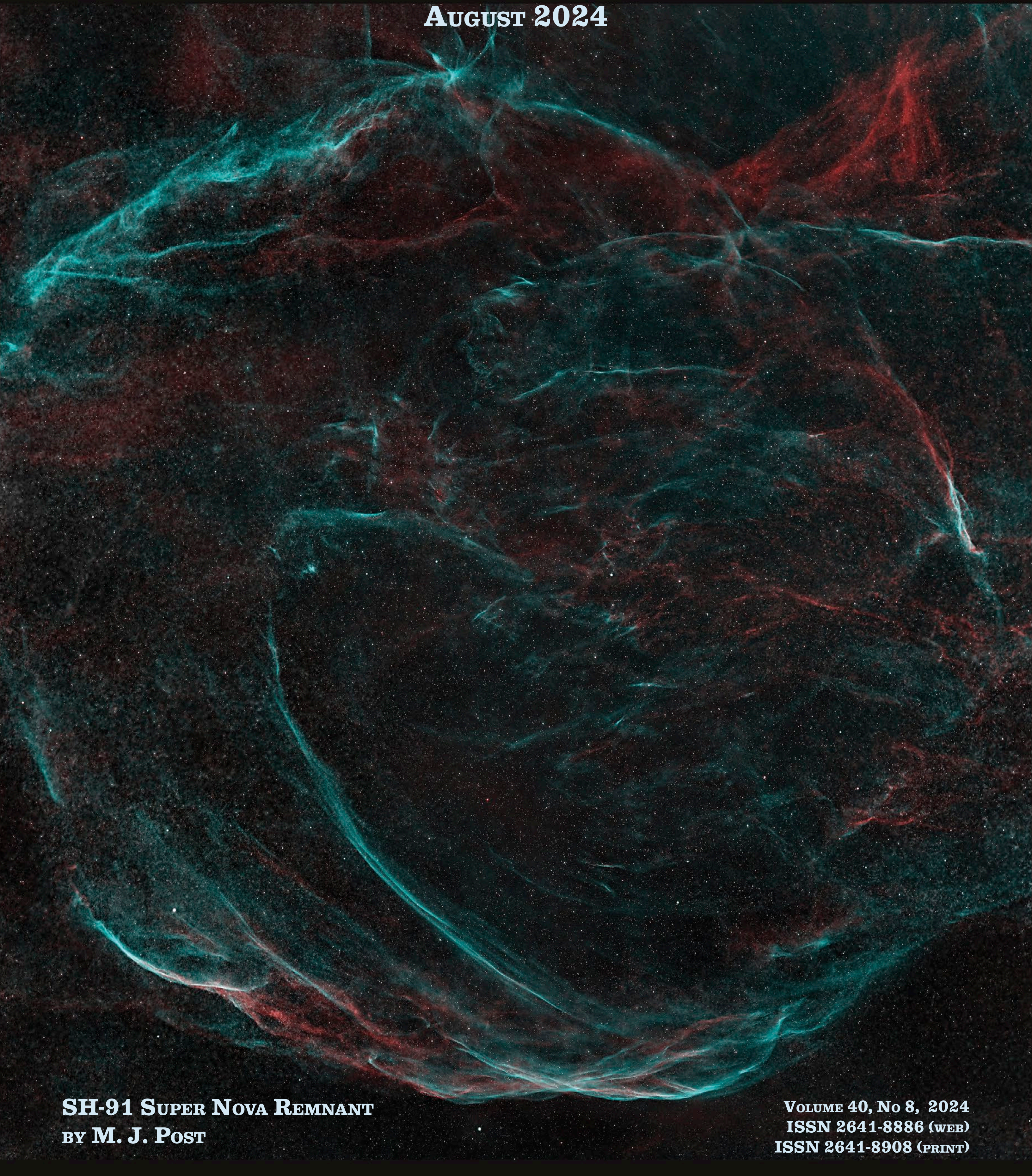
Longmont Astronomical Society

August 2024



SH-91 Super Nova Remnant
by M. J. Post

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Next LAS Meeting August 15 at 7 pm

"Meteorites: What are they, Where do the come from, and How do they relate to the rest of the Solar System" by Dustin Dickens

The presentation at the LAS Meeting on August 15 at 7 pm will be "Meteorites: What are they; where do they come from; and How do they relate to the rest of the Solar System" by Dustin Dickens.

Biography

Dustin Dickens is the Director for the Colorado Center for Meteoric Studies and manages the analysis and analysis services including sample prep, micro probe analysis, classification, and write up for submission to the nomenclature committee.

The meeting will be at the First Evangelical Lutheran Church, 803 Third Avenue, Longmont, CO 80501. If you cannot attend the in-person meeting, it will be available on Zoom.

Would you like to be the LAS Star Party Coordinator?

The star party coordinator handles requests for star parties from Boulder County, City of Longmont, area schools, libraries, and other groups. The coordinator decides which star parties we will support and which ones we won't. The coordinator sets the dates and times for the event in cooperation with the requesting organization. They send out notes to LAS members requesting volunteers, directions of how to get to the event, and where the telescopes are to be set up. They also need to check weather forecasts and decide if the event should be canceled or postponed. In summary, the star party coordinator does everything necessary to make the event happen.

If you are interested in volunteering to be the LAS star party coordinator, please send Vern a note!

About LAS

The Longmont Astronomical Society Newsletter ISSN 2641-8886 (web) and ISSN 2641-8908 (print) is published monthly by the Longmont Astronomical Society, P. O. Box 806, Longmont, Colorado. Newsletter Editor is Vern Raben. Our website URL is https://www.longmontastro.org and the webmaster is Sarah Davis. The Longmont Astronomical Society is a 501 c(3), non-profit corporation which was established in 1987.

The Longmont Astronomical Society is affiliated with the Astronomical League (https://www.astroleague.org). The Astronomical League is an umbrella organization of amateur astronomy societies in the United States.

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Eileen Hall-McKim, Newsletter Archives

Planets in August

Mercury

Mercury is not visible until the last couple days of the month when it can be seen just above the horizon in the east from about 5:10 to 5:50 am. It is magnitude +0.5 in brightness and the waning crescent disk is 8 arc sec across.

Venus

Venus becomes visible about mid-month. Look low in the west about half hour after sunset. It will be magnitude -3.9 in brightness and the nearly full waxing disc will be 11 arc sec across.

Mars

Mars is visible in the eastern morning sky. Its brightness increases from +0.9 to 0.7 magnitude; the disk increases from 5.9 arc sec across to 6.6 this month.

Jupiter

Jupiter moves higher up in the eastern sky this month. On the morning of the 14th it gets within about 18 arc min of Mars. Should be fun to see in same view! It is magnitude -2.1 magnitude in apparent brightness and the disk is 34 arc sec across. The Great Red Spot (GRS) is in good position-for imaging at the following times this month:

- Aug 1 at 4:24 am alt 29°
- Aug 6 at 3:33 am alt 22°
- Aug 8 at 5:12 am alt 42°
- Aug 13 at 4:21 am alt 36°
- Aug 15 at 6:00 am alt 56°
- Aug 18 at 3:30 am alt 29°
- Aug 20 at 5:09 am alt 49°
- Aug 23 at 2:39 am alt 23°
- Aug 25 at 4:18 am alt 43°
- Aug 30 at 3:27 am alt 36°

Saturn

Saturn is in good position for viewing and imaging this month in the early mornings. It increases brightness from +0.8 magnitude to 0.6; the disc is 19 arc sec across. Saturn will be at opposition on Sept 7 at 10:17 pm

Uranus

Uranus visible in the morning sky around 4:30 am or so this month in constellation Taurus. It is magnitude +5.7 in brightness and disk is 3.6 arc sec across.

Neptune

Neptune is visible in constellation Pisces in the early morning. It is magnitude 7.8 magnitude in brightness and the disk is 2.3 arc sec across.

Meteor Showers in August

Our favorite meteor shower of the year, the Perseids peaks on the night of Aug 11-12. Moon set is at 11:13 pm leaving plenty of time to enjoy the show. Typically there are about 100 per hour visible from a very dark location.

Lunar Phases in August

New Moon:
August 4 at 5:14 am

First quarter:
August 12 at 9:20 am

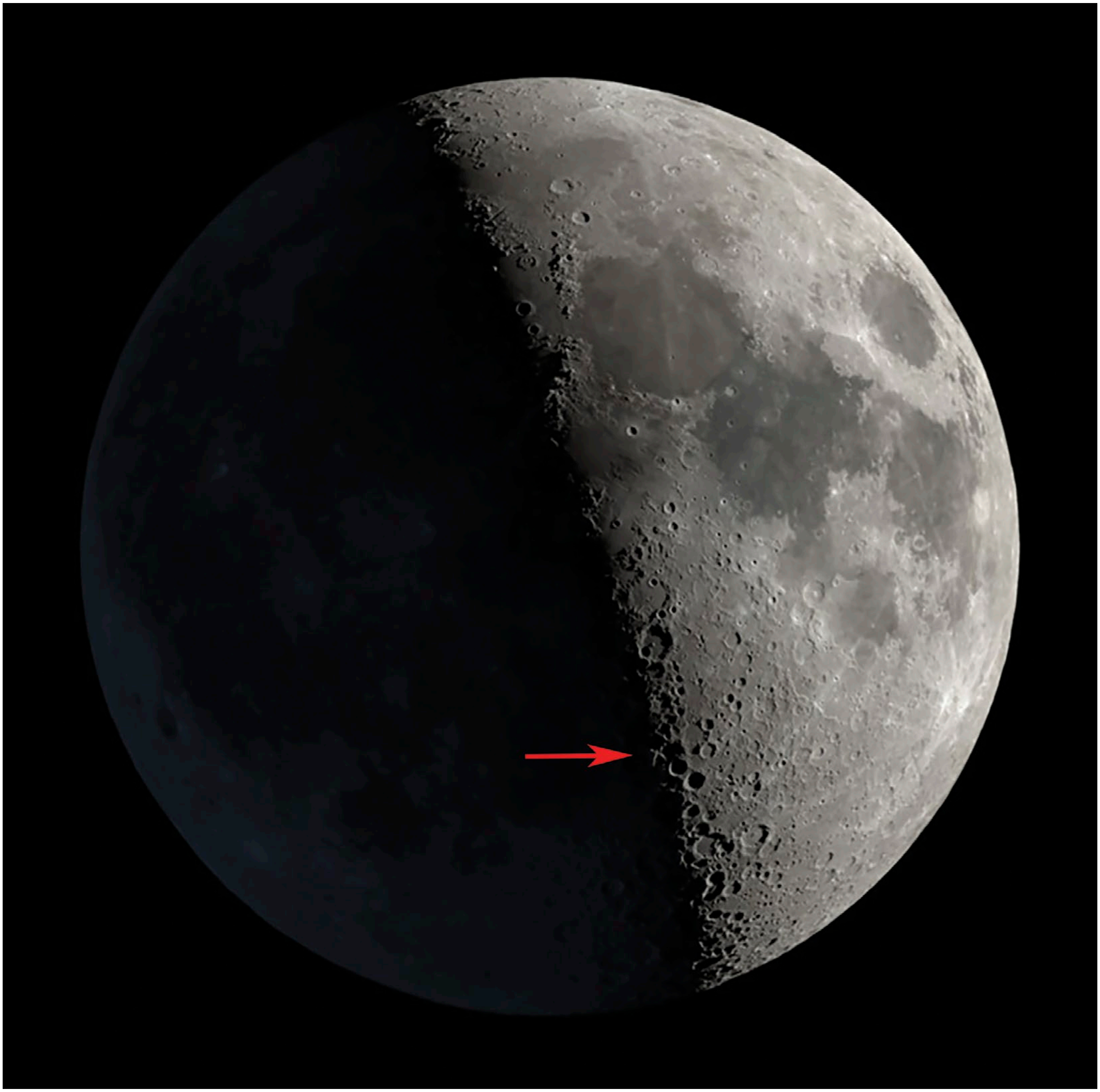
Full Moon:
August 19 at 12:27 pm

Third quarter:
August 26 at 3:27 am

Images created with NASA Scientific Visual Studio's Moon Phase and Libration Tool.
See https://svs.gsfc.nasa.gov/5187/

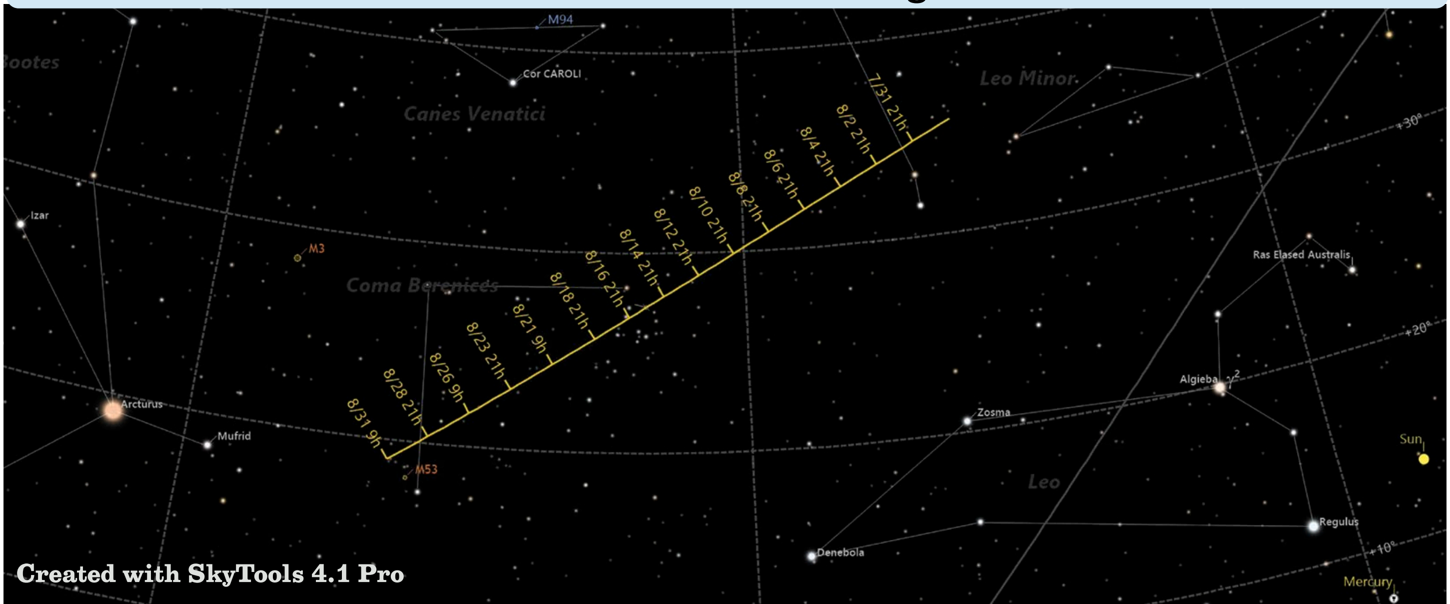
The Lunar 'X'

On August 11 sometime around 7:30 to 8:30 pm MDT see if you can spot the lunar 'X'. The "X" appears northeast of crater Werner when the rising sun first lights up the rims of craters Blanchinus, La Caille, and Purbach while the surrounding areas are still in darkness. Observation of the lunar 'X' has no science value but it is fun to do. Next sighting opportunities are Oct 9 around 6 pm MDT and Dec 7 around 7 pm MST.



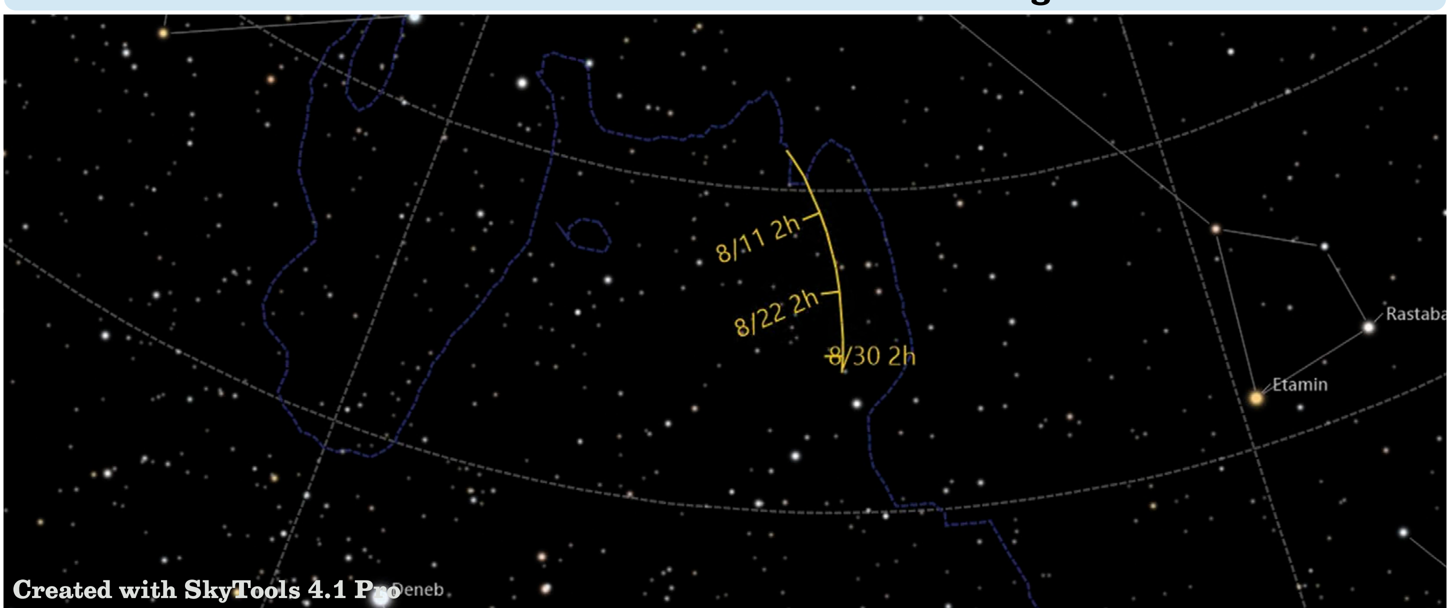
Above image simulation created for 8 pm MDT August 11 (02:00 August 12 UTC) with the NASA Scientific Visual Studio's Moon Phase and Libration Tool. See https://svs.gsfc.nasa.gov/5187/

Comet 13P/Olbers in August



Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Aug. 1	9:47pm	11h24m07.1s	+34°10’16”	Ursa Major	7.4	4.2
Aug. 7	9:38 pm	11h50m58.8s	+31°17’37”	Ursa Major	7.7	4.1
Aug 13	9:28 pm	12h15m51.4s	+28°12’46”	Coma Berenices	8.1	4.1
Aug. 19	9:17 pm	12h38m49.8s	+25°01’32”	Coma Berenices	8.5	4.0
Aug. 25	9:08 pm	13h00m04.5s	+21°48’48”	Coma Berenices	8.9	3.8
Aug. 31	8:57 pm	13h19m46.0s	+18°38’41”	Coma Berenices	9.3	3.7

Comet C/2021 S3 (PanSTARRS) in August



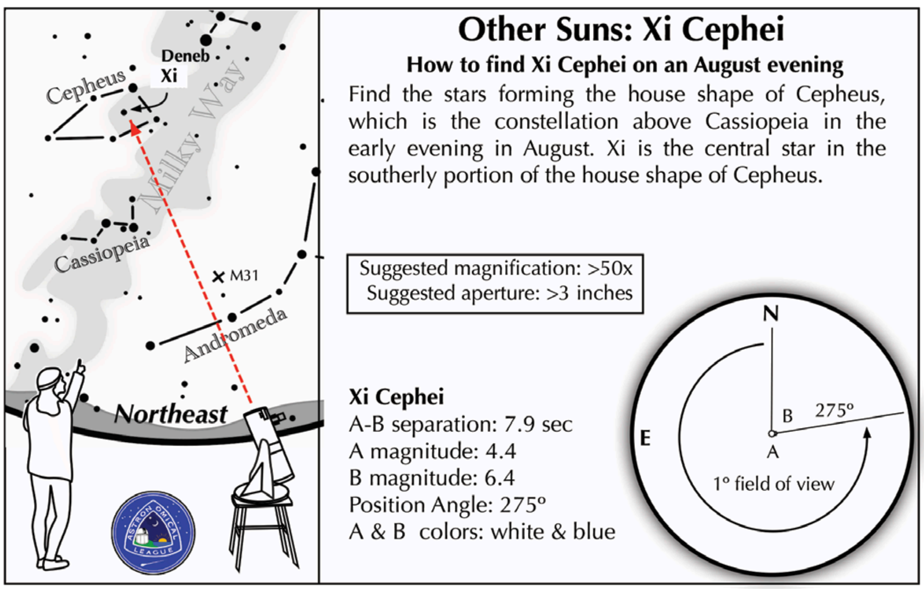
Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Aug. 1	11:47 pm	19h32m55.1s	+61°00’48”	Draco	13.4	1.5
Aug. 7	11:18 pm	19h27m55.6s	+59°58’54”	Draco	13.6	1.5
Aug 13	12:20 pm	19h24m11.8s	+58°45’56”	Draco	13.7	1.4
Aug. 19	Not visible					

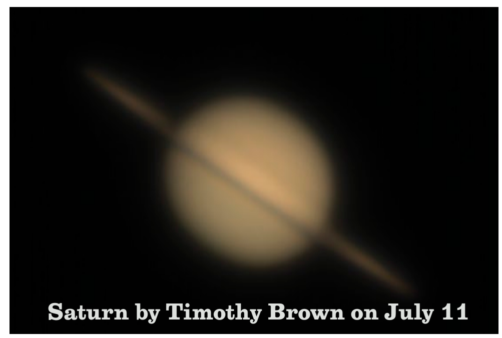
Showpiece Objects in August

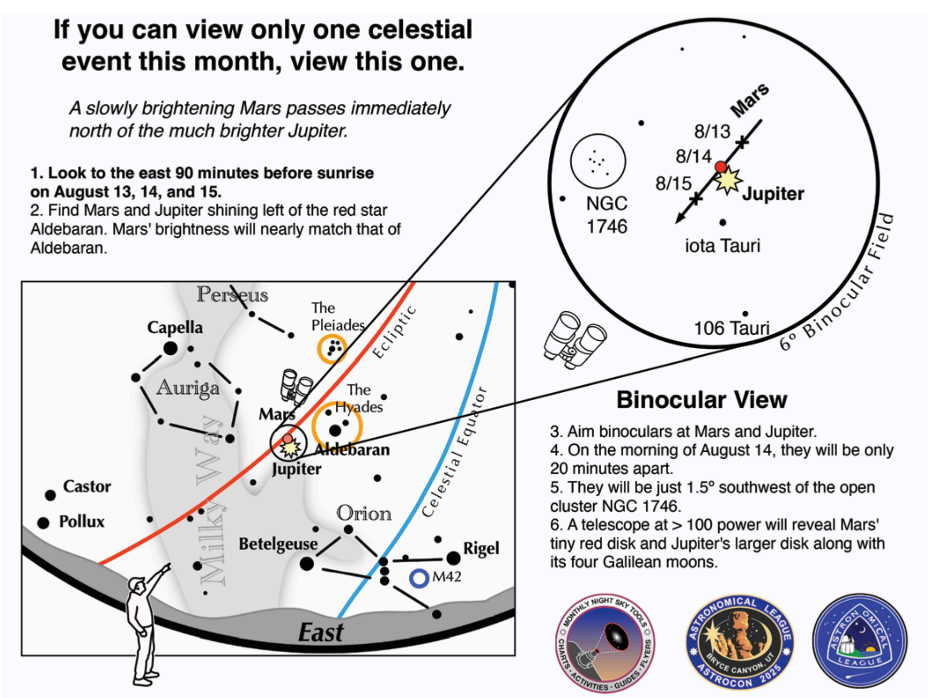
Some early evening objects for mid August:

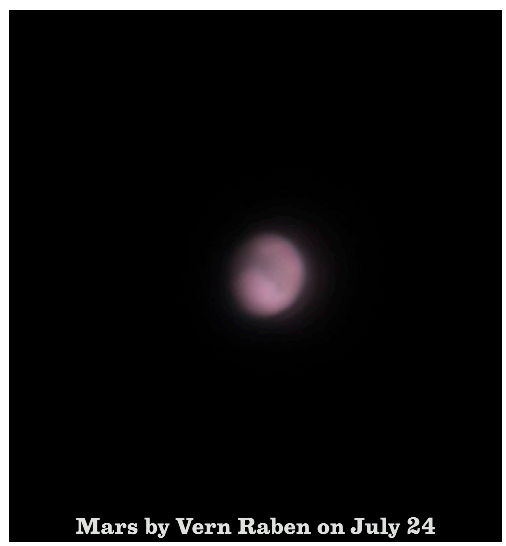
- M 5 globular cluster in Serpens, mag 5.7+
- M 3 globular cluster in Canes Venatici, mag 7.7
- M 81 “Bodes” spiral galaxy in Ursa Major, mag. 7.8+
- M 101 “Pinwheel” spiral galaxy in Ursa Major, mag 8.4+
- M 51 “Whirlpool” spiral galaxy in Ursa Major, mag 8.7
- M 82 “Cigar” irregular galaxy in Ursa Major, mag 9.0
- NGC 5053 globular cluster in Coma Berenices, mag 9.0
- M 106 spiral galaxy in Canes Venatici, mag 9.1
- M 104 “Sombrero” galaxy in Virgo, mag 9.1
- NGC 5466 globular cluster in Bootes mag 9.2
- M 63 “Sunflower” galaxy in Canes Venatici, mag 9.2
- M57 “Ring” Nebula in Lyra, mag 9.4
- NGC 5634 globular cluster in Virgo mag 9.5
- M87elliptical galaxy in Virgo mag 9.6
- M 97 “Owl” nebula in Ursa Major, mag. 9.7
- NGC 4490, “Cocoon” galaxy in Canes Venatici, mag 9.8
- M 86 “Makarian’s chain of galaxies” in Virgo, mag 9.8
- NGC 2683 spiral galaxy in Lynx, mag 10
- NGC 3115, “Spindle” galaxy in Sextans, mag 10.0
- NGC 4565, “Hockey stick” galaxy in Coma Berenices, mag 10.1
- M 96 spiral galaxy in Leo, mag 10.1
- M 88 spiral galaxy in Coma Berenices, mag 10.2
- NGC 4244 “Silver Needle” galaxy in Canes Venatici, mag 10.4

ASTRONOMICAL LEAGUE Double Star Challenge




Saturn by Timothy Brown on July 11

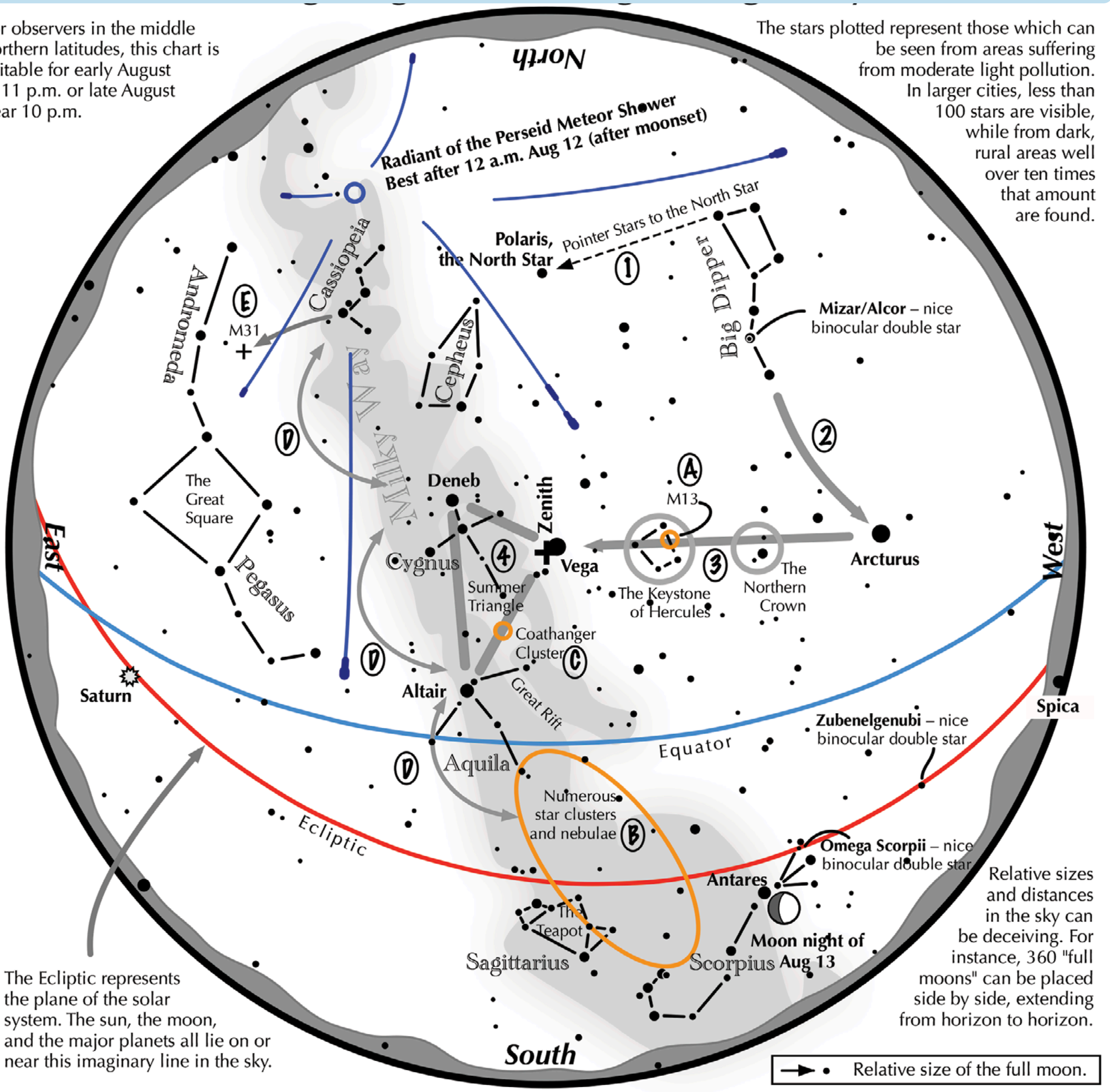



Mars by Vern Raben on July 24

Navigating the mid August Night Sky by John Goss

For observers in the middle northern latitudes, this chart is suitable for early August at 11 p.m. or late August near 10 p.m.

The stars plotted represent those which can be seen from areas suffering from moderate light pollution. In larger cities, less than 100 stars are visible, while from dark, rural areas well over ten times that amount are found.



The Ecliptic represents the plane of the solar system. The sun, the moon, and the major planets all lie on or near this imaginary line in the sky.

Relative sizes and distances in the sky can be deceiving. For instance, 360 "full moons" can be placed side by side, extending from horizon to horizon.

Navigating the mid August night sky: Simply start with what you know or with what you can easily find.

1. Extend a line north from the two stars at the tip of the Big Dipper's bowl. It passes by Polaris, the North Star.
2. Follow the arc of the Dipper's handle. It intersects Arcturus, the brightest star in the June evening sky.
3. To the northeast of Arcturus shines another star of the same brightness, Vega. Draw a line from Arcturus to Vega. It first meets "The Northern Crown," then the "Keystone of Hercules." A dark sky is needed to see these two dim stellar configurations.
4. High in the East lies the summer triangle stars of Vega, Altair, and Deneb.

Binocular Highlights

A: On the western side of the Keystone glows the Great Hercules Cluster.
B: Between the bright stars Antares and Altair, hides an area containing many star clusters and nebulae.
C: 40% of the way between Altair and Vega, twinkles the "Coathanger," a group of stars outlining a coathanger.
D: Sweep along the Milky Way for an astounding number of faint glows and dark bays, including the Great Rift.
E: The three westernmost stars of Cassiopeia's "W" point south to M31, the Andromeda Galaxy, a "fuzzy" oval.

July 18 LAS Meeting Notes by Eileen Hall-McKim

I. Introduction

The July 2024 LAS monthly meeting was held in-person and by zoom on July 18th at the Longmont Lutheran Church, 803 Third Ave. President Vern Raben began the meeting with self-introductions of members attending in person and those on zoom. Twelve members attended in-person, twelve attended on-line.

II. Main Presentation

Our guest speaker for the July meeting was Dr. Paul Hayne. Paul is an associate professor of astrophysical and planetary sciences at the University of Colorado Boulder. He directs the Exploration of Planetary Ices and Climates (EPIC) group at CU's Laboratory for Atmospheric and Space Physics (LASP). He earned his B.S. and M.S. degrees from Stanford University, and his Ph.D. from UCLA. Prior to joining LASP, Dr. Hayne was a research scientist at NASA's Jet Propulsion Laboratory, where he served in a variety of mission science roles, including as an Investigation Scientist for Europa Clipper. He is a Co-Investigator on several active NASA missions, and is Principal Investigator for the Lunar Compact Infrared Imaging System (L-CIRiS), a heat-sensing camera planned for deployment near the south pole of the Moon as part of NASA's Commercial Lunar Payload Services program.

The New Age of Exploration and Science at the Poles of the Moon
By Dr. Paul Hayne

The moon holds a special place in our hearts for a lot of us, the first time we looked though a telescope at the Moon especially at certain phases and first look at the craters in vivid detail. In this way, different from other astronomical bodies that we look at. Similarly, the moon holds a special place in astronomy and planetary science. The moon is a place we have visited with human astronauts, have collected samples, studied in detail with orbiting spacecraft, so we have a better understanding of the Moon than most other planetary bodies in our solar system. A lot of the same processes we see such as impact cratering on the Moon we find elsewhere such as on Mars and even out to the outer solar system and probably beyond.

Image of the Moon in lunar eclipse (Paul Hayne) studies and images the Moon during lunar eclipses at infrared wavelengths. We can learn a lot about the lunar surface by watching how it cools during the lunar eclipse, this can be done now with amateur astronomy equipment.

Earth rise, Apollo 8, December 24, 1968

One of the most famous images in human history and one of most famous in space exploration, this is the Earth rise above the rim of the Moon, from the Apollo 8 spacecraft in orbit at the Moon, one of first images taken in space by a human being.

A Most Extraordinary Eclipse (As viewed on return of Apollo 12) Acrylic painting on aircraft board. Alan Bean – Painted view he saw after return to Earth, completed 2001. Bright spot in center is full moon reflecting off of Earth's oceans back to the spacecraft. The Sun is behind Earth, can see ring of fire around rim of Earth which is sunlight shining through Earth's atmosphere, being refracted by the atmosphere on all sides, perpetual sunset all around, this tells us something about the composition of the atmosphere, flashes of lightning also seen.

A New Wave of Lunar Exploration

Artists impression of what the next wave of Moon exploration by astronauts on the Moon's surface might look like though NASA's Artemis program, collecting samples, doing experiments – doing science, the underlying driving principle of NASA that science is an integral part.

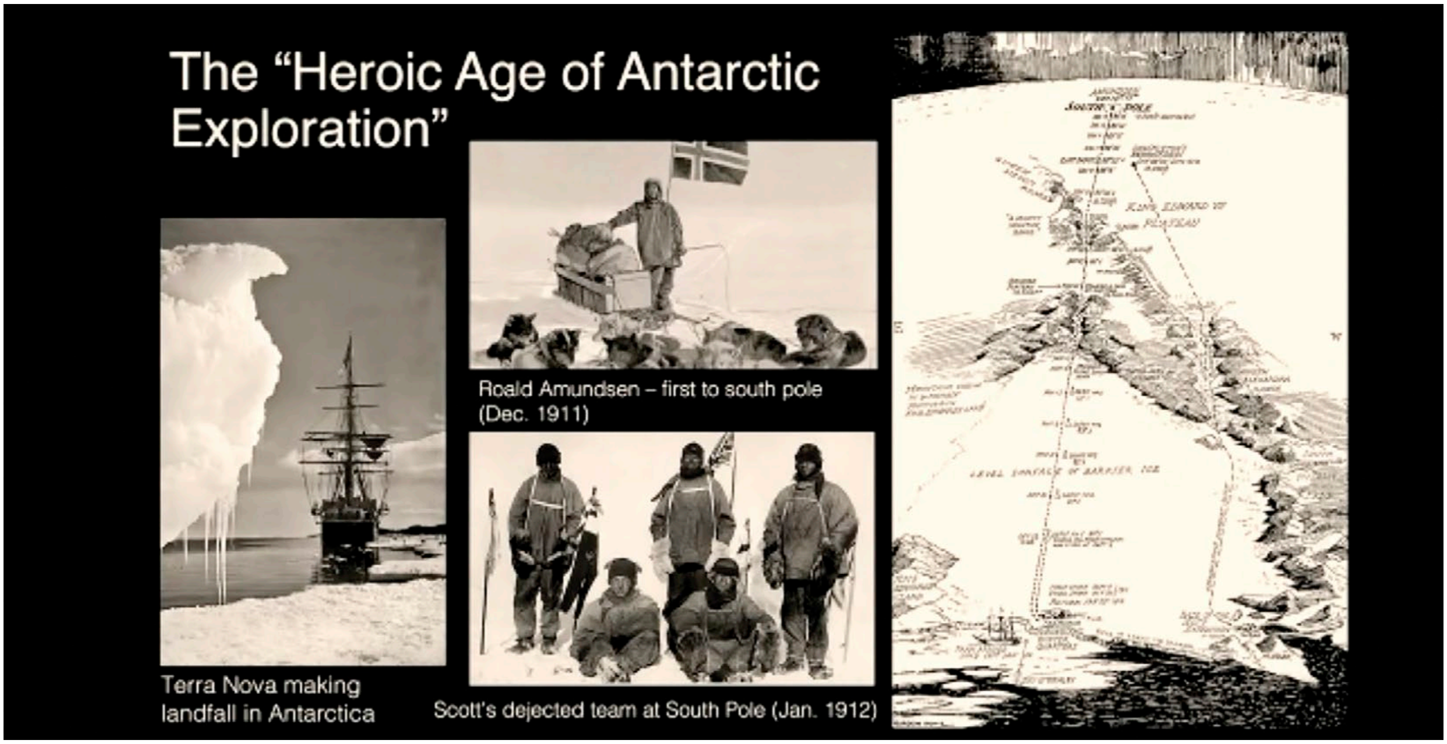
Overview of Artemis Mission

The polar regions of planets are special, because they contain the most sensitive, yet often long-lived climate records. NASA has chosen the south pole of the Moon as target landing site and eventual Artemis base camp. Why? Polar regions are typically cold and contain substances that are not stable elsewhere on the planet and therefore they record past climate history, that is true on our planet also through the study of past climates by analyses of ice cores.

- Condensed volatiles are tracers of climate change – otherwise, they wouldn't be there
- Composition, amount, and location of condensed volatiles provides information on the thermodynamic conditions during a past climate regime
- Time is a critical variable, as is temperature, what is timescale over which the climate has varied? (ice = shorter timescales than rocks)
- The current "race" to the lunar south pole is predicated on the existence of ice. There is still much we do not know about the abundance, location, accessibility and origins of ice on the Moon, will attempt to answer these questions with Artemis mission

The "Heroic Age of Antarctic Exploration"

- Early Antarctic exploration financed through combination of public donations and government grants (e.g., Royal Navy and Royal Geographic Society)
- Equivalent cost of ~$0.50/capita in todays dollars (0.01% GDP of UK in 1910)
- Equivalent to ~ $2 Billion in term of today's dollars
- There was a "race to the poles" by countries to be first to plant flag there

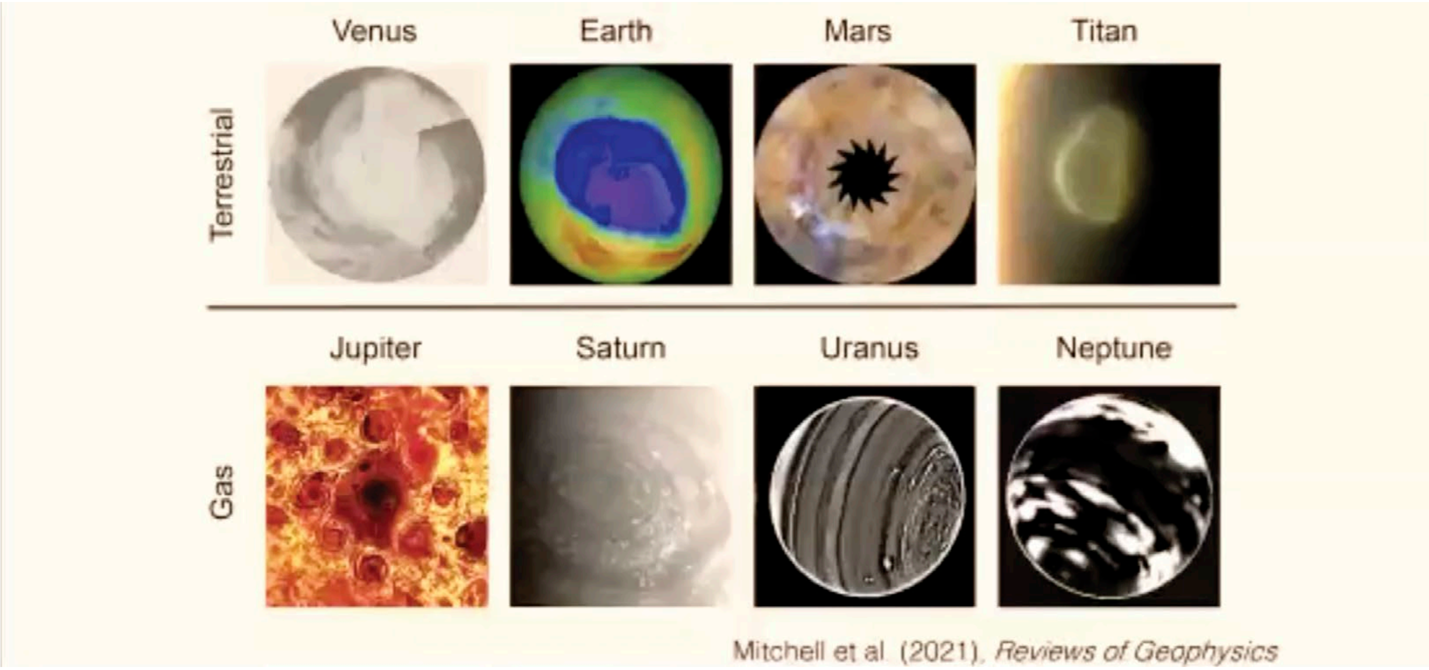


- Map shows routes of the final race to the South Pole, two parties led by Amundsen from Norway and Scott from England
- Terra Nova making landfall in Antarctica
- Raold Amundsen – first to south pole (Dec. 1911)
- Scott's dejected team at South Pole (Jan. 1912) Amundsen first there by two weeks, didn't know until they got close and saw the flag already there
- Polar explorers were like astronauts, similar to outer space at the time, facing unimaginable conditions; encountering many experiences that could not be planned for. Book "Worst Journey in the World" a fascinating first-hand account of the Scott journey to the pole

(Eleanor Lutz) Ice Growth and Decay of Glacial Cycles Over Geological Time

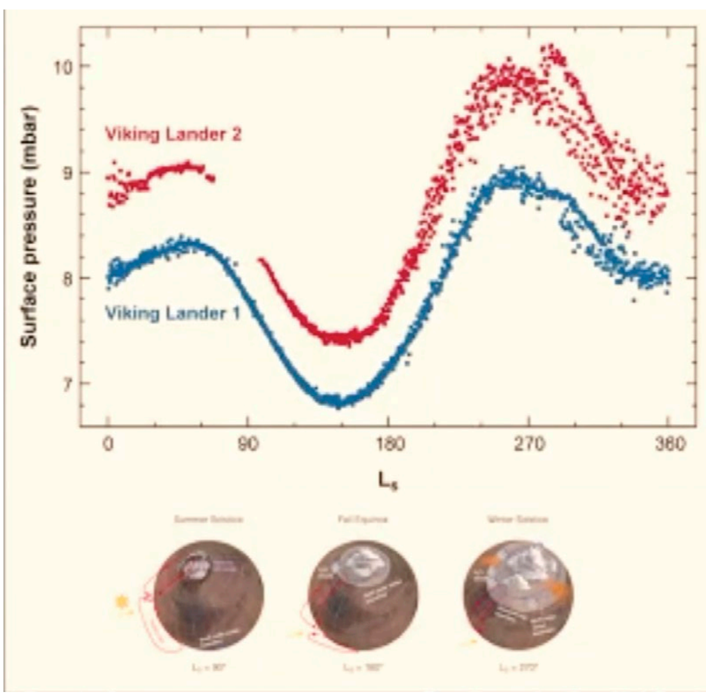
Why do we chose to explore the poles?

- Coldest regions of terrestrial planets control many aspects of the planets climate, such as Milankovitch cycles and glaciation; Mars CO2 and H2O cycles
- Glacial cycles on Earth are the main climate cycle our planet experiences in deep geological time; driven by changes in amount of sunlight received by the polar regions known as (Milankovitch cycles)
- Our climate is more or less controlled by what happens at the poles, that is why there is so much concern about the rapidly rising temperatures in the high latitudes which has an outside influence on the rest of the planet
- On Earth the polar ice deposits extend back 10s of thousands of years, these layers record not only variations in amount of ice accumulation, but also past atmospheric conditions, so can measure the temperature of ocean from which the water came that ended up in these deposits
- Often the poles most inaccessible and inhospitable regions for human exploration



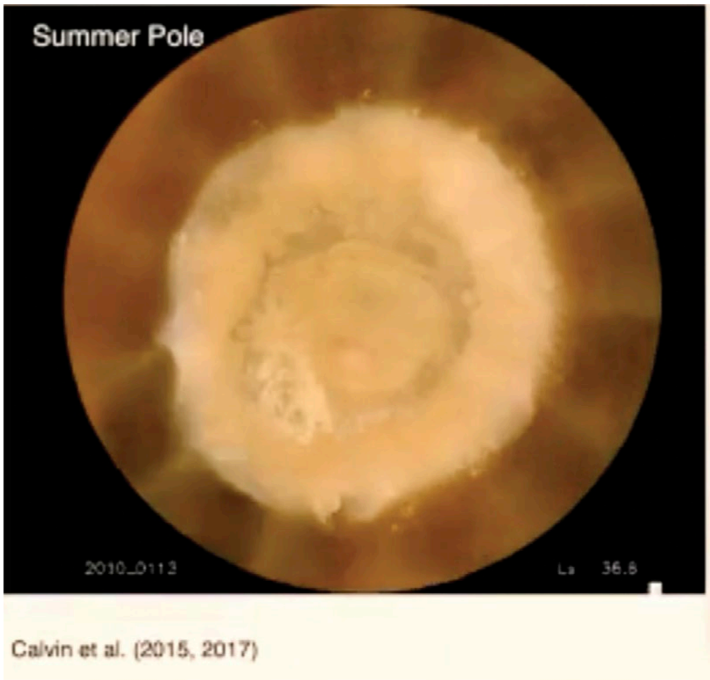
Polar Atmospheres in the Solar System - Mitchell et al. (2021) Reviews of Geophysics
Polar regions of some of planets and moon in our solar system. All these planets with atmospheres also have well-defined polar vortices.

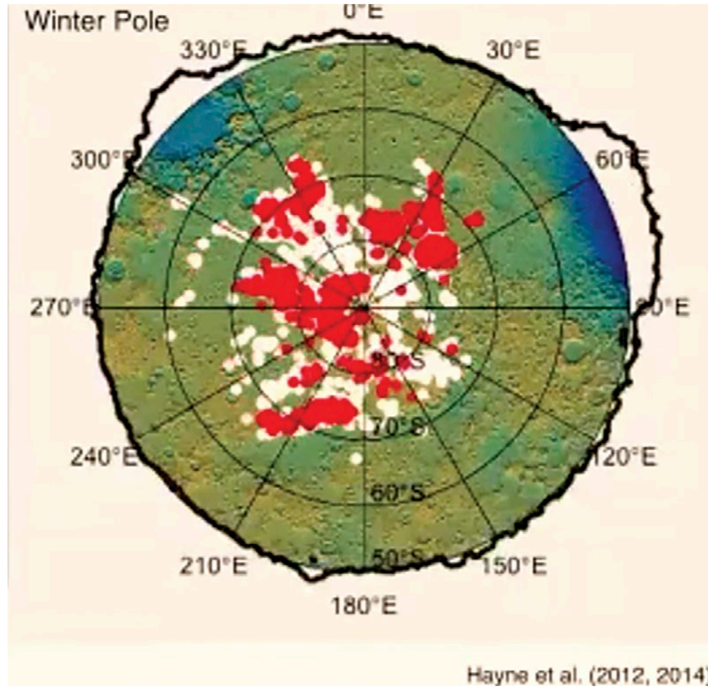
- Polar vortex confines cold air over the polar region which allows for the condensation of volatiles like water
- The spin/axis tilt (obliquity) of the planet controls how much sunlight the pole receives, and therefore how cold/warm it can get, effecting the climate of the rest of the planet



Cold Traps and Climate

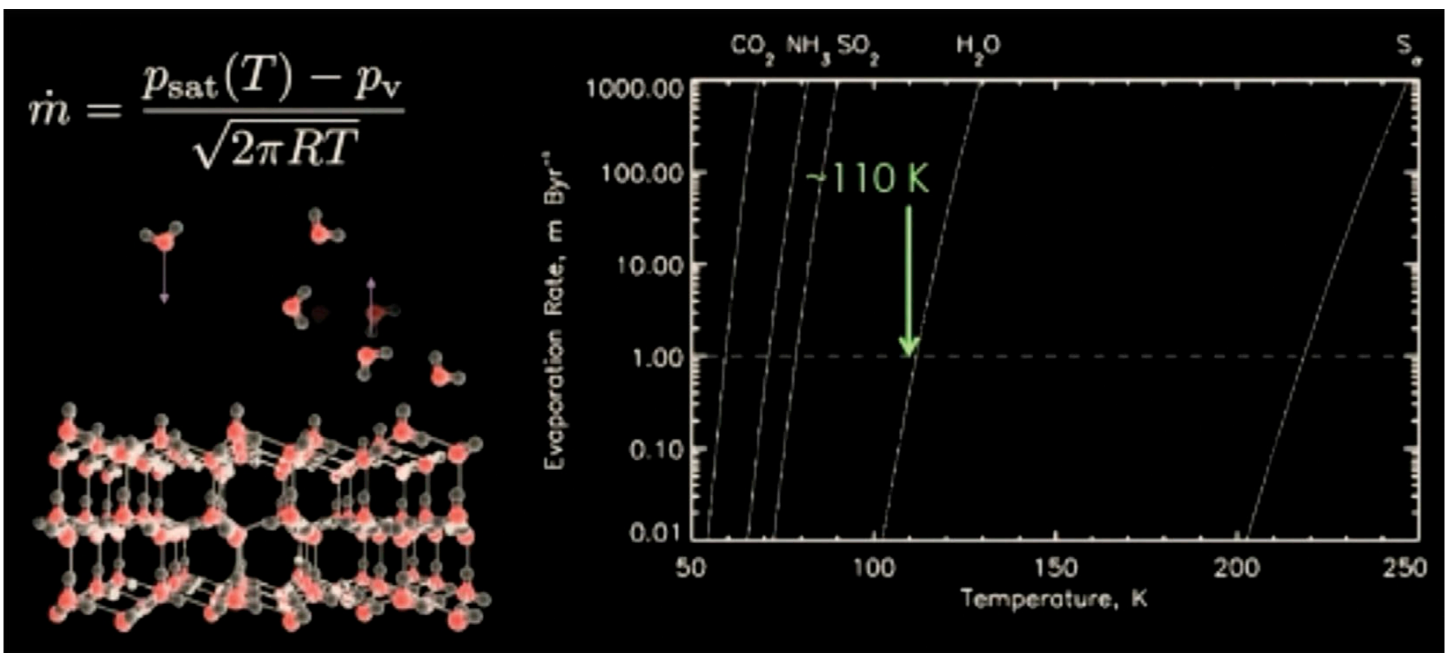
Mars is a special case where the polar regions are so active, the temperature cycles so extreme, that the atmosphere freezes out on the surface and 30% of the atmospheric mass is exchanged between the polar caps and the atmosphere seasonally. The curves measured by Viking landers show atmospheric pressure over a Mars year, the variation in surface pressure is global in nature because atmospheric CO2 is condensing and re-sublimating back into atmosphere.





Has many interesting consequences for the weather on Mars, receding North Polar seasonal ice caps, see dust storms kicking up and all kinds of cyclonic and baroclinic behavior.

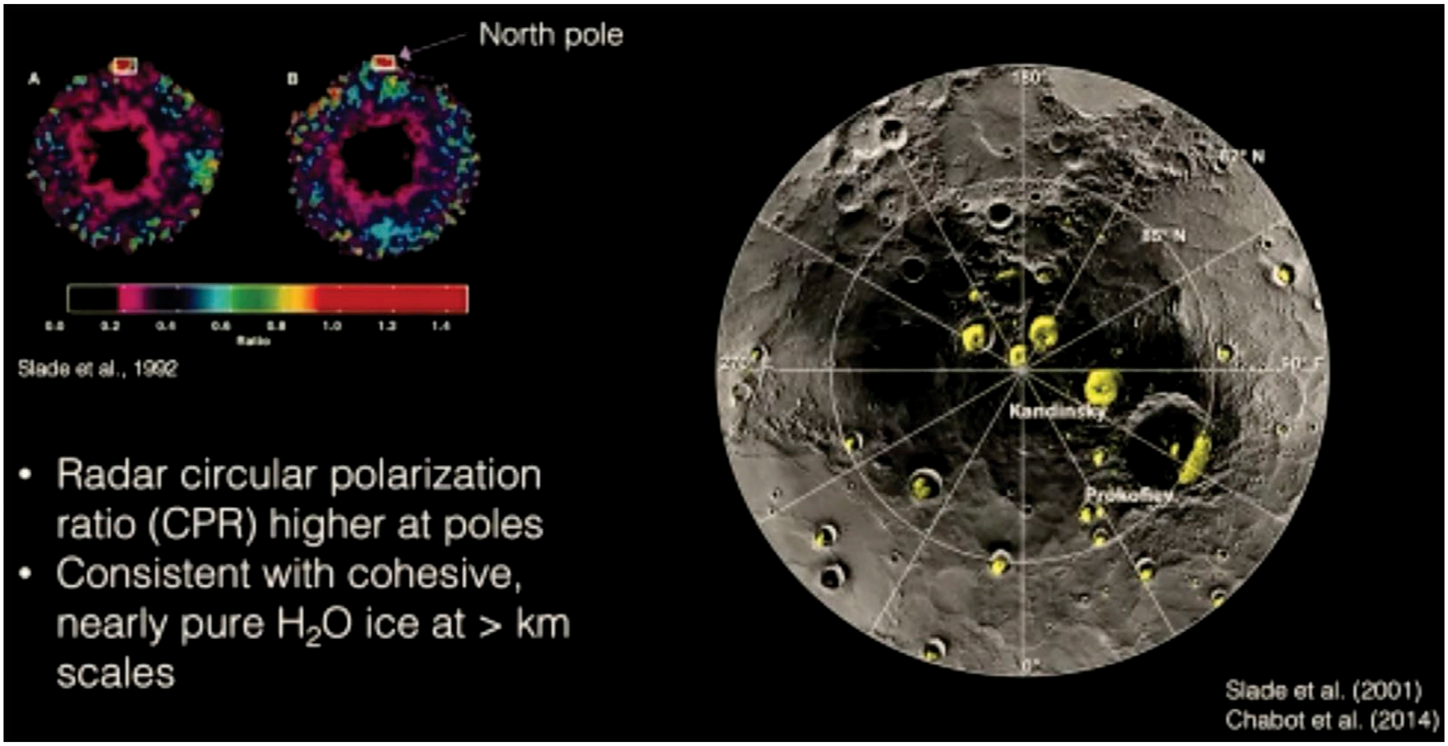
Volatile Stability and Temperature



X-Axis = Temperature   Y-Axis = Evaporation Rate

- Mass loss is proportional to the saturation vapor pressure (Psat)
- As you increase temperature; the vapor pressure goes up exponentially
- If no atmosphere to confine the vapor coming off that solid that's being lost to space, end up with stability curve
- On left side of curve water like a rock, on right side water gone. Very sharp boundary between stability and instability, through a bucket of ice on surface of Moon, goes nowhere at night, in daytime temperature rises, ice disappears immediately

Ice Discovered on Mercury



This led to prediction that was born out, related to Moon, but first verified on Mercury.
Because of Moon's spin axis orientation, has rings of permanent shadows at its poles. Mercury does too, temperature cold enough there that any water that accumulates will never go away.

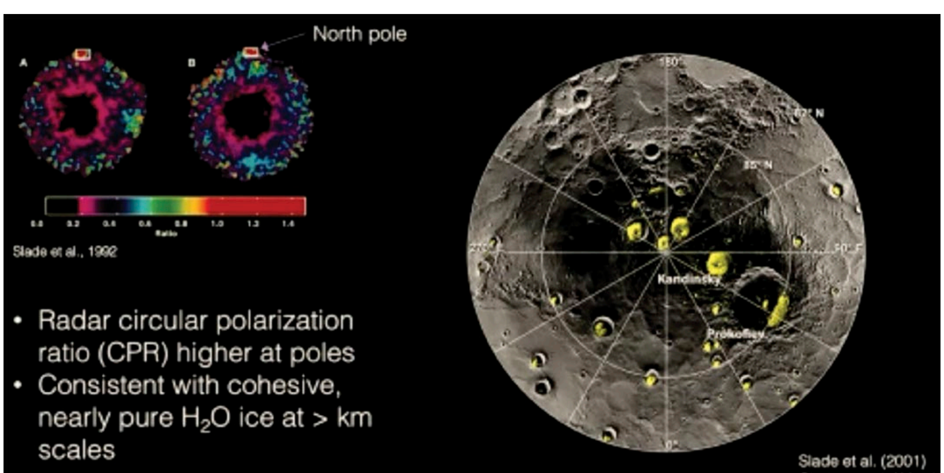
Upper left:

- First radar signals bounced off Mercury, from Goldstone Observatory, bright reflection at North Pole can only be explained by ice (Slade et al. 1992)
- Predicted by Robert Goddard in 1924; scientific papers done in 1960s
- Ice may exist on planet where it really should not be stable
- Mercury has the most extreme temperature range in our solar system of any other body, so unexpected, unless had read old papers

Right:

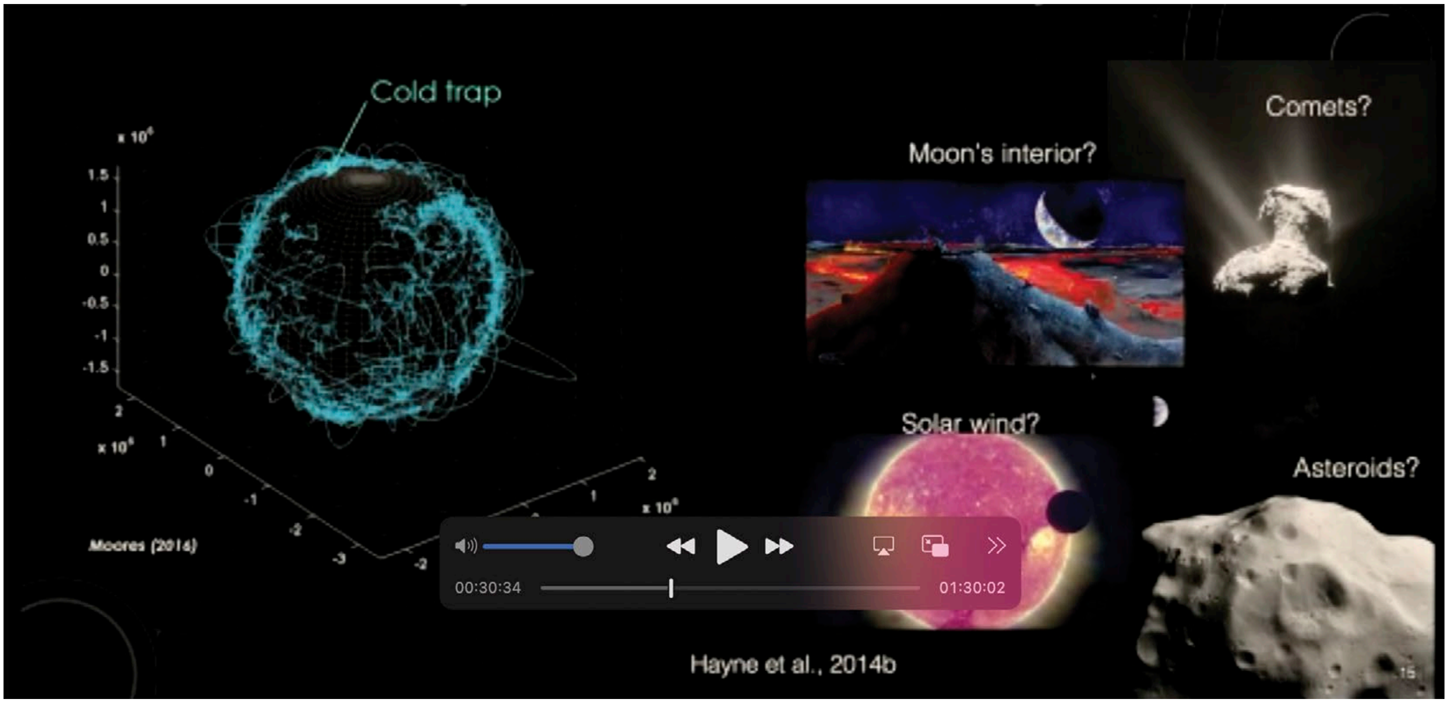
- From Arecibo Telescope in Puerto Rico before its demise - Reflections in yellow of ice deposits, detailed map showing ice deposits exactly where expected (Slade et al. (2001) Chabot et al. (2014)

Ice in the Solar System



- Lead to revolution in ideas about where water should be in the solar system
- Temperature threshold, assumed inner solar system should be dry, outer wet
- What was not expected is whole regions of shadowed ice (tan arrow)
- We don't know how much is there, lead to modeling and plans to explore
- What implications does this have for the delivery of water to Earth?

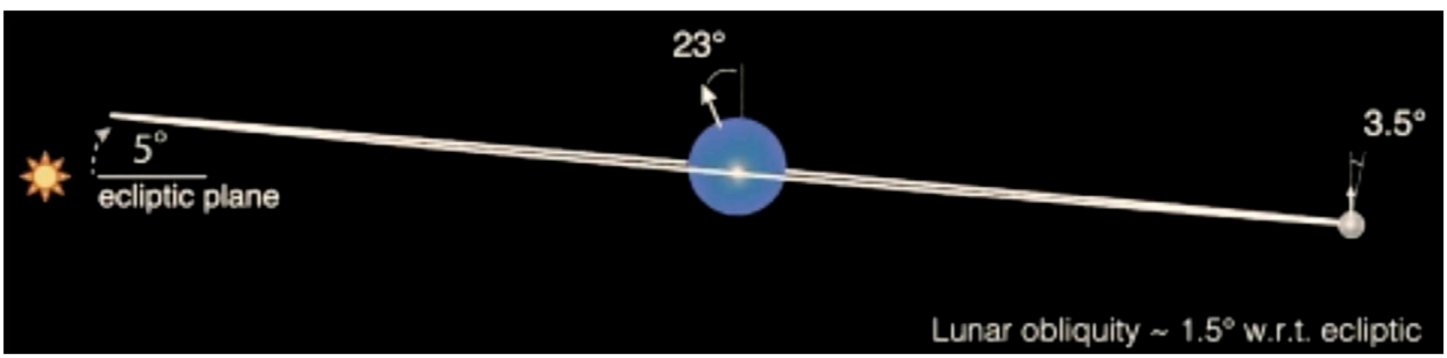
Volatile Delivery to the Earth-Moon System



- How did the Earth-Moon system get its water?
- Earth accreted water as it formed- is possible
- Impacts from comets and asteroids, solar wind
- Moons interior - Moon accreted water as it formed and is contained inside
- Once water is on the Moon, water molecules hop around surface until find place to stick – these know as cold traps

The New Terra Incognita – Searching for Ice at the Poles of the Moon – a place so close but completely unexplored

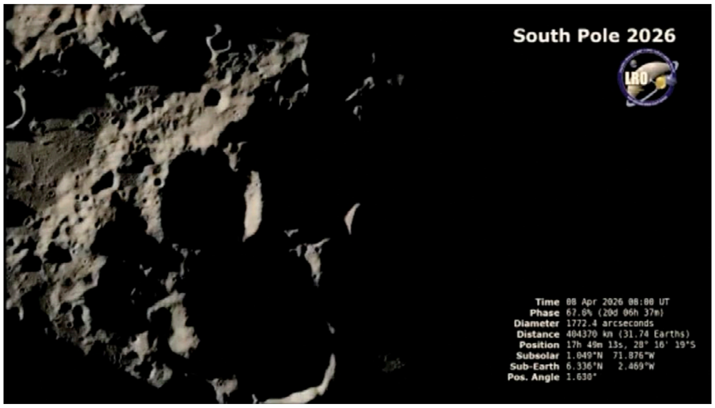
The Moon's Special Orbit

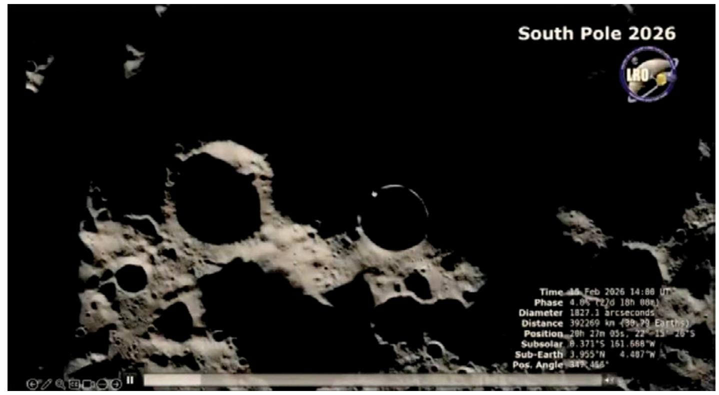


- The Moon's obliquity is 1.5° w.r.t. ecliptic; ecliptic plane 5°
- Earth's tilt 23° – Moon is tilted relative to the Earth and relative to the ecliptic plane
- Cassini State – a resonance that the Moon can get trapped in, there are several of these, it happens to be trapped in one where the tilt exactly cancels the tilt of the orbit around Earth. This was not always the case, the Moon in the past was significantly closer to the Earth and it's tilt would have been quite different

There is a dark side of the moon:

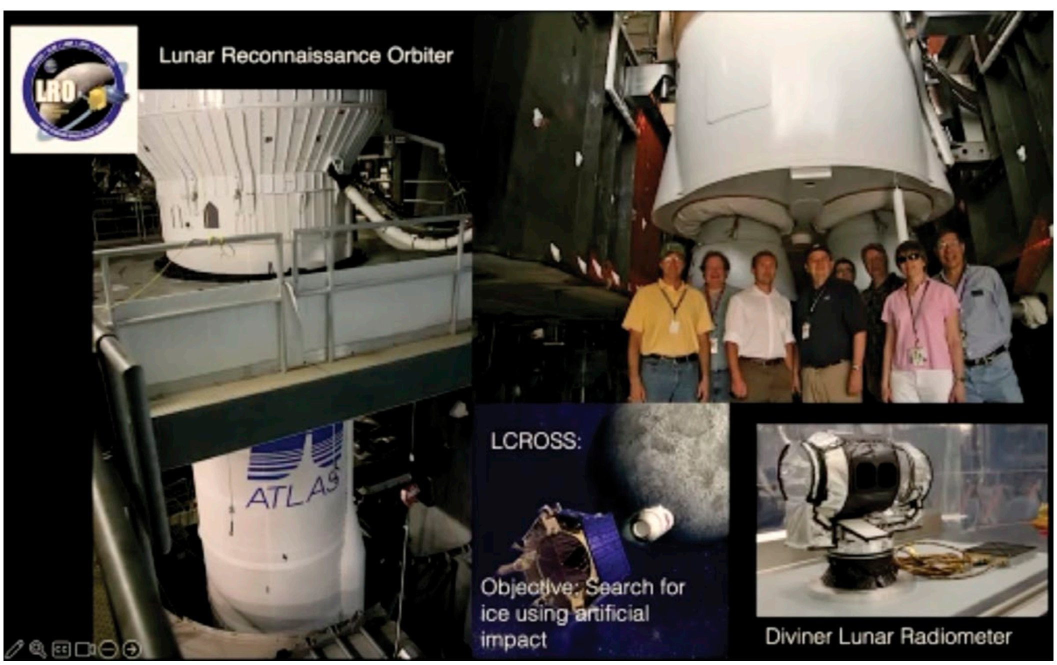
- Not a dark side of the moon but places that have not seen the Sun for 2 billion yrs
- Moon is tidal locked, so we only see one side all the time, but from the perspective of the Sun, can see all sides of the Moon
- There are however permanent dark areas and permanent sunlight, all year round



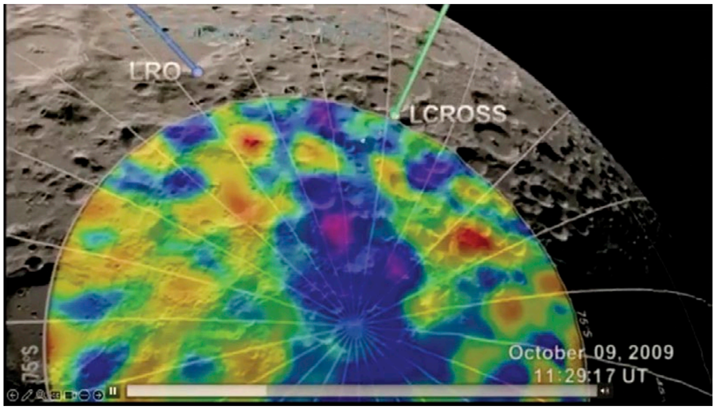


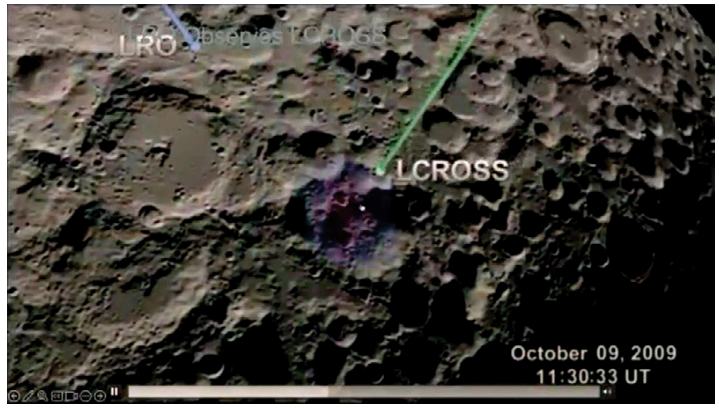
Looking down on South Pole of the Moon (month), can see permanently dark and permanently sunlit areas, large crater is Shackleton. Those that never see Sun, very cold.

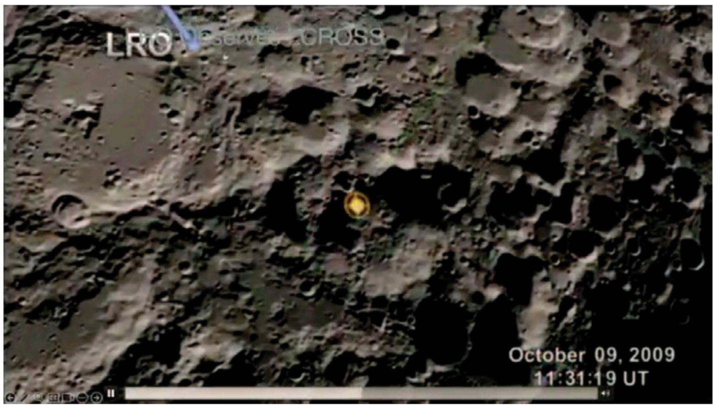
Lunar Reconnaissance Orbiter (LRO)

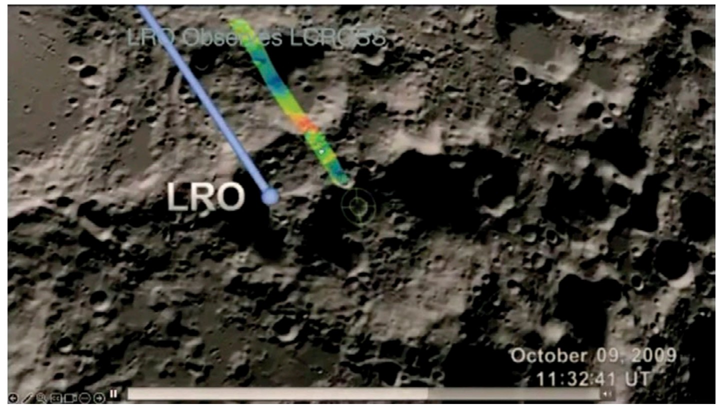


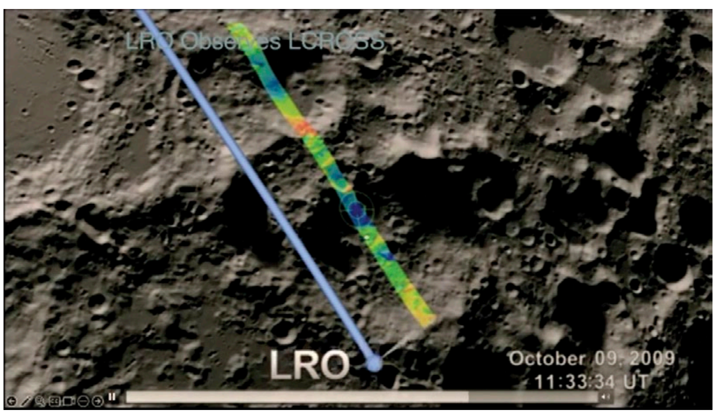
- Infrared imaging system
- Sweeps Moon in swaths of images as it orbits
- Atlas 5 Rocket – all successful launches
- LCROSS mission – Objective: search for ice using artificial impact- purpose was to take ATLAS upper stage and crash into the South Pole into one of the permanent shadows; see if any ice came out of it
- Key measurement was made with this instrument





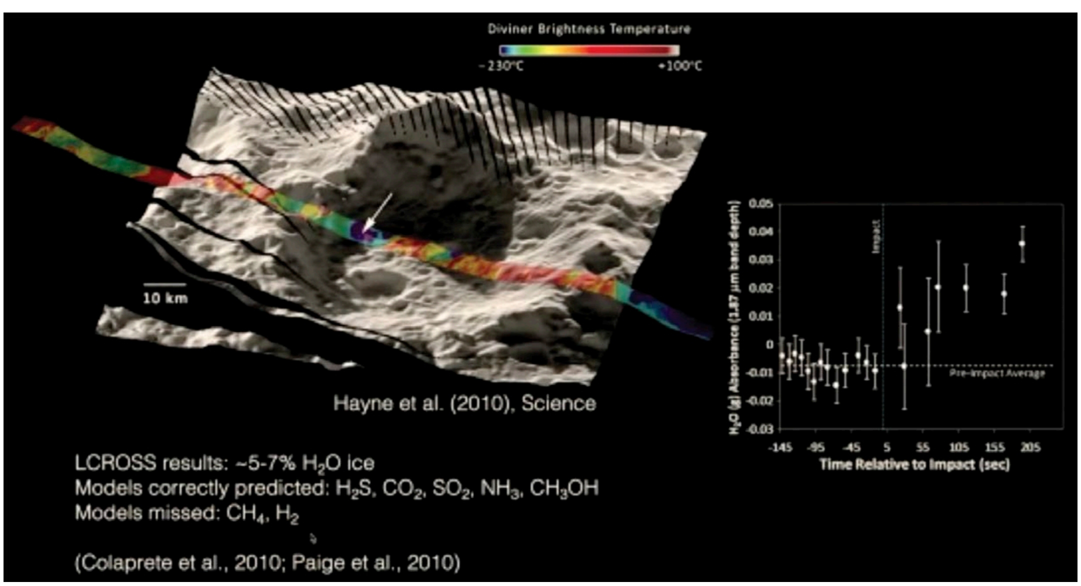






LRO observes – long winding orbit around Earth
LCROSS

- Launched at same time at LCROSS
- Use Diviner programmed to pass over just as impact happens



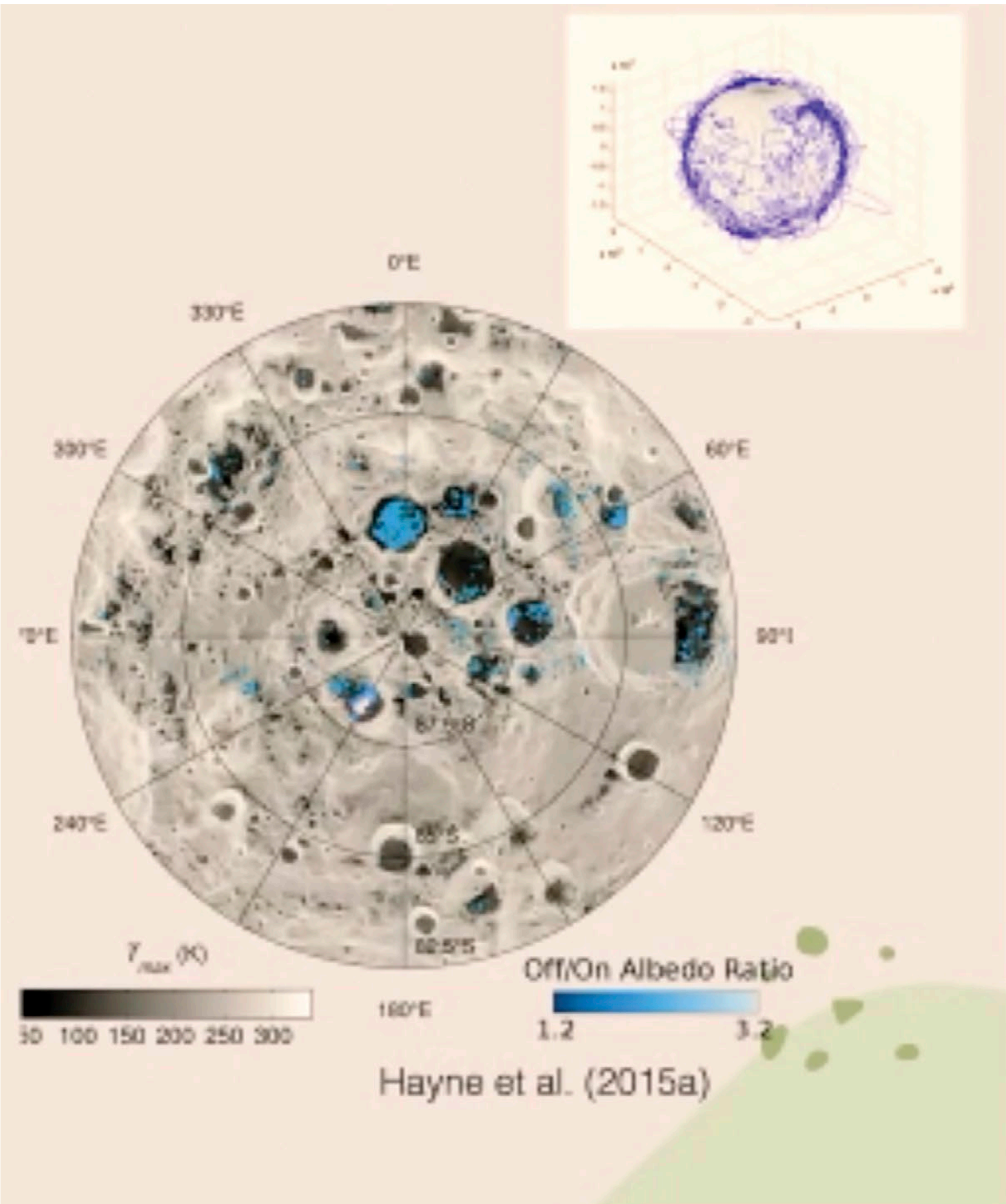
- Swath goes over impact site
- Arrow show glow in thermal infrared left over from impact
- LCROSS results: ~5-7% H2O ice at impact site
- Models correctly pre-dicted: H2S, CO2, SO2, NH3, CH3OH (con-tained in comets)
- Models missed: CH4, H2 (not explained, difficult to understand)

Problems with the Lunar Ice Paradigm

Two paradoxes:
1. Ice should be more uniform and not “patchy”
2. Ice shouldn’t survive in locations where it can be observed
Puzzling - why is the ice even there?

Possible solution: (some problems Paul works on)
1. All ice on the Moon is ancient and mostly buried
2. Water hides in nooks and crannies

Ice Heterogeneity and the Exosphere Problem

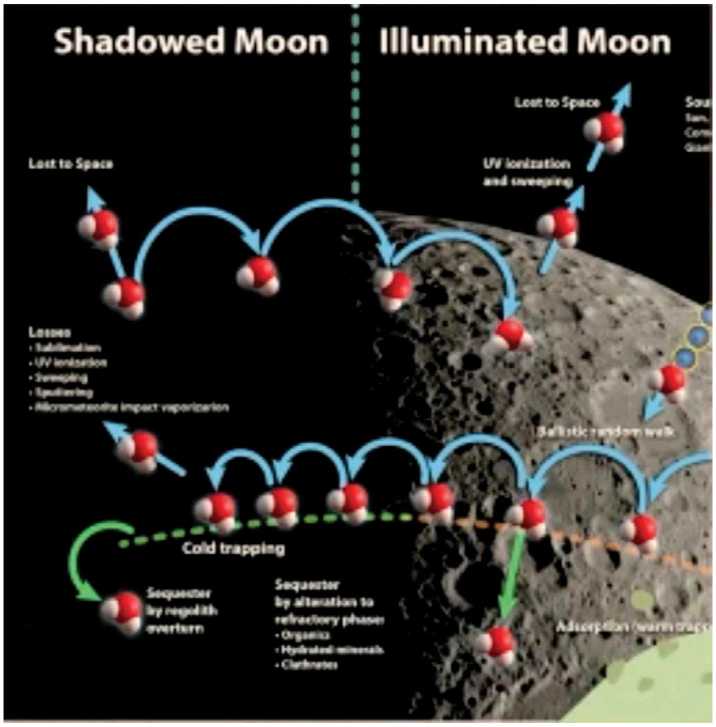


- Image looking down on south pole of the Moon
- Some craters look like not much ice, others do
- Homogeneity expected if (supply rate) > (destruction rate)
- Implies anisotropy in source or loss process
- Suggests supply and destruction of water on the Moon many be close to equilibrium

Problems with the current model:

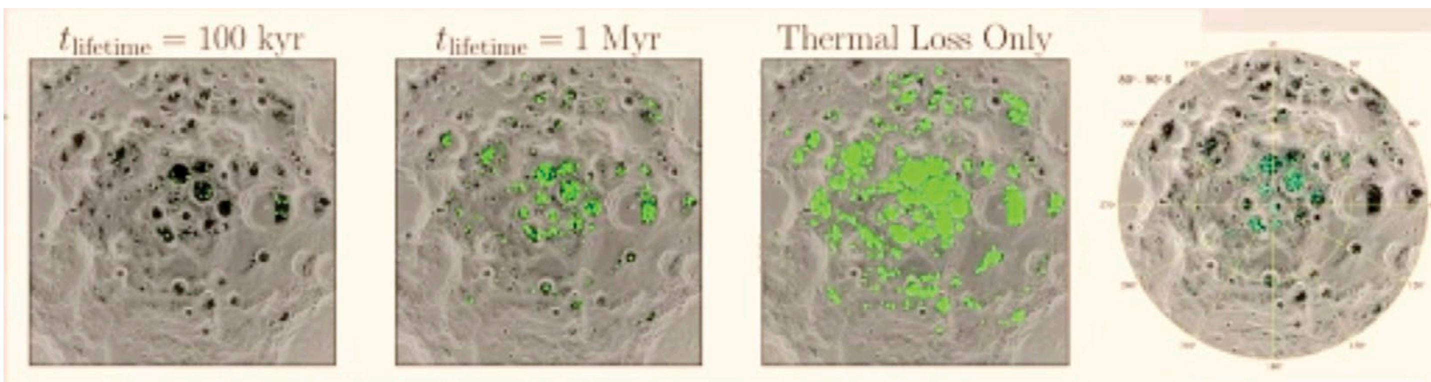
- No significant background water detected in the exosphere, < 6 H2O cm-3 (Benna et al, 2019; Hodges and Farrell, 2022)

The Young Age Problem



- Loss processes dominate over sources
- Photo dissociation dominates within sunlit regions
- Impact vaporization and ejection dominate inside PSRs (Farrel et al, 2019)
- Detection of surficial water ice imply recent accumulation, possibly < 100kyr ago

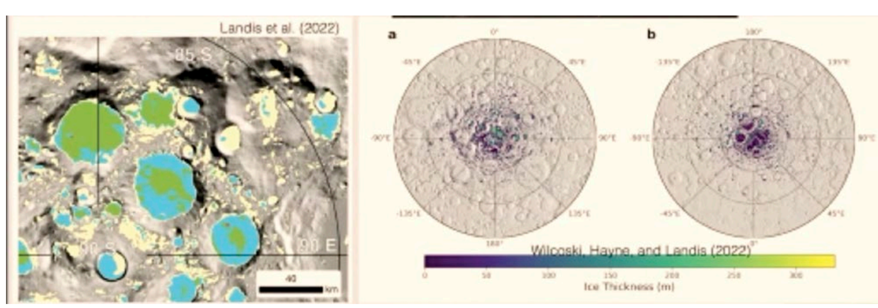
Evidence for Buried Ice



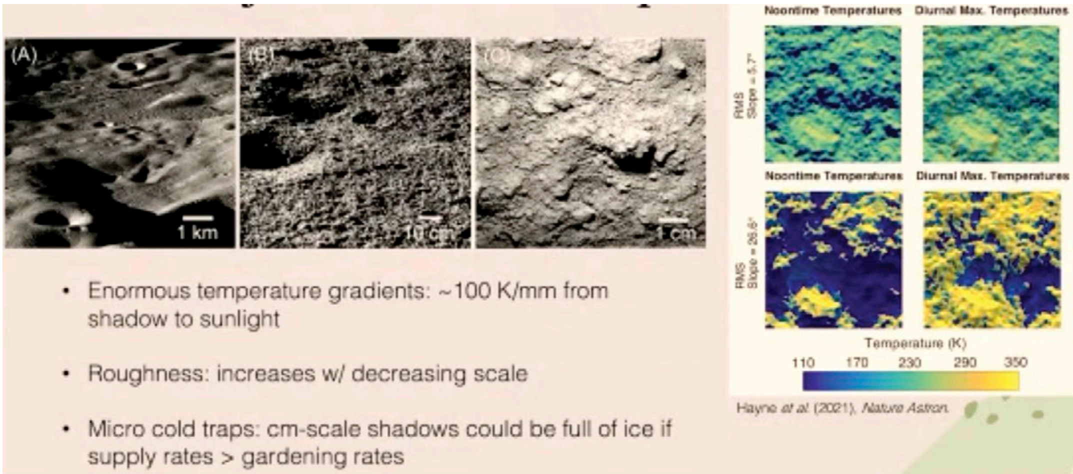
- One possibility is that most ice on the Moon is ancient and buried
- Each frame shows a statistically generated pattern of "ice detections" (green dots)
- For each pixel in the map, the likelihood of detection is equal to the fractional area occupied by surface ice for the local thermal conditions and given time interval (surface ice lifetime)
- The map at right from Li et al. (2018) shows ice detections in cyan, which comprise ~0.05% to 0.25% of cold trap area

Ancient Volcanic Atmospheres?

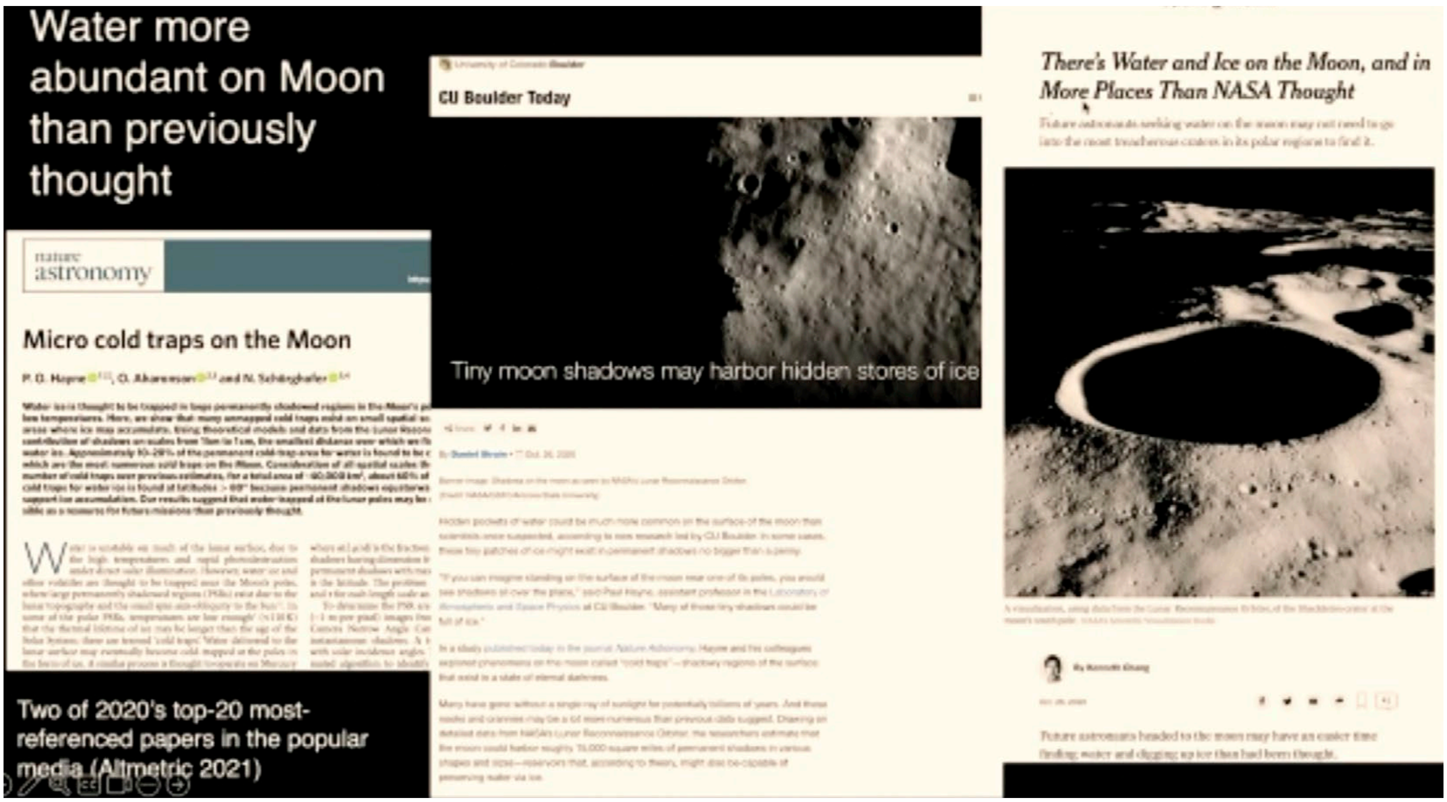
- Volcanic and cometary tracers: sulfur (yellow) water (blue) HCN (green)
- Moon likely had collisional atmospheres lasting ~1-10 kyr, similar surface pressures to present-day Mars
- Water-containing volcanic gas can form ~100-m thick ice ~ 2-4Ga
- Large comet could produce similar results



The Case for "Micro Cold Traps"



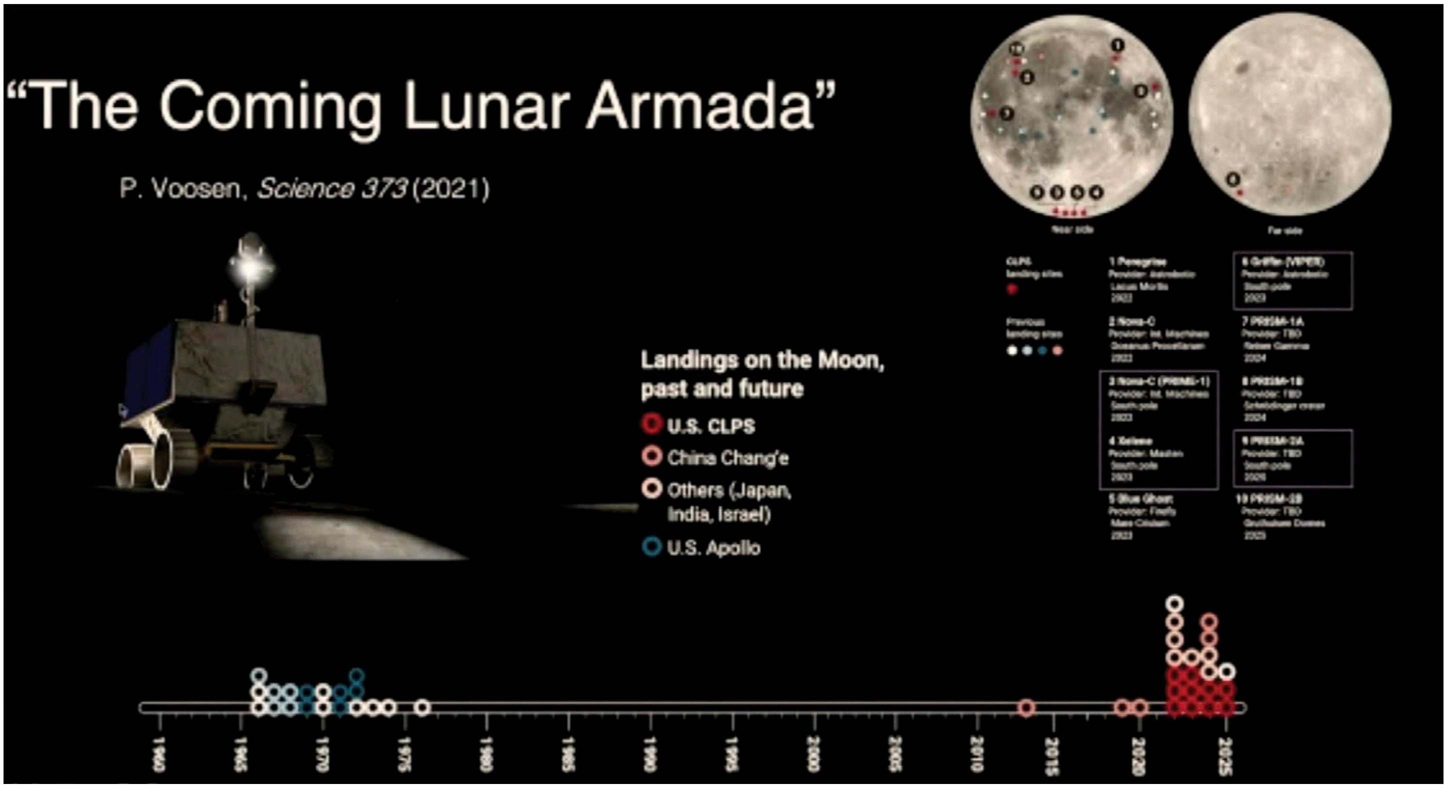
- Enormous temperature gradients: ~ 100K/mm from shadow to sunlight
- Roughness: increases w/ decreasing scale, more places for water to hide
- Micro cold traps: cm-scale shadows could be full of ice if supply rates > gardening rates



Idea gained traction a couple years ago with headlines with 2 of 2020's top-20 most referenced papers in the popular media (Altmetric 2021) New York Times article suggesting there is more water and ice on the Moon and in more places than NASA thought. Not exactly what we said! We said there could be, as there are places that are cold enough, but we don't know if there is water there.

If landing on Moon, what it would look like coming down: fractal behavior, craters of all sizes, could be ice in all those little craters

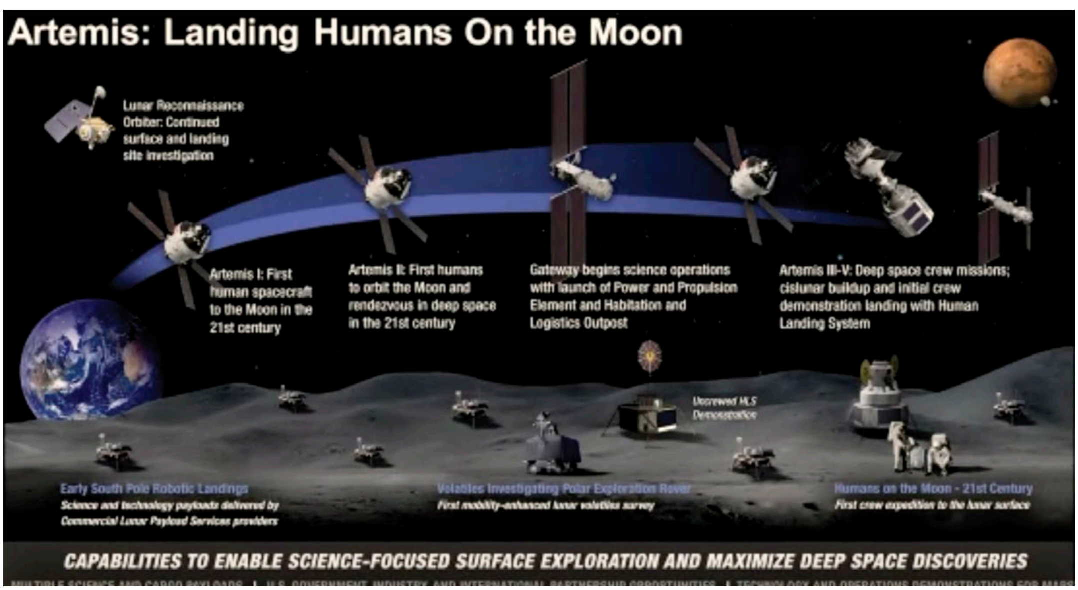
“The Coming Lunar Armada”



Scale showing timeline of Lunar Expeditions beginning in 1960s into 1970s then long hiatus until more recent 2020s with large expeditions planned for 2024-2025.

- Much anticipated Viper mission unexpectedly canceled by NASA July 17, 2024
- Not known why yet, had been completed and delivered

NASA Timeline of Artemis: Landing Humans on the Moon



- Artemis I: First human spacecraft to the Moon in the 21st century- orbits and return
- Artemis II: First humans to orbit the Moon and rendezvous in deep space in the 21st century, orbits the Moon and returns
- Gateway begins science operations with launch of Power and Propulsion Element and Habitation and Logistics outpost
- Artemis III-V Deep space crew missions – Lands at South Pole of Moon

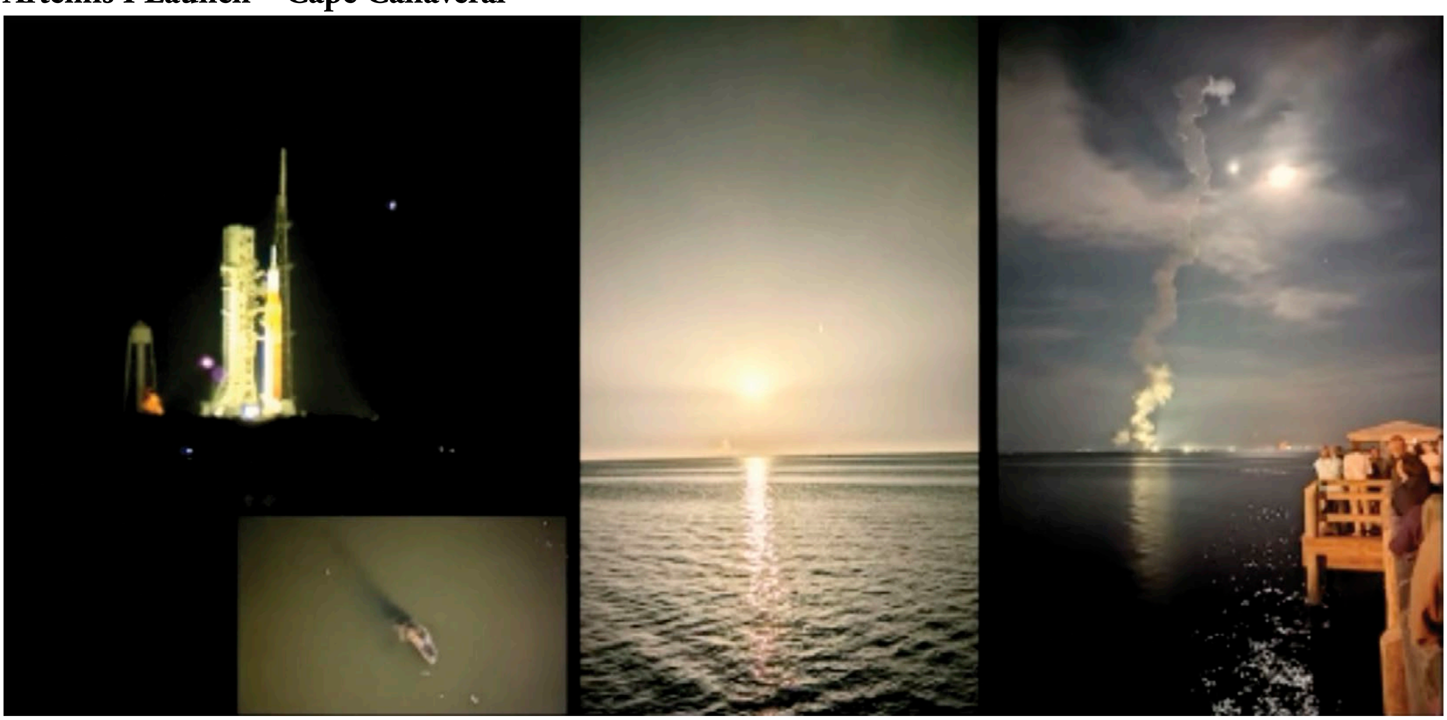
International Efforts

Several other nations embarking on their own Lunar programs. China on path to pass NASA, already landed large uncrewed landers 3-4 times and things NASA hasn't done like brought back samples from far side of the Moon.

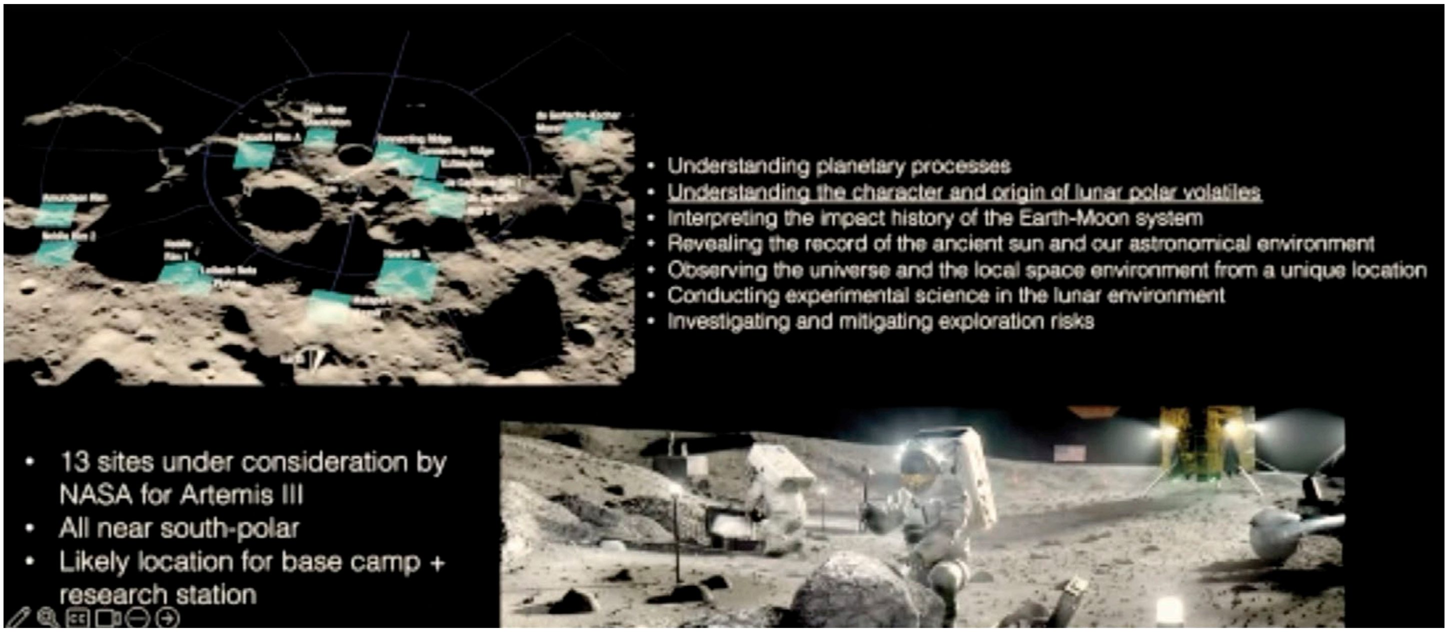
U. S. President's Space Policy Directive-1 (Dec. 2017)

"Lead and innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term explorations and utilization, followed by human missions to Mars and other destinations." NASA sees Moon exploration as stepping stone toward deeper space exploration.

Artemis I Launch – Cape Canaveral



Artemis III + Science Goals

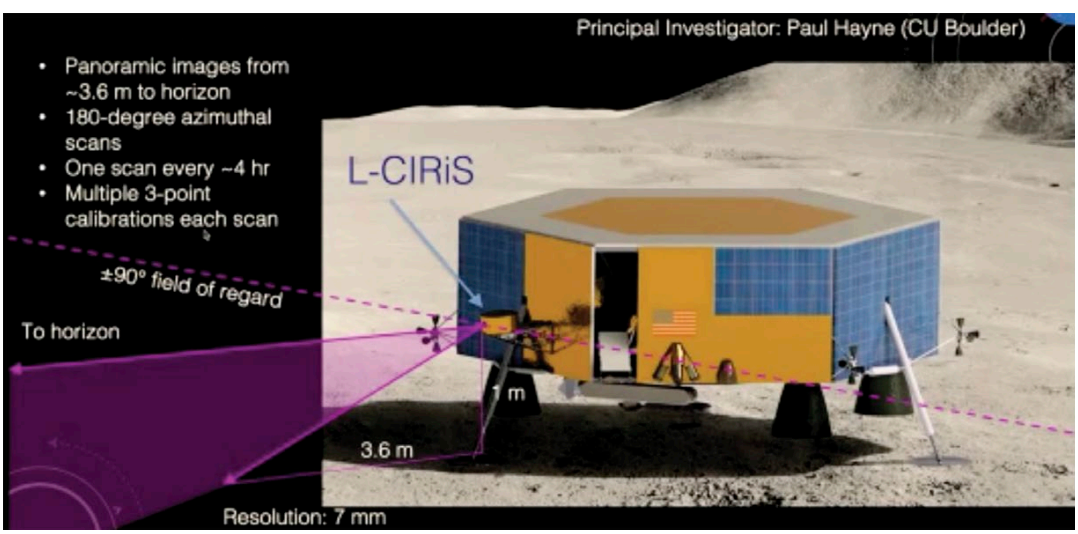


- Understanding planetary processes
- Understanding the character and origin of lunar polar volatiles
- Interpreting the impact history of the Earth-moon system
- Revealing the record of the ancient sun and our astronomical environment
- Observing the universe and the local space environment from a unique location
- Conducting experimental science in the lunar environment
- Investigation and mitigating exploration risk

Landing Sites

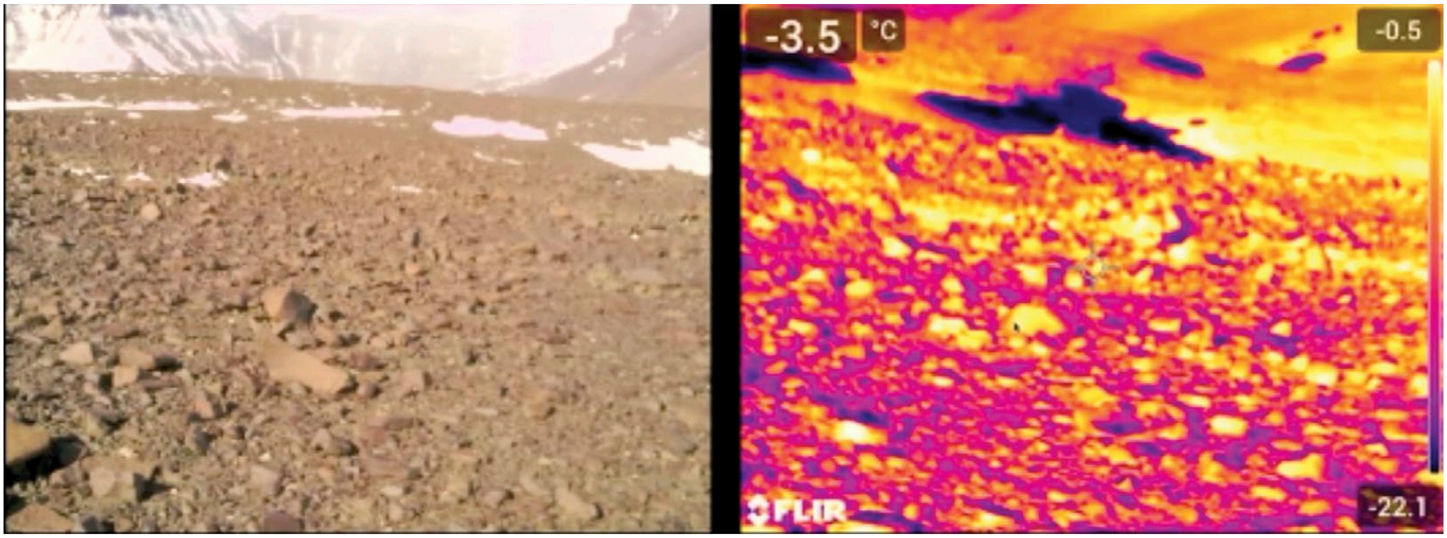
- 13 sites under consideration by NASA for Artemis II
- All near south pole, next to permanently shadowed craters where ice might exist
- Likely location base camp + research stati

Lunar Compact Infrared Imaging System (L-CIRiS)

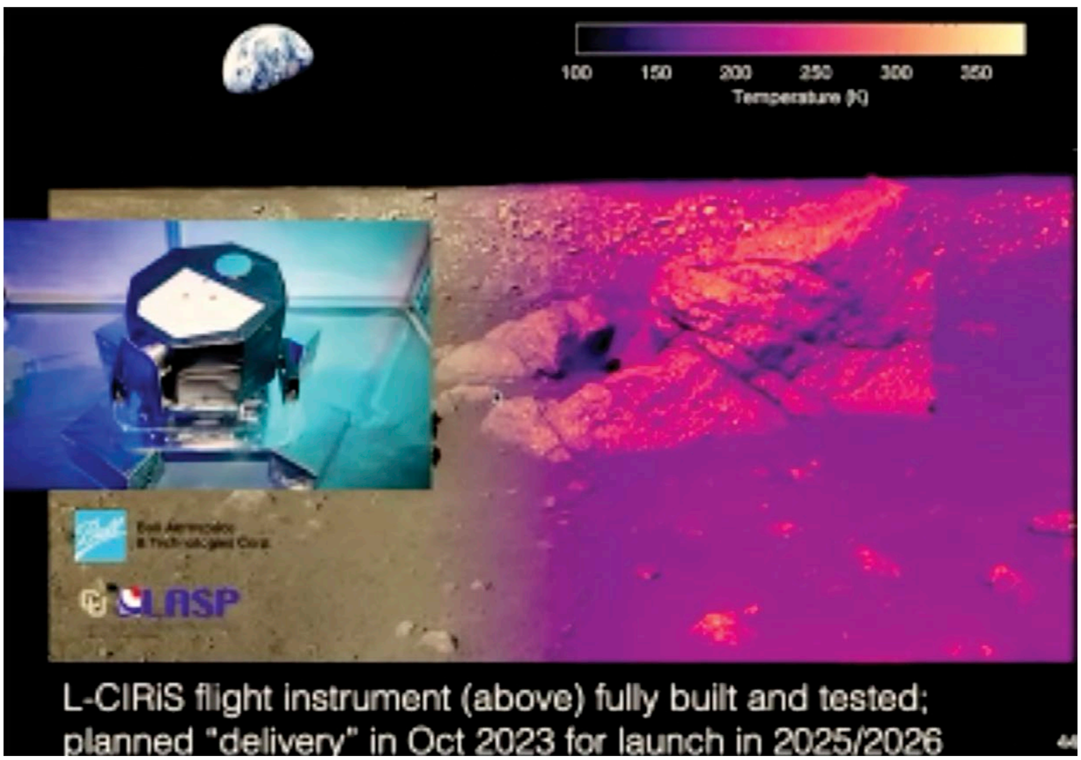


- Thermal infrared camera (L-CiRiS) on board
- Panoramic imaging over a lunar day near the pole

Infrared image from Antarctica



This is the kind of kind of thing you would see on the lunar surface with hot sunlit surfaces and cold shadows. Snow and ice darker areas, not because its colder but has lower emissivity.



First thermal infrared images from the lunar surface. ClRiS flight instrument fully built and tested; planned "delivery" in Oct 2023 for launch in 2025/2026 – Now at LASP at University of Colorado

L-CIRIS: Expected Results and Significance

- First thermal infrared images from the lunar surface
- New understanding of surface roughness and thermo physical variations
- Linkages between sample science and remote compositional measurements
- Better understanding of lunar volatile transport and cold-trapping
- Improved rover and astronaut traffic-ability

McMurdo as a Model for the Moon

- Goal is to build up a base camp as a research station similar to that in Antarctica
- Exploration reasons to find ice, can use for rocket fuel, drinking water, grow plants
- Economic reasons to find ice – costs hundreds of thousands of dollars per gallon to bring water to the moon

McMurdo as a Model for Lunar Exploration

- Origins of McMurdo station and what it looks like today

The lunar poles are the next frontier in long-term scientific exploration of the solar system.

The polar regions of planets and moons are special, because they contain the most sensitive, yet often long-lived climate records. Polar regions are typically cold and contain substances that are not stable elsewhere on the planet and polar ice deposits record past climate variations. NASA has chosen the south pole of the Moon as target landing site and eventual Artemis base camp, and sees Moon exploration as stepping stone toward deeper space exploration. Initial outposts will likely be funded through public, private, and international partnerships. Ultimately, should push for a McMurdo type station on the Moon with year round human presence primarily for scientific purposes. Students at all levels and the public should be involved in this exciting new era of exploration and science. Dr. Hayne's presentation is followed by questions and comments from members. How close to perpendicular to the Sun direction does the spin axis have to be to accumulate ice? What is the time for proposed time frame for Artemis II, the Lunar Station, and Artemis III? What was wrong with the lunar landers of the 1970s that they couldn't scale it up a bit? What did you do your thesis on? The North Pole has ice as well, but not as much cratering, is that why there is so much interest in the South Pole? Can you speculate on what the mixture of ice and regolith there is, do you know, is there a fine aggregate mixture or bigger chunks of ice? How would they process the water out of the mixture regolith?

IV. Upcoming Events

- Star Party for Boulder County Parks and Recreation on Friday, August 2 starting 8:30 pm at Ron Steward Preserve at Rabbit Mountain (canceled because of nearby fires - VR)
- Next LAS Monthly Meeting; Thursday, August 15th at 7pm, First Evangelical Lutheran Church, Longmont, CO 80501

Other Business: The Executive Board had a vote in regards to the Library Telescope Program, and decided to spend about $350 to buy a couple spare telescopes as many of the ones currently used in the program (around 20) are Orion, that has recently gone out of business and there could be future difficulty sourcing parts for repairs, etc.

Videos of our meetings are available to members only at the LAS portal website https://members.longmontastro.org

Longmont Astronomical Society

P.O. Box 806

Longmont, CO 80502-0806

LAS Treasurer's Report - Bruce Lamoreaux **6/20/2024**

Main Checking Account (xxx-1587)

Begin Balance:	$ 8,820.00	**5/2/2024**
Deposits:	$ 50.00	Membership
Expenses:	$ (5.00)	Bank Charges
Current Balance:	**$ 8,865.00**	**6/4/2024**

2-Year Savings Account (xxx-1478) (matures 10/23/23)

Past Balance:	$ 8,200.00	**12/29/2023**
Interest:	$ 15.00	
Balance:	**$ 8,215.00**	**3/29/2024**

Telescope Fund (xxx-0165)

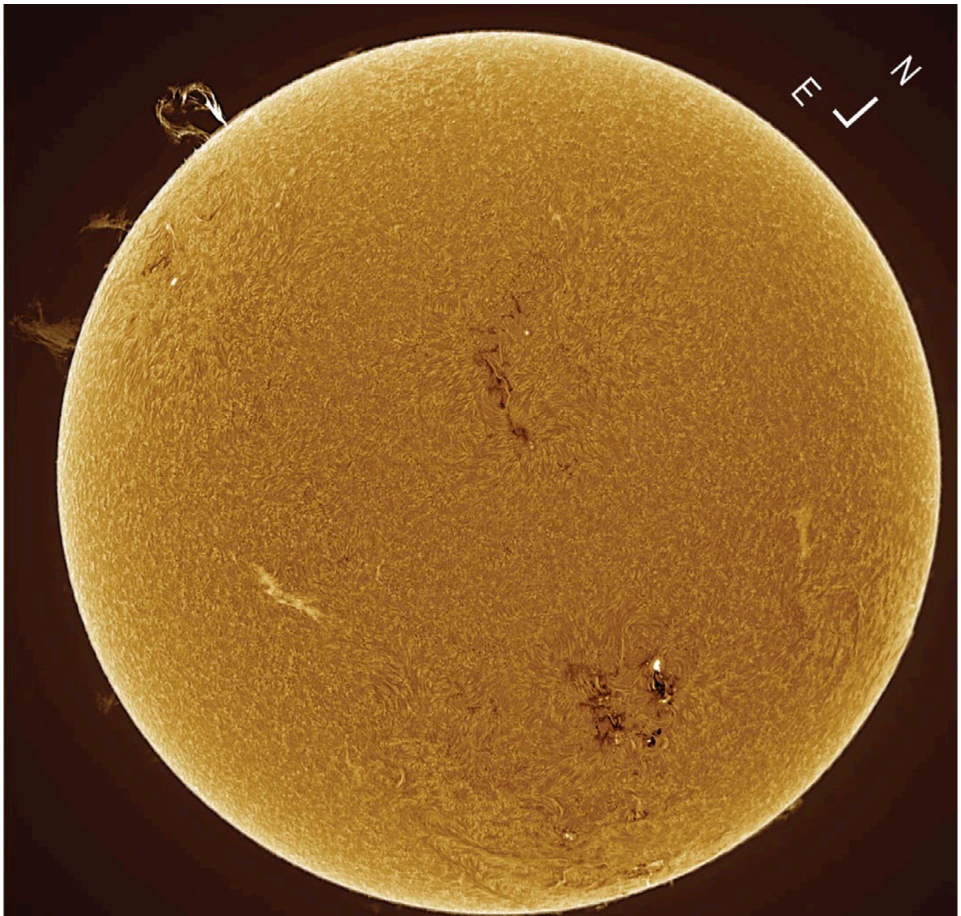
Past Balance:	$ 1,100.00	**3/28/2024**
Deposits:	$ -	
Expenses:	$ -	
Balance	**$ 1,100.00**	**4/29/2024**

Petty Cash

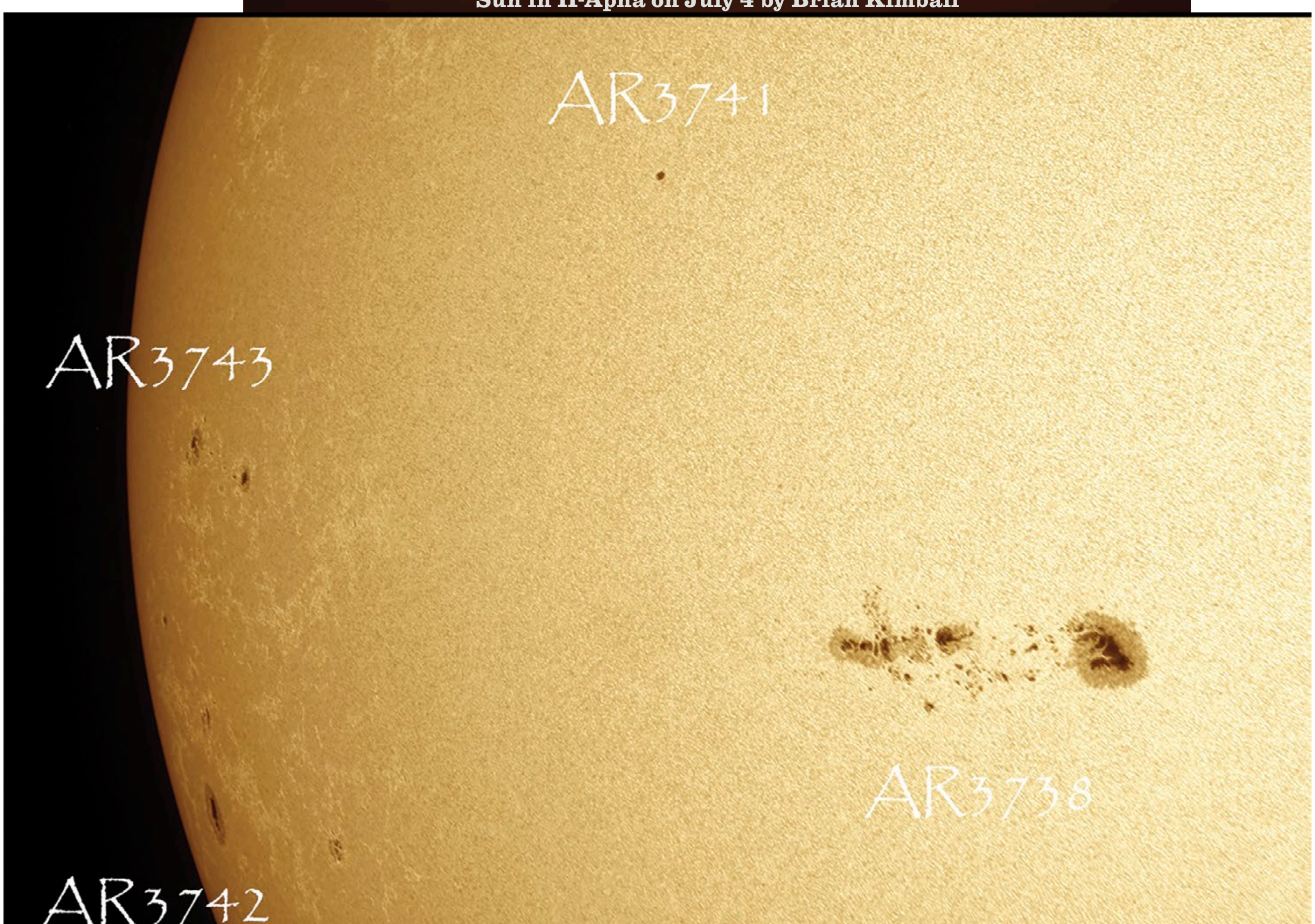
Past Balance:	$ 50.00
Deposits:	$ -
Expenses:	$ -
Balance	**$ 50.00**

Total Assets	**$ 18,230.00**	$ 45.00 Up from May

Active Membership:	**91**
Student Membership:	**1**
Total	**92**



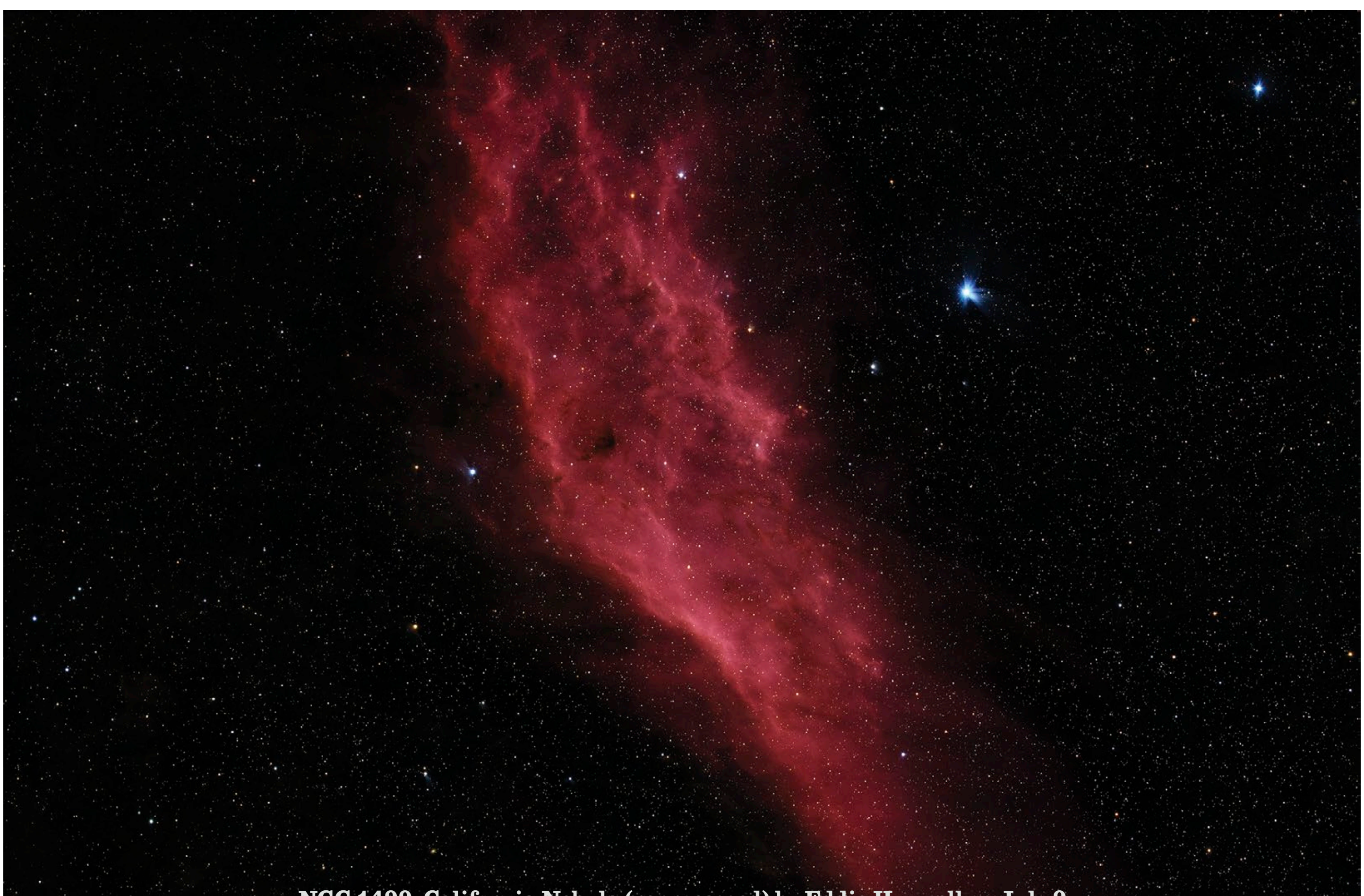
Sun in H-Apha on July 4 by Brian Kimball



Solar Active Regions 3738, 3741, 3742 and 3743 on July 9 by Brian Kimball

Orion and More by David Elmore on July 16

M33 (reprocessed) by Eddie Hunnell on July 7



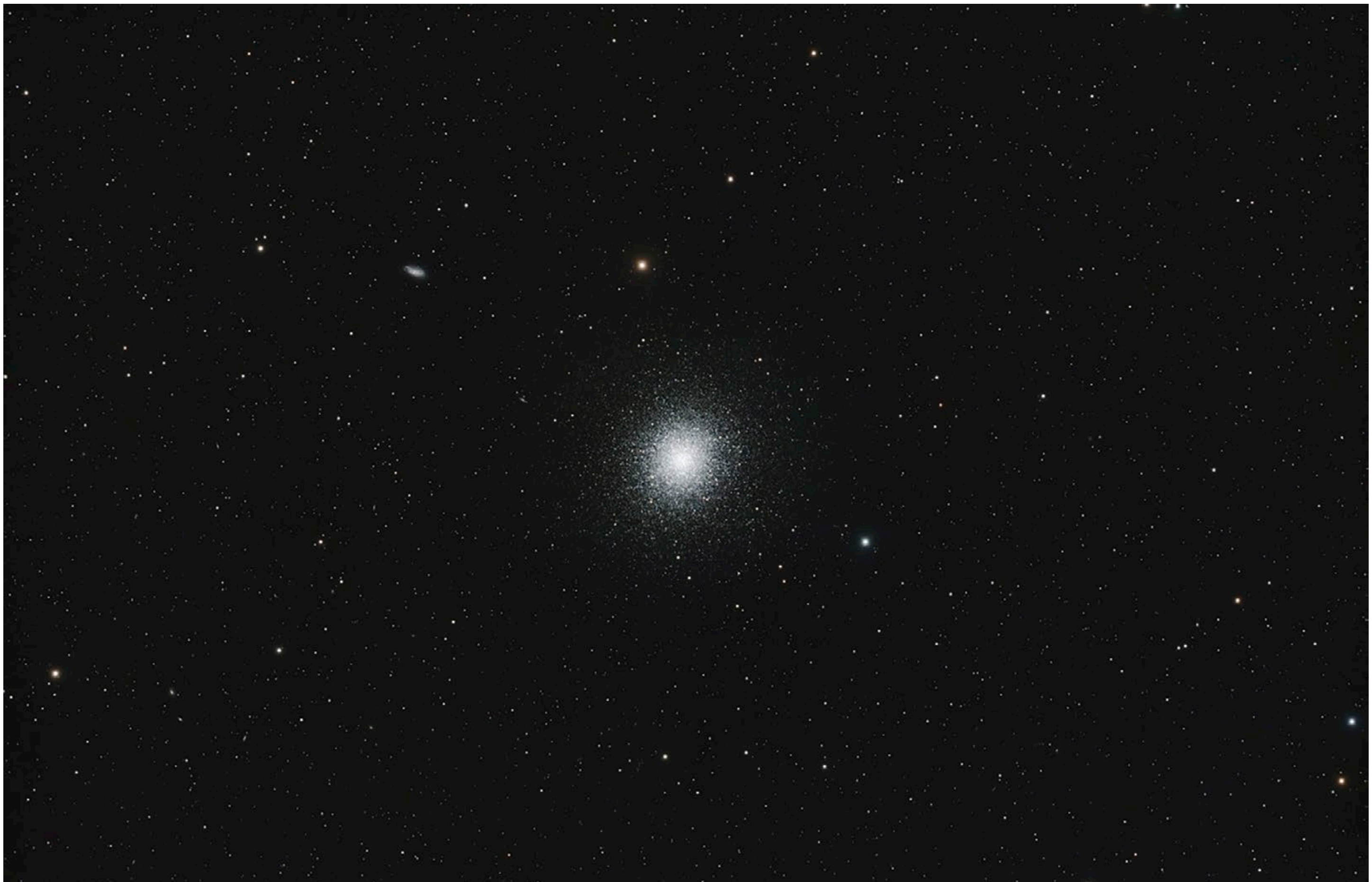
NGC 1499, California Nebula (reprocessed) by Eddie Hunnell on July 9

Barnard 68 by Ellen Steiner on July 7

NGC 6992 Eastern Veil Nebula by Gary Garzone on July 14

NGC 6960 Western Veil Nebula by Gary Garzone on July 14

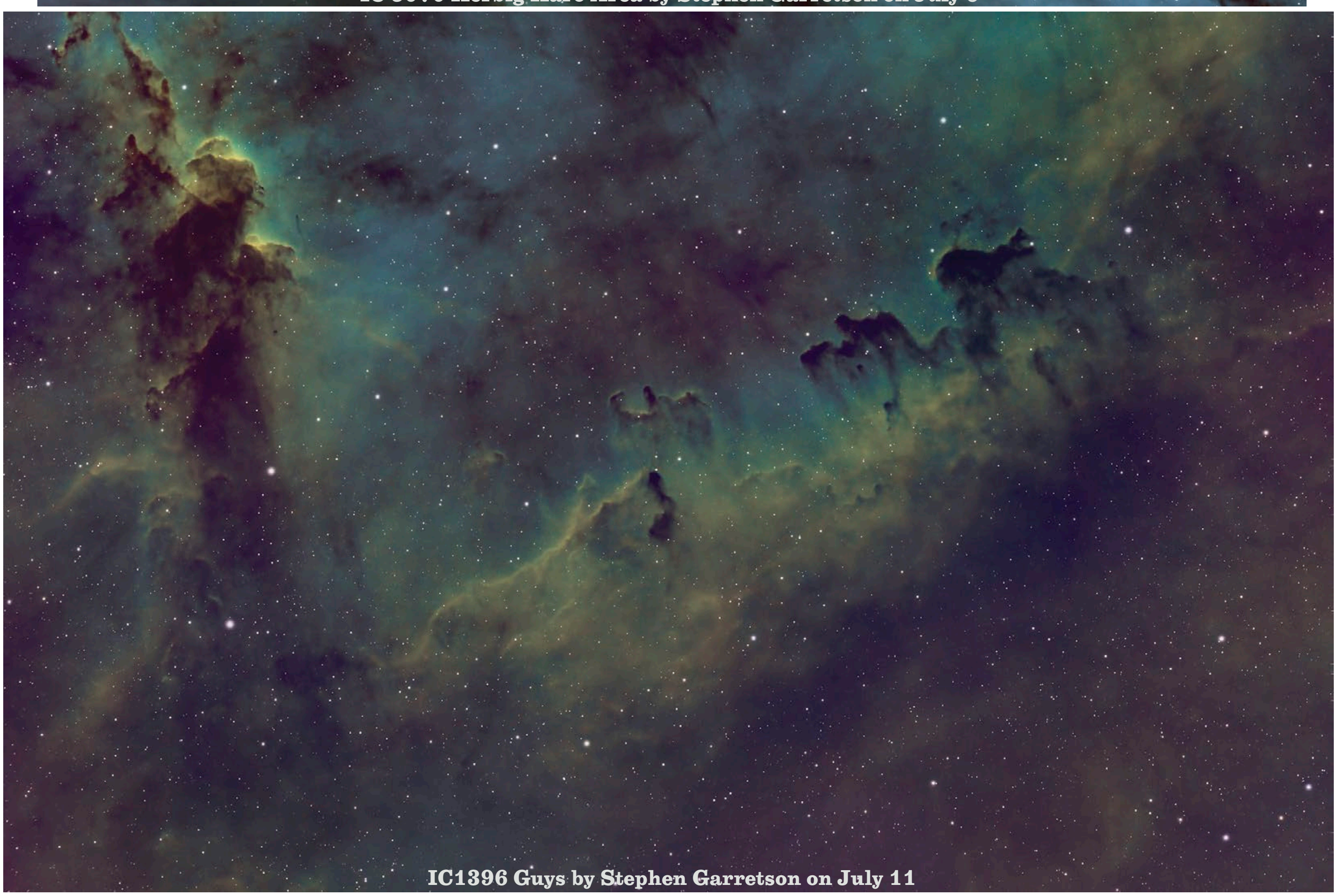
M27 Dumbbell Nebula by Gary Garzone_2024-07-14 on July 14



M13 Globular Cluster by Jim Pollock on July 9

Comet C2023-A3 Tsuchinshan on July 5

IC 5070 Herbig-Haro Area by Stephen Garretson on July 6



IC1396 Guys by Stephen Garretson on July 11

M3 Globular Cluster by Rolando Garcia on July 1

M13 Globular Cluster by Rolando Garcia on July 6

M17 Swan Nebula by Paul Kirkpatrick on July 26

Newsletter Archives by Eileen Hall-McKim

30 Years Ago August 1994

Secretary/Treasury report was given by Bob Ross. It was mentioned that our membership of the IDA has expired and suggested that for $50.00 the L.A.S. “re-up”. A vote was taken and we will be sending the International Dark Sky Association our dues. Mail was presented and the treasury balance is $524.00

The remainder of the meeting was half membership discussion of Jupiter SL9 collision observations and the remaining time was spent watching some professional photographs as presented on a computer by Bob Ross. The meeting immediately adjourned outdoors to enjoy some fantastic views of Jupiter and the “new” look. Many spots were visible through Jim Sharpe’s nice 12” reflector.

20 Years Ago August 2004

For our August meeting, we will be at Fiske Planetarium on the CU Boulder Campus. It’s been a long time since the LAS had a field trip to Fiske, and we are looking forward to renewing our association with them. Our speaker will be Dr. Erica Ellingson, who will give a talk on dark matter.

We will be holding another Tri-Town Star Party in Frederick at Milavec Lake on September 4th at dusk. For those of you looking for a fun local star party, this is it! The site will be towards the north end of the lake, between the lake and the golf course. Club members bringing scopes may use the lake access road to take their scopes to the site. This is part of our continuing public outreach effort, and is important as there is growing interest in astronomy in the Tri-Town area.

Our New Moon star party for September will be on Saturday the 11th. Emily Haynes and her family will be graciously hosting the party at their dark sky site at Caribou above Nederland. This is a great area for observing! Thanks to Emily and Mark; please see the map on the LAS website.

Mike Hotka submitted for the Herschel 400 observing certificate! The double-star observing certificate will be submitted for Bob Spohn next week! Bob described the Astronomical League observing programs: Verified observations, you receive nice certificate and enameled pin. It really helps at star parties, recognizing stuff, finding way around. It is a great accomplishment and feeling, and already paid for as part of dues! Mike Hotka mentioned also the urban observer program, very cool but not necessarily for beginners. Star puppy program for 12 and under. The Messier program is a good place to start. New for Astronomical League: Globular Cluster program, to be approved by Astronomical League next Wednesday. Observe 50 objects, sponsored by our club! LAS created logo, brochure, and web content. Not just observation, must assigned Herschel classification number 1-22.

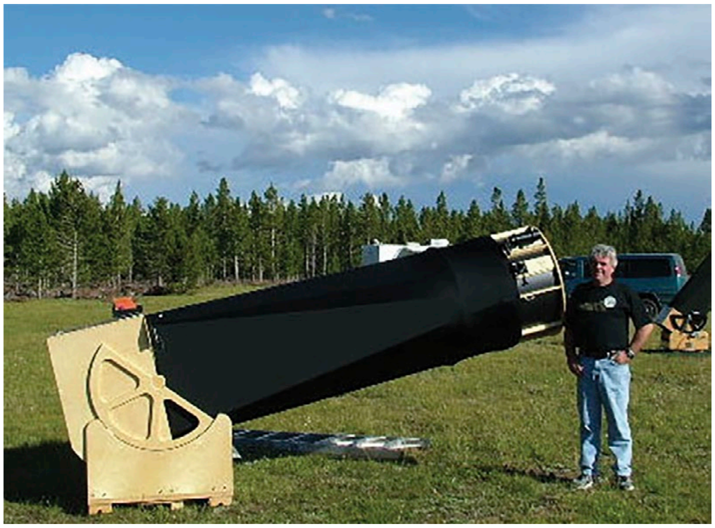
Last year LAS worked with Gilpin school district to fix a 6” refractor that had been donated long ago. Gilpin made inquiries for help to Denver club, but received no response. Philippe and the LAS got involved, casing the situation a couple of times, and we had two successful star parties at the site. We are still attempting repairs, free of charge for school district as part of our outreach program. Archer Sully offered to donate a laptop for driving stepping motors. Motion was made to allocate our $400 donation to this project. Motion passed unanimously.

Members who observed Venus transit were asked to give “show of hands.” A good 1/3 of room raised hands! Bob Spohn reported that his observations were mostly clouded over. Steve Albers and Philippe Bridenne reported their observations.

Upcoming star parties: Fox Park “new moon” star party announced for this weekend. It is about a 2.5 hours drive up 287 to Laramie. Following Saturday Flanders “first quarter” public observing star party. Check the web site for maps to these events.

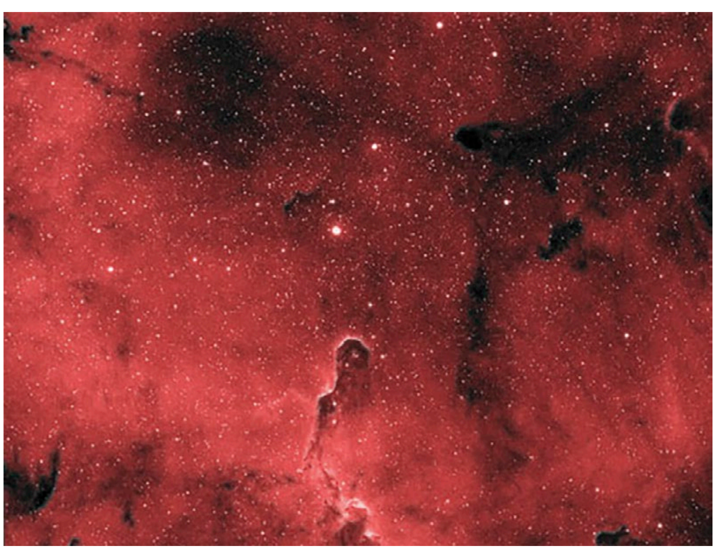
Fox Park report by Gary Garzone I just got back from another super weekend at Fox Park. Nothing comes close to viewing from wide Wyoming, at 9000 feet or so and clear skies , Milky Way was so bright, two comets and over 100 objects viewed over the weekend. Fox Park is an observer’s dream sometimes and this past weekend was what dreams are made of. Several of the Dark Sky marines showed up for a rather dewy Friday night but very clear, after showers and rain that day. Saturday was total clear skies thru entire night, only half as dewy as Friday. LAS people, Bill Travis, Don and Lisa, Ken, Dick Latt, Bill Possel, Dave D, Steve, Terry and Zach Lynch and dogs, Carol, my wife, and myself, Gary, and dog, Sammie.

Newsletter Archive for Aug 2004 continued



Gary Garzone and his 30 at Fox Park

Front cover was Brian Kimball's image of M31 taken with Tak Sky90, 60 min in each color



IC 1396 by Brian Kimball

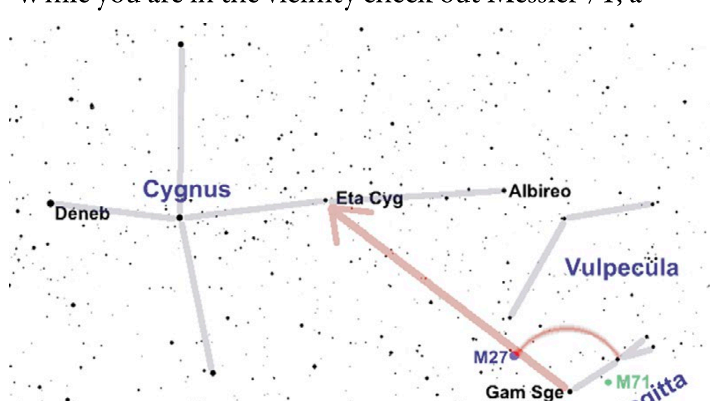
10 Years Ago July 2014

The July meeting was about "show and tell". Vern Raben showed videos, mostly crashes, of his electric tri-copter that he entered in Sparkfun's autonomous vehicle competition last June. Chris Fauble demonstrated his solar graph and talked about its design, and bit about sundial and analemmas. Ken O'Toole told of his trip to Chile and visit to several professional observatories. David Elmore showed graphs of his DSLR's long exposure noise performance. He would like others with astronomy cameras to try this as well. Next month David Elmore will give a presentation on the Daniel K Inouye 4 meter telescope in Haleakala, Hawaii.

A Few August Dark Sky Objects:

M27 by Gary Garzone

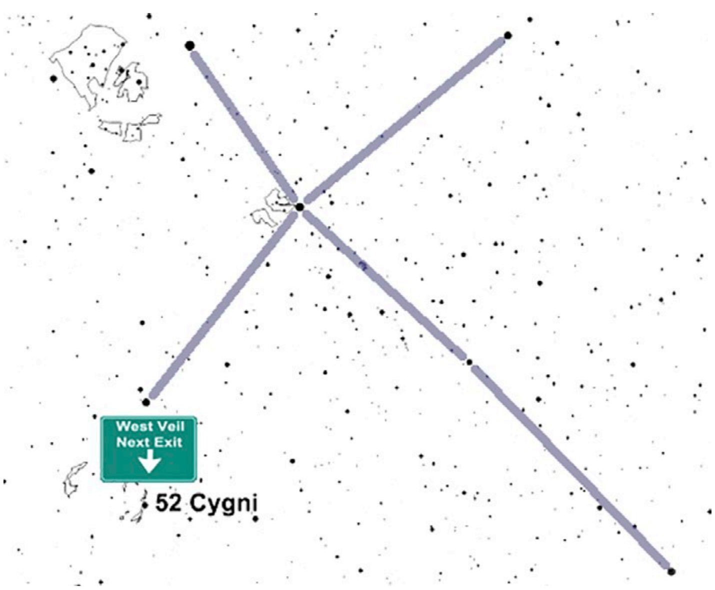
Messier 27 – "the Dumbbell nebula" (aka NGC 6853) is a wonderful planetary nebula in the constellation Vulpecula, and visible in binoculars and small scopes. To view it, first locate constellation Sagitta, "the arrow". Its stars are rather dim but the shape is easy to recognize. Draw an imaginary line straight north from tip of the arrow (Gamma Sagitta) towards Eta Cygnus about the same distance as length of the arrow from the tip to the feathers. While you are in the vicinity check out Messier 71, a



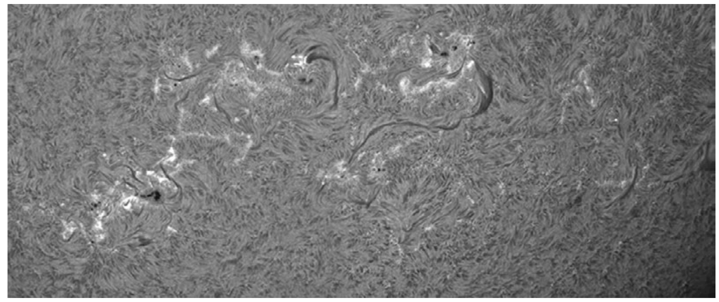
globular cluster located approximately midway between the head of the arrow and feathers in Sagitta. Messier 91 is a very loosely concentrated globular cluster.

Veil Nebula by Jim Pollock

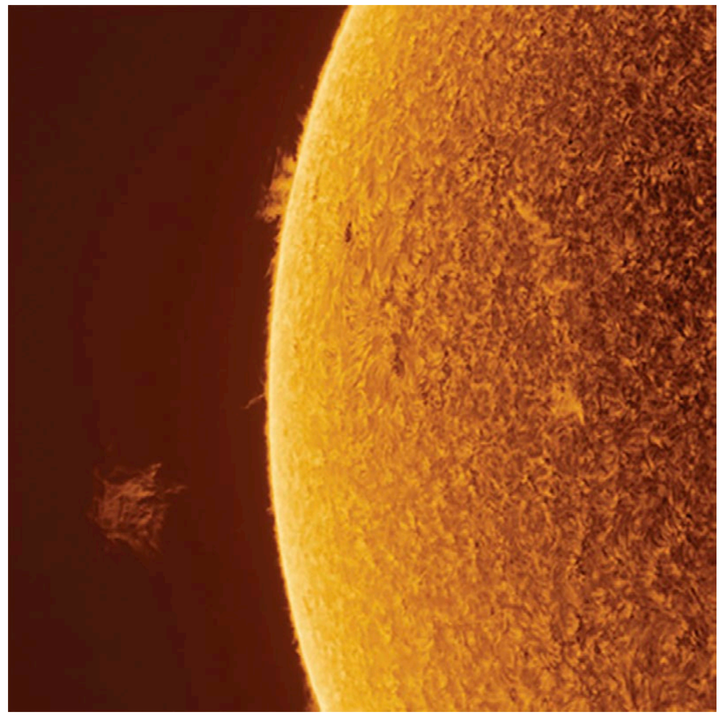
To really see this amazing object you need to get far, far away from city lights. Put on a UHC or an Olll filter and "WOW"! (Especially when you're looking through Gary's 30). My favorite object, period. I could spend hours tracing those wonderful, intricate lacy wisps. The "Veil Nebula" is the visible portion of the Cygnus Loop. It is the remnants of supernova which exploded about 5-8 thousand years ago. Since then it has expanded to ~3° of our night sky.



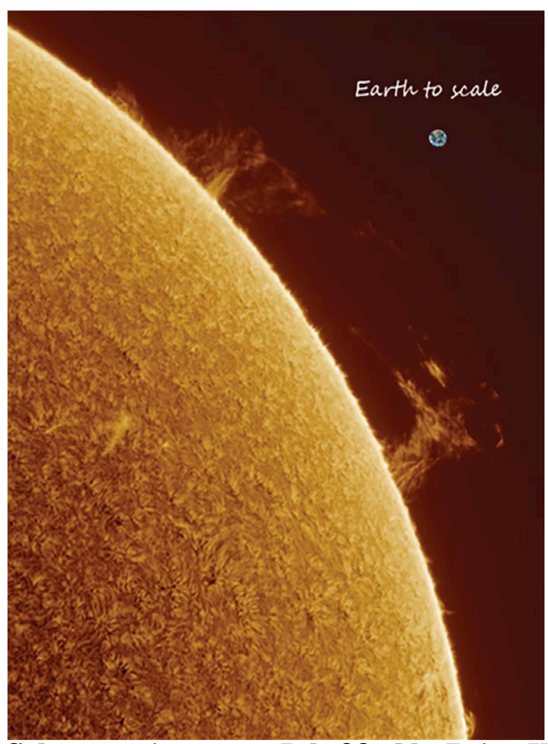
The Eastern Veil (NGC 6992) may be seen through binoculars in truly dark locations. In Jim's picture above, north is approximately to the top and east is to the left so it is on the left side. The somewhat dimmer Western Veil (aka "the Witches Broom", NGC 6960) is on the right side of Jim's picture near the 4.2 mag star 52 Cygni. Pickering's triangle is slightly to the east.



Hydrogen alpha image of solar active regions 2127, 2130, 2131, and 2132 on August 3, 2014 by Brian Kimball



Eruptive Prominence on July 19 by Brian Kimball



Solar prominence on July 22nd by Brian Kimball

Longmont Astronomical Society
P. O. Box 806
Longmont, CO 80506

Crescent Nebula by Martin Butley