Southwest Florida Astronomical Society
SWFAS

The Eyepiece
April 2016

Contents:

A MESSAGE FROM THE PRESIDENT

May gives us a special treat. On the 9th, we have a rare transit of Mercury, which will be totally visible from Florida. Tony, Tom, Tom and Dave are planning a public observing session for it at the Moore Observatory on the FSW campus in Punta Gorda.
I am hosting a public observing session from Centennial Park in downtown Ft. Myers on the river. The transit starts at 7:12am which is only about 20-30 minutes after sunrise and ends at 2:42 pm. Heather would also like some help with observing the eclipse at the Calusa Nature Center Planetarium from 10am til it ends.

We have a CRP star party scheduled for the 7th. Last month we had a good turnout and fairly decent observing.

This month Dr. Derek Buzasi returns with another interesting presentation.

The 13th is the last night of public observing at Moore Observatory for the season. The 28th is the last solar observing session planned for the season at Charlotte County parks.

This is the last call for dues for 2016. If you have not paid, then you will be dropped. I will send out individual last notice e-mails. Dues for 2016 are $20.00 and can be paid at the meeting or via mail to: SWFAS, Inc PO Box 100127 Cape Coral, FL 33910-0127.

People have asked me about advertising their equipment for sale. I have no problem doing it. Simply prepare an email with pictures (make sure they are resized for web display sizes as large pics will not email), descriptions/detail list of what is for sale and your contact information. Please don't use stock photos. I will forward that email to the entire membership list. If you need help pricing something, I can check on that and get back to you, but I do need full details.

Brian

In the Sky this Month

Moon: May – New - 6th; 1st Quarter - 13th; Full – 21st; Last Quarter - 29th.

The Planets: Jupiter is visible early in the evening all month, while Mars & Saturn join it later in the month. The Mercury transit occurs on May 9th so it will be lost in the sun's glare the rest of the month. Mars will offer its best views of last 11 years.

Mercury is not visible this month, but on May 9th it will transit the sun from 7:12 am until 2:42 pm.

Jupiter continues to provide great views high in the east in early evening and remains visible until early morning. It shines at -2.2 magnitude in southeastern Leo.

Mars rises in west Scorpius a couple of hours after sunset. It will reach opposition on May 22nd, and due to its orbital ellipticity, will be closest to earth in last 11 years. Its magnitude will nearly match that of Jupiter's this month. To determine which side of Mars and which surface features face us at any time, go to http://is.gd/marsprofiler

Saturn rises 30 minutes after Mars early in month, but nearly an hour afterwards by end of month due to Mars' rapid retrograde motion. It is north and east of Scorpius and shines at 0.2 to 0.0 magnitude. Its disc diameter is nearly as large as Mars, but since it's 7 times farther from the sun, it is much dimmer.

Eta Aquarid Meteor Shower will peak during daylight hours of May 5th across the United States. Slightly higher rates are likely overnight May 4-5 than on May 5-6 but the shower's broad peak means that both nights will have meteors. Some Eta Aquarid meteors may be visible for a few days before and after the peak. These are fast meteors and they come from Comet Halley. Here in Florida we can expect a peak rate of 10-20 meteors per hour in the early morning skies.

International Space Station: The ISS returns to evening skies over Ft Myers from May 26th – 28th.

Hubble Space Telescope: The HST is visible in our night skies for much of the month. Although it isn't nearly as bright as the ISS, it is an interesting sight to view during the evenings from 11th to 27th. See this link for specific times and routes for both the ISS and HST: http://www.heavens-above.com/

Future Events

Star Party and Event Schedule

Date	Event	Location	Time	Info/Contact
May 5th	Monthly Meeting	Calusa Nature Center & Planetarium	7:30 pm	Brian Risley
May 7th	Star Party	CRP	Dusk	Bruce Dissette
May 13th 2nd Friday	Public Observing	Moore Observatory, FL SW St. College, Punta Gorda	Dusk	Tony Heiner, Tom Segur and Tom Burkett along with Dave Hanson
May 28th 4th Saturday	Solar Observing	Harbour Heights Park, Port Charlotte	9 am - Noon	Tom Segur
June 2nd	Monthly Meeting	Calusa Nature Center & Planetarium	7:30 pm	Brian Risley
June 4th	Star Party	CRP	Dusk	Bruce Dissette
July 5th	Lakes Regional Library Program	Lakes Regional Library	2:00 pm	Scott Flaig
July 7th	Monthly Meeting	Calusa Nature Center & Planetarium	7:30 pm	Brian Risley

May Program – Flying Toasters! The Heating of those "Hot Jupiter" gas giants orbiting other stars. Dr. Derek Buzasi, Whitaker Eminent Scholar in Science at Florida Gulf Coast University and active researcher in this field, will present a summary of what's known and what's theorized about these fascinatingly overheated exoplanets. Each month's astronomy talk is open to the public and is followed by a business meeting for SWFAS.

Minutes of the Southwest Florida Astronomical Society – April 7th, 2016 will appear in a later document

Notable May Events in Astronomy and Space Flight History

Compiled by Mike McCauley

May 5, 1961: Alan Shepard becomes first American in space. Mercury-Redstone 3, or Freedom 7, was the first United States human spaceflight, on May 5, 1961, piloted by astronaut Alan Shepard. It was the first manned flight of Project Mercury. The objective was to put an astronaut into orbit and return him safely. Shepard's mission was a 15-minute suborbital flight demonstrating his ability to withstand the high g forces of launch and atmospheric re-entry. Shepard named his space capsule Freedom 7, setting a precedent for the Mercury astronauts naming their spacecraft. The number 7 was included in all manned Mercury spacecraft names to honor NASA's first group of seven astronauts. His spacecraft reached an altitude of 101.2 nautical miles and traveled a downrange distance of 263.1 nautical miles. It was the third Mercury flight launched with the Mercury-Redstone Launch Vehicle, from Cape Canaveral, Florida. During the flight, Shepard observed the Earth and tested the capsule's attitude control system, turning the capsule around to face its blunt heat shield forward for atmospheric re-entry. He also tested the retrorockets which would return later missions from orbit. After re-entry, the capsule landed by parachute on the Atlantic Ocean off the Bahamas. Shepard and the capsule were picked up by helicopter and brought to an aircraft carrier. The mission was a technical success, though American pride in the accomplishment was dampened by the fact that just 3 weeks before, the Soviet Union had launched the first man in space, Yuri Gagarin, who completed one orbit on Vostok 1.

May 9, 2003: Hayabusa launched. Hayabusa (Peregrine Falcon) was an unmanned spacecraft developed by the Japan Aerospace Exploration Agency (JAXA) to return a sample of material from a small near-Earth asteroid to Earth. Hayabusa was launched on 9 May 2003 and rendezvoused with Itokawa in mid-September 2005. After arriving at Itokawa, Hayabusa studied the asteroid's shape, spin, topography, color, composition, density, and history. In November 2005, it landed on the asteroid and collected samples of tiny grains of asteroidal material, which were returned to Earth aboard the spacecraft on 13 June 2010. Other spacecraft, notably Galileo and NEAR Shoemaker both sent by NASA, visited asteroids before, but the Hayabusa mission was the first attempt to return an asteroid sample to Earth. In addition, Hayabusa was the first spacecraft designed to deliberately land on an asteroid and then take off again (NEAR Shoemaker made a controlled descent to the surface of 433 Eros in 2000, but it was not designed as a lander and was eventually deactivated after it arrived). Technically, Hayabusa was not designed to "land"; it simply touches the surface with its sample capturing device and then moves away. However, it was the first craft designed from the outset to make physical contact with the surface of an asteroid. Despite its designer's intention, Hayabusa did land on the asteroid surface and remained for about 30 minutes. The reentry capsule and the spacecraft reentered Earth's atmosphere on 13 June 2010. The heat-shielded capsule made a parachute landing in the South Australian outback while the spacecraft broke up and incinerated in a large fireball.

May 12, 1930: Adler Planetarium opens. The Adler Planetarium is a public museum dedicated to the study of astronomy and astrophysics. It was founded in 1930 by Chicago business leader Max Adler. It is located on the northeast tip of Northerly Island

at the shore of Lake Michigan in Chicago, Illinois. The Adler is America's first planetarium and part of Chicago's Museum Campus, which includes the John G. Shedd Aquarium and The Field Museum. The Adler's mission is to inspire exploration and understanding of the Universe. The Adler Planetarium opened to the public on May 12, 1930. For its design, architect Ernest A. Grunsfeld, Jr. was awarded the gold medal of the Chicago chapter of the American Institute of Architects in 1931. It was declared a National Historic Landmark in 1987.

May 14, 1973: Skylab launched. Skylab was a space station launched and operated by NASA. It was the first US space station. Skylab orbited Earth from 1973 to 1979, and included a workshop, a solar observatory, and other systems. It was launched unmanned by a modified Saturn V rocket, with a weight of 150,300 pounds. Three manned missions to the station, conducted between 1973 and 1974 using the Apollo Command/Service Module (CSM) atop the smaller Saturn IB, each delivered a three-astronaut crew. On the last two manned missions, an additional Apollo / Saturn IB stood by ready to rescue the crew in orbit if needed. The station was damaged during launch when the micrometeoroid shield separated from the workshop and tore away, taking one of two main solar panel arrays with it and jamming the other one so that it could not deploy. This deprived Skylab of most of its electrical power, and also removed protection from intense solar heating, threatening to make it unusable. The first crew was able to save it in the first in-space major repair, by deploying a replacement heat shade and freeing the jammed solar panels. Numerous scientific experiments were conducted aboard Skylab during its operational life, and crews were able to confirm the existence of coronal holes in the Sun. The Earth Resources Experiment Package (EREP) was used to view Earth with sensors that recorded data in the visible, infrared, and microwave spectral regions. Thousands of photographs of Earth were taken, and records for human time spent in orbit were extended. Plans were made to refurbish and reuse Skylab, using the Space Shuttle to boost its orbit and repair it. However, development of the Shuttle was delayed, and Skylab reentered Earth's atmosphere and disintegrated in 1979, with debris striking portions of Western Australia. Post-Skylab NASA space laboratory projects included Spacelab, Shuttle-Mir, and Space Station Freedom (later merged into the International Space Station).

May 17, 1836: Norman Lockyer born. Sir Joseph Norman Lockyer, (17 May 1836 – 16 August 1920), known as Norman Lockyer, was an English scientist and astronomer. Along with the French scientist Pierre Janssen he is credited with discovering helium. Lockyer also is remembered for being the founder and first editor of the influential journal *Nature*. In 1885 he became the world's first professor of astronomical physics at the Royal College of Science, South Kensington, now part of Imperial College. At the college, the Solar Physics Observatory was built where he directed research until 1913. In the 1860s Lockyer became fascinated by electromagnetic spectroscopy as an analytical tool for determining the composition of heavenly bodies. In 1868 a prominent yellow line was observed in a spectrum taken near the edge of the Sun. With a wavelength of about 588 nm, slightly less than the so-called "D" lines of sodium, the line could not be explained as due to any material known at the time. It was suggested by Lockyer that the yellow line was caused by an unknown solar element. He named this element helium after the Greek word 'Helios' meaning 'sun'. An observation of the new

yellow line also was made by Janssen at the 18 August 1868 solar eclipse so he and Lockyer are awarded joint credit for helium's discovery.

May 22, 1969: Apollo 10 lunar module gets within 50,000 feet of lunar surface. Apollo 10 was the fourth manned mission in the United States Apollo space program, and the second (after Apollo 8) to orbit the Moon. Launched on May 18, 1969, it was the F mission: a "dress rehearsal" for the first Moon landing, testing all of the components and procedures, just short of actually landing. The Lunar Module (LM) came to within 8.4 nautical miles (15.6 km) of the lunar surface, the point where the powered descent to the lunar surface would begin. Its success enabled the first landing to be attempted on Apollo 11 in July, 1969. Apollo 10 was the first of only two Apollo missions with an entirely flight-experienced crew (the other being Apollo 11). Thomas P. Stafford had flown on Gemini 6 and Gemini 9; John W. Young had flown on Gemini 3 and Gemini 10, and Eugene A. Cernan had flown with Stafford on Gemini 9.

May 25, 1961: JFK "moon landing" speech. When John F. Kennedy became president in January 1961, Americans had the perception that the United States was losing the Space Race with the Soviet Union, which had successfully launched the first artificial satellite, Sputnik, almost four years earlier. The perception deepened when in April 1961, Russian cosmonaut Yuri Gagarin became the first man in space before the U.S. could launch its first Project Mercury astronaut. Convinced of the political need to make an achievement which would decisively demonstrate America's space superiority, and after consulting with NASA through his Vice President Lyndon Johnson to identify such an achievement, Kennedy stood before Congress on May 25, 1961, and proposed that "this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth." Kennedy's goal required the expansion of the National Aeronautics and Space Administration's Space Task Group into a Manned Spacecraft Center. Houston, Texas was chosen as the site, and the Humble Oil and Refining Company donated the land in 1961, through Rice University as an intermediary. Kennedy took advantage of the 1962 construction of the facility to deliver a speech on the nation's space effort. On September 12, 1962, President Kennedy delivered his speech before a crowd of 35,000 people in the Rice football stadium. The most memorable and quoted portion of the speech comes in the middle:

We set sail on this new sea because there is new knowledge to be gained, and new rights to be won, and they must be won and used for the progress of all people. For space science, like nuclear science and all technology, has no conscience of its own. Whether it will become a force for good or ill depends on man, and only if the United States occupies a position of pre-eminence can we help decide whether this new ocean will be a sea of peace or a new terrifying theater of war. I do not say that we should or will go unprotected against the hostile misuse of space any more than we go unprotected against the hostile use of land or sea, but I do say that space can be explored and mastered without feeding the fires of war, without repeating the mistakes that man has made in extending his writ around this globe of ours. There is no strife, no prejudice, no national conflict in outer space as yet. Its hazards are hostile to us all. Its conquest deserves the best of all mankind, and its opportunity for peaceful cooperation may never come again. But why, some say, the Moon? Why choose this as our goal?

And they may well ask, why climb the highest mountain? Why, 35 years ago, fly the Atlantic? Why does Rice play Texas? We choose to go to the Moon! ... We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard; because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one we intend to win ...

May 26, 1951: Astronaut Sally Ride born. Sally Kristen Ride (May 26, 1951 – July 23, 2012) was an American physicist and astronaut. Born in Los Angeles, she joined NASA in 1978 and became the first American woman in space in 1983. She remains the youngest American astronaut to have traveled to space, having done so at the age of 32. After flying twice on the Orbiter *Challenger*, she left NASA in 1987. She worked for two years at Stanford University's Center for International Security and Arms Control, then at the University of California, San Diego as a professor of physics, primarily researching nonlinear optics and Thomson scattering. She served on the committees that investigated the *Challenger* and *Columbia* space shuttle disasters, the only person to participate on both. Ride died of pancreatic cancer on July 23, 2012.

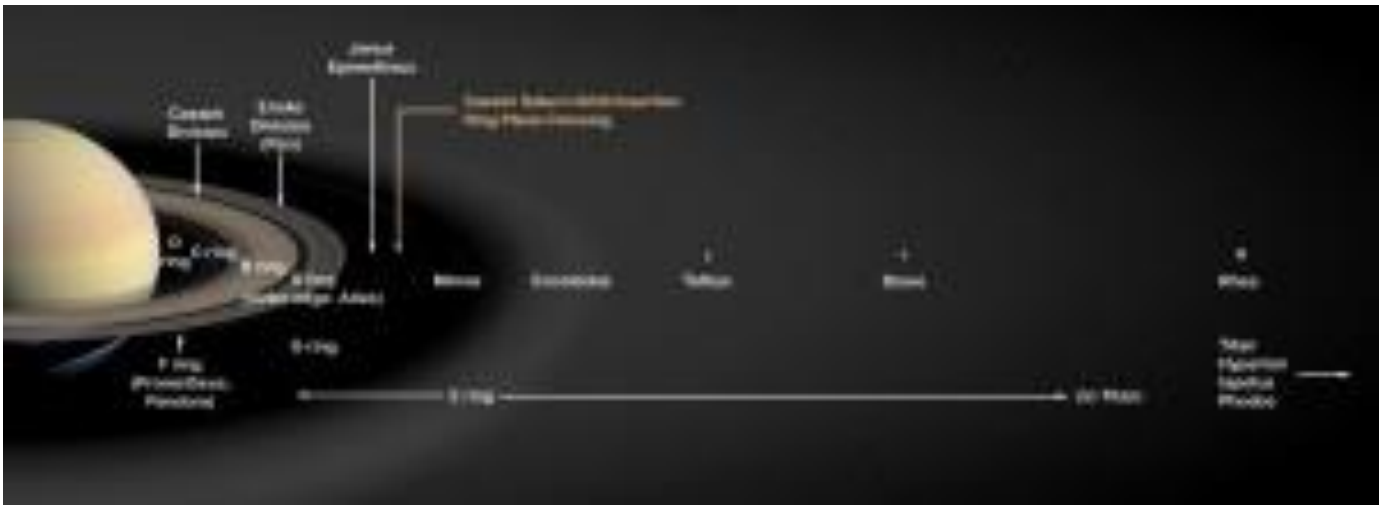
May 30, 1971: Mariner 9 probe launched. Mariner 9 was an unmanned NASA space probe that contributed greatly to the exploration of Mars and was part of the Mariner program. Mariner 9 was launched toward Mars on May 30, 1971 from Cape Canaveral Air Force Station and reached the planet on November 14 of the same year, becoming the first spacecraft to orbit another planet – only narrowly beating the Soviets' Mars 2 and Mars 3, which both arrived within a month. After months of dust storms it managed to send back clear pictures of the surface. Mariner 9 returned 7329 images over the course of its mission, which concluded in October 1972.

May 31, 1975: European Space Agency formed. The European Space Agency (ESA) is an intergovernmental organization dedicated to exploration of space, with 22 member states. Established in 1975 and headquartered in Paris, France, ESA has a worldwide staff of about 2,000 and a budget of about €5.25 billion/$5.77 billion (2016). ESA's space program includes human spaceflight, mainly through the International Space Station, launch and operations of unmanned exploration missions to other planets and the Moon, Earth observation, science, telecommunication, and designing launch vehicles. The main European launch vehicle, Ariane 5, is operated through Arianespace with ESA sharing in the costs of launching and further developing this launch vehicle.

Saturn Moons Could Be Young

By: Camille M. Carlisle from S&T

Planetary scientists increasingly think that some of the ringed giant's moons are only 100 million years old.



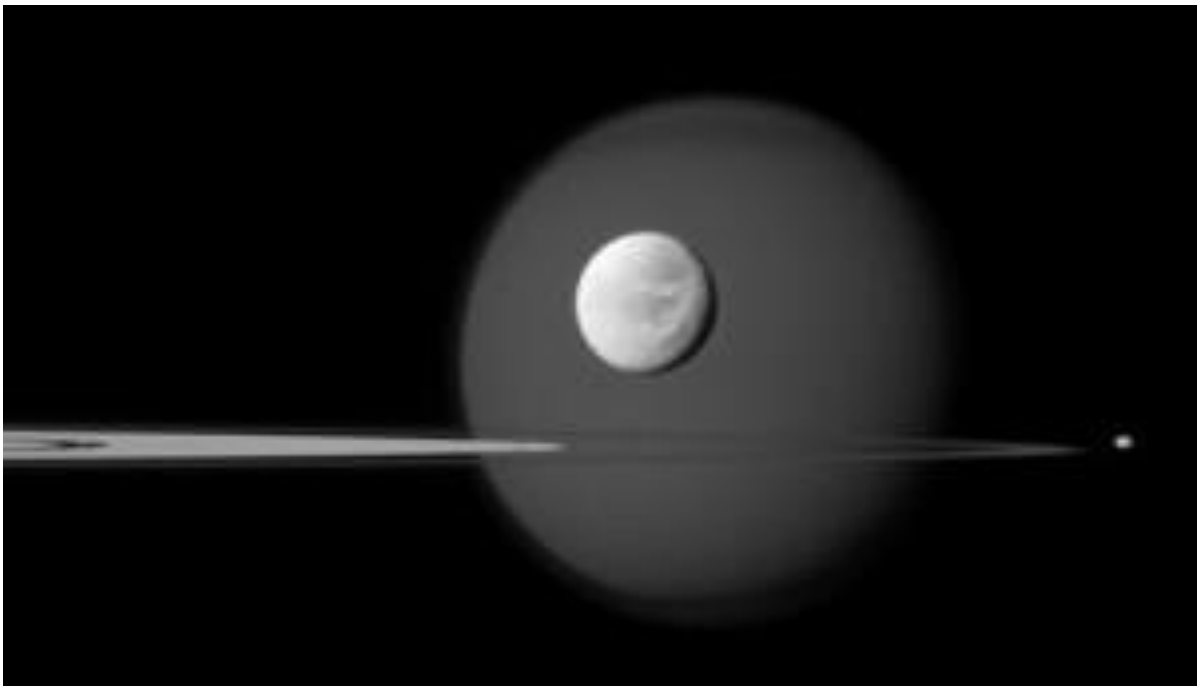
This composite shows several of Saturn's moons lined up in order of their orbital distance from the planet. The mid-size moons, including Mimas and Dione, may have formed a mere 100 million years ago. *NASA / JPL*

Saturn waltzes through space in an elegant hoopskirt that glistens with ice crystals, surrounded by an entourage of 62 moons. Its lone gallant is Titan, whose thick hydrocarbon shroud makes it the only satellite in the solar system with a sizable atmosphere.

Alongside hazy Titan is an assortment of icy, mid-size moons, their diameters ranging from Mimas's 400 km (250 miles) to Rhea's 1,525 km (948 miles). Together, they have a mere $^{1}/_{20}$ as much mass as Titan does. Interspersed with these are a vast collection of moonlets, with sizes of a few tens to a couple hundred kilometers. Some of these are likely born from pileups of ring material.

In terms of numbers, Saturn's retinue matches that of the king of the planets, Jupiter, whose current satellite tally is 67. Jupiter boasts a more glamorous court, with its four Galilean moons (some of the largest moons in the solar system), two of which are comparable in size to Mercury. But Titan's elongated orbit and loner status set it apart from this stately satellite quartet — and Jupiter doesn't have any mid-size moons.

Planetary scientists have long wondered why Jupiter has come out so much the winner when it comes to big moons. In 2013, for example, Erik Asphaug (Arizona State University) and Andreas Reufer (then at University of Bern, Switzerland) suggested that Saturn started with a Galilean system of its own, but the moons crashed into and obliterated one another. The rubble then coalesced into Titan and the mid-size moons.



This image from the Cassini spacecraft shows four of Saturn's moons and the outskirts of the planet's rings. Saturn's largest moon, Titan (3,200 miles, or 5,150 kilometers, across), is in the background. In front of it and above the rings at center is Dione (698 miles/1,123 kilometers across), one of the mid-size moons. The small moon Pandora (50 miles/81 kilometers) orbits beyond the rings on the right of the image. Finally, Pan (17 miles/28 kilometers) peeks out as a spot in the Encke Gap of the A ring on the left of the image. *NASA / JPL-Caltech / Space Science Institute*

A new paper explores this collision idea further. Matija Ćuk (SETI Institute) and his colleagues turned back time by simulating the icy moons' orbital evolution and figuring out when and how they could have interacted, given their current locations. Some moons move in what are called *mean-motion resonances*, which means the time it takes Moon A to complete an orbit around Saturn is a simple fraction (say, one half) of the time it takes Moon B to do so. Resonant moons strongly affect each other's orbits, easily tilting them out of the original plane in which they lay.

Saturn also has an off-putting effect on its satellites, pushing them farther away with time. This tidal push is strong because the planet isn't solid. It affects each of the various moons in different ways, changing each of their orbits with time and making and breaking resonances.

Ćuk and colleagues found that, given their current (and backtracked) orbits, the moons can't have migrated much from where they first formed. But that doesn't make sense if they've been orbiting the planet from the solar system's early days: Saturn's tides are just too tenacious — the moon Enceladus and its tidal-triggered geysers confirm that.

Instead, the team argues, the mid-size moons can only be about 100 million years old — or, as the SETI Institute's press release puts it, "younger than the dinosaurs." (Dinosaurs first appeared in the Triassic period, 230 million years ago.) The moons formed from a ring of debris, born from the collisions of large precursor moons, the team suggests in the April 1st *Astrophysical Journal*.

That's consistent with his Galilean squabble theory, Asphaug says. Unlike Asphaug and Reufer, Ćuk's team doesn't argue in favor of Titan being a merger-born moon, but that suggestion "definitely ranks as hypothetical," Asphaug readily admits.

Ćuk's team offers a test: craters. If the mid-size moons are indeed young, they won't have had time to build up a perfectly homogenous peppering of pockmarks from space. Instead, craters on moons within Titan's orbit (all the mid-size moons but Iapetus) would concentrate around those satellites' equators, because the moons would have been exposed to a lot of debris in the plane of their birth ring but not nearly as much from other angles. Many of the moons are heavily scarred, so it'll take dedicated work to tease out whether the moons have these girdles.

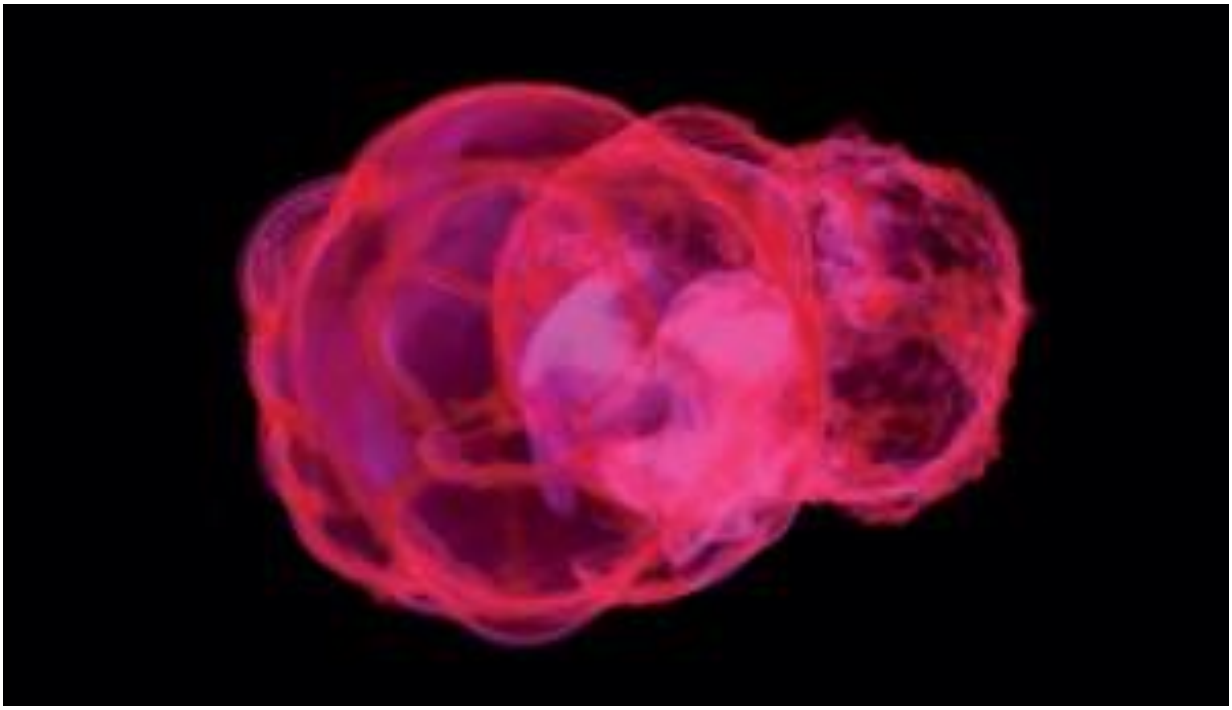
References:

1. Ćuk et al. "Dynamical Evidence for a Late Formation of Saturn's Moons." *Astrophysical Journal*, vol. 820, no. 2 (April 1, 2016).
2. Asphaug and A. Reufer. "Late Origin of the Saturn System." *Icarus*, vol 223, issue 1 (March 2013).

Long-Ago Supernovae Littered Earth

By: Shannon Hall from S&T

Roughly 2 million years ago, as the human ancestor homo erectus was descending from the trees, two supernovae exploded nearby and showered Earth with debris.



The mass density distribution of iron-60 associated with the Local Bubble (as well as a neighboring bubble) 2.2 million years ago. *Michael* Schulreich

It's a classic doomsday scenario. A nearby star explodes in a brilliant supernova, pumping out more energy in a split second than the Sun will emit in a billion years. The blast showers Earth with radioactive elements that destroy the ozone layer and genetically mutate life. But even though astronomers think a nearby star (that is, within 100 light-years of Earth) explodes every million years or so — although not every one has such devastating results — definitive proof has been hard to pin down.

For more than half a century, scientists have recognized two tantalizing clues that nearby supernovae might have showered the Earth roughly 2 million years ago. The first hint lies deep under the Pacific Ocean, where an isotope of iron, iron-60, is embedded within the crust. Although the Earth's formation likely produced some iron-60, its half-life is only 2.6 million years and it would have long since disappeared. So the layers must be the result of something more recent, and nearby supernovae are the likely culprits.

The other hint is the Local Bubble — a vast peanut-shaped and plasma-filled cavity surrounding the Sun. Nearby supernova probably carved out this bubble as well.

Now Dieter Breitschwerdt (Berlin Institute of Technology) and colleagues have put these pieces together to pinpoint the likely locations of ancient supernovae. The results published April 7th in *Nature,* show that two supernovae, both roughly 300 light-years away, exploded 1.5 million and 2.3 million years ago.

Pinpointing Vanished Stars

To find stars that likely died millions of years ago, Breitschwerdt's team started with their surviving family. All stars are born within clusters of hundreds to thousands of stars across a wide range of masses. A cluster's highest-mass stars explode first, while lower-mass siblings live longer lives. So when astronomers spot a cluster made of only low-mass stars, they assume the missing high-mass stars have already gone supernovae.

After digging through archived Hipparcos data, Breitschwerdt and his colleagues found just the family they were looking for: a group of some 70 low-mass stars. The team then estimated the masses of heavyweight stars presumed missing from that cluster — which told them how long those stars would have lived — in order to pin down exactly when those stars would have exploded.

Breitschwerdt and his colleagues calculated that 16 supernovae went off like popcorn during the past 13 million years. They ran computer simulations to show how those supernovae might have carved a bubble in space — and the results perfectly matched maps of the Local Bubble.

This result alone was exciting enough. But Breitschwerdt wanted to see if he could also make the leap between this result and the iron-60 deposited on the ocean floor.

The presence of iron-60 — an isotope that's almost exclusively created in supernova explosions — in Earth's deep-sea crusts allowed the team to nail down a specific time-period to look for the supernovae explosions. "It's a layer that grows very slowly, which means that each successive explosion deposits new iron-60 atoms," says Breitschwerdt. "It's like the rings in trees. If you just count the rings then you know the age of the tree." But rather than counting tree rings, the astronomers counted iron-60 layers, and found that one layer was deposited roughly 2.2 million years ago.

It was immediately evident that two of their supernovae had occurred around that time. But in order to verify that these supernovae were the true culprits, the team first had to calculate how the iron-60 fused in the stellar core gets mixed into the blast wave that eventually hits Earth.

"It's like if you put milk in your coffee, the milk starts to diffuse out, and then you take the spoon and stir it in order to distribute it," says Breitschwerdt. "The supernova explosions are like spoons: they stir the iron-60 into the surrounding medium. And that has to be calculated in detail to find how long it takes to travel to Earth."

Breitschwerdt's calculations show that two supernovae — one that occurred 2.3 million years ago and one that occurred 1.5 million years ago — contributed roughly half of all the iron-60. The rest comes from all the other supernovae combined.

Fortuitously, another paper released in *Nature* by Anton Wallner (Australian National University) reports iron-60 in crust samples from four different locations in the Pacific, Atlantic, and Indian Oceans. Evidence from multiple locations is exactly what scientists expect to see, given that supernovae would have rained the isotope down across the entire globe.

Did Homo Erectus Feel the Blast?

These nearby supernovae would have occurred shortly after human ancestors descended from the trees as Homo erectus. But would these chimp-like humans have been affected by the celestial explosions?

Adrian Melott (University of Kansas) is working on that answer now. The Nature papers refer to supernovae within several hundred light-years, but supernovae have to be much closer to do any real damage, he says. "What we call the kill zone — where you get a really big mass extinction — is like 8 or 10 parsecs [26 to 33 light-years]," Melott notes.

So the effects of supernovae at several hundred light-years from Earth won't be large. But will they be noticeable? Save for a brilliant flash in the sky, it could be that these celestial events went over our ancestors' heads.

References:

D. Breitschwerdt et al. "The Locations of Recent Supernovae Near the Sun from Modelling 60Fe Transport."*Nature*. April 7, 2016.

A. Wallner et al. " Recent near-Earth supernovae probed by global deposition of interstellar radioactive 60Fe."*Nature*. April 7, 2016.

Navy Resumes Celestial Navigation Course

By: David Dickinson from S&T

Modern security threats have brought back an old method — celestial navigation — to help U.S. Navy sailors navigate the high seas.

Brief star trails mark the sky above the Arleigh Burke-class guided-missile destroyer USS Preble as it patrols the U.S. 7th Fleet area of responsibility.
Mass Communication Specialist 3rd Class Paul Kelly / U.S. Navy

It's a scene straight out of a Tom Clancy novel. An adversary, seeking to gain the upper hand, manages to blind GPS satellites in a first strike. As alert levels rise and military leaders attempt to assess the situation, ships at sea must somehow get an accurate fix of their position . . . without the use of modern technology.

The United States Navy recently recognized modern vulnerabilities by bringing back an old method for navigating at sea: the Naval Academy in Annapolis, Maryland, has just resumed training officers in the lost art of celestial navigation. Although this training used to be standard in the U.S. Navy, the advent of GPS technology so simplified and improved the ability to find a ship's position at sea that the Navy ROTC ended celestial navigation training in 2000, and the U.S. Naval Academy phased it out as well in 2006.

But the U.S. Navy and the Department of Defense are taking cyber threats to technological infrastructure seriously. Commercial GPS jammers are now readily available on the internet. And while the U.S., China, the European Union, Russia, and India are all moving to assure they have their own exclusive GPS network in orbit, a deliberate attack may not even be necessary. A space debris chain reaction known as an *ablation cascade* could knock out our GPS capability, or a strong Earth-directed solar storm such as the 1859 Carrington super-flare event could do the job just as well.

"There is an effort throughout the Navy for midshipmen, officers, and sailors to become more familiar and comfortable with celestial navigation," says Lt. Daniel Stayton, an instructor of the U.S. Naval Academy CELNAV course. "We are currently in the first steps of reintroduction back into the fleet."

The U.S. Naval Academy brought back celestial navigation theory for its 2015 summer session, and the graduating class of 2017 will be the first in more than a decade with basic instruction in celestial navigation theory.

A U.S. Navy officer uses a sextant at sea.
Mass Communication Specialist 2nd Class Scott Raegen / U.S. Navy

Losing Our Way — and Finding It Again

This sort of "back to basics" approach echoes a growing refrain: our over-reliance on GPS has made navigational skills all but vanish. My wife and I are the first to admit, it's both amazing and a little scary just how reliant we've become on Google Maps as we travel in Europe. Then again, I also remember that same GPS technology used to lead would-be visitors to our Florida home down a nearby dead-end street.

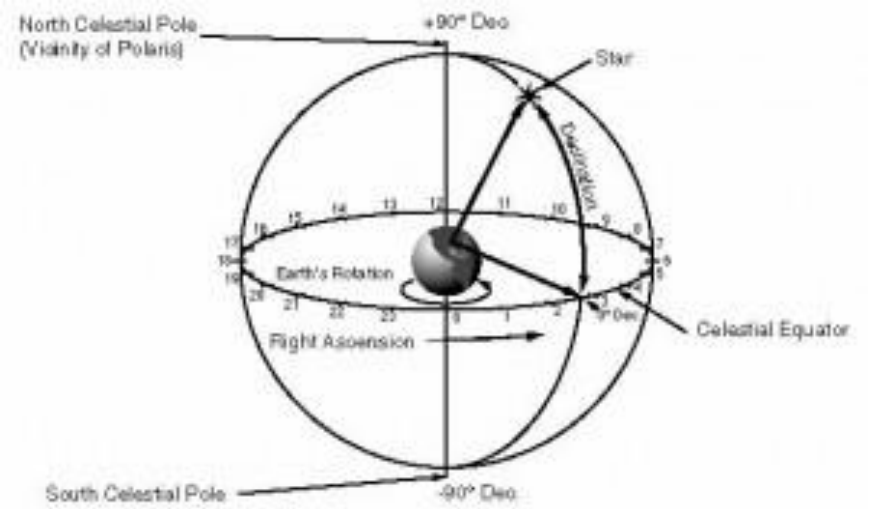
Lt. Daniel Stayton instructs a classroom on celestial navigation in the Navy's CELNAV course. *Mass Communication Specialist 2nd Class Tyler Caswell / U.S. Navy*

Although the U.S. military pioneered the development of GPS technology in the 1970s, widespread civilian use only came after May 2000, when President Clinton directed the removal of intentional inaccuracy (known as selective availability, a precaution to assure an enemy wouldn't utilize GPS) that had been built in to early commercially available systems. The U.S. Navy now typically uses the Voyage Management System developed by Northrop Grumman for navigation at sea.

But for centuries sailors had found their way using the stars.

Celestial Navigation: The Basics

In the Northern Hemisphere, it's pretty straightforward to find latitude by noting the elevation of the star Polaris, which marks the celestial north pole. Navigators can also measure the Sun's elevation at noon. Discerning longitude, however, is trickier and requires accurate timekeeping.



Measuring stars' positions on the celestial sphere (particularly their right ascension) is crucial to celestial navigation. *University of Durham*

From the surface of the Earth, the imaginary sphere of the sky along the celestial equator appears to rotate 15 degrees per hour. In fact, we mark off right ascension in the sky — analogous to longitude of the surface of the Earth — in hours, minutes, and seconds. A land-based observatory will therefore see a celestial object rise, transit the local meridian bisecting the sky from north to south, and set at a different time than a ship at sea.

A navigator would note stars' positions using a sextant to measure the angle between each star and the horizon. Then the navigator would compare the measurement to an almanac published for a particular location. With this painstaking method, a seasoned celestial navigator could reckon a ship's position down to about two kilometers.

Getting an accurate fix on longitude, however, had to wait for accurate timekeeping. Early efforts relied on complex lunar tables. By the mid-19th century, such methods improved and longitude measurements became increasingly accurate. Some clever methods were devised as well: Christopher Columbus and Captain Cook both made use of lunar eclipses to gain one-time measurements of their positions at sea. Astronomers of the day also proposed using the transits of Jupiter's moons in a similar fashion, though observing such events from the deck of a pitching ship at sea proved problematic.

Apollo astronauts even practiced celestial navigation on their missions to the Moon, in the event that a loss of communication meant they had to find their own way home.

"Redundancy improves readiness," notes Stayton. "If the Navy is able to add an additional layer of redundancy . . . by merely teaching a skill, then an opportunity exists to improve readiness throughout the fleet."

It's great to see an old method brought back to guide the modern tech-savvy military. Perhaps we should all take a cue from the U.S. Navy and keep those paper maps handy the next time we head out on our next GPS-guided adventure . . . just in case.

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