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YOUNG ASTRONOMERS NEWSLETTER

SYNOPSIS OF NASA SPACE MISSIONS

The scientific missions sent into space by NASA is impressive and somewhat overwhelming in number and scope. Your editor thought that readers might want to get some idea of the many and varied spacecraft that are still functioning today (or recently terminated). Sources of information vary from Wikipedia to Space.com to NASA and other web sites. Some less publicized missions may be missing from the following list. If your favorite mission is not included, let us know. We will take the projects in chronological order of their launch:

1977

Voyager 1 and Voyager 2: Sent out to explore the outer planets and to continue and gain information about interstellar space. Both are still functioning and broadcasting back to Earth. Voyager 1 is about 13.4 billion miles from the Sun, Voyager 2 is about 11.1 bill. miles.

1990

The Hubble Space Telescope: orbiting at about 340 miles. Carries a 2.4 meter mirror. Covers near ultra violet, visible and near infrared wavelengths. Has hugely expanded our knowledge of our solar system and the cosmos.

1999

Chandra X-ray Observatory: Chandra's mission is to study very hot regions in the cosmos that emit x-ray energy. Such sources can be exploding stars, regions around black holes and around galaxy clusters. It orbits the Earth at a distance of 8,000 to 80,000 miles. It had a gyroscope problem in October, but NASA is confident that this can be corrected.

2001

Odyssey Mars orbiter: Orbits at 2,400 miles above Mars' surface. Looks for evidence for water. Also serves as a communication relay hub between Earth and Mars' landers and rovers.

2003

Mars Express: Orbits Mars and looks for locations of water on or under the planet's surface. Compiling a topographical map of the planet. Acts as a communication relay. Currently scheduled to remain in operation until 2026.

Opportunity Rover: Has been functioning on Mars since 2004 (originally projected to last three months). Has analyzed the Martian rocks and soils. However, this past summer's dust storm soiled its solar panels and caused it to lose power. NASA is currently trying to resume contact and bring it to life.

Spitzer Space Telescope: Studies the cosmos in infrared wavelengths. First telescope to directly observe an exoplanet and some earliest-forming galaxies. Its supply of liquid helium coolant ran out in 2009 and so it continues on a "warm mission".

2005

Mars Reconnaissance Orbiter: Made numerous discoveries on the Red Planet, such as observing flowing salt water on the surface. Also, it was used to look for a suitable landing site for the Phoenix lander. (There have been ten Mars orbiters launched by NASA; six are now active).

2006

New Horizons: Its mission was to study Pluto and its moons, with the possibility for an extended mission to study objects in the Kuiper Belt. New Horizons reached Pluto in July of 2015 and is currently on track to fly by the Kuiper Belt object 2014 MU69 (Ultima Thule) on New Year's Day, 2019.

2007

Dawn Spacecraft: Sent to study the Asteroid Belt. Visited the dwarf planet Ceres and the asteroid Vesta. Retired Nov. 1. Now in random orbit around Ceres.

2008

Fermi Gamma-ray Telescope: Its objective was to map the cosmos in gamma-ray frequencies. It orbits about 340 miles above the Earth. It was able to detect gamma-ray bursts, super novae and other structures going back to the early universe. Went into an extended phase mission in 2013. Will be retired in 2018.

2009

Kepler Space Telescope: Equipped to detect exoplanets (planets outside of our solar system). Particular interest was to find planets that reside in the habitable zone of their stars. Over nine years, Kepler observed 530,506 stars and detected 2,662 exoplanets. Its guidance controls malfunctioned between 2012 -2013. It was put on limited duty until its retirement on October 30, 2018.

Lunar Reconnaissance Orbiter: Currently in an eccentric polar orbit of the Moon. Doing extensive mapping and it carries various instruments for measuring cosmic rays and other celestial phenomena.

2011

Curiosity Rover: A hugely successful rover that is exploring Mars. Carries a digging arm, chemistry lab and other instruments. Confirmed the existence of water and other revealing facts. Still going strong.

Juno: Is in a polar orbit of Jupiter. Has measured Jupiter's gravity field, magnetic field, atmospheric chemicals such as water, ammonia, methane and phosphine. Is scheduled to take a suicide dive into Jupiter in 2021.

2013

MAVEN Orbiter: Designed to study Mars' upper atmosphere. For example, the loss of water vapor (hydrogen and oxygen). Also, it serves as a communication relay between Earth and rovers and landers. An extended (diminished power) mission could last up to ten years.

2016

OSIRIS-REx Mission: Is to study the asteroid Bennu. If all goes well, it will obtain a sample from Bennu and bring it back to Earth in 2023. Latest information indicates that OSIRIS has made a braking maneuver and should get within 12 miles of Bennu on December 3. It will orbit Bennu for about a year before briefly touching the asteroid and taking a sample. Return trip will begin in 2021.

2018

TESS: Transiting Exoplanet Survey Satellite is in a highly elliptical orbit of the Earth as it surveys the sky for exoplanets. It covers an area 400 times larger than did the Kepler telescope. First results should be published in December, 2018.

InSight Mission: Will do extensive geological measurements of Mars. This includes drilling a sample core (Heat Flow and Physical Properties Probe) to a depth of about 16 feet and doing seismic studies. It landed safely on November 26. It also carried two orbiting mini-spacecrafts which will primarily be used for communication.

Parker Solar Probe: Will study the Sun's atmosphere (corona) by way of seven flybys over nearly seven years. Carries a thermal shield to protect instruments and allow it to cruise as close as 3.8 million miles of the Sun.

DARK MATTER CREATES STRUCTURE FOR EARLY GALAXY FORMATION

Dr. Joel Primack, and his colleagues at the University of California, Santa Cruz, have used the Hubble telescope's Wide Field Camera 3 to study galaxy formation in infrared frequencies. This camera's sensitive range enabled it to observe redshifts that go back to very distant galaxies. These galaxies are forming during the early times of the universe. They are young, but old in look-back time from Earth.

The unusual young galaxy feature that was repeatedly found was an oblong shape that Dr. Primack called "pickle shape".

Up to now, astronomers assumed that galaxies formed into flat spirals or round spheroids, that we commonly see today. It appears that these oblong young galaxies are associated with narrow, dark matter filaments. (Think of bright lights on a Christmas tree: one can see the shape of the tree, although the tree itself is dark and not seen.) The Sloan Digital Sky Survey has confirmed the existence of dark matter network structures.

Such structures are predicted by sophisticated computer simulations carried out by Dr. Primack and colleagues. The forming galaxies are lined up along the filaments with their long axes along the web, pointing toward other nearby galaxies.

As time goes on, the young galaxies accumulate ordinary and dark matter until they reach about one-tenth the mass of today's Milky Way. Then the rate of inflow of matter accelerates and the gravitational forces cause a compaction of the central region. New star formation increases. The galaxy shape slowly morphs into the disk or sphere that we see in modern day galaxies. The mass of the dark matter halo around the galaxy ends up to be as much as 30 times the mass of ordinary matter.

According to Dr. Primack, it appears that galaxies go through a period of peak star formation. If the galaxy is too massive, its central black hole gives off sufficient radiation to impede star formation. Lower mass galaxies are now just starting to emerge into their star-forming age. The number of star-forming galaxies seems to have held constant for the past 10 billion years. But the number of old, red galaxies is increasing.

If the universe continues to expand due to the influence of dark energy, many billions of years from now, we will no longer be able to see other galaxies. They will be out of view. [Amer. Scientist, Sept. – Oct., 2018].

NEW HORIZONS WILL DO A FLYBY OF KUIPER BELT OBJECT 2014 MU69 ON JANUARY 1, 2019

After its spectacular success of going past the dwarf planet, Pluto in 2015, New Horizons set sight on the next Kuiper Belt target: 2014 MU69, also known as Ultima Thule. It is rapidly approaching Ultima for a flyby at 12:33 a.m. ET January 1, 2019. This will be at a distance of about 4 billion miles from the Sun. It will be the most distant flyby maneuver ever attempted.

Travelling at about 30,000 mph, New Horizons will pass 2,175 miles above the surface of Ultima, which is closer than it came to Pluto (7,800 miles).

We know very little about 2014 MU69. It is a lot smaller than Pluto (23 miles vs. 1,477 miles). It gives the appearance of having the shape of two spheres stuck together. It's possible that they are two separate bodies that are in tight orbit of each other. We don't know if it has a ring or moons. The teachers and other members of the public can contact NASA at the base of operations: Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Maryland. [pluto.jhuapl.edu/News-Center/PI]

BIRTHDAYS IN DECEMBER

Isaac Newton (Eng.), b. Dec. 25, 1642; d. Mar. 20, 1727. Astronomer-mathematician. Developed laws of gravity, calculus, invented the reflector telescope, studied diffraction of light.
Tycho Brahe (Danish), b. Dec. 14, 1546; d. Oct. 24, 1601. Carefully plotted the positions of the known planets (before the use of telescopes). This enabled Kepler (see below) to formulate his laws of planetary motion.
Maarten Schmidt (Dutch), b. Dec. 28, 1929. Measured distances to quasars. Gave evidence for the vast size of the universe.

Birthdays, continued

Annie Jump Cannon (Amer.), b. Dec. 11, 1863; d. Apr. 13, 1941. Astronomer who studied variable stars and established the O,B,A,F,G,K,M classification of star luminosity/temperature. She did most of her work at the Harvard College Observatory. She created the Henry Draper Catalogue of star spectra.

Gerard Peter Kuiper (Amer., Dutch born), b. Dec. 7, 1905, d. Dec. 23, 1973. Studied the atmospheres of the planets. Discovered Saturn's moon, Miranda and Neptune's moon, Nereid.

Johannes Kepler (Ger.), b. Dec. 27, 1571, d, Nov. 15, 1630. Formulated the famous three laws of planetary motion.

Arthur Stanley Eddington (Brit.) b. Dec. 28, 1882, d. Nov. 22, 1944. English astro-physicist, who worked out various laws for stellar pressure-temperature dynamics and utilization of Einstein's theory of relativity.

MOON PHASES IN DECEMBER: New: Fri. 12/7; First Qtr.: Sat. 12/15; Full: Sat. 12/22; Last Qtr.: Sat. 12/29

THE PLANETS IN DECEMBER: Saturn is low in the southwest right after sunset. Drops out of sight later in the month. **Mars** is a conspicuous evening red "star" in the southern sky. You can't miss dazzling **Venus** in the east, right before the morning sunrise. **Mercury** is briefly seen in the morning at mid-month and is joined by **Jupiter** by the 21st.

OTHER DECEMBER EVENTS: The **Geminid Meteor Shower** peaks around the 14th (early morning). Look for the comet **46P/Wirtanen** which should be visible with binoculars (possibly naked eye) during mid-month. It should be located a bit south of Orion and Taurus. (Best Dec. 10 – 20 with erihelion on Dec. 12) Winter Solstice on the 21st.

WORD SEARCH: Season's Sightings

E D O N N E R O R I O N
C X U S A N T A K H R E
A T M R U D O L P H I P
N A C A P E L L A B G F
I U O V L R D A S H E R
S R M I E T B V S H L K
C U E X I G E M I N I A
N S T E A L R U R F G U
L C A N D C U P I D O R
S B E T E L G E U S E I
B F P G S R S M S C I G
T H K P R A N C E R L A

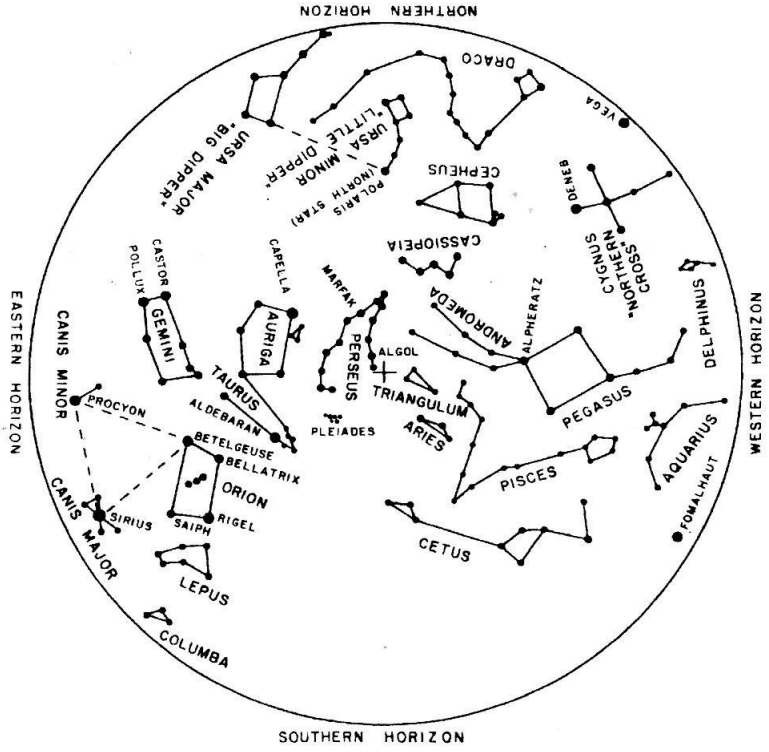
AURIGA
BETELGEUSE
CANIS
CAPELLA
COMET
CUPID
DASHER
DONNER
GEMINI
ORION
PLEIADES
PRANCER
RIGEL
RUDOLPH
SANTA
SIRIUS
TAURUS
VIXEN

Forsyth Astronomical Society: Meetings at Kaleideum North (formally SciWorks) the second Wednesday of the month; 7:30 p.m. Visiters are welcome. Check the FAS website: www.fas37.org for club activities. You can also get information about FAS at the Kaleideum North front desk: 336-767-6730 ext. 1000

See the winter star chart on page 5. Have a nice holiday!! Bob Patsiga, editor

THE WINTER SKY

There are a lot of neat constellations in the winter season. We are looking through the cross section of the Milky Way and so, we see many stars. In December, low in the east, we see the bright star, Sirius, the brightest star in the sky (mag. -1.4, 8.6 LY). Sirius is also known as the Dog Star, because it is found in Canis Major. Up from Sirius, you will see three stars in a row which make up the belt of Orion the Hunter. Sirius and Orion will gradually shift to the west (and more straight up) as we progress into January and February. The right arm of Orion (to our left) is the red giant star Betelgeuse (mag. 0 – 1 variable, 400 LY). In Orion's left leg we see Rigel (mag. 0, 800 LY). With binoculars, you should be able to find the Orion Nebula in the sword of Orion. It shows up as a bright fuzzy region. If you go toward the zenith from Orion, you should see a large pentagon. This is the constellation Auriga, with its main star, Capella. Off to the right (west) of Orion is Taurus the Bull. One of the horns of the bull is part of Auriga. Continuing westward a bit, you'll see the Pleiades star cluster, which is very easy to spot. Going in the eastward direction from Orion, we find Gemini. The Geminid meteor shower occurs in mid December.



THE NIGHT SKY IN DECEMBER