AOH Newsletter

Spring 2023

News and Notes

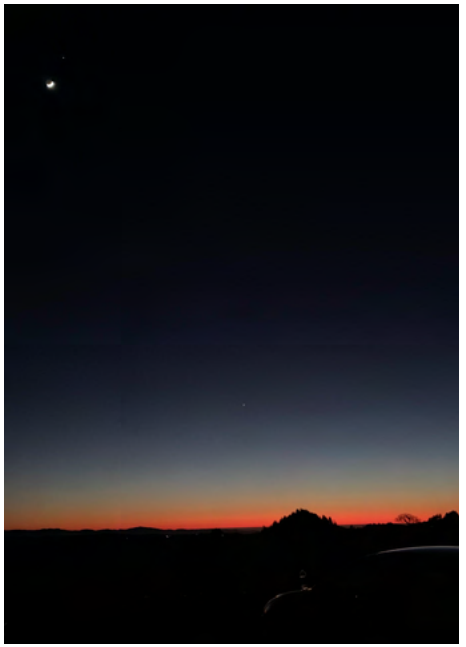
It's been a harsh winter. Regularly-scheduled AOH observing events at Kneeland were canceled in January and February, and we were unable to hold our outreach events at Arts Alive at all this season. But we did return to having an annual Potluck Anniversary Party; AOH members, singly or in small groups, got some viewing and/or photography done between rain, hail, and snow storms; and we had time for one small Zoom meeting.

And Club Members are doing a good job of remembering to get their 2023 dues paid. Please accept our thanks for your support (or go to the renewal page to get on the bandwagon).

Brent and Ken, and Grace setting up at Kneeland in January. —Catrina Howatt

January's Makeup Meeting

When January's meeting was clouded out, a few stalwarts went up to Kneeland on the Wednesday following, eager to get a look at Comet ZTF. Jupiter and Venus were bright in the west; and the Moon was several days old; and the comet was slow to appear, low in the northeast; and the sky was not the most transparent it's ever been; but the small gathering was happy to be able to do some viewing.



Above: Mark getting leveled, and dusk falling. —Catrina Howatt

The Green Comet

Above: Comet ZTF C/2022 E3 was imaged on January 25 in the early morning. It was about a week from closet approach and the comet was zooming its way between Draco, the Little Dipper, and the Big Dipper. The nucleus and the green coma show up quite well and there is a hint of a tail. This is a single image taken through a six-inch Schmidt-Cassegrain telescope. The camera was a Canon EOS Ra. The exposure was 120 sec at 4800 iso.

Above, right: From Eureka on February 14, Aldebaran and Comet ZTF were about 2 degrees apart. Through binoculars, the comet could be seen next to Aldebaran and the nearby Hyades. The photograph was taken with a Canon EOS Ra through an 81mm refractor on an alt-az tracking mount. Twelve light and dark frames were stacked in Affinity Photo (total integration time was 9 minutes). Final processing was done in Photoshop.

—Grace Wheeler

On Zoom

The March 4 meeting had only a few in attendance. A motion to return Pluto to full planetary status failed due to the lack of a quorum.

The Potluck

For the first time since 2020 we were able to celebrate the Club's birthday (it turned 66 this year). We met at the Eureka Woman's Club, had a great dinner, and were treated to an informative and entertaining presentation from Dr. Tyler Mitchell of the Cal Poly Physics and Astronomy Department. Dr. Mitchell spoke on "The James Webb Space Telescope and the Birth of Planets."

Clockwise, from upper left:

President Brent Howatt welcoming the attendees.
—Don Wheeler

Vice President Mark Wilson entertaining the group.
—Don Wheeler

Treasurer Bob Zigler winning a prize in the raffle.
—Scarlet Rose

Loading up plates in the kitchen.
—Don Wheeler

Clockwise, from top:
Tyler Mitchell taking questions after his talk. —Don Wheeler
The audience, playing close attention. —Johnny Thomas
Showing off door prizes and award certificates. —Stuart Moskowitz
Secretary Ken Yanosko giving out outreach awards. —Don Wheeler

Conjunctions

The conjunction of Venus and Jupiter On March 1 gathered a lot of attention. And we had a near-occultation of Mars by the Moon on January 31.

Above: Venus and Jupiter, a half degree apart. —Rick Gustafson, https://rickgustafson.com/

Left: The Moon, just missing Mars (as seen from our vantage point in Humboldt County), —Grace Wheeler.

Outreach Awards

At February's Anniversary Meeting AOH gave out Service Pins and Certificates to those who contributed to our outreach program in 2022. The pin design incorporates the James Webb Space Telescope's segmented mirror, with the text "Night Sky Network Star." Those recognized, and thanked, are: Brent Howatt, Mark Wilson, Ken Yanosko, Bob Zigler, Catrina Howatt, Bernie Christen, Dan Eaton, Rick Gustafson, Mark Mueller, Lisa Hockaday, Pam Cosel, Roger Coy, Susan Coy, Phil Bairrington, Rebecca Bairrington, Russ Owsley, Grace Wheeler, Don Wheeler, Mike Foster, Susie Christian, Susan Frances, Kai Cook, Frank Simpson, Joe Eiers, Barry Evans, and Susan Parsons.

More Outreach

AOH member Barry Evans writes regular columns in two local publications, *The North Coast Journal* and *The Lost Coast Outpost*. Sometimes he waxes eloquent on topics astronomical and/or outer-spatial. Check out these:

"Orion and the Pleiades" https://www.northcoastjournal.com/humboldt/orion-and-the-pleiades/Content?oid=25694962

"Those Bright Winter Stars" https://lostcoastoutpost.com/2023/jan/15/growing-old-ungracefully-those-bright-winter-stars/

"Moon or Mars" https://lostcoastoutpost.com/2022/dec/18/growing-old-ungracefully-moon-or-mars/.

Another Library Scope

Vice President Mark Wilson has recently announced that our highly successful Library Telescope (see the Summer 2022 Newsletter) will soon be joined by another. AOH has been awarded a second 4.5 inch Orion Starblast by the Astronomical League in a drawing held among regional astronomy clubs. As soon as it can be prepared for use by inexperienced borrowers, it will be put into service.

Upcoming Events

Among the bright planets, Venus remains the "Evening Star" all Spring, reaching its greatest eastern elongation (angular distance from the Sun) on June 4. It will be in a "waning gibbous" phase; in a small scope watch it decrease from 80% illuminated on the equinox to 50% at its elongation. Mercury will join Venus at its own greatest eastern elongation on April 11, and then will speed ahead crossing between Earth and Sun (but without a transit) until greatest western elongation on May 28 (look for it in the morning *eastern* sky on the 29th). Mars also remains visible high in the southwest, moving through Gemini and Cancer. Jupiter is rapidly disappearing behind the Sun; by June it will join Saturn in the eastern sky just before dawn.

We get two Spring meteor showers, the Lyrids on April 22-23 and the Eta Aquariids on May 5-6. See details at the American Meteor Society.

A solar eclipse occurs on April 20 and a lunar eclipse on May 5, but you have to be on the other side of the Earth to see either one.

But begin planning now (if you haven't already) for *our* upcoming solar events. An annular eclipse occurs on October 14, 2023. If you want to see the "ring of fire" you'll have to travel; the centerline runs from Reedsport through Winnemucca and on to Corpus Christi. If you stay home you'll get an 85% partial eclipse.

And you should be planning now for the April 8, 2024 total eclipse. That path of totality runs from Texas to New England. Club member Phil Bairrington would like to discuss a group road trip, caravaning and/or ridesharing, to Texas. If you are interested contact him now at phil@astrohum.org.

Thanks

A big thank you to all who helped with this Newsletter: Grace, Mark, Susie, Catrina, Don, Scarlet, Johnny, Stuart, Rick, Yoon, and Susan for articles, pictures, consultation, and proofreading.

Please send anything for the next issue to me at ken@astrohum.org. Your contributions are appreciated.

Road Trips

The American Automobile Association, in the November/December 2022 issue of its *Via Magazine*, published an article entitled "Best Destinations in the West for Stargazing and Astronomy."

Chabot Space and Science Center in Oakland, California
—from Via Maagazine*, November/December 2022*

Each item on their list includes a major Observatory or Science Center open, or soon to be open, to the public, as well as suggestions for nearby dark-sky parks or campsites. The destinations are:

Chabot Space and Science Center in Oakland, California;
Christa McAuliffe Space Center in Pleasant Grove, Utah;
Jack C. Davis Observatory in Carson City, Nevada;
Lowell Observatory in Flagstaff, Arizona;
Museum of the Rockies Planetarium in Bozeman, Montana;
Sky's The Limit Observatory in Twentynine Palms, California;
Anchorage Museum in Anchorage, Alaska;
Flandrau Science Center and Planetarium in Tucson, Arizona; and
Snow King Observatory and Planetarium, scheduled to open in Fall 2023, in Jackson Hole, Wyoming.

The complete article is available at https://mwg.aaa.com/via/places-visit/stargazing-astronomy-spots.

Spring Objects

by Mark Wilson

For those who wish to extend their repertoire of deep-space objects to items beyond the Messier list, we have presented here, and in the most recent Summer, Autumn, and Winter Newsletters, lists of appropriate-to-the-season non-Messier deep space objects. These items are accessible to us amateurs; with a good sky, they are all visible in an 8 inch scope.

There were three sources of literature used to prepare this list of deep space wonders. First was a list put together by Michael Bakich and published in the March, 2022 issue of *Astronomy Magazine* and indicated by "A" in the column labeled "Source." The second was *Sky Atlas For Small Telescopes and Binoculars* by David S. Chandler and Billie E. Chandler. This is an introductory atlas with sky charts similar to Norton's. The objects from the atlas are indicated by "S" in the source column. The *Messier Observer's Planisphere* by Mike Krzywonski was used as the third object source. While this large planisphere is oriented to the Messier hunter it also has 27 other deep space objects of interest. The planisphere objects are indicated by "p" in the source column.

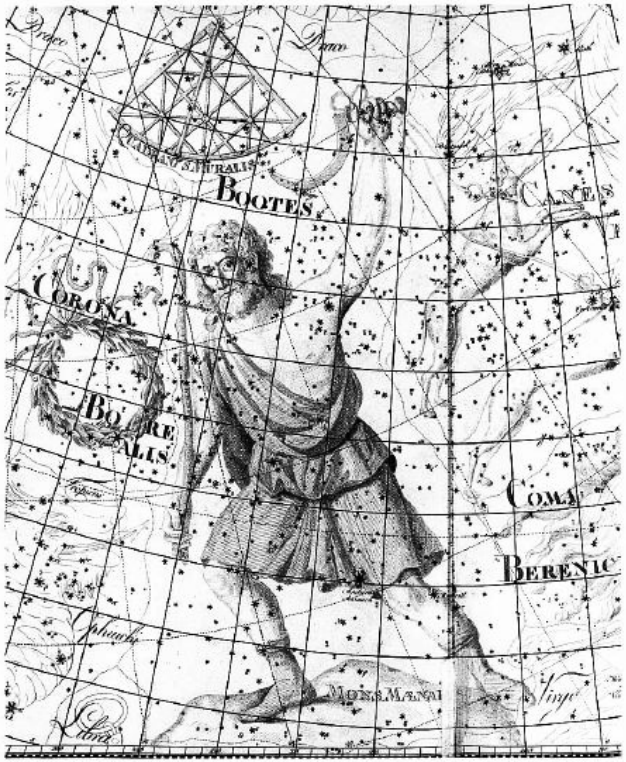
ID	Common Name	Const.	Object	Mag.	Source
Mel 15		Cas	Open Clus	6.6	S
55		Scl	Galaxy	8	S
246		Cet	Planetary N	8.5	S
253		Scl	Galaxy	7.1	S
288		Scl	Globular Cl	8.1	S
300		Scl	Galaxy	8.7	S
1275	Perseus A	Per	Galaxy	12.7	p
1332		Vel	Planetary N		S
1851		Col	Globular Cl	7.3	S
2359	Thor's Helmet	CMa	Nebula	11.5	p
CR 140		CMa	Open Clus	3.5	S
2775		Cnc	Galaxy	10.1	A
2784		Hyd	Galaxy	10	A
3101		Vel	Globular Cl	6.8	S
3115		Sex	Galaxy	8.9	A
3132		Vel	Planetary N	8.2	S
3242	Ghost of Jupiter	Hyd	Planetary N	8.6	S A
3344	Sliced Onion Gal	LMi	Galaxy	9.9	A
3521		Leo	Galaxy	9	A
3621	Frame Galaxy	Leo	Galaxy	8.9	A
3837		Leo	Galaxy	13.3	A
3840		Leo	Galaxy	13.7	A
3842		Leo	Galaxy	11.8	A
3861		Leo	Galaxy	12.7	A
3862		Leo	Galaxy	12.7	A
UGC 5470	Leo I	Leo	Galaxy	10.2	A
UGC 5373	Sextans B	Sex	Galaxy	11.9	A
4038	Antennae Gal	Cor	Galaxy	10.5	A
4039	Antennae Gal	Cor	Galaxy	10.5	A
4244	Silver Needle Gal	CVn	Galaxy	10.7	A
4449		CVn	Galaxy	9.6	A
4490		CVn	Galaxy	9.7	A
4565	Needle Galaxy	Com	Galaxy	9.6	p A
4631	Whale Galaxy	Com	Galaxy	9.7	p
4656	Hockey Stick	Com	Galaxy	10.7	p
Mel 111	Coma Star Cloud	Com	Open Clus	1.8	p
5128	Cen A	Cen	Galaxy	7.6	p S
5139	Omega Centauri	Cen	Globular Cl	3.9	p
7209		Lac	Open Clus	6.7	S
7243		Lac	Open Clus	6.4	S
7320	Stephan's Quintet	Peg	Galaxies	13.2	p
7662		And	Planetary N	8.6	S

The Cowboy

by Ken Yanosko

In the Spring, in the evening, the constellation Boötes ("Boh-teez") rises in the East. He's an ancient Greek figure, mentioned in Homer's Odyssey as one of the constellations that the hero Odysseus uses to navigate his ship home after the Trojan War. His name in Greek is Βοωτης related to the word βοῦς which means cow or ox; he is usually described as a Cattle Driver or Herdsman (hence the title of this article).

But like all very old stories, the Boötes myth has several variations. Boötes is closely connected to the Big Dipper (see below) so some folks skip the cattle reference and refer to him as the "Bear Driver." On the other hand, sometimes the Dipper is seen as a Wagon ("The Wain" in Old English) so if the Wagon is being drawn by an ox he really is an "Ox Driver." And finally, some refer to the Dipper as "The Plow" and so call Boötes "The Plowman." Take your pick. Ian Ridpath, in *Star Tales*, gives the various (somewhat gory) origin stories.

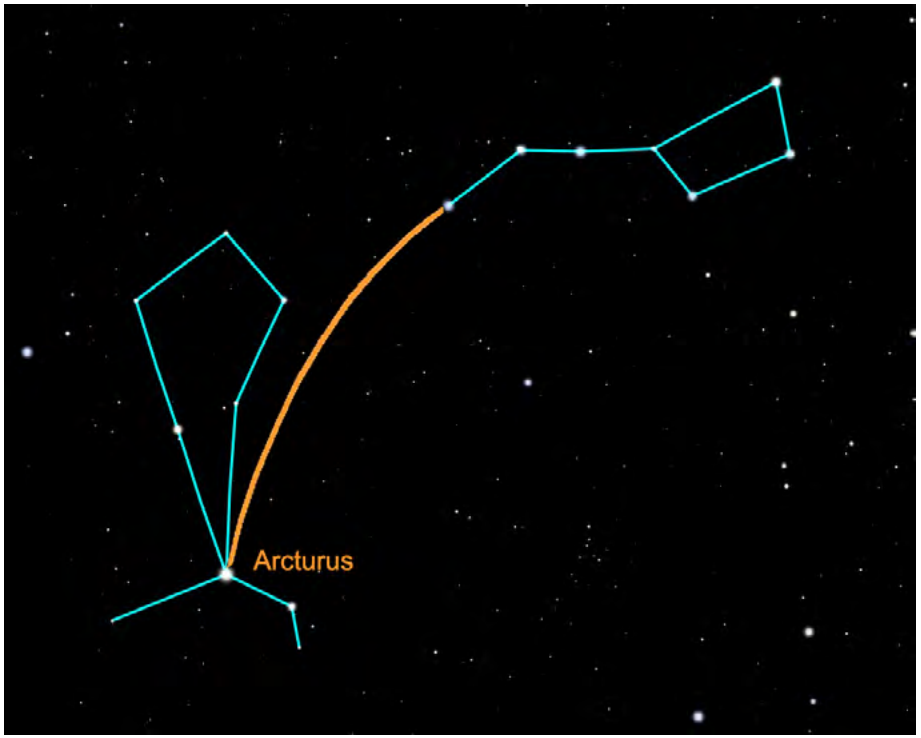


Boötes, from the star atlas Uranographia *of Johann Bode, published in 1801.*
Notice the Hunting Dogs on leashes held by Boötes' left hand, and the Quadrant above his head.

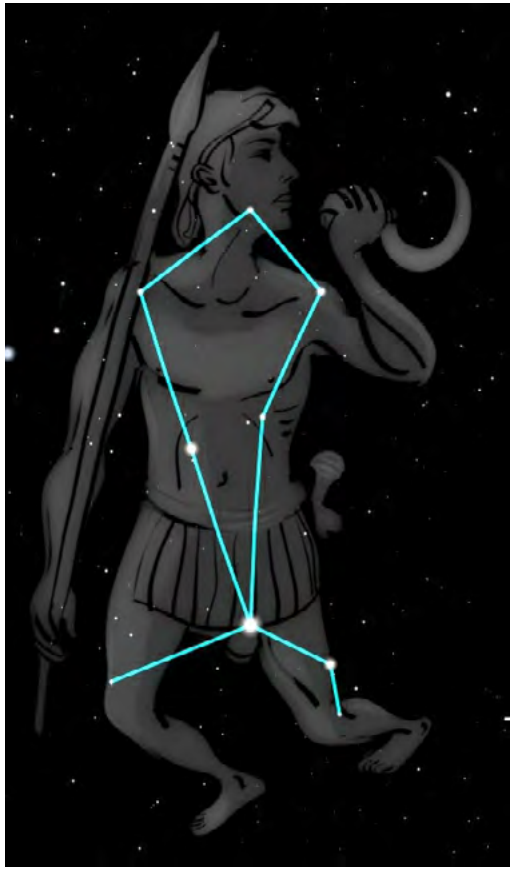
In the seventeenth century the astronomer Johannes Hevelius created a new constellation, Canes Venatici, "The Hunting Dogs," and put them on leashes held by Boötes, thus giving Boötes a new occupation: hunter, or (if you prefer) dog walker. Or maybe Boötes is just an innovative herdsman, using dogs to control his cattle, or bears, or whatever.

To find Boötes in the sky, first find the Big Dipper. Then follow the Arc of the handle about a distance equal to the total length of the Dipper until you come to the star Arcturus. You can't miss it; it's the fourth-brightest star in the sky, an orange giant, and marks the bottom of Boötes' kite-shaped outline. Despite the third-magnitude dimness of the other stars in the constellation, the easy star-hop to Arcturus makes Boötes pretty easy to find. The name Arcturus, from the Greek Ἀρκτοῦρος, meaning "Bear Watcher," evidently gives Boötes his bear-herding persona.

What's interesting about Arcturus is its large proper motion. It's about 40 light-years away, but isn't moving around the galactic center



"Follow the Arc to Arcturus."
From Stellarium.



Boötes, the Herdsman, from Stellarium.

Many people imagine Boötes to be a simple kite. But I always visualize something else when I look at this part of the sky. Click on the picture to see what I see. (If that doesn't work in your browser, click here.)

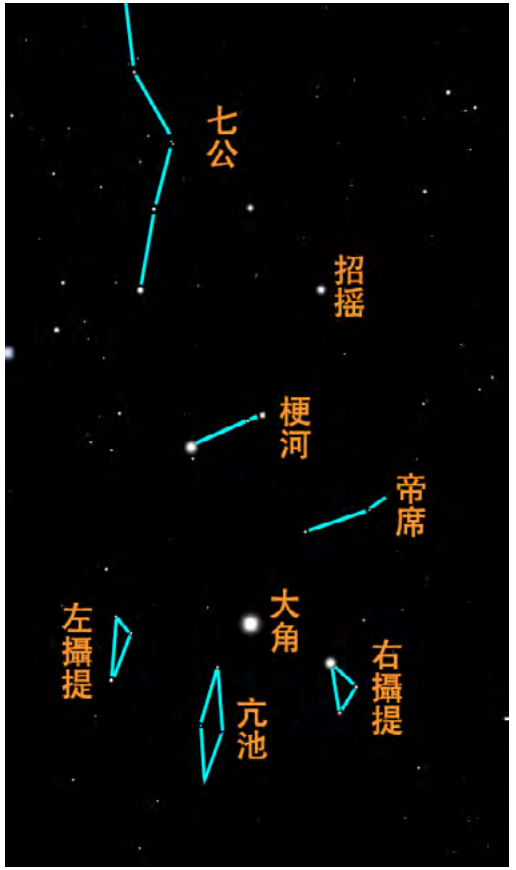
with the velocity expected of one of the Sun's neighbors. Arcturus shares its velocity with a group of 50 or so other stars, dubbed the "Arcturus Stream," which are proposed to be the remnant of an extra-galactic acquisition by the Milky Way. Arcturus' motion across the sky, two arcseconds per year, adds up over the millennia. Hipparchus, who made one of the first star charts twenty-one-and-a-half centuries ago, would probably notice that today Boötes is much taller (by more than two moon-diameters) than he was back then. You can check this out: crank up your planetarium software, look at Boötes, and then set the clock back to 150 bc. While you're at it, set the clock several millennia ahead and see where Arcturus is going.

Boötes doesn't have any Messier objects within its boundaries. Of course Hubble and Webb have shown that there are galaxies everywhere in the sky; but nothing in Boötes is brighter than 10th magnitude. There is one globular cluster around magnitude 10.5. It's NGC 5466, right on the border with Canes Venatici; look for it 23 minutes of Right Ascension eastward of sixth-magnitude Messier 3. No luck? Try this: put M3 in the center of a wide-field eyepiece, and then turn off your clock drive. Wait exactly 23 clock-minutes, and NGC 5466 will come to you.

The January Quadrantid Meteor Shower has its radiant in Boötes. So why are they called Quadrantids, and not Boötids? It's because of that guy Hevelius again. He stuck another constellation, Quadrans, the Quadrant (an instrument like a sextant, only bigger) up above Boötes. When the IAU standardized the list of constellations, it kept the Hunting Dogs but abolished the Quadrant. But the Quadrantids kept their original name.

In the Far East, Boötes wasn't recognized as a single constellation. The Chinese had four major divisions of the sky: the Black Tortoise, the White Tiger, the Azure Dragon, and the Vermilion Bird. These were then divided up into 28 Lunar Mansions, corresponding to the daily position of the Moon in a lunar month. Finally each Mansion consisted of many smaller asterisms. Several of these, in the Domain of the Azure Dragon, in the "Root" Mansion, involve the stars of Boötes. See the chart at right.

So look for Boötes the Cowboy this Spring. And Happy Trails to You!



Chinese asterisms in Boötes. From top to bottom:

七公	*Seven Noblemen*
招摇	*Twinkling Light*
梗河	*Lance or Shield*
帝席	*Emperor's Cushion*
大角	*Great Horn (of the Dragon)*
左攝提	*Left Attendant*
右攝提	*Right Attendant*
亢池	*Lake with Boats*

The Sun in Ca-K

by Grace Wheeler

Observing in Ca-K

Observation of the chromosphere by amateur astronomers is usually done in two wavelengths: H-alpha (656 nm) samples the mid-chromosphere (1500 km above the photosphere), and Ca II K line (394 nm; Ca-K) looks at the lower chromosphere (500-1000 km above the photosphere.) Ca-K refers to the K-line, one of a pair of Fraunhofer lines in violet that corresponds to ionized calcium. Constructing a Ca-K solar telescope requires an optical tube (usually a refractor telescope) and a solar-specific Ca-K filter. For my telescope, I am using a Lunt narrowband Ca-K module inserted into the focuser of an 81 mm refractor telescope. Observing through a Ca-K solar telescope can be difficult because violet light is at the edge of the visible light spectrum. Most people can see a violet-colored sun in a Ca-K solar telescope, but very little detail. This is particularly true for older observers because of the yellowing of the cornea. High-contrast images of the sun in Ca-K can be achieved with astrophotography and is an effective way to observe the sun.

The magnetic field and Ca II K line

The K line of Ca-K is sensitive to the magnetic field, and the strength of this field in solar features is gauged by their brightness in Ca-K.

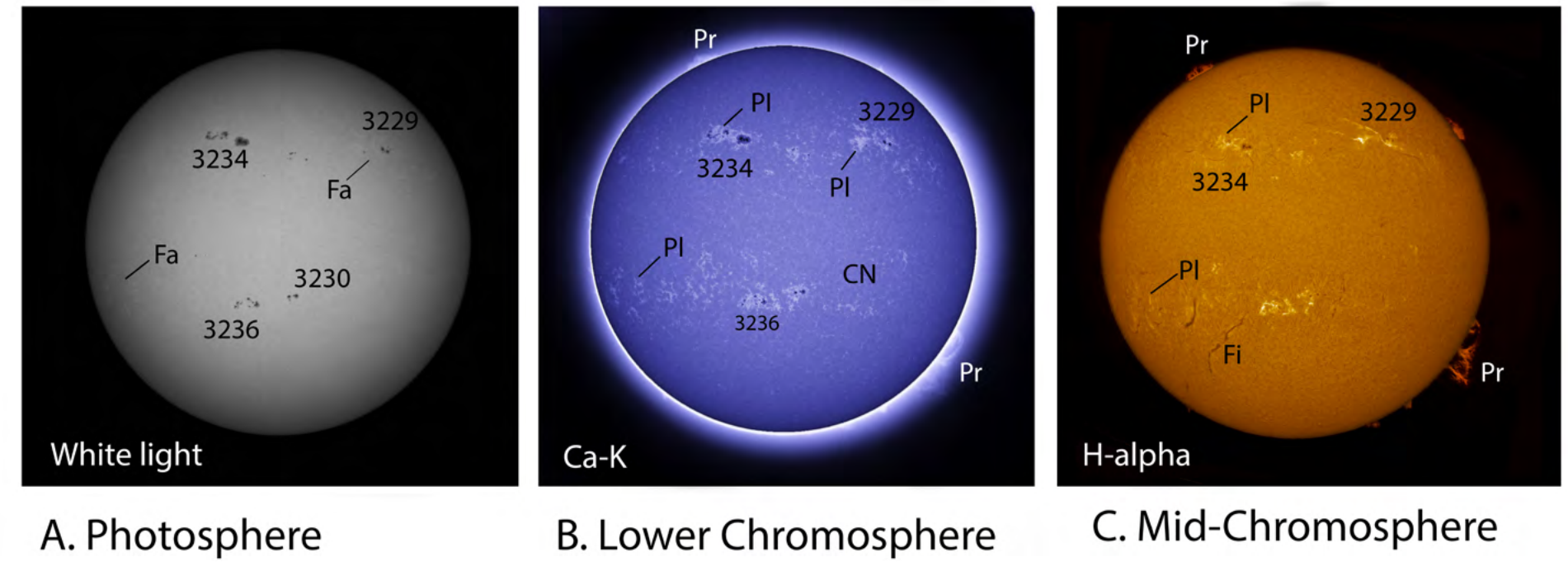


Figure 1. Observations of the sun were made on February 24th, an hour after the eruption of a filament near AR 3229. (A) The photosphere was imaged in white light with a Herschel wedge. Four active regions containing sunspots were seen: 3229, 3234, 3230, and 3236). Faculae (Fa) were seen on the limb. (B) The sun was imaged in Ca-K which primarily samples the lower chromosphere. The features identified in Ca-K include active regions containing sunspots and plage (Pl), prominences (Pr), and the chromospheric network (CN). (C) H-alpha imaging of the mid-chromosphere showed the following structures: active regions with sunspots and plage (Pl), filaments (Fi), and prominences (Pr). Also seen was a bright gash-like area near AR3229; this was the site of a filament eruption.

Faculae and plage have strong magnetic fields and will look bright, while granules have weak fields and appear dark. The exception are sunspots which have intense magnetic fields. In this case, the strong magnetic field prevents convection making the sunspots cooler than their surroundings and giving them a dark appearance.

Features seen on the solar disk in Ca-K

The Ca-K imaging of the sun showed (1) active regions containing sunspots and plage, (2) the chromospheric network made up of supergranules, and (3) faint prominences (Figure 1B). The sunspots in Ca-K are comparable to what is seen on the photosphere in white-light. (Figure 1AB.) The plage has well-defined borders with a finely mottled appearance (Figures 1B, 2, 3). Previously I had written about the faculae (Fa) on the photosphere (Autumn Newsletter 2022) which are bright web-like structures found in active regions of the sun. It is thought that plage is an extension of faculae into the chromosphere, and plage is often referred to as chromospheric faculae.

Because the lower chromosphere is transparent in Ca-K, we see the photosphere and its supergranulation. Supergranules are about 30,000 km in size and are large-scale convections cells that exhibit both horizontal and vertical movement. Supergranulation is not visible in white light, but can be detected with ultraviolet light as shown in the SDO AIA 1700 channel https://sdo.gsfc.nasa.gov/assets/img/latest/latest 4096 1700.jpg.

In Ca-K, we see the chromospheric network overlying the entire face of the sun. (Figures 1B, 2). This is a network of closely packed supergranules that are interweaved with bright threads called filigree. The filigree are made up of magnetic field lines that are concentrated between supergranules as a result of fluid movement of the granules.

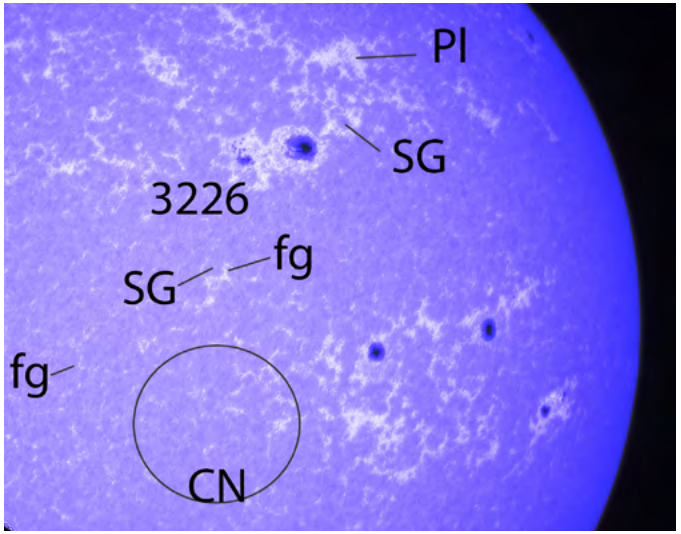


Figure 2. Ca-K image of the sun on Feb. 17, 2023. The chromospheric network covers the solar disk in Ca-K. The network is made up of large roundish convection cells of supergranules (SG) and is interweaved with bundles of magnetic field lines called filigree (fg). Supergranules can also be found in active regions where these are surrounded by plage.

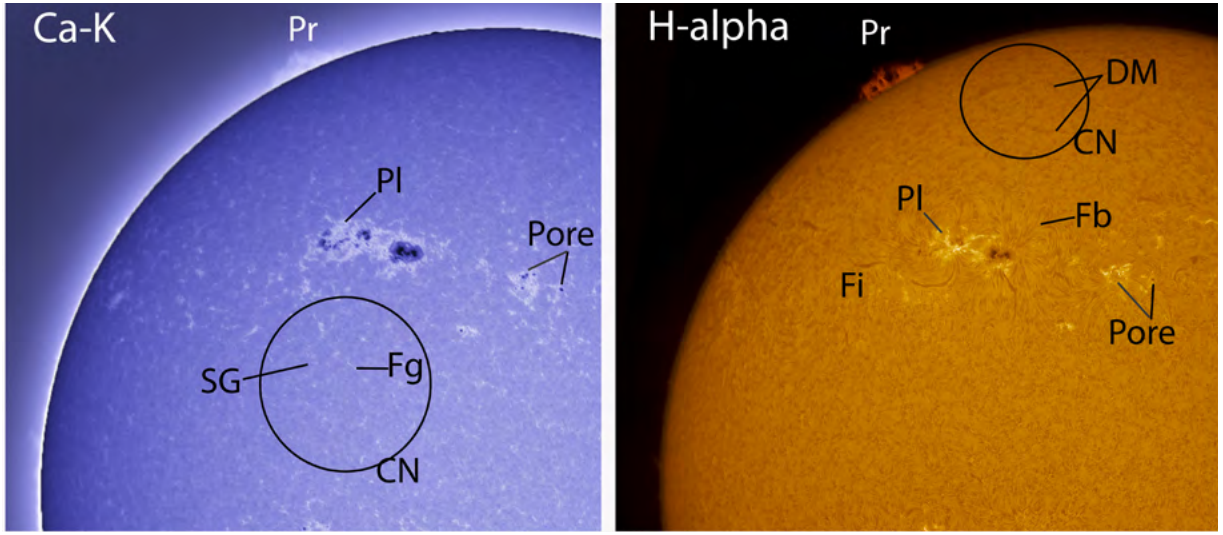


Figure 3. Comparing views of the sun in Ca-K and H-alpha. In Ca-K, the active regions have defined boundaries. The transparency of the chromosphere in Ca-K makes it possible to see the detail of active regions including sunspots and pores (minute sunspots that are only umbra). In Ca-K, the chromospheric network (CN) is seen throughout the disk with its supergranule cells (SG) and filigree (Fg). In H-alpha, the active regions are associated with dark mottles (DM) and fibrils (Fi) which are jets of plasma. The chromospheric network is lined with dark mottles.

The view of the sun in H-alpha and Ca-K

In both Ca-K and H-alpha, the plage forms bright features and demarcates the active regions on the solar disk (Figure 1BC). However, in Ca-K, the active regions are more structurally defined than in H-alpha. In part, this is due to the presence of spicules and fibrils in H-alpha which partially obscure the view of active regions. Spicules, when viewed against the disk, are called dark mottles and have a carpet-like texture https://www.youtube.com/watch?v=BYvVxP0mxYA.

The chromospheric network is also visible in H-alpha but is also somewhat obscured by dark mottle. In the chromospheric network, dark mottle outlines the network.

Filaments, which are threads of plasma held in place by the magnetic field, are apparent in H-alpha but not in Ca-K. Prominences, which are the limb-equivalent of filaments are found in both H-alpha and Ca-K. The prominences in Ca-K are more diffuse and dimmer than those seen in H-alpha.

H-alpha gives a dynamic view of the sun with respect to solar eruptions. Figure 1 shows the sun in Ca-K and H-alpha following a filament eruption in AR 3229 on February 24th. In the H-alpha view, the eruption site is bright and clearly demarcated whereas this is absent in Ca-K. AR 3229 is particularly notable for its eruptive activity: on February 17th, an X2.2 emanated from 3229 and is the strongest flare to date in Solar Cycle 25. Figure 4 shows AR3229 shortly after the eruption: H-alpha shows intense brightening in the active region (and maybe some flaring?) which is not apparent in Ca-K. More about solar flares can be found here: https://www.youtube.com/watch?v=mar0-z saFs.

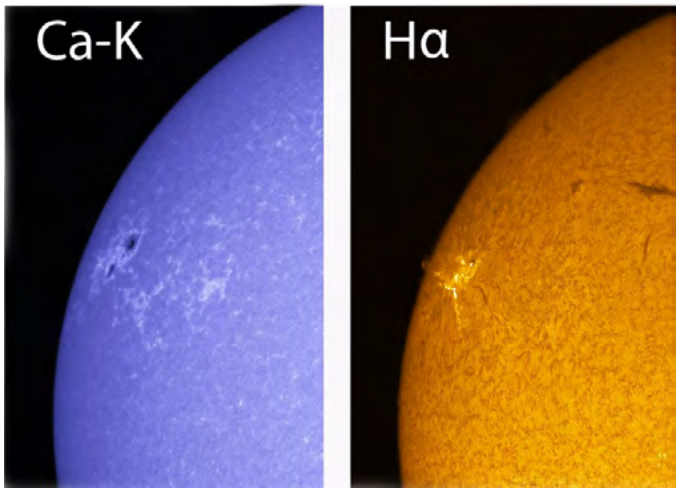


Figure 4. Image of the sun on February 17 after the eruption of class X2.2 solar flare in AR 3229. Brightening of AR 3229 on the solar disk is evident in H-alpha but not in Ca-K.

Equipment:

The photosphere was imaged with a Herschel wedge and an 81mm refractor telescope. For Ca-K, a Lunt Calcium K module was used with an 81mm refractor. For the sun in H-alpha, a Lunt 80mm double-stacked solar telescope was used. Images were captured with a ZWO 294 monochrome camera. Between 1000-1500 images were stacked in Autostakkert and sharpened in IMPPG. The final processing of all images, including the coloration of images in H-alpha and Ca-K, was done in Photoshop.

References:

Jenkins, J. L. (2013). *Observing the Sun: A Pocket Field Guide*. New York, NY. Springer.

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Cohen, H.L. (2015). *Solar Images taken with Calcium K-line Filters*. http://www.astrosurf.com/zodex/guide/CaK/K-Line%20Images%20of%20Sun.pdf.

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Grace Wheeler is a former President of AOH. In addition to her day job photographing the Sun, she spends her nights shooting comets, planets, and deep space objects. *See pages 2, 5, and 13-15.*

The Dwarf II Smart Telescope (Part 1)

by Grace Wheeler

The Dwarf II is a smart telescope that is aptly named: it is smaller than a lunch pail and weighs in at 1.5 kg. It is made by Dwarflab and it is the company's first entry into the smart telescope market.

The Dwarf II is an alt-az GoTo refractor that comes with wide-field and telephoto lenses and a built-in camera. The camera sensor is similar to that used in cell phone cameras. The Dwarf runs on Android or IOS smart phones and tablets and connects to these devices wirelessly through an app. It has two primary modes for photography: "Photo" and "Astro." The "Photo" mode is for general photography, but also has a tracking feature which can be used for nature photography. The "Astro" mode is used for observing and imaging deep sky objects, planets, and the moon. For this review, I'll be focusing on astronomy mode.

I am currently using the beta-version of the IOS app for the iPhone/iPad, and the app does not give the full function of the Dwarf. I'll do a Part 2 of this review for Dwarf once the software issues are resolved.

The Dwarf II comes with two lenses: wide-angle and telephoto. It has a periscope design which allows it to have a greater telephoto capability while remaining compact. The telephoto is used for astronomy. Also shown is the miniature tripod that screws into the base of the Dwarf II.

The Dwarf II with solar filters over the wide-field and telephoto lenses. The Dwarf is mounted on a Celestron AstroMaster Tripod.

The Sun was imaged in "Photo" mode with the telephoto lens. The sun image (cropped) was taken on 2/17/2023 when there were several sunspots on the face.

The live-stacking of M31 on an Apple iPad using the Dwarf App. The image was created by stacking 18 frames of 10s exp/80 gain.

A stacked image of M31. The size of M31 is three degrees by one degree. The image was generated by a live stack of 50 frames (13s exp. 80 gain).

Impressions after 4 weeks

Likes:

(1) The Dwarf is as advertised in its size and weight. It would easily fit into a daypack for hiking and carry-on luggage for air travel. The compact size and simplicity makes this the ideal grab-and-go telescope.

(2) Ease of setup: It takes less than five minutes to put the Dwarf on a tripod, carry it outside, level it, and then point the camera towards the sky for plate solving.

(3) Plate solving takes less than 30 seconds, and so far the GoTo accuracy has been on the mark.

(4) The field of view is 3.5 degrees x 2.5 degrees. A large field of view is ideal for imaging large DSOs like the Andromeda Galaxy, the Orion Nebula, open clusters, and galaxy groups.

(5) The display of the live stacked image on a tablet is good and acceptable for outreach. Presently the IOS version of the Dwarf app cannot stretch the image; being able to stretch the image would greatly improve the quality by brightening the object while reducing the noise.

(6) Decent quality images of deep sky objects can be attained by using the final image from live stacking. The stacked image is retrieved from the SD card and then processed in Photoshop. With stretching the histogram and cropping the size of the image, I am getting very good results with the bright deep sky objects such as the Orion Nebula, the Whirlpool Galaxy, and the Leo Triplet.

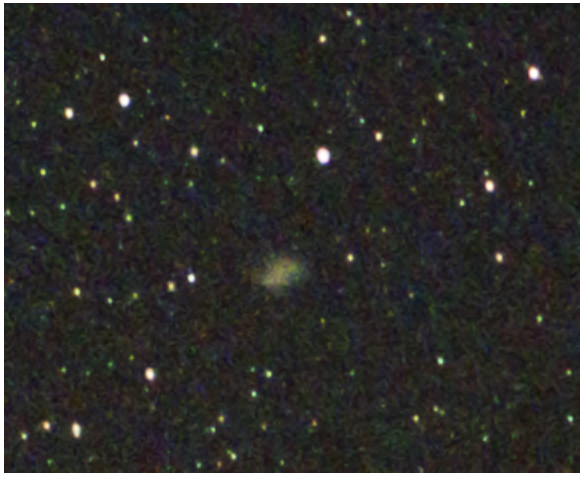
The Markarian Chain in Virgo is an almost linear string of galaxies that includes M84, M86, and the Eyes Galaxies (NGC 4435-NGC 4438). To image the Markarian Chain, I entered the RA and Dec for the NGC 4435 which brought the Chain slightly above center. Included in the image is M87 at the bottom (left of center). The image was generated by stacking 40 frames (15s exp., 150 gain) and was processed in Photoshop. The FOV is 3.5 degrees x 2.5 degrees.

The Double Cluster (NGC 884 and NGC 869) in Perseus. The Double clusters occupy an area of one degree (the moon is about 0.5 degrees). The image was made from 31 stacked frames (13s exp./80 gain).

M42 (the Orion Nebula) and Sh2-279 (the Running Man Nebula). The image was made from 30 stacked frames (8s exp./80 gain). The final image was stretched and cropped in Photoshop. The apparent size of M42 is one degree x one degree.

The Leo Triplet is a group of interacting galaxies—M65, M66, and NGC 3628 (the Hamburger Galaxy). This view is a live stack of 35 frames (15s exp./80 gain.). The image was stretched and cropped in Photoshop.

The Whirlpool Galaxy (M51ab) is a pair of interacting galaxies in Canes Venatici. M51 has an angular diameter is 11x7 arc minutes and an apparent magnitude is 8.4. The image of M51 was generated by stacking 34 frames (15s exp./100 gain). The final image was stretched and cropped in Photoshop.



The Crab Nebula (M1) in Taurus is a supernova remnant. It has an angular diameter of 6 x 4 arc-minutes and has an apparent magnitude of 8.4. The image of M1 was made by stacking 22 frames (10s exp./ 80 gain.). The image was stretched and cropped in Photoshop.

Dislikes and concerns:

(1) Slow CPU: it is an A7 chip and is several generations behind the most recent A series chip. The Dwarf seems slow to respond to commands.

(2) The sensor is similar to what is found in a cell phone camera and probably a few generations behind state-of-the art.

(3) The current IOS app is beta and very buggy. Dwarflab expects to have the IOS app finished in April 2023.

(4) The battery pack lasts for only two to three hours.

(5) Manufacturing defects in the baseplate of the early batches of the Dwarf will most likely require users to repair it with superglue (this is not a problem in the current production run).

(6) The on/off button is fussy and I am concerned that it will fail with time.

(7) The mini-tripod that is supplied with the Dwarf is flimsy and unusable. Users may need to purchase a heftier tripod to use with the Dwarf. I am using a Celestron AstroMaster tripod that I already own, but a camera tripod is also adequate.

(8) Astrophotography: The results with smaller bright objects such as the Crab Nebula, and objects with low surface brightness like the Owl Nebula and the Rosette Nebula are disappointing in the lack of detail. However, before I make any final judgment on this, I want to try imaging under better seeing conditions and using longer exposures.

Final Thoughts

The fact that the Dwarf is glitchy is not surprising as it is a new product. The company admits the quality control on the manufacturing is spotty, and the software needs work. They seem to be serious about fixing these issues. Customer support has been very good: emails are answered in a timely fashion and they are offering web conferencing to customers. There is a one-year guarantee and Dwarflab seems willing to replace any defective telescopes. (With the base problem, users are opting to fix it themselves). It is not out the box ready, and there is a steep learning curve for users not familiar with astronomy equipment and computers.

One can imagine that with a better chip and sensor, an improvement in the software, and better quality control, the Dwarf would be formidable. I think there is a need for a compact smart telescope, especially one that is affordable. Personally, I'm hoping that the company stays in this market and comes out with a Dwarf 3.

Where are the Messier Galaxies?

by Ken Yanosko

Forty of the 110 Messier objects are galaxies. Recently, I was playing with some 3D-graphing software, and I was wondering if I could plot the locations of these 40 objects. (That's the kind of thing we nerdy types do when it's too cold and rainy to go outside.) I put the distance, right ascension, and declination of each of the Messier galaxies into a spreadsheet, converted those numbers into x-y-z coordinates, and had my computer make the drawings. I added the labels by hand. Here are the maps I came up with.

The coordinate systems are Earth-centered. Each map shows a horizontal plane (the plane of the Earth's equator) with every fourth hour

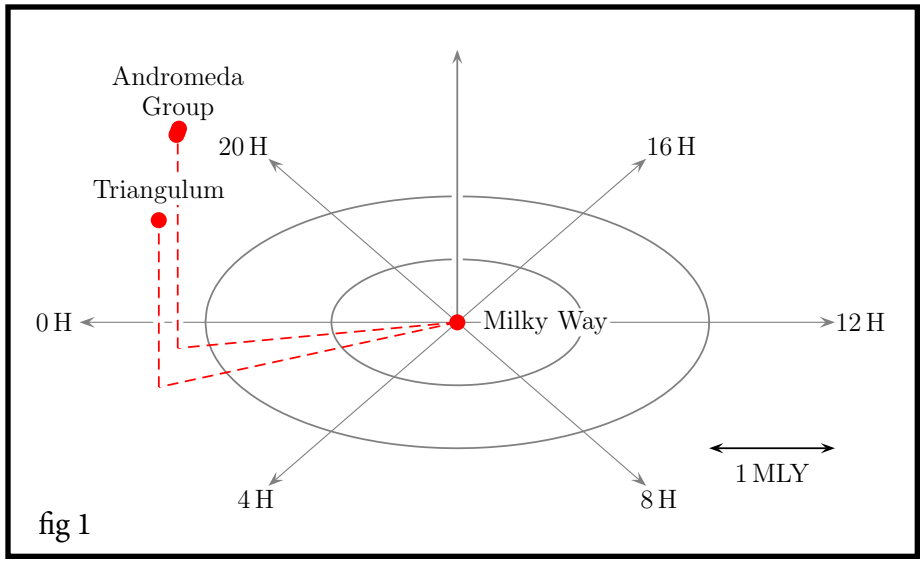


fig 1

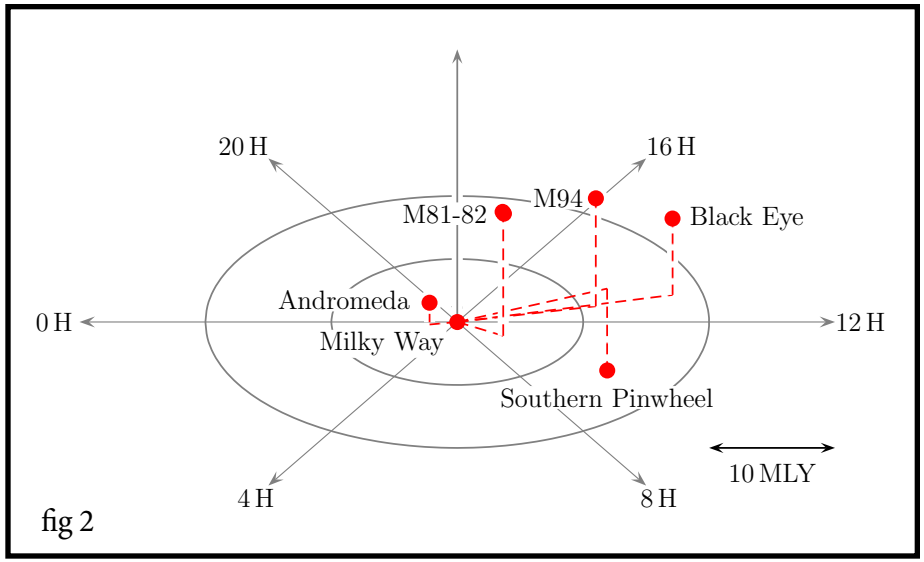


fig 2

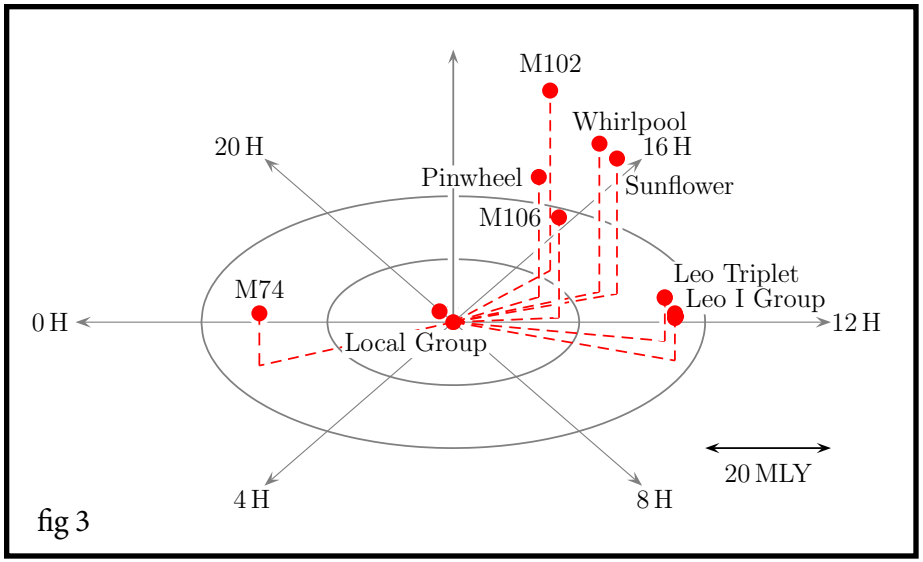


fig 3

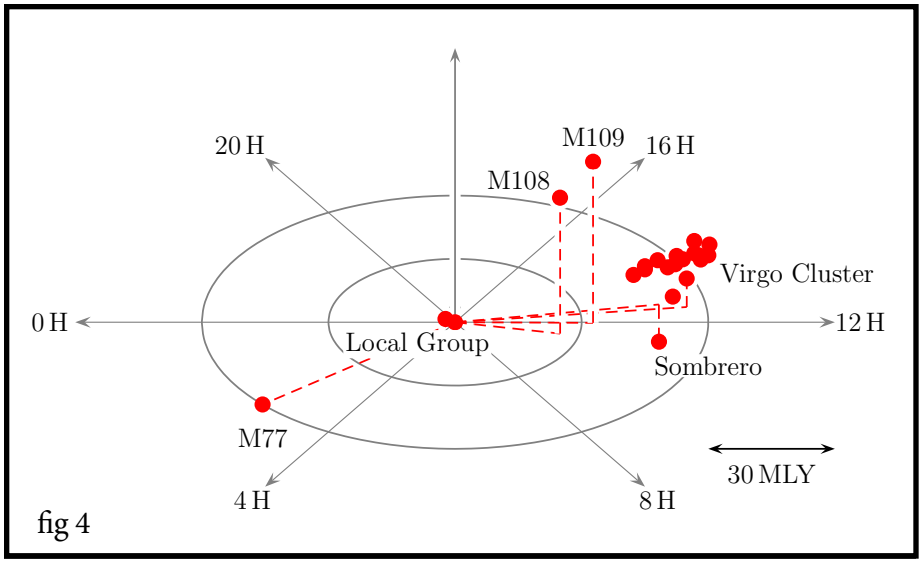


fig 4

of right ascension indicated. The vertical arrow is Earth's north polar axis. Each map shows a distance scale in millions of light-years (MLY); it is in each case equal to the radius of the inner equatorial-plane circle. The dotted lines help you see the location of each galaxy in three dimensions; the horizontal lines are in the equatorial plane and the vertical lines are perpendicular to it. The dots representing the galaxies are just dots; they indicate location but not shape or size.

In the latter figures, galaxies from the earlier figures (except for Andromeda) are omitted for clarity.

It is also the case that these are only the galaxies on Messier's list. These are of course the biggest and brightest from our point of view, and are mostly in the Earth's northern hemisphere. There are many more "dwarf" galaxies in nearby space, but the ones on Messier's list are generally indicative of the distribution of nearby visible matter. What the maps clearly show is that our Milky Way is on the outskirts of the Virgo Supercluster. Most of the nearby extragalactic "stuff" is out there between 10 and 14 hours of right ascension, and 10 to 30 degrees of declination. There are other clusters in the direction of Dorado and Fornax, out of sight of Messier (and us) but they are probably part of the same "filament" of stuff sticking out of Virgo that we are on.

The maps also show what veteran Messier Marathoners already know: the Galaxies M74 and M77 are in the "wrong" direction. Get them spotted right away because they'll be on the wrong side of the Earth for most of the night. And when Virgo rises you'll be pretty busy. There's no way I could have labeled all the Virgo/Coma galaxies, but all the dots are there.

I suppose the next project could be to plot the Messier globular clusters (there are 29 of them) and see how their distribution shows that our solar system is on the outskirts of the Milky Way; and also do the galactic clusters and nebulae, perhaps revealing some structure of our nearby spiral arms. But the weather's getting better.

Maybe next year.

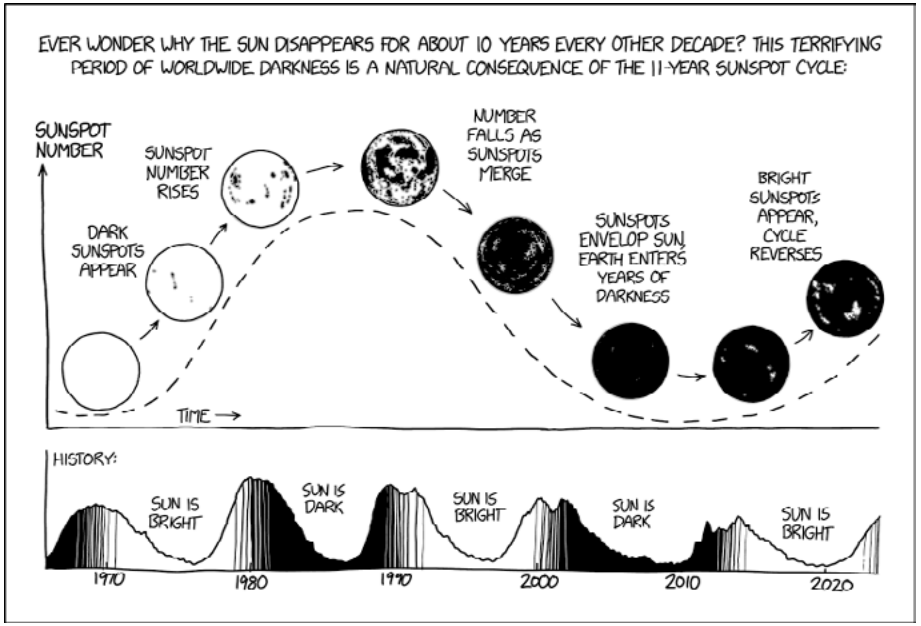
After Words

"Astronomy is perhaps the science whose discoveries owe least to chance, in which human understanding appears in its whole magnitude, and through which man can best learn how small he is."

Georg C. Lichtenberg
Aphorisms (1765-1799)

"So Einstein was wrong when he said, 'God does not play dice.' Consideration of black holes suggests, not only that God does play dice, but that he sometimes confuses us by throwing them where they can't be seen."

Stephen Hawking and
Roger Penrose
The Nature of Space and Time (1996)



Randall Munroe, [xkcd](), Creative Commons

Heavenly Bodies by Susie Christian