A word from your editor by
Sapavith ‘Ort’ Vanaprux
Presenting “Space telescopes are better?” by Andrew Cooper

Opponents of the Thirty Meter Telescope attack the telescope in any way possible. Any argument is fodder in social media and newspaper editorials. Many of these arguments depend on a superficial level of knowledge about astronomy, this claim is a good example of this.
The claim is that a ground based telescope like TMT is not needed as a space telescope is more capable. Why spend the money? Why build TMT on Mauna Kea?

Given the stunning accomplishments of the Hubble Space Telescope this sounds plausible. This argument also ignores a number of fundamental realities in telescope design and use. Both have their limitations and we will discuss some of the more important ones here.
Certainly a telescope in space has a number of advantages over a ground based telescope. Not having an atmosphere to look through helps, it helps a lot. This is countered by the way ground based telescopes have developed solutions to overcome those limitations. The limitations on a

(Continued on page 6)
The 50th anniversary of the Apollo 11 mission is now behind us, but the Moon is still very much in the news. The Chandrayaan-2 mission has successfully launched and is currently operating as planned. It consists of an orbiter, a lander, and a rover. If the planned landing on September 7th on the lunar nearside near 70° S is successful, India will become the 4th nation to land a mission on the Moon. One of its objectives is to continue the search for water that was advanced by the Chandrayaan-1 mission. The next critical step is lunar orbital insertion on August 20th.

The U.S. continues to plan for new missions to the Moon, including the return of American astronauts, but it doesn’t enjoy the great lead it once had on the rest of the world. In fact, the U.S. is at risk of being left behind by others. China, Russia, and Europe are considering establishing a research station on the Moon together.

The “Wolf Amendment” to the appropriations bill funding NASA prohibits direct cooperation between NASA and the China National Space Administration (CNSA) unless the FBI certifies that there is no national security risk and Congress specifically approves the plans. This has prohibited China from participating in activities at the International Space Station. It now appears that this policy may have resulted in the U.S. isolating itself from this new lunar endeavor. However, since neither Congressman Wolf nor his successor on the appropriations committee (who supported the amendment) are in Congress, the time might be ripe for this policy to change.

(Continued on page 4)
Observer’s Notebook—August 2019 by Jay Wrathall

**Planets Close To the Moon**

Times are Hawaii Standard Time

- Aug 9, 15h, Moon 2.5° NNE of Jupiter (118° from sun in evening sky)
- Aug 12, 22h, Moon 0.31° E of Saturn (146° from sun in evening sky)
- Aug 17, 07h, Moon 3.5° SE of Neptune (156° from sun in morning sky)
- Aug 21, 01h, Moon 4.4° SE of Uranus (111° from sun in morning sky)

Mercury, Venus and Mars are closer than 15° from the sun when near the moon in August.

**Other Events of Interest**

Times are Hawaii Standard Time

- Aug 9, 13h, Mercury at greatest elongation (19.0° west of the sun in morning sky.)
- Aug 12, 20h, 15 Eunomia reaches opposition (Magnitude +8.2)
- Aug 13, Perseid Meteors
- Aug 13, 20h, Venus at Superior Conj. with sun (Passes into evening sky)
- Aug 15, 02:30h, Full Moon
- Aug 30, 00:37h, New Moon

**Planets in August**

<table>
<thead>
<tr>
<th>Planet</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mercury</strong></td>
<td>can be seen low in the morning dawn in the middle of the month. It reaches greatest elongation on August 9.</td>
</tr>
<tr>
<td><strong>Venus</strong></td>
<td>is too close to the sun to be seen in August.</td>
</tr>
<tr>
<td><strong>Mars</strong></td>
<td>is also too close to the sun to be observed in August.</td>
</tr>
<tr>
<td><strong>Jupiter</strong></td>
<td>Shines brightly high in the western sky after sunset at a magnitude of -2.3.</td>
</tr>
<tr>
<td><strong>Saturn</strong></td>
<td>reached opposition last month, so is still very well placed for viewing in the southern sky of Sagittarius. Magnitude +0.2.</td>
</tr>
<tr>
<td><strong>Uranus</strong></td>
<td>rises about 10:00 PM and is best viewed in the early morning hours.</td>
</tr>
<tr>
<td><strong>Neptune</strong></td>
<td>rises about midnight and can be best viewed in the morning sky shortly before dawn.</td>
</tr>
<tr>
<td><strong>15 Eunomia (Asteroid)</strong></td>
<td>Reaches opposition on August 12 at a magnitude of about +8.2.</td>
</tr>
<tr>
<td><strong>Pluto (Dwarf Planet)</strong></td>
<td>reached opposition last month and so is still well placed for viewing. It is best viewed near late in the evening. It is very close to the moon on August 12.</td>
</tr>
</tbody>
</table>

**Times are Hawaii Standard Time**
President Chris Peterson called the July 2nd, 2019 meeting of the Hawaiian Astronomical Society to order at 7:30 p.m. The meeting was held in the Planetarium on the grounds of the Bishop Museum, Honolulu, Hawaii.

April Lew stepped down. HAS needs new Secretary.

Duties – Take notes at BoD Meeting & Club Meeting.

June Meeting Minutes needs to fix Dan’s father’s name. Meeting Adopted

Mark updated on previous and future School Star Party
   • Thursday, July 25 at Camp Palehua
   • Friday, October 18 at Pearl Harbor Elementary – Need people.
   • There is December request to be signed up later

Chris reported on astronomy news items:
   • Total Solar Eclipse at Argentina & Chile
     ◊ Corona looks good.
   • Kahala & Geiger Star will have young Moon.
   • Visitors: Brian & Fidel from Bolivia, Bree & Kim from Seattle, and Greg from Hawaii Baptist.
   • NASA re-announced GRAIL, (Gravity Recovery and Interior Laboratory) data two crafts (Grail – A & B) showed excess mass under Moon south pole basin. Mass caused by impactor.
   • 50th Anniversary of Apollo Mission on July 20th, 2019 and Space Race History.
   • New efforts to explore the Moon – China, India, & Russia.
   • NASA encourages private companies to deliver payloads to the Moon.
   • Lunar Planetarium Institute would host “Apollo 11 Looking back to move forward” on July 20.
   • Website that shows images, video, & audio of Apollo 11. (Apollo in Real time)

Peter presented
   • Dave’s images of Milky Way from Big Island
   • Fighting Space Alien on ISS (Mole Spores)
   • Space X – launched 24 satellites but could not recovered center booster.
   • Air Force contract for launching satellite for 2022-2026. Only SpaceX met all criteria
   • NASA capsule test for future space travel.
   • Video about Titan by Anton Petrov (his haircut)
   • Wow reaction by telescope viewing patron.

Jon showed us upcoming night sky and Bolivia’s night sky.

As there was no other business, the meeting was adjourned at 9 pm.

(Continued from page 2) President’s Message

I have long thought that the best way forward for lunar exploration is international cooperation among all the principal space powers. If everyone is participating in the establishment of a lunar base, for example, there will have to be agreement by all on what activities are permitted and what is prohibited. Perhaps there is still time for the U.S. and others (such as India) to be included in a truly global effort to expand human presence to the Moon.
Hawaiian Astronomical Society
Event Calendar

<<Upcoming Star Parties>>

Public Party Geiger/Kahala August 10
Club Party-Dillingham August 24
Public Party Dillingham August 31

Upcoming School Star Parties

Volume 69, Issue 8
space telescope are not created by the atmosphere and as such are far more practical and daunt-
ing. Why does the atmosphere matter? There are two major issues. The first is that turbulent air
over the telescope will blur the image, something astronomers call ‘seeing’. Look at a star using high magnification in even a small telescope and you will not see a pinpoint of light, you will see a
dancing, shimmering blob. Seen from the ground stars twinkle.

The second challenge created by the atmosphere is absorption of the light. Some wavelengths
of light, including many that are interesting to astronomers are blocked by the atmosphere. We think of air as transparent, and it is in the optical wavelengths, the red, green, and blue our eyes use. Other wavelengths? Not so much.

The result is that for and astronomer wishing to observe some sections of the spectrum such as the far infrared, much of the ultraviolet, x-rays, or gamma rays, there is no choice but to put a telescope into space. And we have done just that with a range of space telescopes.

There is only one way a ground based telescope can address the absorption issue, choose a
good site. The higher the site is, the drier the site is, the better it is. This is one of the main rea-
sions Mauna Kea is the preferred site for TMT. For an optical and infrared telescope like TMT
the site will offer an undimmed view of the universe across most of the wavelengths the

telecope will operate at.

The atmospheric distortion, the blurring, can be dealt with using a complex system that cor-
crects the distortion. This is an adaptive optics system, and all large telescopes are equipped with
such systems. These systems allow the telescope to operate much nearer their full potential and
gather the sharpest images possible.

AO systems are not perfect, they can only correct so much. Thus it is imperative that the site
be as good as possible, that the natural quality of the sky be good to start with, the AO systems
can then turn good into superb.

The size of a telescope is critical. Signal to noise improves with the square of the telescope size. Thus TMT will have 21 times the light gathering capability of the 6.5 meter James Webb Space Telescope. Resolution, the finest detail that can be seen goes up with the size as well, with TMT having 4.6 times the resolution of JWST. An artist’s concept of the

James Webb Space
Telescope

Thus, despite looking thought the atmosphere a properly sited, AO equipped large telescope
can drastically outperform a space based telescope.

Why not just build a thirty meter space based telescope? Cost.

JWST has run up impressive cost overruns. Putting a telescope into space is incredibly chal-
 lenging, and thus costly. The mission will probably be close to $9 billion on launch, and $10
billion over the lifetime of the telescope.

Another serious problem is the difficulty of repair. The Hubble Space Telescope was fa-
mously repaired on several occasions. Each repair mission took a space shuttle launch, around
two hundred million dollars, with untold e ort by hundreds of people. Repairing a large ground
based telescope requires two guys and a pickup truck.

JWST cannot be repaired. Its orbit will be out of reach of any of our current manned launch
capability.

JWST cannot be upgraded. Ground based telescopes are continuously upgraded with new
instruments and new equipment. As parts of the facility age they can be replaced. As a result the
service lifetime of a ground based observatory can be up to a century, vastly more return for the
investment.

As new technology becomes available it can be installed in a ground based telescope, new

(Continued on page 9)
Is the summer heat getting to you? Cool off overnight while spotting one of the solar system’s ice giants: Neptune! It’s the perfect way to commemorate the 30th anniversary of Voyager 2’s flyby.

Neptune is too dim to see with your unaided eye so you’ll need a telescope to find it. Neptune is at opposition in September, but its brightness and apparent size won’t change dramatically as it’s so distant; the planet is usually just under 8th magnitude and 4.5 billion kilometers away. You can see Neptune with binoculars but a telescope is recommended if you want to discern its disc; the distant world reveals a very small but discernible disc at high magnification. Neptune currently appears in Aquarius, a constellation lacking in bright stars, which adds difficulty to pinpointing its exact location. Fortunately, the Moon travels past Neptune the night of August 16th, passing less than six degrees apart (or about 12 Moon widths) at their closest. If the Moon’s glare overwhelms Neptune’s dim light, you can still use the its location that evening to mark the general area to search on a darker night. Another Neptune-spotting tip: Draw an imaginary line from bright southern star Fomalhaut up to the Great Square of Pegasus, then mark a point roughly in the middle and search there, in the eastern edge of Aquarius. If you spot a blue-ish star, swap your telescope’s eyepiece to zoom in as much as possible. Is the suspect blue “star” now a tiny disc, while the surrounding stars remain points of white light? You’ve found Neptune!

Neptune and Uranus are ice giant planets. These worlds are larger than terrestrial worlds like Earth but smaller than gas giants like Jupiter. Neptune’s atmosphere contains hydrogen and helium like a gas giant, but also methane, which gives it a striking blue color. The “ice” in “ice giant” refers to the mix of ammonia, methane, and water that makes up most of Neptune’s mass, located in the planet’s large, dense, hot mantle. This mantle surrounds an Earth-size rocky core. Neptune possesses a faint ring system and 13 confirmed moons. NASA’s Voyager 2 mission made a very close flyby on August 25, 1989. It revealed a dynamic, stormy world streaked by the fastest winds in the solar system, their ferocity fueled by the planet’s surprisingly strong internal heating. Triton, Neptune’s largest moon, was discovered to be geologically active, with cryovolcanoes erupting nitrogen gas and dust dotting its surface, and a mottled “cantaloupe” terrain made up of hard water ice. Triton is similar to Pluto in size and composition, and orbits Neptune in the opposite direction of the planet’s rotation, unlike every other large moon in the solar system. These clues lead scientists to conclude that this unusual moon is likely a captured Kuiper Belt object.

(Continued on page 10)
The Astronews

Meteor Log—August 2019 by Tom Giguere

The reliable Perseid meteor shower (peak on August 13) will be washed out by the near full Moon this year. This is two days prior to the full moon. Under these bright Moon conditions Perseid rates will usually be reduced by at least 75% (Robert Lunsford, AMS). These rates are still better than most nights of the year. Thus, if your sky is clear and transparent it would not be a waste to try and view this activity. Robert recommends that you view in the opposite direction of the moon so that you can see the faintest possible meteors. Please report your observations as it would be interesting to see how many meteors can be seen under such circumstances!

Part 3 of the story by Toshi Kasuga et al. “A Fireball and Potentially Hazardous Binary Asteroid (164121 2003 YT1, preliminary report. Last month we examined the meteor detection network in Japan. The system incorporates automation to classify each object. The magnitude of the object is calculated by a least squares method if there are 5 or more stars in the image frame (Figure 6). The

![Figure 6](image_url)

(Continued on page 11)

<table>
<thead>
<tr>
<th>Shower</th>
<th>Activity</th>
<th>Maximum Date</th>
<th>Radiant λ⊙</th>
<th>α</th>
<th>δ</th>
<th>V_∞</th>
<th>r</th>
<th>ZHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perseids</td>
<td>(007 PER)</td>
<td>Aug 17-Aug 24</td>
<td>Aug 13</td>
<td>140°</td>
<td>48°</td>
<td>+58°</td>
<td>59</td>
<td>2.2</td>
</tr>
<tr>
<td>κ-Cygnids</td>
<td>(012 KCG)</td>
<td>Aug 03-Aug 25</td>
<td>Aug 18</td>
<td>145°</td>
<td>286°</td>
<td>+59°</td>
<td>25</td>
<td>3.0</td>
</tr>
</tbody>
</table>

The α-Capricornids are still active (Jul 3 – Aug 15) and also the South δ-Aquariids (Jul 12 – Aug 23), which may be easier to spot that the washed out Perseids! For more info contact: Tom Giguere, 808-782-1408, Thomas.giguere@yahoo.com; Mike Morrow, PO Box 6692, Ocean View, HI 96737.
Treasurer’s Report  
by Peter Besenbruch

Cash Flow - 6/10/2019 to 7/09/2019

<table>
<thead>
<tr>
<th>Beginning Balance</th>
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<tbody>
<tr>
<td>Money into selected accounts comes from</td>
<td></td>
</tr>
<tr>
<td>Membership - Electronic</td>
<td>$40.00</td>
</tr>
<tr>
<td>Membership - Family</td>
<td>$2.00</td>
</tr>
<tr>
<td>Total Money In</td>
<td>$42.00</td>
</tr>
</tbody>
</table>

| Money out of selected accounts goes to | |
| Astronews | $103.55 |
| Astronomical League | $370.00 |
| Total Money Out | $503.00 |

| Difference | $-461.00 |
| Ending Balance | $2220.61 |

June payments to the Astronomical League show up here. I sent an updated membership list to them, as well so that new people will receive the Reflector magazine. I send updated lists to them periodically.

Another aside is that the treasurer keeps our tax exempt status up to date. This requires filing a form with them by May 15 every year. Terrible things happen if you are late: They accept the form, anyway, unless you are three years late. Then you lose your tax exempt status.

Thanks to all who have renewed their membership, including those whose applications were processed after July 9. Welcome to all newcomers. We are happy to see you. Finally, a reminder to everyone that we need you to help out when it comes to volunteering for school star parties and the Bishop Museum.

(Continued from page 6)  Parting words from your editor

instruments are delivered every few years that keep the telescope on the leading edge of technology.

If new discoveries require new ideas and capabilities to follow up, it is possible to modify or replace the instrumentation of a ground based observatory to explore something that was unanticipated by the telescope builders.

The result is that large ground based telescopes can, with some limitations, dramatically outperform a space based telescope. Both are valuable, but more fundamental science is done at the large ground based telescopes, for far less cost. Often both space telescopes and ground based telescopes will work together to study the same problem, each providing critical data.

Result: Mostly False
Discover more about Voyager 2, along with all of NASA’s past, present, and future missions, at nasa.gov

Clockwise from top left: Neptune and the Great Dark Spot traced by white clouds; Neptune’s rings; Triton and its famed icy cantaloupe surface; close-up of Triton’s surface, with dark streaks indicating possible cyrovoleano activity. Find more images and science from Voyager 2’s flyby at bit.ly/NeptuneVoyager2 Image Credit: NASA/JPL

Finder chart for Neptune. This is a simulated view through 10x50 binoculars (10x magnification). Please note that the sizes of stars in this chart indicate their brightness, not their actual size. Moon image courtesy NASA Scientific Visualization Studio; chart created with assistance from Stellarium.
trajectory plane of the meteor is calculated by least square pole determination (Figure 7). The orbital elements are determined for the fireball and found to be very close to known asteroid 164121 (2003 YT1), see figure 8 and 9. To be continued…

<table>
<thead>
<tr>
<th>Object</th>
<th>a(AU)</th>
<th>q(AU)</th>
<th>e</th>
<th>ω</th>
<th>Ω</th>
<th>inc.(°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fireball</td>
<td>1.111±0.016</td>
<td>0.781±0.007</td>
<td>0.297±0.004</td>
<td>91.2±2.7</td>
<td>38.315±0.00</td>
<td>43.9±0.9</td>
</tr>
<tr>
<td>2003YT1</td>
<td>1.110</td>
<td>0.7857</td>
<td>0.2919</td>
<td>91.042</td>
<td>38.335</td>
<td>44.064</td>
</tr>
</tbody>
</table>

You never know when the best time to observe a meteor will be – the best advice is to keep your eye on the sky. Actually, as I was writing this article I saw a bright fireball out the living room window to the southeast. The -8 magnitude fireball traveled straight down, greenish in color with an orange train (7/25/2019, 12:11am.)
Hubble Snaps a Galactic Potpourri of Particles

The sharply angled perspective in this Hubble image of spiral galaxy NGC 3169 makes it seem as if we, the viewers, are craning our necks to see over a barrier into the galaxy's bright center. In the case of NGC 3169, this barrier is the thick dust embedded within the galaxy's spiral arms.

Image credit: ESA/Hubble & NASA, L. Ho