IAAS Monthly Astronomy Newsletter
April 2018

The International Association for Astronomical Studies provides this newsletter as a service for interested persons worldwide.

This newsletter is published on the World Wide Web at http://www.ki0ar.com/astro.html - The Home of KI0AR - and is received nationally and internationally. A PDF formatted downloadable version of the newsletter is at http://www.ki0ar.com/current_nl.pdf.

An Open Invitation - For amateur radio operators and scanner enthusiasts, when in the Denver metro area, please join the Colorado Astronomy Net on the Rocky Mountain Radio League's W0WYX **146.94 MHz** and **449.825 MHz** repeaters. The RMRL **146.94** repeater is also linked with the WB0WDF Cripple Creek **447.400 MHz** repeater and Allstar nodes **28298**, **28299**, **29436**. We are also linked via Echolink, links are **k0jsc-r** and **canoncty** courtesy of K0JSC and K0GUR. More information on the WB0WDF repeater links, Allstar nodes and Echolinks can be found at k0jsc.com. We are also linked with Allstar nodes in Florida as well, courtesy of KA4EPS. The net meets on Tuesday nights at 7 P.M. Mountain Time (US).

Obtaining your Amateur Radio (Ham) License or your General Radio Operator's License (GROL)! Visit the South Metro VE Team website for more information. The South Metro VE Team provides test sessions on the 1st Saturday of each month at our new Eagle Street Facility, The City of Centennial, 7272 South Eagle Street, Centennial, Colorado 80112-4244 from 9am until 1pm.

The Colorado Astronomy Net and the IAAS are on Facebook page. Be sure to "Like" us.

Excerpts from JPL mission updates are provided as a public service as part of the JPL Solar System Ambassador / NASA Outreach program.

Donate to the IAAS!

If you shop Amazon.com, sign up or sign in to smile.amazon.com and select the **International Association for Astronomical Studies**. 0.5% of every purchase will be donated to the group. Thank you!

In This Newsletter...

"Mars and Saturn appeared a few degrees apart against the backdrop of Virgo (with blue-white Spica just to their left) in August 2012. The two planets make a return engagement in Sagittarius in early April." Astronomy Magazine, April 2018, p.36.
LUIS ARGERICH

The Month At-A-Glance

The current month's calendar displaying the daily astronomical events.

The Moon

Phases:

- Last Quarter Moon occurs on the 8th.
- New Moon occurs on the 15th.
- First Quarter Moon occurs on the 22nd.
- Full Moon occurs on the 29th.

- The Moon is at Apogee on the 8th, 251,123 miles from Earth.
- The Moon is at Perigee on the 20th, 229,108 miles from Earth.

Moon/Planet Pairs:

- Mars passes 1.3° south of Saturn on the 2nd.
- The Moon passes 4° north of Jupiter on the 3rd.
- The Moon passes 1.9° north of Saturn on the 7th.
- The Moon passes 3° north of Mars on the 7th.
- The Moon passes 1.9° south of Neptune on the 12th.
- The Moon passes 4° south of Mercury on the 14th.
- The Moon passes 5° south of Venus on the 17th.
- The Moon passes 1.1° north of Aldebaran on the 19th.
- The Moon passes 1.2° north of Regulus on the 24th.
- Mars passes 1.6° south of Pluto on the 25th.
- The Moon passes 4° north of Jupiter on the 30th.

For reference: The Full Moon subtends an angle of ~0.5°.

The Planets & Dwarf Planets

Planetary Reports are generated by "TheSky" software. These reports provide predicted data for the planets on the first of each month for the current year. The rise and set times for the Sun and the Moon for each day of the month as well as meteor shower radiants are also included in the reports. These reports have been optimized for the Denver, Colorado location, however, the times will be approximate for other locations on Earth.

(All times are local unless otherwise noted.)

Planetary Highlights for April

"The evening sky hosts the two brightest planets — Venus and Jupiter — with the former on view shortly after sunset and the latter rising later in the evening. April mornings belong to the equally riveting duo of Mars and Saturn. The Red Planet grows steadily bigger and brighter this month as it approaches a spectacular opposition in late July. Although the ringed planet appears a bit dimmer, it's always a treat to view through a telescope. These two worlds enjoy a memorable conjunction when they pass within a couple of degrees of each other in early April." Astronomy Magazine, April 2018, p. 36.

Mercury

Is in inferior conjunction on the 1st. Mercury is stationary on the 13th. Mercury is at greatest western elongation (27°) on the 29th. Mercury rises at 6:33 a.m. on the 1st and about 5:07 a.m. by month's end. Mercury is visible in the morning sky this month low in the east. Start looking for Mercury after the first week of the month when it will have moved out of the Sun's morning twilight glow, though the best time to view Mercury will be at the end of the month hen it will be highest in the morning sky. Mercury is in the constellation of Pisces this month shining at magnitude 0.3 on the 30th.

Venus

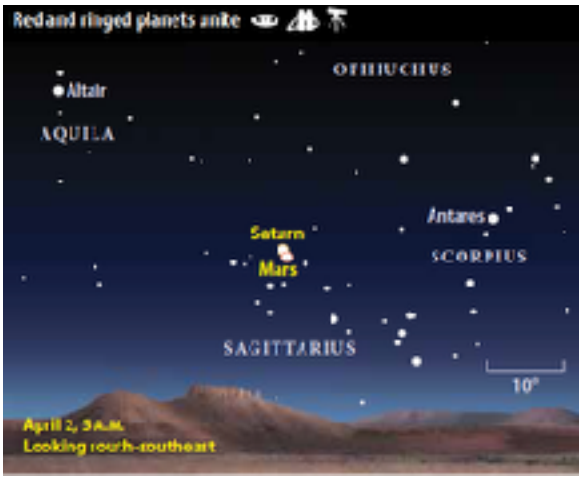
Venus sets at 9:03 p.m. on the 1st and about 10:13 p.m. by month's end. Venus continues to set later in the evening and is easily spotted low to the west as evening descends. Venus moves from the constellation of Aries into Taurus this month shining at magnitude -3.9.

Earth

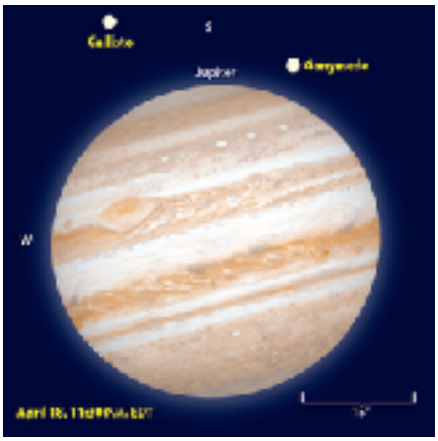
N/A.

Mars

Rises at 2:18 a.m. on the 1st and about 1:23 a.m. by month's end. Mars continues to brighten, reaching its best appearance in 15 years sometime in July. On the morning of the 2nd, look for Mars and Saturn in conjunction. These two planets appear within 1.3° of each other to the southeast before



sunrise. On the morning of the 25th, Mars passes within 1.6° of Pluto. Mars is in the constellation of Sagittarius shining at magnitude 0.0.



Jupiter

Rises at 10:35 p.m. on the 1st and about 8:22 p.m. by month's end. Look for Jupiter now rising in the late evening. About the same time Venus is setting, Jupiter will be rising. Jupiter is in the constellation of Libra shining at magnitude -2.4.

Saturn

Rises at 2:16 a.m. on the 1st and about 12:18 a.m. by month's end. Saturn has caught up with Mars. These two planets are in conjunction the 2nd. As the month progresses, these two planets will separate with Saturn rising earlier each night. Saturn is at aphelion (936 million miles from the Sun) and is stationary on the 17th. Look for Saturn to the southeast in the early morning sky in the constellation of Sagittarius, shining at magnitude 0.4.

Uranus

Is in conjunction with the Sun on the 18th and is lost in the Sun's twilight glow all month. Uranus is in the constellation of Pisces shining at magnitude 5.9.

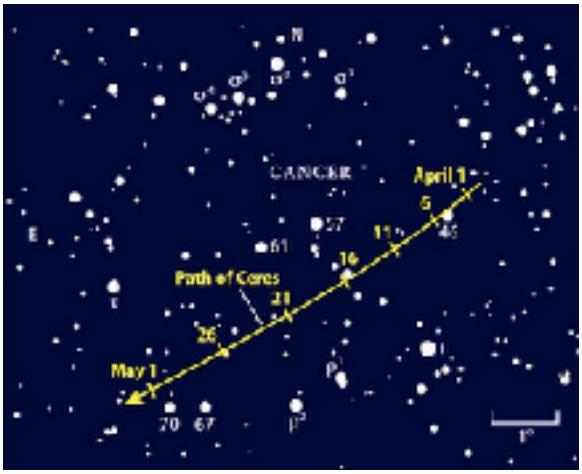
Neptune

Rises 5:46 a.m. on the 1st and about 3:51 a.m. by month's end. Neptune can be spotted to the south-east before dawn. Neptune is in the constellation of Aquarius shining at magnitude 7.9.

Dwarf Planets

Ceres

Sets at 5:09 a.m. on the 1st and about 3:17 a.m. by month's end. Once the skies darken, Ceres may be spotted to the southwest maybe an hour or two after sunset. Ceres can be spotted just above the apex of the constellation Cancer shining at magnitude 8.2.



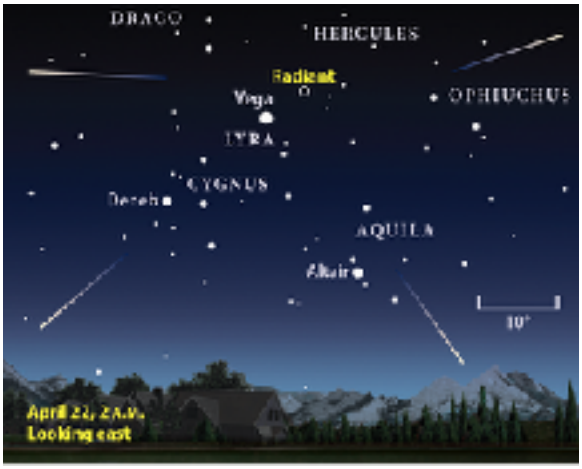
Pluto

Rises at 3:04 a.m. on the 1st and about 1:07 a.m. by months end. Pluto is stationary on the 22nd. Pluto is better placed for early morning viewing this month. Mars is in conjunction with Pluto on the morning of the 25th. Pluto is in the constellation of Sagittarius shining at magnitude 14.3.

As always, good luck at spotting Neptune, Ceres and Pluto, a large telescope and dark skies will be needed.

Astronomical Events

Meteor Showers



The Lyrids [meteor showers] are typically visible between April 16 and 25. Maximum occurs during April 21-22. Although the maximum rate is about 10, there have been instances during the last 200 years when rates were near or over 100 per hour. The average magnitude of the meteors is near 2.4 and the speed is described as rapid. About 15% of the meteors leave persistent trains.

For more information about Meteor Showers, visit Gary Kronk's Meteor Showers Online web page at http://meteorshowersonline.com/.

Meteor Shower Radiant Report

Meteor Scatter (or Meteor burst communications) - http://en.wikipedia.org/wiki/Meteor_burst_communications - "is a radio propagation mode that exploits the ionized trails of meteors during atmospheric entry to establish brief communications paths between radio stations up to 2,250 kilometres (1,400 mi) apart." Tune your shortwave or your HF amateur radio to 54.310 MHz USB CW and see if you can hear any pings.

Comets

Comet PANSTARRS (C/2016 R2) is still passing through the constellations of Perseus and Auriga this month. Comet PANSTARRS has dimmed to 11th or 12th magnitude this month, requiring a 10-12 inch telescope to spot this one. Look high in the west during the early evening to spot Comet PANSTARRS.

For information, orbital elements and ephemerides on observable comets visit the Observable Comets page from the Harvard-Smithsonian Center for Astrophysics. (http://cfa-www.harvard.edu/iau/Ephemerides/Comets/index.html)

For more information about Comets, visit Gary Kronk's Cometography.com web page at http://cometography.com/.

Eclipses

- No solar eclipse activity this month.

- No lunar eclipse activity this month.

Observational Opportunities

(from evening to morning)

- Enjoy Venus and Jupiter in the evening skies after sunset.
- Look for Mars and Saturn in the morning skies before sunrise.
- Try to spot Comet PANSTARRS passing through Perseus and Auriga.

Asteroids

(From west to east)

- **Pallas** is in the constellation of Eridanus.
- **Iris** is in the constellation of Taurus.
- **Vesta** is in the constellation of Ophiuchus.

Information about the Minor Planets can be found at http://www.minorplanetobserver.com the Minor Planet Observer web site.

Occultations

Information on various occultations can be found at http://lunar-occultations.com/iota/iotandx.htm, the International Occultation Timing Association's (IOTA) web site.

Member Meteor Sightings

This is a new section where I will post meteor, fireball, etc sightings that have been published on the American Meteor Society's web site. I want to make this an active section of the web pages and newsletter and would like to publish the links to member sightings. If you have any published sightings, please provide me with the links and I will post them here for all to enjoy.

Event ID	Date/Time	Location	Observer	Link
3587-2015	2015-11-22 17:38 MST	CO	Kevin S	3587aw
3829-2015	2015-12-05 18:06 MST	CO	Burness A	3829a
3871-2015	2015-11-13 01:55 MST	CO	Charles N	3871a

Subscriber Gallery

I have created a web page containing images taken and submitted by subscribers to the email newsletter, check-ins to the Colorado Astronomy Net and readers of the online newsletter and some of my own images. Any one wishing to submit their images to the gallery, please let me know. The images must be taken by the submitter and be astronomy related. Please include a description and your information so that I can give proper credit to your work. I will post the most recent submissions here.

August 21, 2017 - Total Solar Eclipse - "Bailey's Beads" and the "Diamond Ring"
Taken by: Burness Ansell, Location: Guernsey, WY - More to come. I will be creating a special Solar Eclipse page to showcase subscriber contributions.

Planetary/Lunar Exploration Missions

(Excerpts from recent mission updates)

JPL Latest News

The Latest from Space

JPL Latest News

March 30, 2018
NASA Invests in Shapeshifters, Biobots, Other Visionary Technology

Full Article & Images

"NASA is investing in technology concepts that include meteoroid impact detection, space telescope swarms and small orbital debris mapping technologies that may one day be used for future space exploration missions. Five of the concepts are from NASA's Jet Propulsion Laboratory, Pasadena, California.

The agency is investing in 25 early-stage technology proposals that have the potential to transform future human and robotic exploration missions, introduce new exploration capabilities, and significantly improve current approaches to building and operating aerospace systems."

Read the latest news and discoveries from JPL's dozens of active space missions exploring Earth, the solar system and worlds beyond.
Past, Present, Future and Proposed JPL Missions - http://www.jpl.nasa.gov/missions.

For special JPL programs and presentations in your area visit the JPL Solar System Ambassador web site at http://www2.jpl.nasa.gov/ambassador/index.html.

Juno

March 07, 2018
NASA Juno Findings - Jupiter's Jet-Streams Are Unearthly

Full Article & Images

"Data collected by NASA's Juno mission to Jupiter indicate that the atmospheric winds of the gas-giant planet run deep into its atmosphere and last longer than similar atmospheric processes found here on Earth. The findings will improve understanding of Jupiter's interior structure, core mass and, eventually, its origin.

Other Juno science results released today include that the massive cyclones that surround Jupiter's north and south poles are enduring atmospheric features and unlike anything else encountered in our solar system. The findings are part of a four-article collection on Juno science results being published in the March 8 edition of the journal Nature."

NASA's JunoCam website can be visited at:

https://www.missionjuno.swri.edu/junocam

More information on the Juno mission is available at: http://www.nasa.gov/juno

The public can follow the mission on Facebook and Twitter at:
http://www.facebook.com/NASAJuno
http://www.twitter.com/NASAJuno

Cassini Legacy

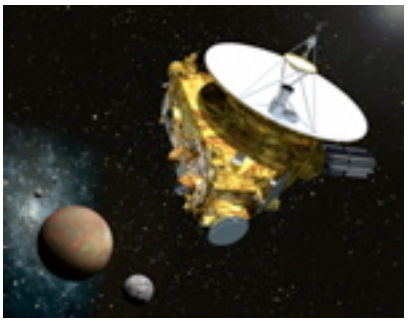
March 29, 2018
Linda Spilker: Cassini's Amazing Discoveries

Full Article & Images

"In this recording, Spilker's remarks begin at the 11:45 mark."

Raw images are available at http://saturn.jpl.nasa.gov/photos/raw/index.cfm.

More information about Cassini is available at the following sites:
http://saturn.jpl.nasa.gov & http://www.nasa.gov/cassini.



New Horizons

March 13, 2018
New Horizons Chooses Nickname for 'Ultimate' Flyby Target

Full Article & Images

"As NASA's New Horizons mission continues exploring the unknown, the mission team has selected a highly appropriate nickname for its next flyby target in the outer reaches of the solar system.

With substantial public input, the team has chosen "Ultima Thule" (pronounced ultima thoo-lee") for the Kuiper Belt object the New Horizons spacecraft will explore on Jan. 1, 2019. Officially known as 2014 MU69, the object, which orbits a billion miles beyond

Pluto, will be the most primitive world ever observed by spacecraft -- in the farthest planetary encounter in history."

New Horizons gallery

For more information on the New Horizons mission - the first mission to the ninth planet - visit the New Horizons home page: http://pluto.jhuapl.edu/.

Dawn

March 14, 2018

NASA Dawn Reveals Recent Changes in Ceres' Surface

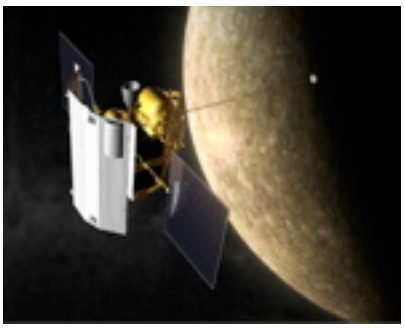
Full Article & Images

"Observations of Ceres have detected recent variations in its surface, revealing that the only dwarf planet in the inner solar system is a dynamic body that continues to evolve and change.

NASA's Dawn mission has found recently exposed deposits that give us new information on the materials in the crust and how they are changing, according to two papers published March 14 in Science Advances that document the new findings.

Observations obtained by the visible and infrared mapping spectrometer (VIR) on the Dawn spacecraft previously found water ice in a dozen sites on Ceres. The new study revealed the abundance of ice on the northern wall of Juling Crater, a crater 12 miles (20 kilometers) in diameter. The new observations, conducted from April through October 2016, show an increase in the amount of ice on the crater wall. "

For more information on the Dawn mission, visit the Dawn home page: http://www.nasa.gov/mission_pages/dawn/main/index.html.



MESSENGER

The MESSENGER mission is officially ended but there is a lot to learn about the planet closest to our Sun. Visit the new, updated MESSENGER website:

UNLOCKING THE MYSTERIES OF PLANET MERCURY
for resources, to learn, and to explore.

(Click Link above for Full Article & Images)

TOP 10 SCIENCE RESULTS AND TECHNOLOGY INNOVATIONS

"After more than 10 years in operation, the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft impacted the surface of Mercury on April 30, 2015, at a speed of more than 3.91 kilometers per second (8,750 miles per hour), marking the end of operations for the hugely successful Mercury orbiter. At the MESSENGER Nears End of Operations media and public event, scientists and engineers discussed the mission's accomplishments, providing the top 10 scientific discoveries, as well as the technological innovations that grew out of the mission."

The MESSENGER app is available for download on iTunes.

For more information on the MESSENGER mission, visit the MESSENGER home page: http://messenger.jhuapl.edu/.

Mars Missions

Be A Martian

Mars website mobile version is here!
Simply type
http://mars.jpl.nasa.gov
into your mobile browser.

Mars on the Go! NASA Be A Martian Mobile App

If you want the latest news as it happens, try our Be A Martian app.
Download on Mobile Devices
Android | iPhone | Windows Phone

JMARS

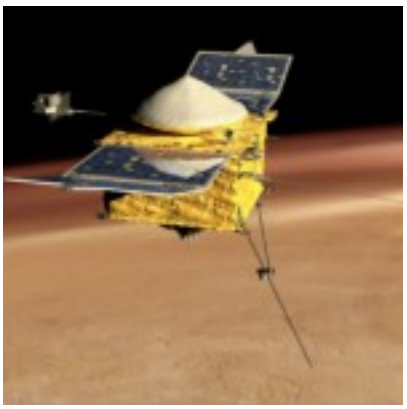
JMARS is an acronym that stands for Java Mission-planning and Analysis for Remote Sensing. It is a geospatial information system (GIS) developed by ASU's Mars Space Flight Facility to provide mission planning and data-analysis tools to NASA's orbiters, instrument team members, students of all ages, and the general public. https://jmars.mars.asu.edu/

Laboratory for Atmospheric and Space Physics

"The Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado Boulder (CU) began in 1948, a decade before NASA. We are the world's only research institute to have sent instruments to all eight planets and Pluto.

LASP combines all aspects of space exploration through our expertise in science, engineering, mission operations, and scientific data analysis. As part of CU, LASP also works to educate and train the next generation of space scientists, engineers and mission operators by integrating undergraduate and graduate students into working teams. Our students take their unique experiences with them into government or industry, or remain in academia to continue the cycle of exploration.

LASP is an affiliate of CU-Boulder AeroSpace Ventures, a collaboration among aerospace-related departments, institutes, centers, government labs, and industry partners."



MAVEN

December 13, 2017
MAVEN Sheds Light on Habitability of Distant Planets

Full Article & Images

"How long might a rocky, Mars-like planet be habitable if it were orbiting a red dwarf star? It's a complex question but one that MAVEN can help answer.

"The MAVEN mission tells us that Mars lost substantial amounts of its atmosphere over time, changing the planet's habitability," said David Brain, a MAVEN co-investigator and a professor at the Laboratory for Atmospheric and Space Physics, or LASP, at the University of Colorado Boulder. "We can use Mars, a planet that we know a lot about, as a laboratory for studying rocky planets outside our solar system, which we don't know much about yet."

Visit LASP and MAVEN for more information.

Mars Science Laboratory - Curiosity

March 30, 2018

Sols 2008-2010: Exploring variations in composition, texture, and color

Full Article & Images

"Yesterday Curiosity drove 35 m to the southeast, which set us up for some great contact science on the rim of a small impact crater. We're working our way toward Region 13 on Vera Rubin Ridge and exploring changes in bedrock composition, texture, and color, as shown in the Navcam and MAHLI images."

To follow the Mars Curiosity rover and NASA on Foursquare, visit: http://www.foursquare.com/MarsCuriosity and http://www.foursquare.com/NASA

For information about NASA's partnership with Foursquare, visit: http://www.nasa.gov/connect/foursquare.html.

Mars Rover Landing - Free for the Xbox 360 (requires Kinect)

Visit the Mars Science Laboratory page at http://mars.jpl.nasa.gov/msl.

Mars Exploration Rover Mission (Spirit and Opportunity)

March 27, 2018

SPIRIT UPDATE: Spirit Remains Silent at Troy - *sols 2621-2627, May 18-24, 2011*:

"More than 1,300 commands were radiated to Spirit as part of the recovery effort in an attempt to elicit a response from the rover. No communication has been received from Spirit since Sol 2210 (March 22, 2010). The project concluded the Spirit recovery efforts on May 25, 2011. The remaining, pre-sequenced ultra-high frequency (UHF) relay passes scheduled for Spirit on board the Odyssey orbiter will complete on June 8, 2011.

Total odometry is unchanged at 7,730.50 meters (4.80 miles)."

OPPORTUNITY UPDATE: Opportunity Completes In-Situ Work on 'Aguas Calientes' - *sols 5033 to 5038, March 19, 2018 - March 27, 2018:*

"Opportunity is continuing the exploration of "Perseverance Valley" on the west rim of Endeavour Crater.

The rover is positioned about halfway down the approximately 656 feet (200-meter) valley. Opportunity is investigating the surface target called, "Aguas Calientes," an exposed rock outcrop. Although the target had been ground already, the science team wanted to grind "Aguas Calientes" another 2 millimeters deeper.

On Sol 5032 (March 20, 2018), the Rock Abrasion Tool (RAT) was placed back into the ground hole and ground further. During the grind the Inertial Measurement Unit (IMU) reported a questionable flag. However, the IMU was tested again on Sol 5035 (March 24, 2018) and was found to be healthy. After the deeper grind, the Microscopic Imager (MI) collected a mosaic of the grind and then the Alpha Particle X-ray Spectrometer (APXS) was placed for a multi-sol integration.

The rover also collected a set of 13-filter Panoramic Camera (Pancam) images of selected targets. On Sol 5035 (March 24, 2018), the robotic arm offset the APXS for further integrations, along with the IMU test, and imaged the RAT bit for wear. No additional bit wear was seen after the grind. By Sol 5038 (March 27, 2018), the in-situ (contact) work on "Aguas Calientes" was finished and the rover bumped away about 7.5 feet (2.3 meters).

As of Sol 5038 (March 27, 2018), the solar array energy production was 670 watt-hours with an atmospheric opacity (Tau) of 0.524 and an improved solar array dust factor of 0.830.

Total odometry is 28.04 miles (45.12 kilometers)."

Landing sites link - http://marsoweb.nas.nasa.gov/landingsites/

Visit the Mars Exploration Rover page at
https://mars.nasa.gov/mer/home/.

Mars Reconnaissance Orbiter Mission

February 20, 2018
Nearly a Decade After Mars Phoenix Landed, Another Look

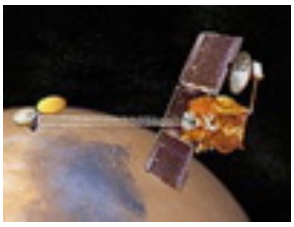
Full Article & Images

"A recent view from Mars orbit of the site where NASA's Phoenix Mars mission landed on far-northern Mars nearly a decade ago shows that dust has covered some marks of the landing.

The Phoenix lander itself, plus its back shell and parachute, are still visible in the image taken Dec. 21, 2017, by the High Resolution Imaging Science Experiment (HiRISE) camera on NASA's Mars Reconnaissance Orbiter. But an animated-blink comparison with an image from about two months after the May 25, 2008, landing shows that patches of ground that had been darkened by removal of dust during landing events have become coated with dust again."

MARS RECONNAISSANCE ORBITER HIRISE IMAGES

All of the HiRISE images are archived here: http://hirise.lpl.arizona.edu/.
More information about the MRO mission is available online at http://www.nasa.gov/mro.



Mars Odyssey Orbiter

October 4, 2017
Examining Mars' Moon Phobos in a Different Light

Full Article & Images

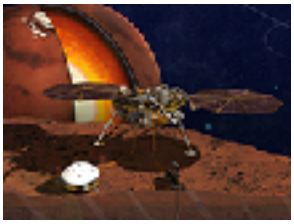
"NASA's longest-lived mission to Mars has gained its first look at the Martian moon Phobos, pursuing a deeper understanding by examining it in infrared wavelengths.

The Thermal Emission Imaging System (THEMIS) camera on NASA's Mars Odyssey orbiter observed Phobos on Sept. 29, 2017. Researchers have combined visible-wavelength and infrared data to produce an image color-coded for surface temperatures of this moon, which has been considered for a potential future human-mission outpost."

DAILY MARS ODYSSEY THEMIS IMAGES
Thermal Emission Imaging System (THEMIS) web site: (http://themis.asu.edu/gallery)

The Odyssey data are available through a new online access system established by the Planetary Data System at: http://starbrite.jpl.nasa.gov/pds/

Visit the Mars Odyssey Mission page at http://mars.jpl.nasa.gov/odyssey/index.html.



Journey to Mars

InSight - Revealing the Heart of Mars
March 29, 2018
NASA is Ready to Study the Heart of Mars

Full Article & Images

"NASA is about to go on a journey to study the center of Mars.

The space agency held a news conference today at its Jet Propulsion Laboratory in Pasadena, California, detailing the next mission to the Red Planet.

InSight -- short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport -- is a stationary lander scheduled to launch as early as May 5. It will be the first mission ever dedicated to Mars' deep interior, and the first NASA mission since the Apollo moon landings to place a seismometer on the soil of another planet."

Learn more about the InSight mission at: http://www.jpl.nasa.gov/missions/insight/

Mars Missions Status

New Mars missions are being planned to include several new rover and sample collection missions. Check out the Mars Missions web page: http://mars.jpl.nasa.gov/missions/ and the Mars Exploration page: http://marsprogram.jpl.nasa.gov/.

Astronomy Links and Other Space News

(If you have a link you would like to recommend to our readers, please feel free to submit it.)

Colorado Astronomy Links

Radio Astronomy Links

Other Astronomy Links

Acknowledgments and References

Much of the information in this newsletter is from "Astronomy Magazine" (Kalmbach Publishing), JPL mission status reports, "Meteor Showers - A Descriptive Catalog" by Gary W. Kronk and other astronomical sources that I have stashed on my book shelves.

The author will accept any suggestions, constructive criticisms, and corrections. Please feel free to send me any new links or articles to share as well. I will try to accommodate any reasonable requests. Please feel free to send questions, comments, criticisms, or donations to the email address listed below. Enjoy!

Subscription Information

- Email Newsletter archives -
http://ki0ar.com/pipermail/astronews_ki0ar.com/

- Full documentation of the online administration system is available at http://ki0ar.com/mailman/listinfo/astronews_ki0ar.com.

- The latest version of the newsletter is accessible from http://www.ki0ar.com/astro.html.

Keep looking UP!

73 from KI0AR

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JPL Solar System Ambassador, Colorado
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