orbiting the nearby star Beta Pictoris in 2008, astronomers have not been able to get a definitive measurement of the planet's mass. A new study of precise positions of Beta Pictoris from the Hipparcos and Gaia spacecraft showed that the planet's gravitation is causing the star to wobble. From precise measurements of the wobble, the planet's mass was calculated at about 11 times the mass of Jupiter, with a rough orbital period of 22 years or more. This in turn implies a distance between the exoplanet and its star of about the distance Saturn is from our Sun.

Exo-Planet Growth

A recently imaged (**see right**) exo-planet gas giant known as PDS 70b has just been confirmed to be growing by accreting gas. (The planet is within a protoplanetary disk, so it was expected to be still gaining material during the planet-formation process.) Data used to validate the young planet's image suggest an accretion rate of roughly one hundred-millionth of a Jupiter mass per year. The astronomers believe that the accretion rate was higher in the past, and that the planet has already accreted 90% of its eventual mass.



PDS 70b, the bright dot to right of center, scoops up material from a proto-planetary disk in this image from the SPHERE instrument on the ESO's Very Large Telescope. The central star is deliberately occluded (black circle) to prevent its glare from washing out the image.

Credit: ESO/A. Müller et al.

Brown Dwarf Aurora

Brown dwarfs are objects that are more massive than planets, but not massive enough to sustain the nuclear fusion that powers genuine stars. At one point in their lives, brown dwarfs fuse a little heavy hydrogen (deuterium), but they cannot attain the temperature needed to fuse ordinary hydrogen. Astronomers studying brown dwarf stars using radio telescope data were surprised to find that many of them have auroral activity and surprisingly strong magnetic fields.

Auroral activity on planets in our solar system involves particles from the solar wind hitting those planets' magnetic fields. But one of the brown dwarfs with aurorae was free-floating—that is, not orbiting a star—so stellar wind is not involved. The free-floating brown dwarf, known as SIMP0136, has a magnetic field 200 times as strong as Jupiter's.

Albireo

Albireo's visual components are probably an "optical double" star, rather than a true binary, after all. Study of data from the Gaia spacecraft shows that the two stars in everyone's favorite blue-and-gold duo are moving with sufficiently different velocities to very likely *not* orbit each other. Previous measurements had put the components at somewhat different distances, but close enough that they might reasonably have been in a wide orbit. [Ironically, Albireo A, the orange star of the pair, really *does* have a companion in orbit—it's too close to be seen in amateur 'scopes, but would appear much like Albireo B, the blue star. —*Ed.*]

Lunar Ice

The first *direct* evidence was observed of exposed water ice in the permanently shadowed craters of

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DAS NEWS

DAS Auction

Join us at this year's DAS Auction to turn your old "astro stuff" into CASH and DAS DONATIONS! Pick up some great gear at a bargain price while you're supporting the DAS!

Haul your old 'scopes, mounts, eyepieces, filters, CCDs, observing aids, and other astro stuff to the annual DAS member auction by about **11 AM on the morning of Saturday, October 27th**.

We'll all review the loot for a few hours, break for a quick lunch, and then **the auction will start at 1 PM and last until 3 or 3:30 PM.**

Proceeds will go in varying amounts to the DAS (10% minimum, specified before the bidding). The DAS portion is allocated to support of DAS activities. The rest goes to you!

ITEMS TO SELL OR BUY:

Eyepieces... CCDs... adapters... lenses... mirrors... secondaries... filters... telescopes... mounts... wedges... Crayfords... guide scopes... focusers... motors/drives... books... star atlases... observing guides... astronomical computer programs... astro-imaging software... MORE!!!

Please—no computers, and no computer programs, books or manuals that aren't astro-related.

The 2017 Auction.

Membership Management Platform Update

Our current member count of more than 500 (and growing!) has meant we can no longer manage things the way we did in the past. Since early 2018, an ad hoc committee has been evaluating a variety of membership management software options for Denver Astronomical Society. After narrowing down the choice to a preferred solution, extensive behind-the-scenes testing was conducted by the committee, E-Board, and several other members.

During the September 28th E-Board meeting, our new membership management platform, from provider Wild Apricot, was given the green light. The new platform will be rolled out later this month—stay tuned for more information!

October In-Reach

Does your reflector telescope give you blurry or "streaky" views, even when it's stabilized for the outside temperature? Our next In-Reach, for DAS members and their guests, will show you how to get the best possible image from your reflector telescope by learning how to properly align—or *collimate*—its mirrors.

Join us at **7:30 PM on Saturday, October 20th**, at the **Chamberlin Observatory**—bring your 'scope and some snacks !

Astro Update

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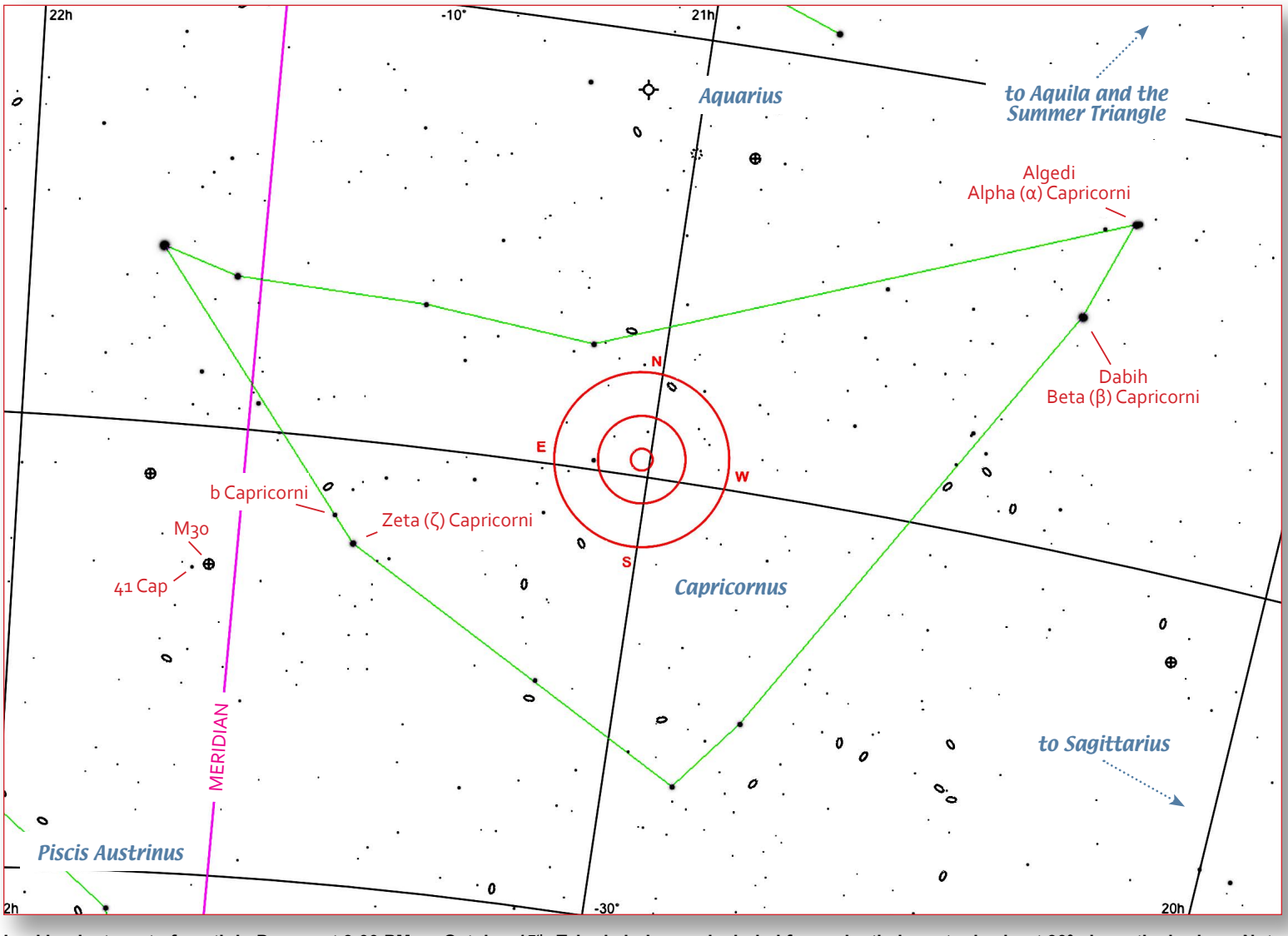
the Moon's poles. (Indirect evidence was previously announced, such as detecting hydrogen, which suggests the presence of water molecules.) The new observations took data from India's Chandrayaan-1 lunar orbiter and NASA's Lunar Reconnaissance Orbiter to detect the ice itself, using the dim light scattered into the shadows from areas that are in sunlight. Unexpectedly, the ice areas were patchier than similar ice formations on Mercury and Ceres.

Telescope Upgrade

The Arecibo radio telescope in Puerto Rico has received a grant to design and install an array of 166 antennas at the focal point of the huge dish. This will allow a larger piece of the sky to be observed, and will speed up searches for objects by a factor of five or six. Work should be completed in 2022. Repair work of Hurricane Maria damage continues at Arecibo, though the telescope has been in operation again for some time.

Rule of Thumb

A tiny hole was found in the Soyuz spacecraft attached to the International Space Station, which was slowly leaking air. European astronaut Alexander Gerst plugged the hole with his thumb while his colleagues got epoxy glue and Kapton tape to temporarily repair it.



Looking just west of south in Denver at 9:00 PM on October 15th. Telrad circles are included for scale; their center is about 30° above the horizon. Note that with 3rd- and 4th- magnitude stars in its outline, most of Capricornus will likely *not* be visible to the naked eye under city lights.

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

October Skies

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the western horizon 30 minutes after sunset, leaving it a blurry target at best. By the end of the month, it will be only 5° up. Superior conjunction, when the planet lines up behind the Sun and is lost in the star's glare, occurs in late November; after that, Jupiter, too, will become a pre-dawn object.

Saturn remains a good target through at least mid-October. By the end of the month, though, you'll only have a short while to observe—in twilight—before the planet gets low over the horizon. (Saturn will be only 16° up, 90 minutes after sunset on Halloween, and just 12° up 30 minutes later that evening.)

Uranus, on the other hand, is an easier target in October, almost 28° up by 10 PM on the 1st, and 49° up at that hour on Halloween. Opposition is on the 23rd; on that night, Uranus is highest in the sky and due south just before 1 AM. The planet is easy to see in a 4-inch Mak, so don't pass up Uranus for lack of bigger apertures (try about 100x in small 'scopes). Look for the light-blue planet about 3½° northeast of Omicron (o) Piscium early in the month, and about 2½° northeast at month's end.

Neptune is well up after 9 PM at the beginning of October, though 10 PM might be a bit better. By the 31st, the planets *transits* (sits highest in the south) at 9:20 PM. Look for it about halfway between Hydor (Lambda [λ] Aquarii) and Phi (ϕ) Aquarii all month. Neptune is also about ½° from 81 Aqr, a 6th-magnitude orange star near that halfway point.

Stars and Deep Sky

Our targets this month lie in the constellation Capricornus, which lies in the south around 9 PM in mid-October. Most of Capricornus's stars are somewhat dim at 3rd and 4th magnitude, but its outline is easily recognizable in a dark sky once you know where to look. Though its historical shape is supposed to be a "sea goat," a more modern observer will find it easier to look for a "giant bikini bottom," and that is how the outline will be referenced—especially since referring to "bikini strings" at the top corners will get you oriented more quickly than trying to point out the "nose" or "tail" of a mythological beast. If you're not familiar

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October Skies

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enough with Capricornus to find it, see "Getting Your Bearings," on page 4 of the October 2015 Observer, at https://www.denverastro.org/xobserver/october2015_denverobserver.pdf.

Our first target, **M30**, at **21h 41m, -23° 06'**, is a large globular cluster—that is, a round, or "globe-ular," ball of 100,000 stars or more (perhaps double that, in M30's case). While reasonably bright, M30 isn't a "showpiece" globular like the more famous M13 in Hercules or M5 in Serpens. In fact, it appears about 1½ magnitudes dimmer; that's partly due to M30's distance from us of about 28,000 light-years (some sources say 26,000), and also because M30 is intrinsically a bit dimmer, too. Still, it's more than bright enough to be seen even in small 'scopes, and it's an interesting object for other reasons.

If you're familiar with globulars, you likely have a mental image of a "classic" one as a big ball of stars, as suggested above; typically, they're somewhat brighter near the center and darken gradually out to the edge. M30, like a few others, departs from that—it's *significantly* brighter at its core, because the population of stars there is much more tightly concentrated than the already-dense groupings of stars in most globulars, and the core is relatively small.

Numerous sources, including Prof. James Kaler's *The Cambridge Encyclopedia of Stars* and Jeff Kanipe's *Annals of the Deep Sky*, discuss the likelihood that M30 has undergone core collapse. Such an event is thought to result from the sorting of stars in the cluster; interactions between massive stars and lighter ones tend to send the former towards the cluster's center, and the latter ones away from it—some of these lighter stars get flung out of the cluster entirely. The grouping of the massive stars near the cluster's center leads to the collapse, and the star density there climbs dramatically.

In M30, this effect is clearly seen in small telescopes, including the 4-inch Maksutovs I had a chance to observe through in early September. One night, the skies were especially "soupy" and I could only barely see Capricornus's "bikini" naked-eye, but M30's small inner core was easily visible in a 4-inch with direct vision at 50-85x. Averted vision showed the cluster's halo glowing quite a way out from the center.

An important aspect of amateur astronomy for some folks is that along with our *visual* observations, we bring our own minds and understanding to bear on the targets—in M30's case, then, there are the "blue stragglers." This type of hot, blue star is found in other globulars, but M30's are often mentioned, and they used to be something of a conundrum. On the one hand, the population of stars in globulars is old—typically nine *billion* years or older, and about 12 billion in M30's case. Blue stars, though, ordinarily have much shorter lives than that—they shine brightly, but burn out quickly. If all the stars in the cluster presumably formed at about the same time, why are there still blue "stragglers" alive in M30 (and elsewhere)?

The answer, astronomers now understand, involves M30's core collapse. The great density of stars near the cluster's center means that stars are frequently interacting with each other, and in some cases, grabbing hydrogen from each other. (One way is a binary star with a tight orbit siphoning gas from its companion, and another is by collision.) The different methods produce subtle differences in color and spectra in the stragglers—if you'd like to become a "blue straggler connoisseur," there's plenty of material about that in the books above, and on the web…

One last observational note about M30 before moving on is that in 8-inch 'scopes and up, the cluster is known for streams or chains of stars sprouting from the north or northwest side. Observers with 12-inch 'scopes and up often report three streams, and those with smaller apertures, just two.

To get to M30, have a look at the left (eastern) side of Capricornus's bikini shape; about a third of the way down along the outline, you'll see a noticeable pair of stars less than a degree apart, just where the outline bends—the lower and brighter of the two is 4th-magnitude Zeta (ζ) Capricorni. Look about 3½° roughly eastward of Zeta, and you'll see an unassuming 5th-magnitude star, 41 Capricorni ("41 Cap" for short); M30 is less than ½° west of it. Though far from bright, 41 Cap sits out there almost alone when viewed naked-eye, and shouldn't be hard to recognize (there are only two other naked-eye stars within two degrees of it, and they're over a magnitude dimmer at magnitude 6.4 or so).

Centering 41 Cap in your Telrad would put M30 near the middle of a finderscope field, if the finder is strong enough to show the cluster—it should faintly appear as a fuzzy object in a 9x50, but if it doesn't, that's no big deal. Just nudge your 'scope gently from 41 Cap towards Zeta—a ¼° bump will put M30 into your telescope's eyepiece, and a ½° bump (the same as the innermost circle on your Telrad) will roughly center it. For folks with equatorial mounts, centering 41 and slowly slewing westward (i.e., with your Right Ascension control) will put M30 in your eyepiece.

On a lousy night, when 5th-magnitude stars like 41 Cap aren't naked-eye visible, put Zeta and its pair-mate, b Cap, a bit north of the western edge of your finderscope field. 41 Cap should be visible on the eastern side, or almost directly opposite Zeta and b. Once you center 41, you can nudge the telescope as described above.

Our second target, **Dabih**, or **Beta (β) Capricorni** (**β Cap** for short) lies on the other side of Capricornus, at **20h 22m, -14° 43'**, just below the bikini's top-right (northwestern) corner. It's a *very* easy multiple star, with its brightest components about 205" apart. That's wide enough for them to be a naked-eye split, at least in theory, and far enough for the companion to have its own name, Dabih Minor, or Beta^2 Cap (the brighter component, as you might guess, is Dabih Major). They're also easy because they're relatively bright, at magnitudes +3.1 for Dabih Major and +6.1 for Dabih Minor—in a dark sky, either star would be visible on its own to the naked eye. (You might not actually be able to see Dabih Minor without optical aid, because of the glare from Dabih Major.)

Dabih lies about 330 light years from Earth, so the fact that either star in the pair is naked-eye visible at that distance tells us that both of them must be intrinsically bright—at the same range, our own Sun would be a feeble magnitude +10, too dim to be seen, even in a 6x30 finderscope.

Taken together, Dabih's distance and the components' angular separation also tells us how far apart those components are in space, and the answer is at least 21,000 AU. (One AU, or astronomical unit, is the distance from Earth to our Sun.) 21,000 AU is also about a third of a light-year, so light takes four *months* to travel from Dabih Major to Dabih Minor, or vice versa—in contrast, light takes just hours to go from the Sun all the way out to Pluto.

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According to Prof. Kaler, the stars' distances apart and their masses suggest an orbital period of roughly 1,000,000 years. He also notes that the main star, a cool giant about 35 times the diameter of our Sun, has a companion in a (relatively) small orbit around it—you won't see it, but the companion can be detected with a spectrograph, and it orbits the main star in just under four years. "But wait!" It's binary too—so Dabih *Major* is a three-star system. Dabih Minor *also* has an unseen companion, so the entire Dabih system contains at least five stars.

Ironically, even though the complexity of the system will exist mostly in your mind's eye, with only the two main components visible (that is, Dabih Major and Minor), they look like they have company in a telescope eyepiece. A third star lies about the same angular distance from Dabih Major as Dabih Minor does, making for the *appearance* of a triangular star system. As it happens, this third star lies more than 100 light-years farther from us than Dabih, so it's just a line-of-sight coincidence, but it makes for a beautiful arrangement nonetheless. (At magnitude +8.8, this third star is almost three magnitudes dimmer than Dabih Minor, so you shouldn't have much trouble telling the Dabih members from the interloper.)

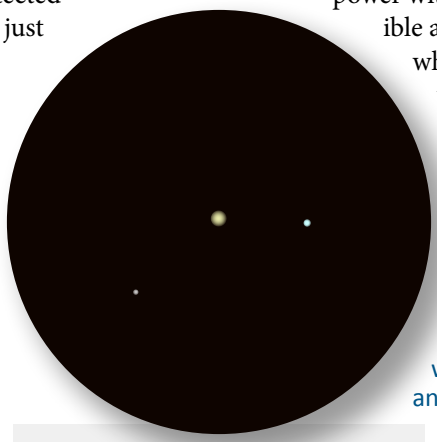

Illustration of eyepiece view of the Dabih system (north is up). Dabih Major is at center, and Dabih Minor is to its right.

Image: Z. Singer

Viewing the system was lovely at just over 50x using a 25mm eyepiece in a 4-inch Mak, and the split was easy. Doubling the power with a 12mm eyepiece, the third star was more visible and Dabih's colors stood out a little better – a pale wheat yellow for the primary and a subtly blue-tinted secondary.

Finding Dabih is simple—as mentioned above, it's near the "top-right" of Capricornus's bikini. If you look at that corner, you'll see a reasonably bright star there—sharp-eyed observers might see a pair, about 6' apart. Whether as a single star or a pair, that's Algedi, *aka* Alpha (α) Capricorni. Dabih is the next bright star you'll see when you glance down the right side of the bikini, roughly where you'd imagine "bikini strings," if there were any. Easy-peasy!

My warmest thanks to Sorin of Mile High Astronomy, and to July Candia, for the opportunity to do extended observing with their respective 4-inch Maksutovs.

—See you next month.

The Denver Astronomical Society
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