FIRST LIGHT

Journal of the South Bay Astronomical Society – June 2017
on line at http://sbastro.net/
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On Yahoo Groups at: https://groups.yahoo.com/neo/groups/SBASTRO/info

Monthly General Meeting: Friday June 2nd 7:30 PM

"Why String Theory"

Tim Thompson, JPL/LAAS

The May 5 Meeting

President Ken Rossi began the meeting at 7:32 by asking several newcomers to introduce themselves. They were students from Perry Hacking's astronomy class, and President Rossi welcomed them and encouraged them to return. He also encouraged all present to become members of the SBAS if they are not already.

Peter Landecker described his recent visit to Palomar Observatory, noting that the tours on Saturday and Sunday can let you onto the observatory floor, for a closer look at the 200-inch telescope. Ken Munson described a recent night under the stars at Red Rock, that included a visit by some dirt bikers who showed a great interest in the sky as seen through Ken's telescope. Jerry Gmoser pointed out that Sputnik was launched sixty years ago, and that the evening's presentation would illustrate how far we've come since that first orbiting spacecraft in 1957.

After an eleven-minute social break, President Rossi introduced the evening's speaker, Matthew Ota, who spoke on "Cassini at Mission's End". The Cassini mission to Saturn was launched on October 15, 1997 and arrived on June 30, 2004 after passing through the Jupiter system in 2000 to obtain a gravity boost. On January 14, 2005, Cassini launched the Huygen's probe that landed on Titan, which is Saturn's largest moon. In January 2006, Cassini discovered lakes of liquid methane on the surface of Titan.

Cassini has examined an impressive list of objects beside Saturn and Titan, including Dione, Mimas, Rhea, Methone, Hyperion, Enceladus and the rings of Saturn. Matthew Ota then showed a movie of Saturn taken by Cassini on April 26, just nine days earlier! After 13 years in orbit around Saturn, Cassini has been maneuvered into orbit between the cloud-tops and the inner rings, and is destined to enter Saturn's atmosphere on September 15 and burn up.

He ended by urging the 40 people in attendance to see the full-sized mock-up of the Cassini spacecraft at the California Science Center in Exposition Park, Los Angeles. He then fielded more than a dozen questions, and received a Certificate of Appreciation from President Rossi along with applause from the audience. The meeting ended at 9:08.

- Dr. Steven Morris

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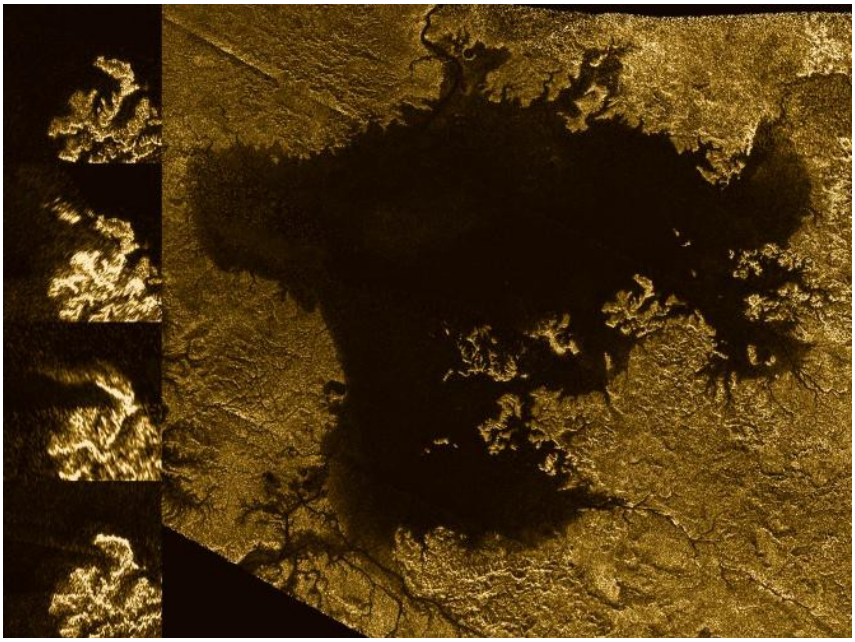
The Fizzy Seas of Titan

By Marcus Woo

With clouds, rain, seas, lakes and a nitrogen-filled atmosphere, Saturn's moon Titan appears to be one of the worlds most similar to Earth in the solar system. But it's still alien; its seas and lakes are full not of water but liquid methane and ethane.

At the temperatures and pressures found on Titan's surface, methane can evaporate and fall back down as rain, just like water on Earth. The methane rain flows into rivers and channels, filling lakes and seas.

Nitrogen makes up a larger portion of the atmosphere on Titan than on Earth. The gas also dissolves in methane, just like carbon dioxide in soda. And similar to when you shake an open soda bottle, disturbing a Titan lake can make the nitrogen bubble out.



Caption: Radar images from Cassini showed a strange island-like feature in one of Titan's hydrocarbon seas that appeared to change over time. One possible explanation for this "magic island" is bubbles. Image credits: NASA/JPL-Caltech/ASI/Cornell

But now it turns out the seas and lakes might be fizzier than previously thought. Researchers at NASA's Jet Propulsion Laboratory recently experimented with dissolved nitrogen in mixtures of liquid methane and ethane under a variety of temperatures and pressures that would exist on Titan. They measured how different conditions would trigger nitrogen bubbles. A fizzy lake, they found, would be a common sight.

On Titan, the liquid methane always contains dissolved nitrogen. So, when it rains, a methane-nitrogen solution pours into the seas and lakes, either directly from rain or via stream runoff. But if the lake also contains some ethane—which doesn't dissolve nitrogen as well as methane does—mixing the liquids will force some of the nitrogen out of solution, and the lake will effervesce.

"It will be a big frothy mess," says Michael Malaska of JPL. "It's neat because it makes Earth look really boring by comparison."

Bubbles could also arise from a lake that contains more ethane than methane. The two will normally mix, but a less-dense layer of methane with dissolved nitrogen—from a gentle rain, for example--could settle on top of an ethane layer.

In this case, any disturbance—even a breeze—could mix the methane with dissolved nitrogen and the ethane below. The nitrogen would become less soluble and bubbles of gas would fizz out.

Heat, the researchers found, can also cause nitrogen to bubble out of solution while cold will coax more nitrogen to dissolve. As the seasons and climate change on Titan, the seas and lakes will inhale and exhale nitrogen.

But such warmth-induced bubbles could pose a challenge for future sea-faring spacecraft, which will have an energy source, and thus heat. "You may have this spacecraft sitting there, and it's just going to be fizzing the whole time," Malaska says. "That may actually be a problem for stability control or sampling."

Bubbles might also explain the so-called magic islands discovered by NASA's Cassini spacecraft in the last few years. Radar images revealed island-like features that appear and disappear over time. Scientists still aren't sure what the islands are, but nitrogen bubbles seem increasingly likely.

To know for sure, though, there will have to be a new mission. Cassini is entering its final phase, having finished its last flyby of Titan on April 21. Scientists are already sketching out potential spacecraft—maybe a buoy or even a submarine—to explore Titan's seas, bubbles and all.

To teach kids about the extreme conditions on Titan and other planets and moons, visit the NASA Space Place: https://spaceplace.nasa.gov/planet-weather/

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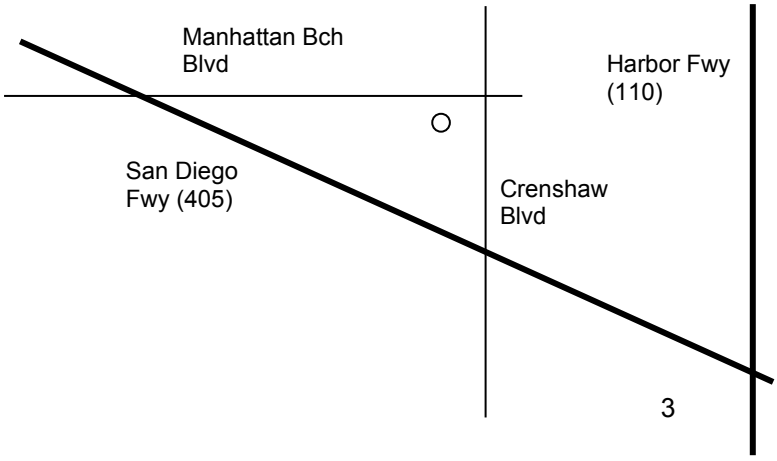

Monthly General Meetings

We normally meet on the first Friday of each month at 7:30 p.m. in the Planetarium at El Camino College (16007 Crenshaw Bl. In Torrance). If the first Friday is on or close to a holiday, we usually defer the meeting until the second Friday of the month. The

Planetarium is on the south side of Manhattan Beach Blvd., one block west of Crenshaw Blvd. (near the center of the map at left).

The planetarium is the only round, domed building on campus. There is on-street parking, and we can often use campus parking: check inside to see if you need a FREE parking permit for your car.

We enjoy the planetarium facilities through the courtesy of the El Camino College Administration, and have several faculty members of the Astronomy Department as members of our Club. Our meetings always include an informal opening, when new attendees are invited to introduce themselves and let us know about their interests in astronomy. Members share their latest news and observations at this time. The rest of the evening is devoted to guest speakers, who range from amateur astronomers to professional astronomers to representatives from local aerospace companies to college professors. We are fortunate to have all these talented people in our area, willing to come and talk to us.

Monthly Planning Meeting

Committee members (and anyone else with an interest in Society activities) meet each month, usually on the Monday following the general meeting. Meetings are sometimes rescheduled due to travel and other circumstances. Exact date and time of each month's meeting will be announced in the monthly meeting. The March planning meeting will be held at the home of TBD.

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SBAS Dues

Month Join/Due	Member (Family) Email Only	Student	Expires
January	$40.00	$25.00	Dec
February	$36.67	$22.92	Dec
March	$33.33	$18.75	Dec
April	$30.00	$20.83	Dec
May	$26.67	$18.75	Dec
June	$23.33	$16.67	Dec
July	$20.00	$14.58	Dec
August	$16.67	$12.50	Dec
September	$13.33	$10.42	Dec
October	$10.00	$8.33	Dec
November	$6.67	$6.25	Dec
December	$3.33	$4.17	Dec

Note to Current U.S. Mail Members: The SBAS Board has decided that it is no longer cost effective to publish and mail out hard copies of the FirstLight. Since this decision was made after some 2016 renewals for U.S. Mail memberships were received, we will either refund the difference or extend your full 2015 membership though March of 2016.

To simplify the dues, we suggest that all membership expire in December. Dues are $40.00/year ($25.00/year for students) and expire on December 31, of the current year. The FirstLight is now only available via Email notification and on our web site. New members use Month Join, and current members select your expiring Month to calculate the amount. Members that expire in October or November may wish to write one check and include next year's

membership. Make checks payable to the South Bay Astronomical Society. Dues may be paid at the general meeting or mailed to:

South Bay Astronomical Society
Attn: Greg Benecke
P.O. Box 1937
Redondo Beach, CA 90278

SBAS Membership Benefits

Contact Greg Benecke for magazine subscriptions at club rates: "Sky & Telescope" $32.95 and "Astronomy" $34.00/1 year or $60.00/2 years!
Note: S&T subscribers at the club rate renew their subscriptions by mailing their renewal notice and check or calling the 800# on the renewal notice.
Only new subscribers or subscribers converting their subscription to the club rate need to contact Arnie or send a check to the PO Box. Astronomy subscriptions and renewals still go through Arnie or via the PO Box.

Astronomy Technology Today has become a digital only magazine. They have stated that current print subscribers will continue to be able to access digital issues without any cost. New subscribers should check their website for ordering details and subscription costs (www.astronomytechnologytoday.com).

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3 years/36 Issues….$85.95

This year, there is an additional option for club member to order or renew. If you prefer, you can complete your individual transaction online with a credit card. Please follow the instructions below:

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3) Select the order term (1 year, 2 years, or 3 years).
4) Enter your name, address and credit card information. Please note: you do not need to enter the promotion code a second time on this order page. That entry field can be disregarded.
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If you have any questions, call one of our Customer Service Representatives at 1-800-533-6644, Monday – Friday 8:30 AM – 4:30 PM CT. Outside the US and Canada, please call 262-796-8776.

Astronomical League Observing Clubs

All SBAS members in good standing are also members of the Astronomical League and are eligible to participate in the League's Observing Clubs. The Astronomical League provides many different observing programs (clubs). These programs are designed to provide a direction for your observations and to provide a goal. The programs have certificates and pins to recognize the observers' accomplishments and for demonstrating their observing skills with a variety of instruments and objects. For more information, go to:
http://www.astroleague.org/observing.html.

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Useful and Interesting Astronomy Websites

Website	Description
http://www.calsky.com/	A useful site for planning an evening's star gazing if you don't have your own planetarium software.
https://www.aavso.org/	Information for observers with an interest in tracking variable stars.
http://www.cleardarksky.com/csk/prov/California_clocks.html	Good site to check to know what the weather will be like where you might be planning on going.
http://ssd.jpl.nasa.gov/horizons.cgi	Great site to use when you want to find a new comet or asteroid that isn't already in your planetarium software's list. See the Ephemeris Generator file on the SBAS Yahoo group site for instructions.
http://heavens-above.com	Check this site to find out what satellites may be visible in your sky.
http://www.lunar-occultations.com/iota/iotandx.htm	Website for the International Occultation Timing Association. Good place to find information on asteroid occultations of background stars.
http://pictures.ed-morana.com/ISSTransits/predictions/	Find out when the ISS will transit in front of the Sun or Moon as seen from your location.
http://www.aerith.net/comet/weekly/current.html	Weekly information on bright comets. Good place to learn where there are bright comets to be seen. Refer to the Horizons website above to generate ephemerides.
http://sohowww.nascom.nasa.gov/	See the sun in ways you might never have imagined! You can even create your own movies of the sun in different the different frequencies imaged by the SOHO spacecraft.

Observing Reports

Harbor City – On Thursday, May 18th, I set up my scope in my front yard to do some testing with my newly purchased astro imaging camera. It's a ZWO ASI170MC camera from ZWO Optical out of SuZhu, China. Had to get a new camera since my Nightscape was no longer working. It came with some recommended software, mostly freeware, that worked with the camera and links to downloaded more up-to-date versions.

I did some preliminary imaging of Jupiter using my trusty NexImage5 from Celestron. The recently downloaded driver update seems to have fixed the issue I had with this camera. It was once again able to do imaging at all the various settings although, it turned out the seeing was so bad, it really wasn't getting very good images as I've had on better nights.

I was about to switch to the 170MC when a teenage neighbor came by walking her dogs. She'd recently rescued my dog after he got out of the yard one day. She was curious as to what I was doing so I have her a tour of the night sky. Between the bad seeing and the 4 bright stadium-quality lights that were recently installed at our nearby intersection, it wasn't the best possible tour but she enjoyed her first look through at telescope seeing Jupiter and its moons, M3, M5, a couple of nice double stars and a galaxy, M104.

After she'd left to take her dogs home, I rearranged things to try some testing of the 170MC. It'd been a while since I'd set up for imaging and it took me a long time to get the polar alignment done. Once that was done, guiding was working really well with :PHD and my Meade DSI mounted in the Onyx 80, piggybacked on my Nexstar 11. The 170MC was mounted in the star diagonal on the Nexstar 11.

By this time it was getting late and a bit dewy so I just did a series of 30 second exposures on M5, the globular cluster in Serpens Caput. By the time that was finished it was 1 AM and I had to put everything away to get to bed since the next day was a work day.

The next day, I processed the image using the software that I used to use with the Nightscape. It worked okay but the color seemed a bit off, tending more towards purple. Later on, I dug out my disks for Images Plus and reloaded it onto my laptop. That processed the images a lot more cleanly and I ended up with a nicer looking image of M5.

So far, it boded well for this camera.

- ***Ken Munson***

Ridgecrest School – On Saturday, May 20th, club members Ken Rossi, Gerry Stowe, Steve Pedersen and Ken Munson gathered at the Ridgecrest school in RPV for a night of observing. The prediction was for clear dark skies with excellent seeing conditions. Sadly, the seeing conditions never did materialize and Jupiter continued to be more of a watery blob. The weather was comfortable but with a light breeze blowing.

I was more interested in doing more testing of the ASI170MC camera so I configured things for imaging with the Onyx 80 piggy-backed on top of the Nexstar 11. The Onyx would be the guide scope with the Nexstar as the imaging scope. This time, I was much fasted at getting a polar alignment done and imaging was soon underway.

The first target was M99, a nice spiral galaxy in the Virgo cluster. I decided to do about 35 minutes on that one. Once the imaging was done I tried processing with AstroFX, the Nightscape software (I hadn't yet reloaded ImagesPlus). Unfortunately, it kept refusing to align the images. Eventually was reduced to manually picking the star to align each image too. Even then, the final image was terrible. Disappointing, to say the least! Only when I looked at the individual images did I realize what the problem was. I'd thought M99 was well up in the sky but for almost half the imaging run, I'd actually been shooting through the volleyball net next to my setup!

I swung up to M51 next, which was high overhead and would definitely not have any obstructions in the way. I would have had a really good image of it, too. Unfortunately, I hadn't realized that I didn't get the image centered properly. I'd mistakenly thought I was zoomed in and had more image available below the bottom edge of the window. Instead, I'd been zoomed out and the spiral galaxy was right on the edge of the image. Oops.

It should be noted that the software I was using to take the images was Sequence Generator Pro (SGP for short). It came with a full-featured download that was free to use for 45 days. It's pretty powerful in that it can control the camera, the guider, the telescope, the focuser, and a dome. It's a bit of overkill for my simple setup but it was so amazingly easy to start using that I immediately liked it. It doesn't come with a user manual, though. I'd been lamenting about the difficulty of getting the camera focused when I decided to check the Help. Duh! Turns out, it does have a focusing routine, although, not quite what I was used to. But it does the same thing in that it allows you to select a subframe and It'll take continuous rapid-fire images as you tweak the focus to get a star to as small a shape as you can. May have to test this feature out some more.

The next target was M57, the Ring Nebula in Lyra. I was able to get the focus adjusted pretty well, and started a 45-minute imaging run. This was a series of 45 1-minute exposures. About halfway through the run, everyone else decided to call it a night. Found another nice feature of SGP then. It can pause the imaging run, finishing the current image, and then hold until you tell it to resume. This allowed everyone to leave with their lights on to avoid obstacles without interfering with my imaging. Once they were gone, I resumed and finished the run. In the end, I ended up with a very good image of M57, although only 38 frames were usable due to the light breeze that rocked the scope a bit.

With it now approaching 2 AM, I swung up to M13, the great globular in Hercules. After a bit of focus tweaking, I set about an imaging run of 30 1-minute exposures. This time, I was not disappointed. The wind had died down completely and all the images were usable and had nicely focused stars. The mushy seeing left that more spread out that perhaps would have been best but, oh well. Later processing with ImagesPlus and I was able to get the best image of this amazing cluster that I've ever done! Very happy with this camera now!

By this time, it was 2:30 AM so I decided to pack up and head for home.

- ***Ken Munson***

Redrock/Inyokern Road – On Saturday, May 27th, I went out to the Redrock/Inyokern Road area for a night of dark sky observing, hoping for a good night for doing some photography. It turned out to be a pretty good night, indeed, with very dark, transparent skies, comfortable temperatures, and most importantly, no significant wind. At least not for most of the night. The seeing could have been a bit better but it was okay.

I must be getting better at polar alignment because I managed to get an excellent alignment within a half hour and was ready to star imaging. Once again, using the ASI 170MC camera on the Nexstar 11 with the Onyx 80 and the Meade DSI being used for autoguiding. I

Over the course of the next several hours I was able to image M104, NGC 4565, M64 and M51. M51 ended up being my final imaging run as by then, about 2 AM, the wind had picked up enough to where it was difficult to get a long exposure without significant vibration in the scope. I considered switching the cameras to do some wide-angle imaging with the Onyx 80 but decided not to risk messing up the polar alignment. The images came out pretty good with my first pass through the processing.

Switching to visual mode, I took a look at Saturn but was disappointed at not seeing any detail. A check of a star showed my collimation was off a bit so I tweaked it. Saturn looked better and I was able to see some cloud bands using the Radian 10mm eyepiece but couldn't seem to get good detail on the rings.

From there, I settle in to go through a couple of observing lists from Sky & Telescope. The May targets are all either really low in the west or already below the horizon so they not much to see. June's list, which consisted of a series of asterisms was more interesting. Most were fairly easy to see in the Nexstar with the 35mm Panoptic eyepiece but one, The Eiffel Tower was a very recognizable copy of its namesake. Napoleon's Hat was another that was easily recognizable. I missed seeing the Ring of the Niebelungen because I forgot the it required a lot of magnification to zoom in on it. The Zigzag (or Flower) asterism was one that required the wider FOV that the Onyx 80 provided. And yeah, to me it resembled a flower. The Candle and Holder asterism took me a while to recognize because it was upside down (and required a bit of contortion to get to the eyepiece. Of course, the Diamond Ring asterism with Polaris was easy to spot with binoculars.

The night was finished off with a look through Neptune, Uranus, Venus and even Pluto. Took me a while to figure out which faint pinpoint of light was Pluto but at least I was able to this distant, recently visited planet. And yes, it's still a planet in my book.

The Big Star That Couldn't Become a Supernova

Science Daily 25 May 2017 - For the first time in history, astronomers have been able to watch as a dying star was reborn as a black hole.

It went out with a whimper instead of a bang.

The star, which was 25 times as massive as our sun, should have exploded in a very bright supernova. Instead, it fizzled out -- and then left behind a black hole.

"Massive fails" like this one in a nearby galaxy could explain why astronomers rarely see supernovae from the most massive stars, said Christopher Kochanek, professor of astronomy at The Ohio State University and the Ohio Eminent Scholar in Observational Cosmology.

As many as 30 percent of such stars, it seems, may quietly collapse into black holes -- no supernova required.

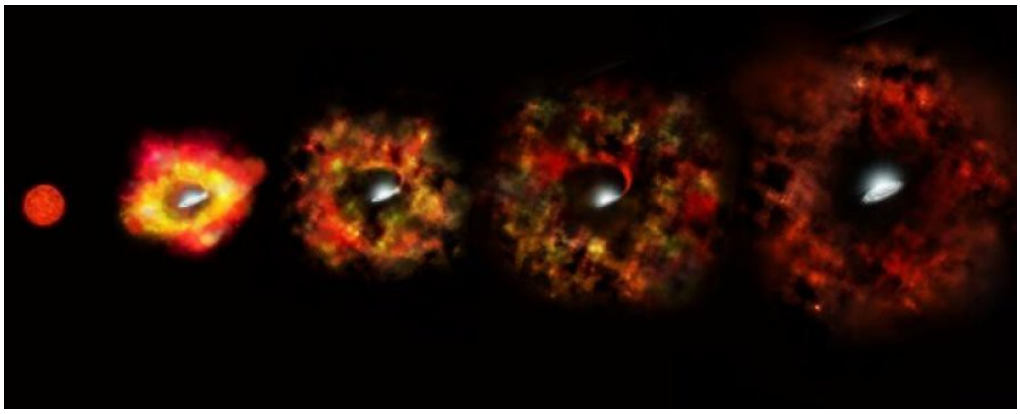
"The typical view is that a star can form a black hole only after it goes supernova," Kochanek explained. "If a star can fall short of a supernova and still make a black hole, that would help to explain why we don't see supernovae from the most massive stars."

He leads a team of astronomers who have been using the Large Binocular Telescope (LBT) to look for failed supernovae in other galaxies. They published their latest results in the *Monthly Notices of the Royal Astronomical Society*.

Among the galaxies they've been watching is NGC 6946, a galaxy 22 million light-years away that is nicknamed the "Fireworks Galaxy" because supernovae frequently happen there -- indeed, SN 2017eaw, discovered on May 14th, is shining near maximum brightness now. Starting in 2009, one particular star in the Fireworks Galaxy, named N6946-BH1, began to brighten weakly. By 2015, it appeared to have winked out of existence.

The astronomers aimed the Hubble Space Telescope at the star's location to see if it was still there but merely dimmed. They also used the Spitzer Space Telescope to search for any infrared radiation emanating from the spot. That would have been a sign that the star was still present, but perhaps just hidden behind a dust cloud.

All the tests came up negative. The star was no longer there. By a careful process of elimination, the researchers eventually concluded that the star must have become a black hole. It's too early in the project to know for sure how often stars experience massive fails, but Scott Adams, a former Ohio State student who recently earned his Ph.D. doing this work, was able to make a preliminary estimate.



In the failed supernova of a red supergiant, the envelope of the star is ejected and expands, producing a cold, red transient source surrounding the newly formed black hole, as illustrated by the expanding shell (left to right). Some residual material may fall onto the black hole, as illustrated by the stream and the disk, potentially powering some optical and infrared emissions years after the collapse.
Credit: NASA, ESA, P. Jeffries (STScI)

"N6946-BH1 is the only likely failed supernova that we found in the first seven years of our survey. During this period, six normal supernovae have occurred within the galaxies we've been monitoring, suggesting that 10 to 30 percent of massive stars die as failed supernovae," he said.

"This is just the fraction that would explain the very problem that motivated us to start the survey."

To study co-author Krzystof Stanek, the really interesting part of the discovery is the implications it holds for the

origins of very massive black holes -- the kind that the LIGO experiment detected via gravitational waves. (LIGO is the Laser Interferometer Gravitational-Wave Observatory.)

It doesn't necessarily make sense, said Stanek, professor of astronomy at Ohio State, that a massive star could undergo a supernova -- a process which entails blowing off much of its outer layers -- and still have enough mass left over to form a massive black hole on the scale of those that LIGO detected.

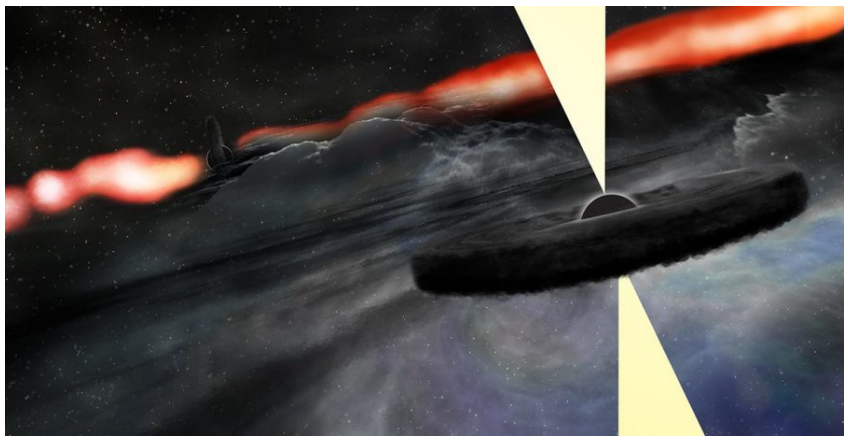
"I suspect it's much easier to make a very massive black hole if there is no supernova," he concluded.

New Object Near Supermassive Black Hole in Famous Galaxy

Discovery indicates galaxy probably merged with another

Science Daily 23 May 2017 - Pointing the Very Large Array (VLA) at a famous galaxy for the first time in two decades, a team of astronomers got a big surprise, finding that a bright new object had appeared near the galaxy's core. The object, the scientists concluded, is either a very rare type of supernova explosion or, more likely, an outburst from a second supermassive black hole closely orbiting the galaxy's primary, central supermassive black hole.

The astronomers observed Cygnus A, a well-known and often-studied galaxy discovered by radio-astronomy pioneer Grote Reber in 1939. The radio discovery was matched to a visible-light image in 1951, and the galaxy, some 800 million light-years from Earth, was an early target of the VLA after its completion in the early 1980s. Detailed images from the VLA published in 1984 produced major advances in scientists' understanding of the superfast "jets" of subatomic particles propelled into intergalactic space by the gravitational energy of supermassive black holes at the cores of galaxies.



Artist's conception of newly-discovered secondary supermassive black hole orbiting the main, central supermassive black hole of galaxy Cygnus A.
Credit: Bill Saxton, NRAO/AUI/NSF

"This new object may have much to tell us about the history of this galaxy," said Daniel Perley, of the Astrophysics Research Institute of Liverpool John Moores University in the U.K., lead author of a paper in the *Astrophysical Journal* announcing the discovery.

"The VLA images of Cygnus A from the 1980s marked the state of the observational capability at that time," said Rick Perley, of the National Radio Astronomy Observatory (NRAO). "Because of that, we didn't look at Cygnus A again until 1996, when new VLA electronics had provided a new range of radio frequencies for our observations." The new object does not appear in the images made then.

"However, the VLA's upgrade that was completed in 2012 made it a much more powerful telescope, so we wanted to have a look at Cygnus A using the VLA's new capabilities," Perley said.

Daniel and Rick Perley, along with Vivek Dhawan, and Chris Carilli, both of NRAO, began the new observations in 2015, and continued them in 2016.

"To our surprise, we found a prominent new feature near the galaxy's nucleus that did not appear in any previous published images. This new feature is bright enough that we definitely would have seen it in the earlier images if

nothing had changed," said Rick Perley. "That means it must have turned on sometime between 1996 and now," he added.

The scientists then observed Cygnus A with the Very Long Baseline Array (VLBA) in November of 2016, clearly detecting the new object. A faint infrared object also is seen at the same location in Hubble Space Telescope and Keck observations, originally made between 1994 and 2002. The infrared astronomers, from Lawrence Livermore National Laboratory, had attributed the object to a dense group of stars, but the dramatic radio brightening is forcing a new analysis.

What is the new object? Based on its characteristics, the astronomers concluded it must be either a supernova explosion or an outburst from a second supermassive black hole near the galaxy's center. While they want to watch the object's future behavior to make sure, they pointed out that the object has remained too bright for too long to be consistent with any known type of supernova.

"Because of this extraordinary brightness, we consider the supernova explanation unlikely," Dhawan said.

While the new object definitely is separate from Cygnus A's central supermassive black hole, by about 1500 light-years, it has many of the characteristics of a supermassive black hole that is rapidly feeding on surrounding material.

"We think we've found a second supermassive black hole in this galaxy, indicating that it has merged with another galaxy in the astronomically-recent past," Carilli said. "These two would be one of the closest pairs of supermassive black holes ever discovered, likely themselves to merge in the future."

The astronomers suggested that the second black hole has become visible to the VLA in recent years because it has encountered a new source of material to devour. That material, they said, could either be gas disrupted by the galaxies' merger or a star that passed close enough to the secondary black hole to be shredded by its powerful gravity.

"Further observations will help us resolve some of these questions. In addition, if this is a secondary black hole, we may be able to find others in similar galaxies," Daniel Perley said.

Rick Perley was one of the astronomers who made the original Cygnus A observations with the VLA in the 1980s. Daniel Perley is his son, now also a research astronomer.

"Daniel was only two years old when I first observed Cygnus A with the VLA," Rick said. As a high school student in Socorro, New Mexico, Daniel used VLA data for an award-winning science fair project that took him to the international level of competition, then went on to earn a doctoral degree in astronomy.

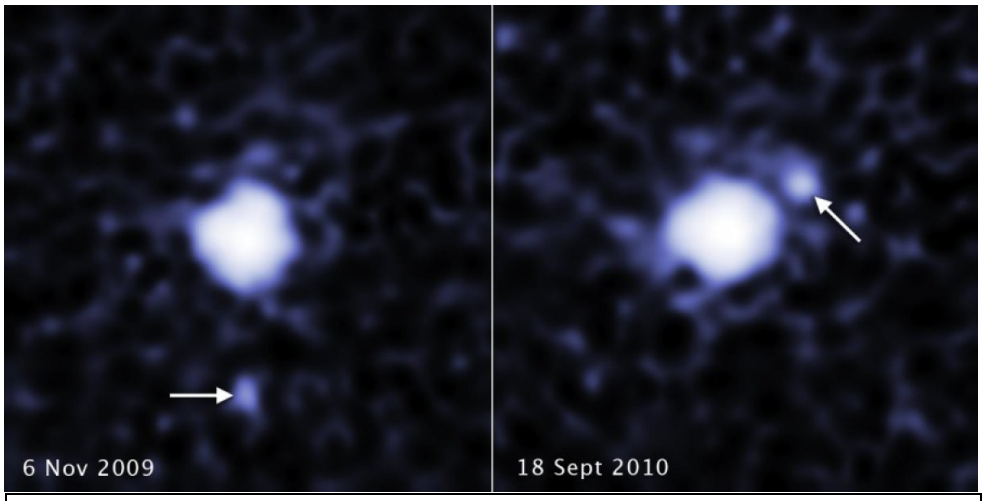
Moon Orbits Third Largest Dwarf Planet in Our Solar system

Science Daily 18 May 2017 - The combined power of three space observatories, including NASA's Hubble Space Telescope, has helped astronomers uncover a moon orbiting the third largest dwarf planet, catalogued as 2007 OR10. The pair resides in the frigid outskirts of our solar system called the Kuiper Belt, a realm of icy debris left over from our solar system's formation 4.6 billion years ago.

With this discovery, most of the known dwarf planets in the Kuiper Belt larger than 600 miles across have companions. These bodies provide insight into how moons formed in the young solar system.

"The discovery of satellites around all of the known large dwarf planets -- except for Sedna -- means that at the time these bodies formed billions of years ago, collisions must have been more frequent, and that's a constraint on the formation models," said Csaba Kiss of the Konkoly Observatory in Budapest, Hungary. He is the lead author of the science paper announcing the moon's discovery. "If there were frequent collisions, then it was quite easy to form these satellites."

The objects most likely slammed into each other more often because they inhabited a crowded region. "There must have been a fairly high density of objects, and some of them were massive bodies that were perturbing the orbits of smaller bodies," said team member John Stansberry of the Space Telescope Science Institute in Baltimore, Maryland. "This gravitational stirring may have nudged the bodies out of their orbits and increased their relative velocities, which may have resulted in collisions."



These two images, taken a year apart, reveal a moon orbiting the dwarf planet 2007 OR10. Each image, taken by the Hubble Space Telescope's Wide Field Camera 3, shows the companion in a different orbital position around its parent body. 2007 OR10 is the third-largest known dwarf planet, behind Pluto and Eris, and the largest unnamed world in the solar system. The pair is located in the Kuiper Belt, a realm of icy debris left over from the solar system's formation.
Credit: NASA, ESA, C. Kiss (Konkoly Observatory), and J. Stansberry (STScI)

But the speed of the colliding objects could not have been too fast or too slow, according to the astronomers. If the impact velocity was too fast, the smash-up would have created lots of debris that could have escaped from the system; too slow and the collision would have produced only an impact crater.

Collisions in the asteroid belt, for example, are destructive because objects are traveling fast when they smash together. The asteroid belt is a region of rocky debris between the orbits of Mars and the gas giant Jupiter. Jupiter's powerful gravity speeds up the orbits of asteroids, generating violent impacts.

The team uncovered the moon in archival images of 2007 OR10 taken by Hubble's Wide Field Camera 3. Observations taken of the dwarf planet by NASA's Kepler Space Telescope first tipped off the astronomers of the possibility of a moon circling it. Kepler revealed that 2007 OR10 has a slow rotation period of 45 hours. "Typical rotation periods for Kuiper Belt Objects are under 24 hours," Kiss said. "We looked in the Hubble archive because the slower rotation period could have been caused by the gravitational tug of a moon. The initial investigator missed the moon in the Hubble images because it is very faint."

The astronomers spotted the moon in two separate Hubble observations spaced a year apart. The images show that the moon is gravitationally bound to 2007 OR10 because it moves with the dwarf planet, as seen against a background of stars. However, the two observations did not provide enough information for the astronomers to determine an orbit.

"Ironically, because we don't know the orbit, the link between the satellite and the slow rotation rate is unclear," Stansberry said.

The astronomers calculated the diameters of both objects based on observations in far-infrared light by the Herschel Space Observatory, which measured the thermal emission of the distant worlds. The dwarf planet is about 950 miles across, and the moon is estimated to be 150 miles to 250 miles in diameter. 2007 OR10, like Pluto, follows an eccentric orbit, but it is currently three times farther than Pluto is from the sun.

2007 OR10 is a member of an exclusive club of nine dwarf planets. Of those bodies, only Pluto and Eris are larger than 2007 OR10. It was discovered in 2007 by astronomers Meg Schwamb, Mike Brown, and David Rabinowitz as part of a survey to search for distant solar system bodies using the Samuel Oschin Telescope at the Palomar Observatory in California.

The team's results appeared in *The Astrophysical Journal Letters*.

Schedule of Coming Events

Date	Event
2 June	**Venus Passes 1.8° from Uranus** See these two inner and outer planets together in the predawn sky to the east.
2 June Friday Night 7:30PM	**Monthly General Meeting** **Topic: "Why String Theory" Tim Thompson, JPL/LAAS**
3 June	**Venus at Greatest Western Elongation.**
5 June Monday Night 7:30 PM	**Monthly Planning Meeting** See directions on Page 4.
15 June	**Saturn at Opposition**
17 June Saturday Evening	**In Town Dark Sky Observing Session at Ridgecrest Middle School–** 28915 NortbBay Rd. RPV, Weather Permitting**:** Please contact Greg Benecke to confirm that the gate will be opened!
24 June Saturday Night	**Out of Town Dark Sky Observing Session** Contact Greg Benecke to coordinate a location.

South Bay Astronomical Society

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Next General Meeting at El Camino College Planetarium

Friday, June 2nd 7:30 PM

"Why String Theory"

Tim Thompson, JPL/LAAS

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South Bay Astronomical Society
P.O. Box 1937
Redondo Beach, CA 90278