SIRIUS ASTRONOMER

www.ocastronomers.org

The Newsletter of the Orange County Astronomers

December 2016 *Free to members, subscriptions $12 for 12 issues* **Volume 43, Number 12**

Although this picture was taken in July, a nice fir tree for the holidays is in this picture of the Milky Way over Diamond Peak, Oregon by Sam Pitts. Sam used a Canon F1 imager with a 22mm lens at f/2 to create this image. The camera was piggybacked to an FS78 refractor for guiding. Whatever holiday or occasion you celebrate, we at OCA wish you the best of the season!

OCA CLUB MEETING

The free and open club meeting will be held December 9 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, Dr. Bruce Banerdt of JPL will discuss the InSight mission to Mars and the birth of rocky planets!

NEXT MEETINGS: Jan. 13, Feb. 10

STAR PARTIES

The Black Star Canyon site will open on December 17. The Anza site will be open on December 24 and December 31. Members are encouraged to check the website calendar for the latest updates on star parties and other events.

Please check the website calendar for the outreach events this month! Volunteers are always welcome!

You are also reminded to check the web site frequently for updates to the calendar of events and other club news.

COMING UP

The next session of the Beginners Class will be held at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana on December 2. The following class will be held January 6.

NEW! Youth SIG: contact Doug Millar
Astro-Imagers SIG: Dec. 13, Jan. 10
Remote Telescopes: contact Delmar Christiansen
Astrophysics SIG: Dec. 16, Jan. 20
Dark Sky Group: contact Barbara Toy

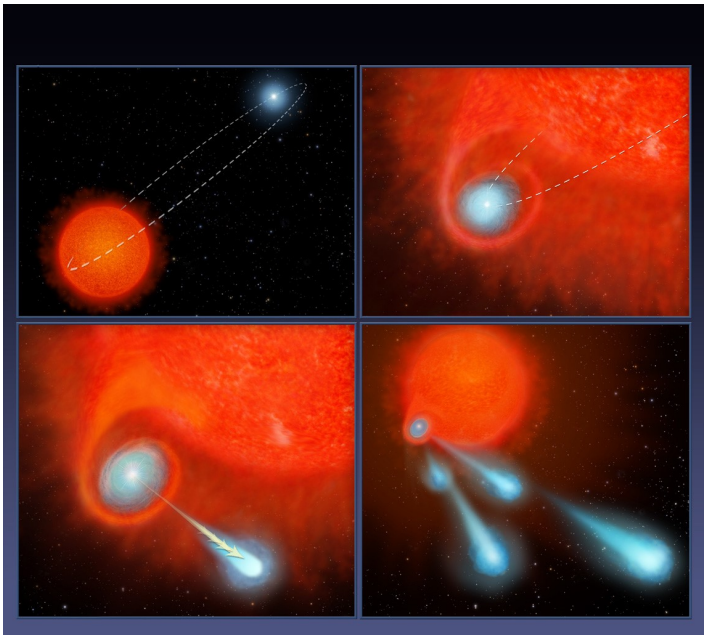
Dimming stars, erupting plasma, and beautiful nebulae

By Marcus Woo

Boasting intricate patterns and translucent colors, planetary nebulae are among the most beautiful sights in the universe. How they got their shapes is complicated, but astronomers think they've solved part of the mystery—with giant blobs of plasma shooting through space at half a million miles per hour.

Planetary nebulae are shells of gas and dust blown off from a dying, giant star. Most nebulae aren't spherical, but can have multiple lobes extending from opposite sides—possibly generated by powerful jets erupting from the star.

Using the Hubble Space Telescope, astronomers discovered blobs of plasma that could form some of these lobes. "We're quite excited about this," says Raghvendra Sahai, an astronomer at NASA's Jet Propulsion Laboratory. "Nobody has really been able to come up with a good argument for why we have multipolar nebulae."



This four-panel graphic illustrates how the binary-star system V Hydrae is launching balls of plasma into space. Image credit: NASA/ESA/STScI

Sahai and his team discovered blobs launching from a red giant star 1,200 light years away, called V Hydrae. The plasma is 17,000 degrees Fahrenheit and spans 40 astronomical units—roughly the distance between the sun and Pluto. The blobs don't erupt continuously, but once every 8.5 years.

The launching pad of these blobs, the researchers propose, is a smaller, unseen star orbiting V Hydrae. The highly elliptical orbit brings the companion star through the outer layers of the red giant at closest approach. The companion's gravity pulls plasma from the red giant. The material settles into a disk as it spirals into the companion star, whose magnetic field channels the plasma out from its poles, hurling it into space. This happens once per orbit—every 8.5 years—at closest approach.

When the red giant exhausts its fuel, it will shrink and get very hot, producing ultraviolet radiation that will excite the shell of gas blown off from it in the past. This shell, with cavities carved in it by the cannon-balls that continue to be launched every 8.5 years, will thus become visible as a beautiful bipolar or multipolar planetary nebula.

The astronomers also discovered that the companion's disk appears to wobble, flinging the cannonballs in one direction during one orbit, and a slightly different one in the next. As a result, every other orbit, the flying blobs block starlight from the red giant, which explains why V Hydrae dims every 17 years. For decades, amateur astronomers have been monitoring this variability, making V Hydrae one of the most well-studied stars.

Because the star fires plasma in the same few directions repeatedly, the blobs would create multiple lobes in the nebula—and a pretty sight for future astronomers.

If you'd like to teach kids about how our sun compares to other stars, please visit the NASA Space Place: http://spaceplace.nasa.gov/sun-compare/en/

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!

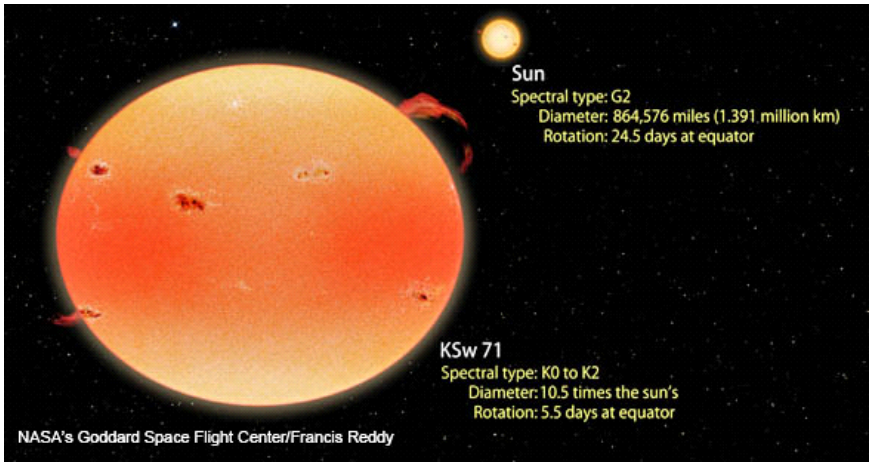
AstroSpace Update

December 2016

Gathered by Don Lynn from NASA and other sources

Stripped galaxy – A team of astronomers made a search using a radiotelescope to look for supermassive black holes that are not at the centers of galaxies. Theoretically, such should be produced sometimes when galaxies merge. The only object they found (dubbed B3 1715+425) turned out on closer scrutiny to be a black hole at the center of a galaxy nearly stripped of all its stars, and trailing ionized gas toward a nearby larger galaxy. Apparently the black hole and a bit of its galaxy survived a close pass with the large galaxy, and are now speeding away at over 1200 mi/sec (2000 km/sec). What's left of the small galaxy does not have much material to form stars, and so will eventually fade away.

Heartbeat stars are binary stars that got their name because the plot of brightness over time looks like an electrocardiogram. They are binary stars with quite elongated orbits. The Kepler planet-finding space telescope discovered large numbers of them. At the point of their closest approach, the stars' mutual gravitational pull causes them to become slightly ellipsoidal in shape, which is one of the reasons their light is so variable. The close encounters also set one or both of the stars vibrating. A new study measured the orbits of 19 heartbeat systems using a high-resolution spectrometer on the Keck Telescope in Hawaii. The stars studied were found to be hotter and bigger than our Sun. Tidal effects during the close approaches should theoretically push the orbits toward circular, and yet all these were found with quite elliptical orbits. The leading theory to explain the eccentricity is that there are 3rd stars involved that are too dim to have been found yet. Researchers plan further observations that might uncover 3rd stars in these heartbeat systems.



Pumpkin stars – Astronomers using observations from the Kepler planet-finding space telescope and the Swift gamma-ray space telescope have discovered 18 rapidly spinning stars that produce X-rays at more than 100 times the peak levels of our Sun. The stars spin so fast that they are squashed into pumpkin shapes, and the poles get brighter and the equator darker. They are thought to be the result of close binary systems where 2 Sun-like stars merge. Rapid rotation amplifies the same kind of activity seen on the Sun, such as sunspots and solar flares. The most extreme member of the group, a K-type orange giant dubbed KSw 71, is more than 10 times larger than the Sun, rotates in just 5.5 days, and produces X-ray emission 4000 times greater than the Sun at solar maximum. The stars were found as part of an X-ray survey of a part of the original field of view where Kepler was looking for planets. The X-ray survey found 93 new sources, about evenly split between active galaxies and various types of X-ray stars. Spectra of the brightest sources were taken with the Palomar telescope, which showed clear evidence of enhanced stellar activity. The Kepler measurements were used to determine the rotation periods and sizes for 10 of the stars, which range from 2.9 to 10.5 times that of the Sun. Their surface temperatures range from somewhat hotter to slightly cooler than the Sun. The stars are giants and subgiants, and all of them will become much larger red giants. The theory of how these form was developed 40 years ago: a close binary system in which 1 star reaches the end of its fuel and enlarges. The stars coalesce to form a single rapidly spinning star, initially in a disk that later dissipates.

Tilt – A number of planets are known that orbit binary stars. Normally the plane of the planet orbits is the same as the rotational equator of the stars and the plane in which the binary stars orbit each other. That means the planets formed in a disk that lay in this plane. New observations using the ALMA radiotelescope array show a binary star pair with 3 planet-forming disks, one around each star and a 3rd around the center of mass of the pair. The 3 disks lie in 3 different planes! The binary is known as IRS 43 and has been observed by various radiotelescopes for over a decade. It's located in the Rho Ophiuchus star-forming region. 2 proposals have been made to explain this: 1) there is a 3rd star there, as yet undiscovered, that is stirring up the planes, 2) binaries form like this, and the planes are pushed together later. Further observations of this system and similar ones are required.

Super-Earth – Using the radial velocity technique, astronomers have found a nearby super-Earth planet orbiting a red dwarf star known as GJ 536. It is about 33 light-years away and its mass is at least about 5 times that of Earth. It takes 8.7 Earth days to orbit its star. It is not in the habitable zone, that is, where liquid water could exist on a planet. However it is interesting because the close orbit about an apparently bright star makes it a good candidate for spectroscopy if and when it passes in front of (transits) its star,

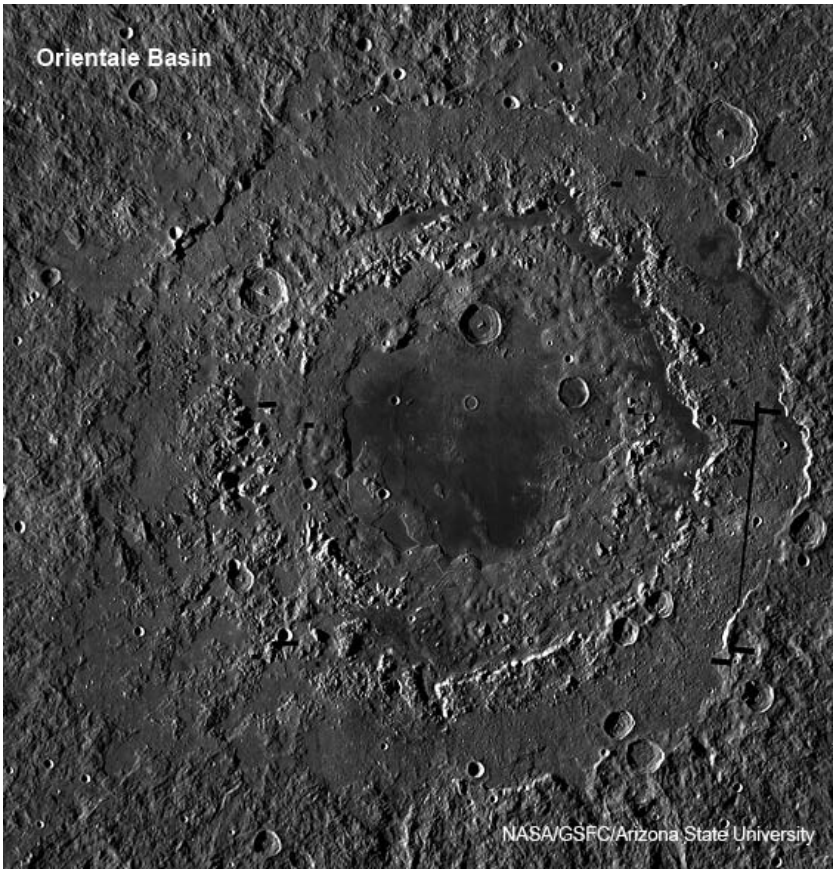
thereby allowing astronomers to determine the content of the planet's atmosphere. The search is on to see if it indeed transits its star. The discovery observations of the planet also determined that the star rotates in about 44 days and has a magnetic cycle (star spot cycle) that lasts less than 3 Earth years.

Rare binaries explained – Scientists believe a new study has explained binary stars consisting of a millisecond pulsar and a low-mass white dwarf that orbit with an eccentric orbit. There are 5 such systems known. The explanation for low-mass white dwarf stars has long been known. At first they were mysteries, because white dwarfs form when a star has run out of hydrogen fuel. The lower the mass of the star, the slower it consumes fuel, and so the longer it takes to run out of fuel. The lowest mass white dwarfs known should have taken 100 billion years to run out of fuel. The Universe has not been around that long. The answer to this mystery is that a close binary companion star gravitationally stole most of their mass. If the companion is a pulsar, then the stolen mass falling into the pulsar spins it up to very high speeds, and so it rotates every few milliseconds. So this scenario explains the pairing of a millisecond pulsar with a low-mass white dwarf. But such a pair close enough to steal that much mass will have terribly strong tidal forces that will circularize their orbit. So just the ones with eccentric orbits needed to be explained by the new study. 3 theories for eccentric orbits were studied, but only 1 theory fit the parameters (mass, period, etc.) of the known examples. That theory is that the white dwarf had a strong stellar wind that blew off a lot of material that formed into a disk around the pair of stars. The gravity of the disk disturbs the stars' orbit, increasing the eccentricity.

X-ray flare ups – A few instances have been seen of a burst of X-rays coming from a source that normally produced only a few X-ray photons per hour. A new search through X-ray data for similar objects found 2 more, one of which has repeated at least 4 times since 2007. The objects are apparently in a dwarf galaxy near the galaxy Centaurus A, and in a globular cluster near galaxy NGC 4636. The characteristics of these 2 objects ruled out all proposed explanations except an intermediate-sized black hole. The search will continue for more X-ray flare ups like these. More evidence will be needed to show these are intermediate-sized black holes, since such are extremely rare.

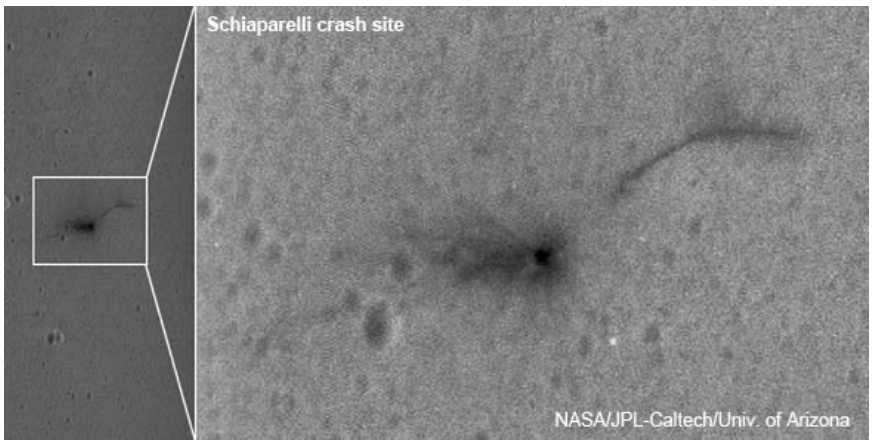
Water worlds – Following the recent discovery of many planets orbiting red dwarf stars, including one at our nearest neighbor Proxima Centauri, theorists wrote computer simulations of how planets form very close to red dwarfs. The result was that over 90% of the simulations produced planets that were more than 10% water by total mass. For comparison, Earth is only 0.02% water. Most of the planets simulated ended up roughly Earth's size. We know that life developed on Earth, but it is not clear if that would repeat on a planet that has no land, only ocean.

Orientale Basin – New results from the GRAIL mission (orbited the Moon in 2011-2012) are providing insights into how the huge impacts known as "multi-ring basins" formed. Craters larger than about 180 miles (300 km) are referred to as basins. With increasing size, craters tend to have increasingly complex structures, often with multiple concentric raised rings. The new results studied Orientale Basin, which is about 580 miles (930 km) wide and has 3 distinct rings. Multi-ring basins are found on many of the rocky and icy worlds in our Solar System. GRAIL provided gravity data on structures under the surface to help understand features like Orientale. Near the end of the GRAIL mission, spacecraft were lowered to less than 1.2 miles (2 km) altitude when they passed over Orientale to get better data from closer passes. Various past theories had the initial crater size at one of the 3 rings. GRAIL data showed the initial crater was between the 2 innermost rings. Rebounding material created the rings and covered evidence of the initial crater. The impact excavated at least 816,000 cubic miles (3.4 million km^3) of material, 153 times the combined volume of the Great Lakes. A 2nd team developed a simulation of the impact that was able to reproduce the gravity signatures found by GRAIL. It answered the question of why mantle material is not visible at Orientale, only churned up crust material. The simulation showed that crust material flowed back on top of the mantle material, and hid it. It is possible that there are undiscovered basins on the Moon because later activity covered them. However, study of gravity data such as GRAIL took should be able to find them.



Venusian volcanoes – There is a lot of evidence that volcanoes are still active on Venus, but we've never observed an eruption. A new study of old data from Venus Express and Pioneer Venus Orbiter found excess heat on the flanks of the mountain Idunn Mons for a period of time, and calculations showed that the amount of heat seen is the amount that would be given off by fresh lava flows of sizes matching fresh-looking lava flows that were radar imaged. That's as close as we've gotten to observing an eruption. It is hoped that a future high-resolution radar spacecraft can actually catch an eruption.

Uranus – A new study of old Voyager 2 data from the 1986 flyby of Uranus has found evidence that there may be 2 moons, as yet undiscovered, orbiting near Uranus's rings and disturbing them. Patterns seen in the Alpha and Beta rings resemble those in Saturn rings that are known to be caused by the gravity of nearby small moons. The patterns were seen in radio occultation and star occultation data, that is, when the rings blocked the spacecraft radio signal or light from background stars. If there are small moons near Uranus's rings, it could explain why the rings don't spread out and dissipate. Moons have been shown to gravitationally shepherd ring material so that it does not dissipate.

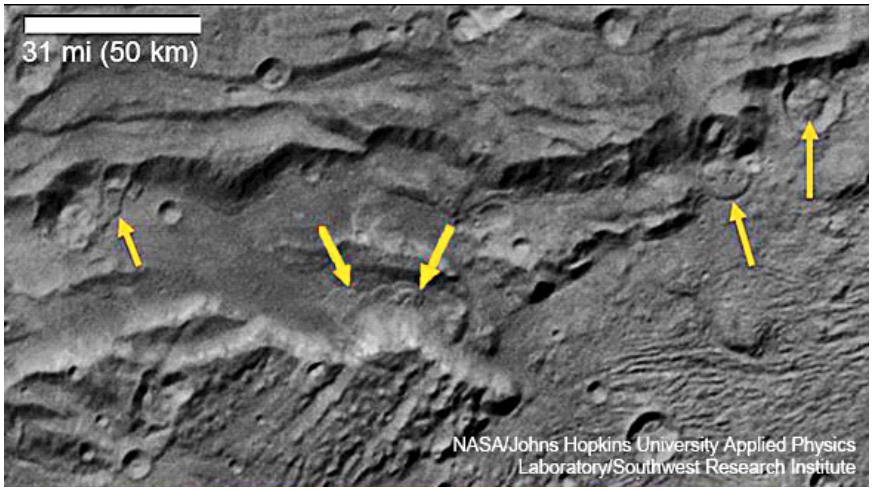


ExoMars – When we checked on ExoMars last month, its orbiter (called TGO) was about to go into orbit and its lander (called Schiaparelli) was about to land. The orbiter successfully orbited, but the retrorocket on the lander shut off too early, and the lander crashed. Mars Reconnaissance Orbiter found a big splat where it was supposed to land. The parachute and heat shield were lying nearby. Mission officials at the European Space Agency now have to determine what went wrong, and if it can be fixed in time to launch a planned rover to Mars in 2020. TGO will spend about a year to reach its final science orbit, mostly spent in aerobraking (barely dipping into the top of the atmosphere to change its orbit). Then 5-7 years of observing are planned, measuring methane, water vapor and other gasses in the Martian atmosphere.

Curiosity (Mars rover) spied a rounded dark rock that controllers are calling "Egg Rock". The initial guess was that it is an iron-nickel meteorite, which was verified by ChemCam analysis. Phosphorus was also detected, suggesting the mineral schreibersite, which is almost exclusively found in iron-nickel meteorites. Curiosity and the rover Opportunity have found at least 3 previous meteorites laying on the surface of the red planet.

Unexpected water – Observations in infrared of asteroid Psyche have found water or hydroxyl (2/3 of a water molecule) on the surface. Psyche is the largest known metal asteroid, thought to be nearly pure nickel-iron. Such asteroids are believed to be broken pieces of the core of an early protoplanet. Forming that way should leave no water on it. To explain the new observations, either it did not form from a core or something added water later. Suggestions for the "something" are solar wind interactions or collisions by carbonaceous asteroids. There is a proposal to send a mission to Psyche, so we may get a closer look at this in a few years.

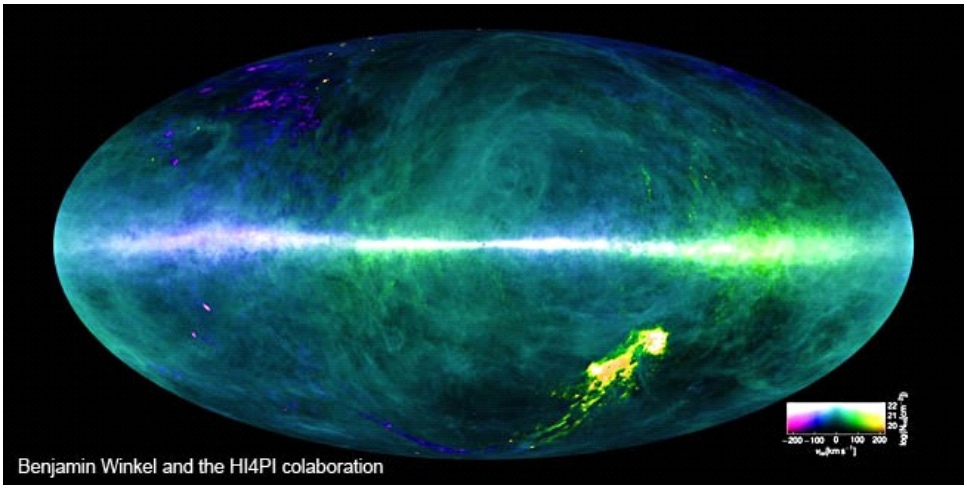
New Horizons – All the data gathered by New Horizons during its July 2015 flyby of the Pluto system have now been radioed to Earth. It took about 15 months, just slightly faster than planned. After a final check of the data, it is being erased from the spacecraft to make room for further observations of Kuiper Belt objects, including its flyby of 2014 MU_{69} on January 1, 2019. New scientific results from Pluto: a handful of objects that are likely clouds (as opposed to haze, previously seen) have been found. There is no way to confirm they are clouds, now that Pluto is long passed. They all are near the terminator (boundary of daylight), so clouds likely form only at dawn or dusk. No landslides have been found in Pluto images, but several have been on its large moon Charon.



Antares – In late 2014 I reported here that an Antares rocket, made by Orbital ATK, exploded, destroying a load of supplies on its way to the International Space Station (ISS). The explosion was attributed to use of old Russian rocket engines that had been in storage for decades. Orbital redesigned the Antares rocket to use newer engines, and was put back into service October 18, delivering more than 5100 lbs (2300 kg) of supplies to ISS. Dozens of experiments are included, such as a study of flames in micro gravity and the Fast Neutron Spectrometer.

I previously reported here that a SpaceX **Falcon 9** rocket exploded during a routine fueling test September 1. SpaceX has replicated the problem (helium froze something that wasn't intended to freeze, and broke open the oxygen tank), so they believe they can fix it and resume launches by the end of the year.

Instant AstroSpace Updates



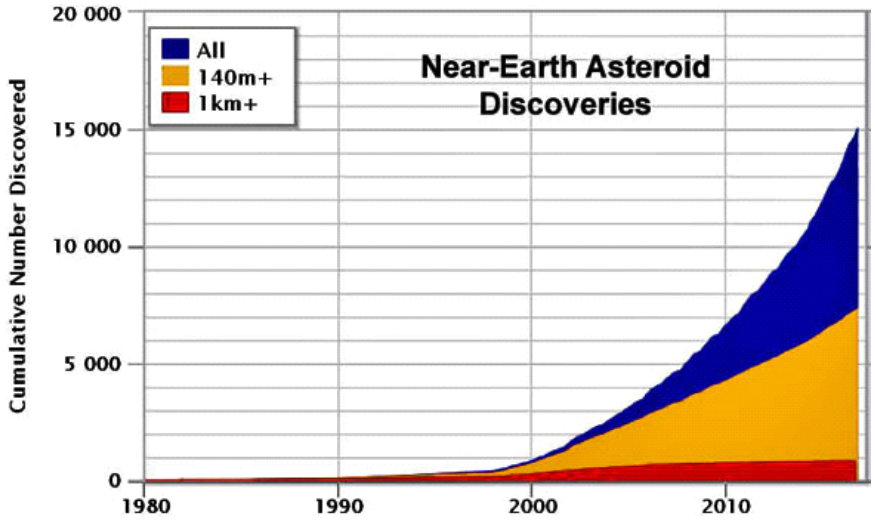
Scientists have created a detailed **map of the entire sky**, particularly the Milky Way, dubbed the HI4PI map, using 2 large radiotelescopes (the Max-Planck 100-meter in Germany and the 64-meter CSIRO in Australia) at the frequency of neutral hydrogen gas. It has twice the sensitivity and 4 times the resolution of the best previous hydrogen all-sky survey.

Images from Cassini show that the strange hexagon found at Saturn's north pole is **changing color** from bluish to more golden with the approaching northern summer solstice. It is thought that increasing sunlight is causing golden hazes to form.

A new computer simulation of **formation of rings** around a planet found that the diverse rings observed around all 4 gas giant planets in our Solar System can be explained by close encounters with Pluto-sized objects, during which tidal forces tore apart the object and trapped some of the material as orbiting rings.

Juno (Jupiter orbiter) detected slow valve operation during a test, and experienced a computer reset that put the spacecraft into safe mode; so the decision was made to postpone for one orbit performing the engine burn that will lower Juno's orbit to the planned science orbit. Next close approach to Jupiter is December 11, and full science observations are planned.

2007 OR_{10}, the 3rd largest and 3rd farthest known object beyond Neptune, was found to have a moon in images taken with the Hubble Space Telescope.



2 aggressive search programs for **near-Earth asteroids** (NEAs) (the Catalina survey and Pan-STARRS 1) have pushed the total of known NEAs over the 15,000 mark.

The largest deformable mirror ever (over a meter across, but only 2 mm thick) has been installed on the 8-meter unit 4 telescope of the Very Large Telescope in Chile as part of the most advanced **adaptive optics** system to compensate for the turbulence of our atmosphere. 1170 actuators guided by 4 lasers drive the mirror.

In March I reported here that astronomers had predicted another planet (still not found), which they are calling **Planet Nine**, orbiting far beyond Neptune, based on 2 groupings of objects in the Kuiper Belt that appear to have been pushed into their groupings by a massive planet. A new study shows that this Planet Nine could have pushed the tilt of the 8 planets (compared to the plane of the Sun's equator) into its observed position.

What books do you take on vacation or a cruise?

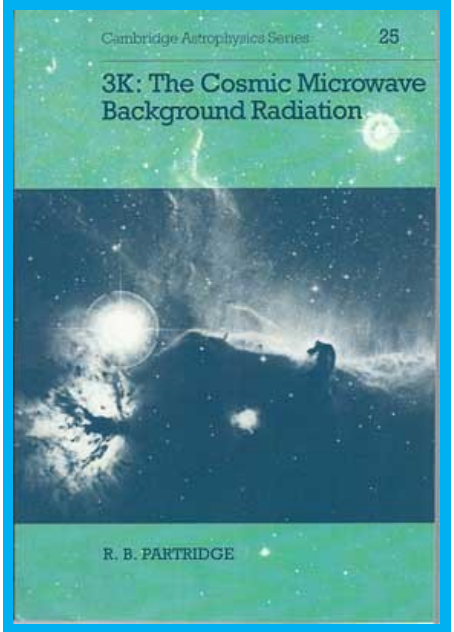
George Robison

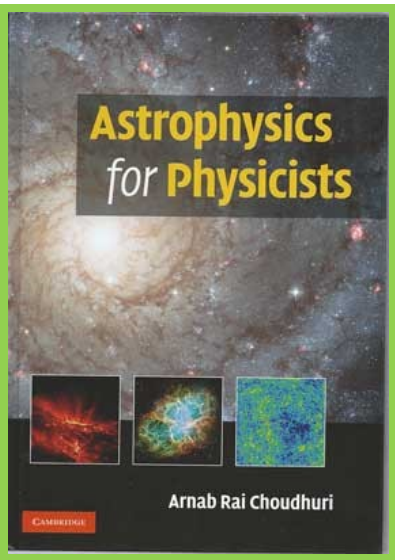
Greetings from (offsite) Palmia Observatory

Well, I've had quite a time deciding what books to take with us on our cruise vacation. Resident Astronomer Peggy has a couple of paperback novels and some science periodical, like Science News, The New Scientist, Astronomy, and Sky and Telescope magazine and her Ipad, so she is good to go. I had a hard time because as much as I want to read a lot of good books, I know that as often as not, the books
go mostly unread on vacation. How about you, do you do much the same thing? Now, I don't often pack a novel with me, well, because I am mostly a physicist wannabe and nerd after all, so I pack a lot of technical type books. These are the six or seven books that after a lot of soul searching I put aside and will find room in the luggage. I'm on a break from general relativity, until the class starts next week, and have been struggling through more quantum mechanics, entanglement and astrophysics. It is the case though, as you can see by the titles and question I have asked, that these books are really mystery stories told in the language of science and physics. I hope to make progress on at least one of these topics.

I will of course have my Ipad too, but it remains a total mystery regarding how many pages I will actually read on our vacation. How many would you take and how many pages of these six books will I read? Sometimes, I get asked, if I know that reading will be hard, why take more than just one book? My answer is that I often get stuck with one book and one subject and so I like to switch to the other book and subject until I can get some help with the first problem. In addition, some smart alecs will proclaim that no matter what the final page count, the number of martinis ordered will exceed the number of pages read. Hey, what are they trying to say???? We will just have to wait and see!

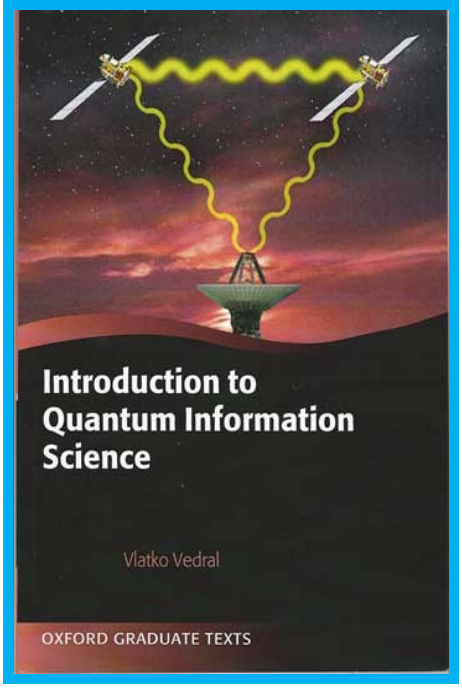
How does one glean from the measurement of the CMB findings how we can describe and predict the amount of dark matter, dark energy, and the flatness and homogeneity and isotropy of the universe?



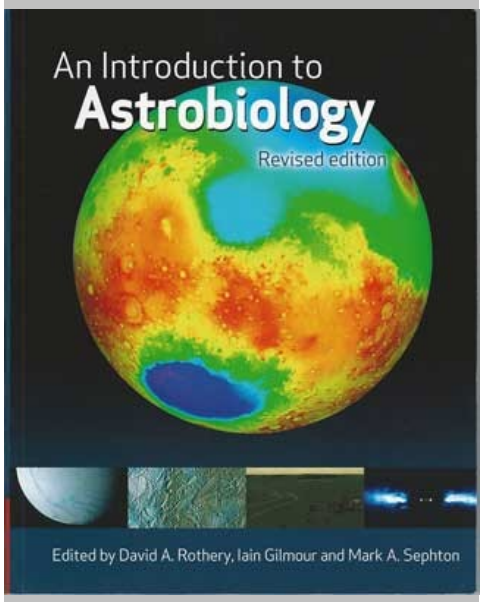


What are the physical processes that cause and modulate the radiation coming from astrophysical objects and how is it used to determine what is going on at millions and billions of light years from us and how these processes explain the formation of stars, planets and galaxies?

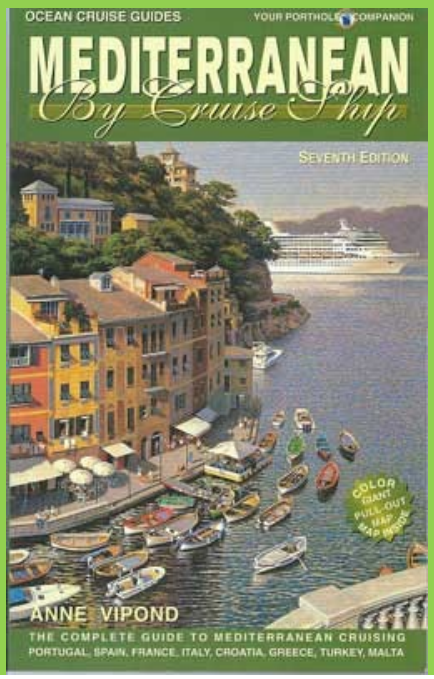
Why is quantum mechanics and the area of a black hole related and why is there a big controversy over whether information, just like energy and momentum, is conserved or not?



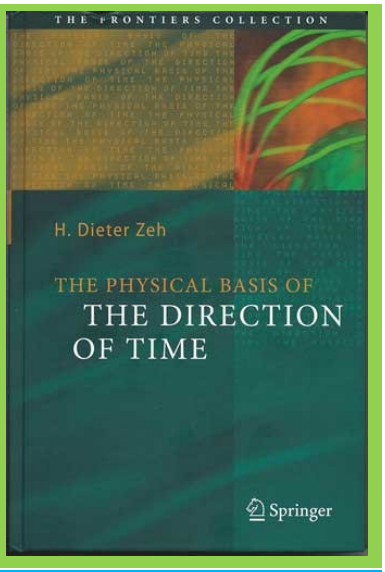
What does the discovery of organic compounds, like amino acids, and plausible causes for the molecules' chirality in life, and were these and water transported to earth and it tells us about the conditions necessary for and the possibility and likelihood of life in other parts of the cosmos. This book is relevant for the upcoming astrobiology workshop in December

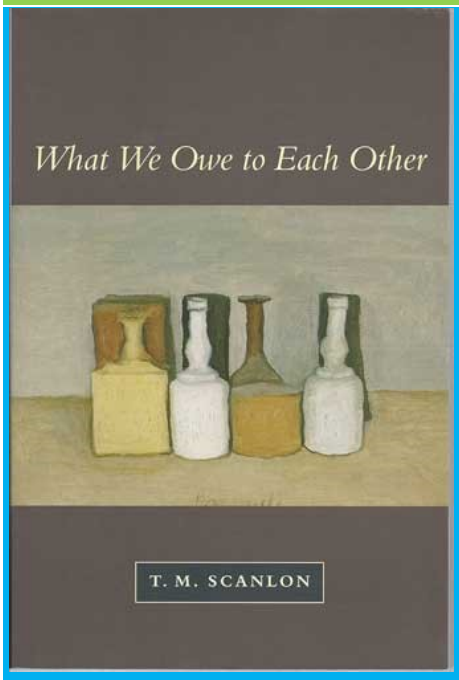


Hey, we are on a cruise after all, so shouldn't I have at least one little book on the area where we are cruising?



The asymmetry of time is one of the most striking features of our everyday experience, but for the laws of fundamental physics, which don't really care about the direction in time, so where does this directionality come from? Is the well established and verified 2nd law of thermodynamics to be explained only by the supposedly low entropy occurring during the initial conditions of the past, which for the universe was at the big bang?





How do we review and evaluate different visions for the future of our society. This philosophical text discusses some broad issues covering moral issues, fairness and justice in a world of widely differing values. We are surrounded and bombarded by different political positions offering what kind of future they advocate for, but how can we get a handle on where our own political positions come from and why do we hold them? I spend a lot of time reviewing and learning my physics and cosmological positions and now how hard that is to get good understanding, so how can I be sure my political positions are valid for the world we live in, given the meager amount of time I spend evaluating politics? How do we delay motivated reasoning to support our team so at first we can look for the truth of the situation?

So, I have no idea if I will make much or any progress through these texts, but at least they will be available. We have a couple of sea days, and I can see us out on our balcony enjoying the sea flow past and considering some of these deep physical ideas. Any bets on the number of pages of each book I get through? My previous experience has shown that a number between 3-5 pages per book works out about right. At least they will be onboard.

Until next time!

WINTER OVRO TRIP PLANNED FOR DEC. 16-17

I am planning a winter trip to Owens Valley Radio Observatory facility this December on Dec.16-17.

The trip is for young and old. We would like people to bring their telescopes and help us with observing. The winter skies up there are excellent.

We will have a great warming room. We will have the usual fun activities like a tour of the facilities and experiments with liquid nitrogen, snow play and great pizza.

There is no cost involved, but you need to arrange your own transportation, lodging and meals. The observatory is a few miles East and North from Big Pine, Ca. along Highway 395.

Please let me know if you would like to go via email or phone, and I will send you more details.

Hope you can join us,

Dr.Doug Millar EdD. K6JEY drzarkof56@yahoo.com 562 810 3989 cell/text

OCA 2017 Banquet
Date: January 14 2017 (Saturday night)
Theme: 2017 Solar Eclipse
Time: 7:00 PM - 9:30 PM
Place: JT Schmid's, Anaheim
2610 E. Katella Ave, Anaheim, CA 92806

Cost: Free entry, but you must pay for the meals & drinks you order. Dinner menu ranges from $12 salads, $15 hamburgers to more expensive full dinner meals.

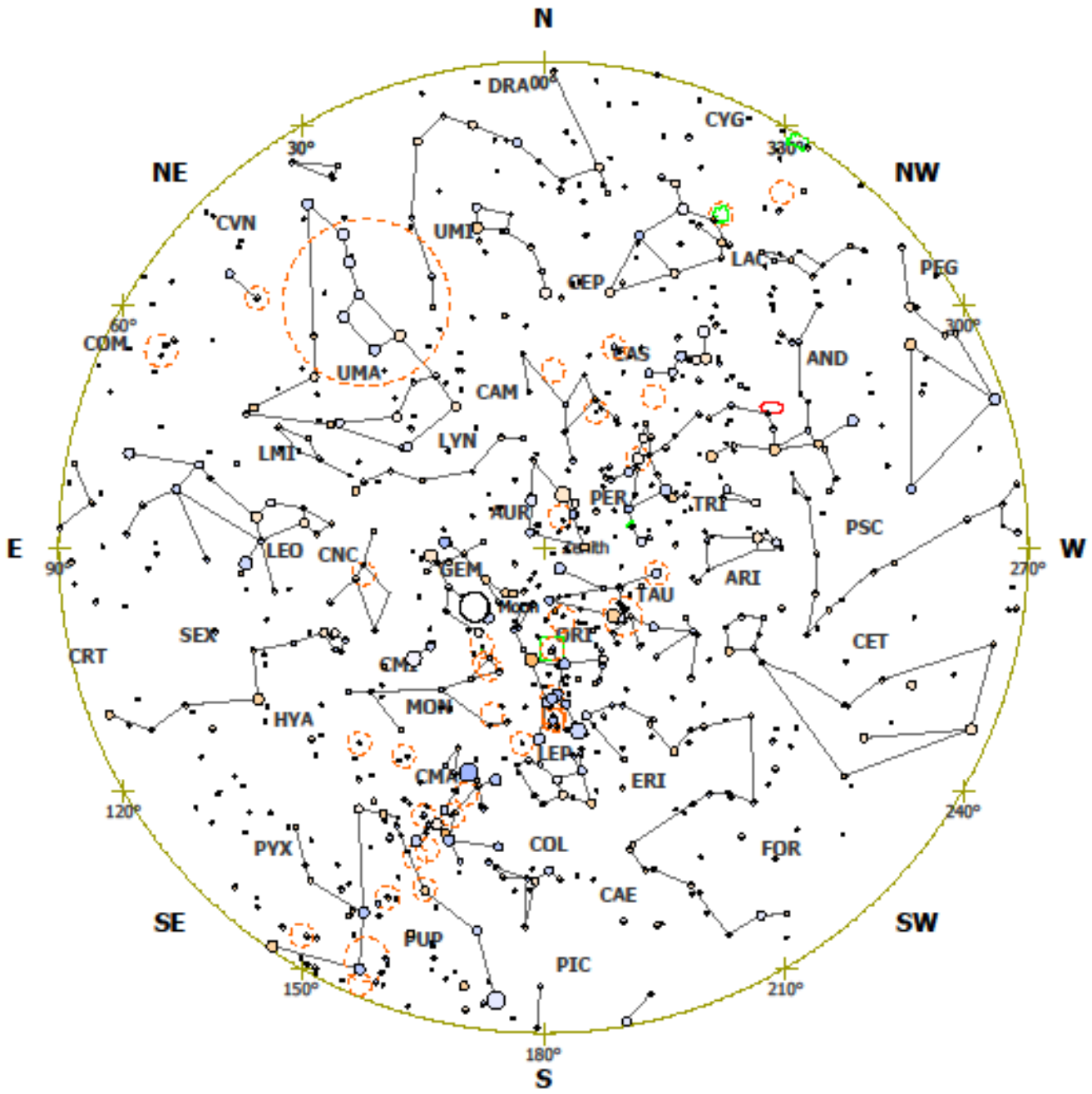
Plenty of free parking in the Artic Transportation lot A behind JT Schmid's.

Speaker: Joel Harris, Solar Eclipse Expert

Will raffle off a few prizes, including an Anza Pad paid for 1 year along with a few restrictions.

Seating will be limited so please email Steve Short to reserve the number of people in your party. (nightskytours@hotmail.com)

December 2016 Whole Sky Map



Symbols

- Galaxy
- Quasar
- Globular cluster
- Open cluster
- Bright nebula
- Dark nebula
- Planetary nebula
- Supernova remnant
- Antisolar point
- Asteroid
- Comet
- Meteor shower

Magnitudes and temperatures (× 1000 K)

-6	-5	-4	-3	-2	-1	0	1	2	3	4	5
40	25	20	15	10	8	7	6	5	4	3	2

Location

United States, CA, Long Beach
Lon: 118° 11′ 18″ W, Lat: 33° 46′ 01″ N
Time zone: GMT-08:00
Elevation: 29 feet above sea level

Time

Local time: 2016-12-15 00:00:00
Universal time: 2016-12-15 08:00:00
Julian date: 2457737.83333
Sidereal time: 05h 44m 53s

View

Field of view: 200° 00′ 00″
RA: 05h 44m 52.88s, Dec: +33° 46′ 01.0″
Azi: 180° 00′ 00.0″, Alt: +90° 00′ 00.0″
Constellation: Auriga

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