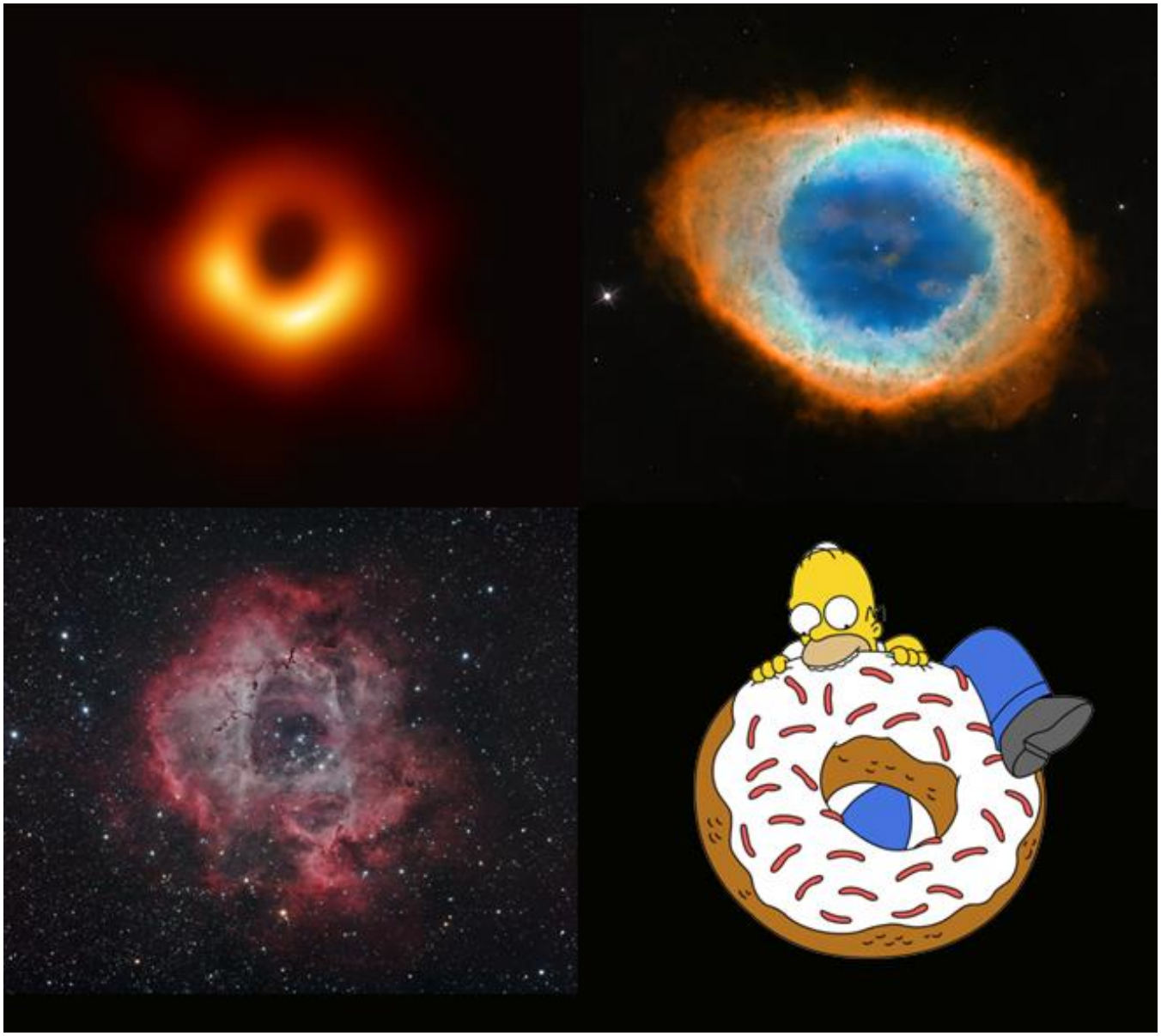
SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

April 2020



The Doughnut is an Important Cosmic Object

Science magazine selected the Event Horizon Telescope image of the black hole at the center of Messier 87 (upper left) as the 2019 "Breakthrough of the Year." It's not the only cosmic object of that shape that has universal significance.

Due to the COVID-19 pandemic, all WAA group events are canceled until we are given notification by public health authorities that such group activities are permitted.

As of this writing, Ward Pound Ridge Reservation is open. Updated accessibility information can be found at https://parks.westchestergov.com/covid-19-update. WAA members may observe at Ward Pound Ridge with proper notification to the park 24 hours in advance. Call the number on the back of your ID card, which was sent with your membership or renewal, and bring the card. Remember that social distancing is applicable on the observing field. It is reasonable for each instrument to be used by a single individual to prevent any possible contamination.

Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to visit the WAA website.

WAA Members: Contribute to the Newsletter!
Send articles, photos, or observations to
waa-newsletter@westchesterastronomers.org

Editor: Larry Faltz
Assistant Editor: Scott Levine
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New Members

Siva Narayanan	Scarsdale
Peter Tagatac	New York
Alfredo Viegas	New Fairfield

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Garth Landers	Stamford
Gary Miller	Pleasantville
Robert Rusinko	Tarrytown
Dor Zaidenberg	White Plains

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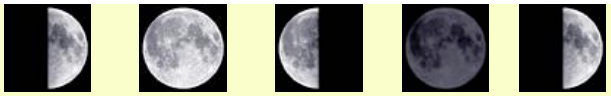
NEAF Virtual Experience

Because of the coronavirus pandemic, the Northeast Astronomy Forum was postponed until September. The organizers are planning a "Virtual Experience" for Saturday, April 4th, with on-line presentations by vendors, some of them linked to sales. WAA is planning to show a brief video as well. As of this writing we don't have details about how to access the event. WAA will send out an eblast as soon as the details are forwarded to us, which you may see before you read this issue of SkyWAAtch!

Star Parties will happen again!

ALMANAC For April 2020

Bob Kelly, WAA VP for Field Events



The April Full Moon is the closest of the year, (219627.25 miles, 353455.8 km), with perigee 221,772 miles, 356,907 km) only eight hours before Full Moon. According to NASA's Scientific Visualization Studio's Dial-a-Moon website at https://svs.gsfc.nasa.gov/4768, April's Full Moon is 216 miles closer than March's. Once again, watch out for higher than normal tides around the date of the Full Moon.

Venus bowls along the edge of the dipper-shaped Pleiades cluster on the 3rd, just missing a strike. Photographers will be mightily challenged to capture the almost eight-magnitude difference between the sublime group of young stars with a planet over 600 times brighter. Binoculars will help us human viewers. The Moon will have made a similar pass by the Beehive Cluster just before dawn on the 3rd.

The Moon lines up with Venus on the 26th, hanging out above the Hyades and Pleiades clusters. This is a sight worth finding a clear western horizon to view. Aim a telescope at Venus anytime this month and note its waning phase. The second planet from the Sun has its greatest illuminated extent on the 27th, coming around the corner toward Earth, blazing at magnitude -4.7 despite doing its impression of a crescent Moon. Use sunglasses or sky-darkening filters to find Venus in daylight. (Warning: Make sure the Sun is entirely out of view!) The crescent shape will be easier to see in a bright sky or with good filters. Venus' angular distance from the Sun decreases from 45 degrees to 30 in April.

I always think of stars as being very old, but the Pleiades are "only" about 100 million years old. Venus is over four *billion* years old. Had some of the early dinosaurs watched Venus pass by the location of the modern-day Pleiades, they might have seen a large, bright nebula like the present-day Orion Nebula.

Jupiter and Saturn give Mars the slip in the morning sky, taking off toward the south-southeast. Our Moon joins the planet party in the morning sky at mid-month for wonderful photo-ops from the 14th through 16th.

Jupiter is at quadrature, getting sideways with the Earth. Shadows of Jupiter's moons project farthest away from the moons, making the Jupiter-scene look very three dimensional.

Use Jupiter as a pointer to Pluto! From now through mid-April, Jupiter and Pluto will appear less than two degrees (but 17 magnitudes) apart. They are closest on the 9th at a half-degree apart. The New Horizons spacecraft is to the upper right in Sagittarius' "teapot." Pluto is a 14th magnitude object, so you'll need a large telescope or a sensitive astro-camera to see it.

This is a good time to compare the diameters of Mars, Saturn and Jupiter in a telescope. Jupiter appears six times wider than Mars and Saturn, not including the rings), is half as wide as Jupiter

Mercury will stay low in the morning twilight. At 15 degrees from the Sun and with its brightness increasing through magnitude -1, Mercury should be easy to find. But it's at its maximum distance south of the ecliptic, so for observers in the northern hemisphere it's about as hard to find as it gets.

The very minor Lyrids meteor shower peaks on the morning of the 22nd. Lyrids are mostly faint meteors, with fewer than 20 per hour at the peak. The 22nd is a dark night due to the New Moon, so you might notice some glowing grains left over from Comet Thatcher (C/1861 G1), a comet with a period of over 400 years.

Asteroid 52768 (1998 OR2) will pass just 1.4 million miles from Earth on the 29th. It's a big rock, about two miles wide. 1998 OR2 will be visible low in the evening sky in Hydra at magnitude +10 or 11. It will continue to loop through the inner solar system, passing across Earth's orbit every $3^2/_3$ years.

Some big snowballs are swooping through the inner Solar System. Comet C/2019 Y4 (ATLAS) is reported to be brightening through 9th magnitude in Camelopardalis. It has the potential to be viewable with the unaided eye in late May, but it will be very close to the Sun then. Optimal viewing for evening viewing from our area will be in the second half of April. On April 15th it will be about 45° above the northwestern hori-

zon at 10:30 pm, and possibly magnitude 5 or 6. Later in the month it will be much brighter but closer to the horizon. It's following the orbit of the Great Comet of 1844/5 and might be a chip off that block.

C/2019 Y1 (ATLAS) is in Andromeda, where it may peak at 9th magnitude. C/2017 T2 (PANSTARRS) floats into Camelopardalis from Cassiopeia. It may peak at magnitude 8. It's farther from the Sun than the Earth is, so it stays well out of the solar glare.

A sunspot was seen on the Sun last month. Okay, but we remain in the sunspot minimum with many days without visible sunspots. Statistical models predict sunspot numbers should increase in 2020, but data used for some dynamical models aren't promising an increase in solar spottiness any time soon. Auroras are still being seen. Chinks in the Earth's magnetic armor occasionally let streams of energetic particles into our upper atmosphere to light up far northern (and southern) skies. For more on sunspots and the solar cycle, see the January 2014 SkyWAAtch.

ISS overflights are visible in the evening sky through the 6th and morning twilight overflights commence on the 23rd.

Uranus might be visible moving against the background stars in the Solar & Heliospheric Observatory's field of view when passing through conjunction with the Sun on the 26th. Mercury passes Uranus on April 30th/1st of May on its way toward solar conjunction on the far side of the Sun in May. ■

Bob Kelly's pre-dawn shot on March 18th of the waning crescent Moon, showing earthshine. The Moon is accompanied by, from left to right, Saturn, Jupiter and Mars, with 52 Sgr at mag 4.6 at the 5 o'clock position, one lunar diameter away from the Moon. Canon XS on tripod, f/2 50 mm lens, 1/4 second exposure, ISO 800. From Bob's front yard through a gap in the trees and just above the Con Ed power lines.

Member Profile: Dor Zaidenberg

Home town: White Plains

Family: Wife Ayelet, two kids: Leah (4), Ethan (2)

How did you get interested in astronomy? Since I was a little kid I was interested in space, astronomy, physics and astrophysics. I always wanted to be able to see planets and other space objects with my own telescope

Do you recall the first time you looked through a telescope? What did you see? The first time was back in Israel. It was in an observatory. We saw the moon and it was amazing

What's your favorite object(s) to view? Jupiter's big red spot, followed by Saturn.

What kind of equipment do you have? My main telescope is an Orion 8" f/8 Ritchey-Chretien. I also have a 4 inch Cassegrain.

What kind of equipment would you like to get that you don't have? I think any further investment will make my setup very complicated to prepare and probably beyond my skill set at the moment. Perhaps in 10 years when my kids are older I will consider a 12" telescope.

What I really want with my astronomy capabilities is to be able to set up GPS tracking for my telescope. I was never able to figure that out, and I am manually aiming my telescope at space objects which is a bit frustrating, but on the other hand now I now know by heart the location of many cool objects such as the Dumbbell and Ring Nebulas.

Have you taken any trips or vacations dedicated to astronomy? Tell us about them. Not yet. When the kids are older I plan to travel to the Finger Lakes region with the telescope. I also would really like to travel to Hawaii, as well as to a location in the southern hemisphere, to see the night sky over there.

Are there areas of current astronomical research that particularly interest you? Is Betelgeuse going supernova?!? Dark Matter, Dark Energy.

Do you have any favorite personal astronomical experiences you'd like to relate? It's really a thrill when I show Jupiter and the other planets to kids, and they see it for the first time.

What do you do (or did you do, if retired) in "real life"? I work as an engineering manager at Google in the City.

Have you read any books about astronomy that you'd like to recommend? *A Short History of Nearly Everything* by Bill Bryson

How did you get involved in WAA? I found you on Facebook.

What WAA activities do you participate in? Star parties and outreach events.

If you have a position in WAA, what is it, what are your responsibilities and what do you want the club to accomplish? I am a relatively new "junior" member.

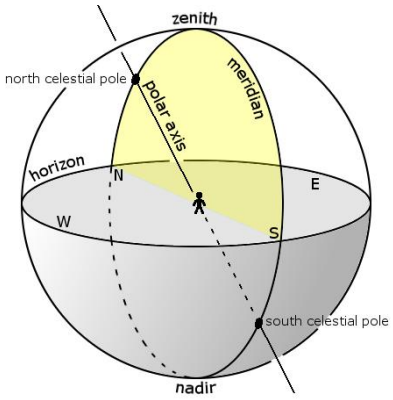
Provide any other information you think would be interesting to your fellow club members, and don't be bashful! I think we should add guitars to our star parties ■

Astronomy 101: Culmination and the Meridian

Scott Levine

At its simplest and most beautiful, astronomy is time spent watching things move across the sky. From day to day, stars rise and set. From season to season, stars come and go.

Imagine, if you can, the whole sky as a big sphere. I mean, the whole sky, all of it, even the parts below the ground. So, Earth is a ball within this bigger sky ball. Astronomers use the word *meridian* to describe the imaginary line that runs from the due north horizon straight up overhead, through the zenith (the sky's highest point), to due south where it disappears below the horizon. From there, it runs through the nadir (the lowest point), and continues until it meets back up with itself at the northern horizon. This big circle of the meridian cuts the whole sky into an eastern and a western half. If you're new to the sky, meridian is a good word to keep handy because it gives you a bit of a key into how we see things move.



As Earth rotates, the stars and planets rise in the east, then reach their highest point in the sky as they cross the meridian. Maybe that point is also at the zenith. Maybe it's just a couple of degrees above the horizon. Usually it's somewhere between. Wherever it is, we say things *culminate* when they cross the meridian. The culmination nearer the zenith is called the upper culmination; the one nearer the nadir, the lower culmination. So, everything culminates twice a day. By itself, culmination usually means upper culmination.

It's a magical place; a spectacular moment of change where objects go from rising to setting.

Here in the northern hemisphere, we usually think of things culminating along the meridian in the south. The Sun is a great example. Sure, it rises in the east and sets in the west, but the trip between happens along the southern sky. In fact, we have a special word for when the Sun culminates; for when it crosses the meridian: *noon*. AM and PM stand for ante-meridian and post-meridian: before and after the meridian, before and after noon.

But not everything is in the south. Polaris is almost exactly due north, and it looks from Westchester to sit still all night. It's hard to see, but it actually carves out a tiny circle in the sky each day. Both of its culminations happen due north, less than a degree apart. Things in that end of the sky are so far north that they reach their lower culmination above the horizon and never set.

As you keep learning the sky, you might start to get a feel for when things culminate. Since it's the time when an object is at its highest, it's the time when it's usually easiest to see it. Around April 15, Regulus (α Leo) culminates at about 9:30 pm. The other two stars of the Spring Triangle lag behind. Spica (α Vir) culminates around 9:30 pm on June 3, Arcturus (α Boo) on June 16.

If you stretch these nightly trips out to seasons, you start to see some patterns. The meridian is the line between rising and setting, but also the line between the beginning and the end. Stars rise four minutes earlier each day, so they also culminate four minutes earlier. Before long, these few minutes add up. A star that culminated at 9:30 pm in January, culminates at 5:30 pm in March. By the time springtime darkness falls, the star is already on the setting half of the sky. Once it crosses the line, its time with us is short and it won't be long until it vanishes. It will be gone until months later when it starts the whole trip over again.

We usually think of the sky as permanent and unchanging, but if you watch long enough, you can start to see places where change happens right before our eyes, and the meridian and where lots of it happens.

Scott Levine's astronomy blog, *Scott's Skywatch*, can be found at https://scottastronomy.wordpress.com/ or email him at astroscott@yahoo.com

Astronomy Can Be Funny — Larry Faltz

In honor of April Fool's Day (appropriate to honor since there seems to be so many more fools around in the present cosmic era), I thought it might be interesting to devote this month's SkyWAAtch to the deep problem of whether it's possible to illuminate important problems of physics and astronomy with humor. Every field of human endeavor can be lightened and enlightened with wit, and the physical sciences aren't exempt. Most physics and astronomy jokes, however, are simple puns and double-entendres, such as the following:

> Did you hear about the great new restaurant on the Moon? The food is excellent, but there's no atmosphere.
>
> What did the Sun say to Canis Major? "Why so Sirius?"

Or, the joke only uses astronomy as a pretext:

> Two blondes in Las Vegas were sitting on a bench looking at the Moon. One blonde says to the other, "Which do you think is farther away ... Florida or the Moon?" The other blonde turns and says "Dummy, can you see Florida?"

Then there is this famous story, which I've known since childhood:

> Astronauts from America, Russia and the Country-You-Wish-to-Insult (CYWTI, politically incorrectly often referred to as Poland) meet in the 1960s at the UN. The American says "We're going to land on the Moon!" The Russian says, "Ha! That's nothing. We're going to land on Mars." And the astronaut from CYWTI says "We've got you both beat. We're going to land on the Sun." Both the American and the Russian start laughing. "Why are you laughing?" "Because if you land on the Sun, you'll burn up!" "What, do you think we're stupid?" replies the astronaut from CYWTI. "We're going at night!"

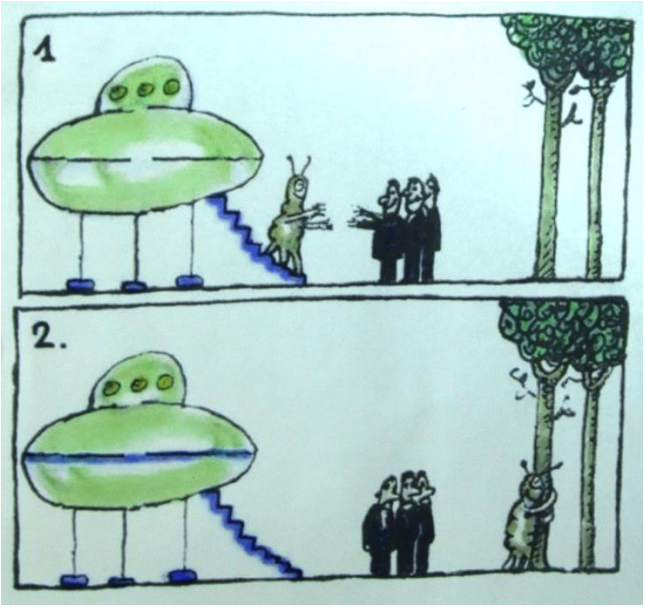
Some famous scientists have said some funny things. Wolfgang Pauli was said to have dismissed a paper by a young physicist by saying "Das ist nicht nur nicht richtig; es ist nicht einmal falsch!" which translates as "That's not only not right, it's not even wrong." The witty Albert Einstein reportedly said "Put your hand on a hot stove for a minute, and it seems like an hour. Sit with a pretty girl for an hour, and it seems like a minute. THAT'S relativity." The always clever Neil DeGrasse Tyson observed "Next time you're stunned by large Moon on horizon, bend over and view it between your legs. The effect goes away entirely." Defending basic science, Richard Feynman offered "Physics is like sex: sure, it may give some practical results, but that's not why we do it."

There are lots of astronomical cartoons, a few of which make quite trenchant observations, such as:

Aliens are often good for a laugh (OK, Gort and that thing that bores through John Hurt's stomach aren't very funny). The usual examples are Mork, Alf, Kodos and Kang from *The Simpsons* and Paul, from the 2011 movie of the same name, as well as Gonzo the Great, who was revealed to be an alien in the movie *Muppets from Space*.

The following cartoon was actually posted on the door of the main control room at the Atacama Large Millimeter Array (ALMA) Headquarters in Chile when

I visited there in 2017. It provides important guidance to the astronomers at the facility in case of First Contact:



But I'm looking for jokes that address scientific issues in astronomy, where humor might illuminate the topic in a way that a straightforward discussion can't.

The ideal format for astronomy humor would be a spoof-scientific paper. It turns out that the prototype for this genre may be a paper written by none other than Isaac Asimov in 1948, "The Endochronic Properties of Resublimated Thiotimoline". Asimov had been doing doctoral research in chemistry at Columbia in the late 1940's, although by that time he had turned out quite a few science fiction stories. Impressed by the solubility of a substance he was working with, he imagined a compound so soluble that it would dissolve *before* it hit the solvent. So he invented thiotimoline, an organic compound derived from the bark of the fictional shrub *Rosacea karlsbadensis rugo.* Although its structure was not yet fully elucidated, It was determined that it gets its solubility from the fact that one of its carbon atoms has only two of its four chemical bonds in normal space and time, while another bond projects into the future and the fourth one into the past. This is a riff on the optical isomerism of carbon atoms, so important for organic chemistry (discovered, by the way, by Louis Pasteur) and ever confusing to pre-med students taking organic. Asimov's paper has lots of serious-looking graphs and tables and it's quite deadpan throughout. Through the use of made-up references he gives thiotimoline a scientific provenance. He discusses potential theories that could account for its going to solution tachyonically. One I particularly liked was "F. Harley-Short, Determinism and Free-Will. The application of thiotimoline solubility to the Marxian dialectic, *Philosophical Proceedings & Reviews*, 15, 125-197 (1946)." Of course you can't read the actual paper, since there is no journal *Philosophical Proceedings & Reviews.*

Asimov had no way of getting this article published in a serious scientific journal (they have to keep themselves serious, after all) so it appeared in the March 1948 issue of *Astounding Science Fiction*.[1] He followed it with three other thiotimoline papers, "The Micropsychiatric Applications of Thiotimoline" (1952), "Thiotimoline and the Space Age" (1959) and "Thiotimoline to the Stars" (1973). This last article is a science fiction story set in the future. Naturally, the endochronic nature of thiotimoline is harnessed for faster-than-light-speed travel.

Scientific journals have little interest in humor. When I was just starting my interest in medicine in the early 1960's I came upon a humor page in the *Journal of the American Medical Association*. The jokes had to be simple and clean, such as this one, a veritable brainworm that has stuck in my head since I read it.

> "Doc, I'm psychoceramic." "What? You mean 'psychosomatic' don't you?" "No, 'psychoceramic.' I'm a crack-pot."

The JAMA humor page is long gone, maybe in part due to stupid jokes like this. What little that can pass for humor in journals needs to be factual, not a spoof (even if it ends up having that effect), such as a report in the prestigious *New England Journal of Medicine* of "jogger's penis," frostbite of the male organ resulting from running in -8°C weather with a strong wind-chill factor.[2] Such opportunities are extremely rare. So, where does one go to publish a spoof scientific paper? The answer turns out to be arXiv.

arXiv (arxiv.org) is the repository of "pre-prints," articles that have been written and may, or may not, be submitted for publication in refereed journals. Papers communicated to arXiv are "moderated." There are

[1] https://archive.org/stream/Astounding_v41n01_1948-03_UnkSc-cape1736#page/n119/mode/2up

[2] Hershkowitz, M, Penile Frostbite, an Unforeseen Hazard of Jogging, *N Engl J Med* 1977; 296:178

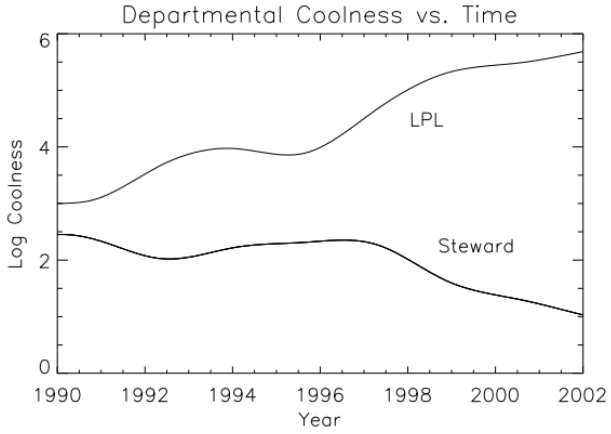
individuals who ensure that the paper is relevant to the scientific area it's concerned with and has at least some validity, but they do not critique it, leaving that for journal referees if the paper ends up being presented for publication. arXiv is administered by the Cornell University Library. Ten thousand papers a month are submitted in the fields of physics, astronomy, mathematics, statistics, engineering, computer science and similar areas of research.

In astronomy, a large proportion of the papers that appear in the big-league journals (*Science*, *Nature*, *Astronomical Journal*, *Astronomy and Astrophysics*, etc.) start out on arXiv. Sometimes, when there's an important study that has major public relations importance, it will go directly to a journal and be rolled out with a public ceremony, such as the Event Horizon Telescope's black-hole visualization in 2019 or the announcement of gravitational waves from the neutron-star merger in 2017 (see the December 2017 SkyWAAtch). The latter event was kept under wraps; 65 papers were queued up for publication and they were all released on the day of the public announcement.

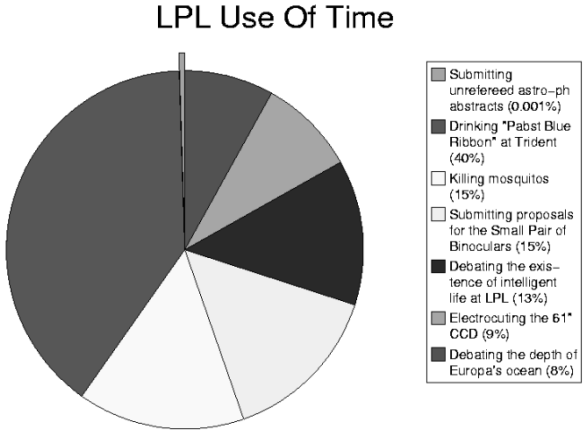
Another value of arXiv is that after an important finding, scientists from all over the world submit analyses and new theories, all looking for recognition, credibility and priority. When the B-mode polarization in the Cosmic Microwave Background radiation was announced by the BICEP-2 collaboration in 2016, within days scores of papers appeared with theoretical analyses of the physics and cosmology behind the discovery (later withdrawn). Such a phenomenon reflects the intensity of scientific endeavor around the world and the impact of rapid communication. It matters little if many of the theories are at the limits of, or even beyond, credibility, with details residing in complex mathematics or unproven models. At least everyone is thinking and communicating.

But, "all work and no play makes Jack a dull boy," and a few brave souls have used arXiv as the site to post papers that are in one way or another descendants of Asimov's thiotimoline. I've found most of the spoofs posted since 2000 that concern astronomy. I'll summarize them briefly for you. They are all richer and more delicious than these meager outlines can portray, worthy of your attention. Like all good spoofs, there's some real science behind them.

There appears to be friendly internecine warfare between graduate students at the Lunar and Planetary Laboratory (LPL), the planetary science division of the University of Arizona, and the Steward Observatory, the university's astronomy department. In 2001, a paper was posted by LPL entitled "Superiority of the Lunar and Planetary Laboratory (LPL) Over Steward Observatory (SO) at the University Of Arizona".[3] It included this graph, in which the ordinate is logarithmic, making the purported difference between the two groups even greater than it first appears.



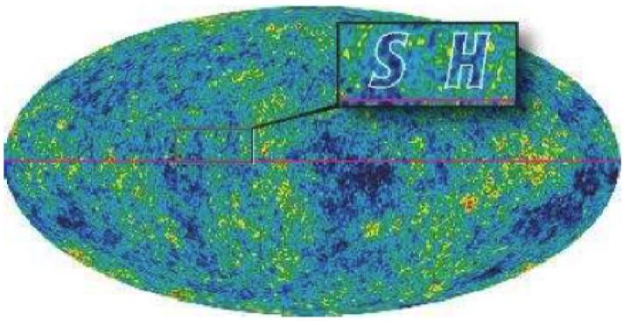
Needless to say, the Steward Observatory fought back, submitting a paper entitled "On the Utter Irrelevance of LPL Graduate Students: An Unbiased Survey by Steward Observatory Graduate Students".[4] This paper claims to have scientifically determined that that "the actual number of useful results from LPL graduate students is 0±0.01 (5σ)." It also shows the following pie chart, with the caption being merely Homer Simpson's "mmmmm….pie":



[3] https://arxiv.org/pdf/astro-ph/0204013.pdf
[4] https://arxiv.org/pdf/astro-ph/0204041.pdf

Response and counter-response were enough, and no further scientific output from this competition has been published. This conflict evidently lacked the staying power, or importance, of Galileo vs. the Inquisition or Curtis vs. Shapley.

There are seven papers on arXiv by Ali Frolop, co-authored by cosmologist Douglas Scott of the University of British Columbia (and a member of the Planck team). The first was posted on April 2, 2006. "Cosmic Conspiracies",[5] discusses some of the interesting coincidences from data derived from the 3-year WMAP release (which was then the most current CMB dataset), in particular, the equation $H_0t_0=1$ (actually 1.03±0.04 per WMAP) where H_0 is the Hubble constant and t_0 is the present time. But it seems to me that since the inverse of the Hubble Constant, $1/H_0$, *is* the age of the universe, that is, t_0, the result ought to be 1! After this bit of astro-sophistry, Scott and Frolop suggest some other coincidences, including reminding us of a previously reported identification of Stephen Hawking's initials in the CMB.



The facetious nature of the paper can easily be found in a footnote in support of statistical identity that reads "*E.g*. "That was a close race, my horse only lapped your horse once!' Or Amazing, your birthday's in October and mine is in July!'" Scott and Frolop conclude "Perhaps one of [the various coincidences] will be the 'smoking grail' that cosmologists have been looking for to lead us beyond vanilla ΛCDM into a whole new ice cream parlour of models."

On March 30, 2007, the two cosmologists were at it again, with "Natural Dark Energy",[6] which riffs on the total lack of knowledge about the nature of dark matter and dark energy. After a scientifically reasonable description of the standard model of cosmology, the authors suggest utilizing the dictum of "Walter of Ockham" (the previously unknown younger brother of William of Ockham), who said *Entia sunt multiplicanda praeter necessitatem,* translated as "you can't get enough of a good thing."[7] They suggest that there should be multiple forms of dark energy and explore their consequences and their impact on the equation of state of the cosmos. "We call these sextessence, septessence, octessence etc. The ninth component would be nonessence, which clearly does not exist." They also note the "tired light" hypothesis, which holds that "photons are partially absorbed by all the darkness which they have to travel through," quoting Terry Pratchett, who said that "Light thinks it travels faster than anything but it is wrong. No matter how fast it travels, it finds the darkness has always got there first, and is waiting for it."

In the March 31, 2008 posting "Down-Sizing Forever"[8] Scott and Frolop extrapolate from star-forming data in early and more recent galaxies to conclude that in fact galaxies do not form at all! They note two theories of galaxy formation, the "Monolithic" model where galaxies collapse from a single immense cloud (the reference given is "Kubrick S., 1968, '2001: A Space Odyssey', MGM") and the "ELS" model, where galaxies agglomerate from smaller subunits, "much like in the preparation of a multi-layered snack food." ELS stands for Egg and Lettuce-Bacon Sandwich. Extrapolating back to the era of the CMB, they note "It is often said that the last scattering surface is like the cosmic photosphere, and hence looking at the microwave sky is like looking at a star, except inside-out. However, this also misses the point – the early Universe was in fact a giant galaxy, not a star at all!" They go on to razz the cyclic universe proponents (Penrose, Steinhardt and others) noting they might favor multiple cycles "because just one period of eternity might not be enough for their work to gain the fame it deserves."

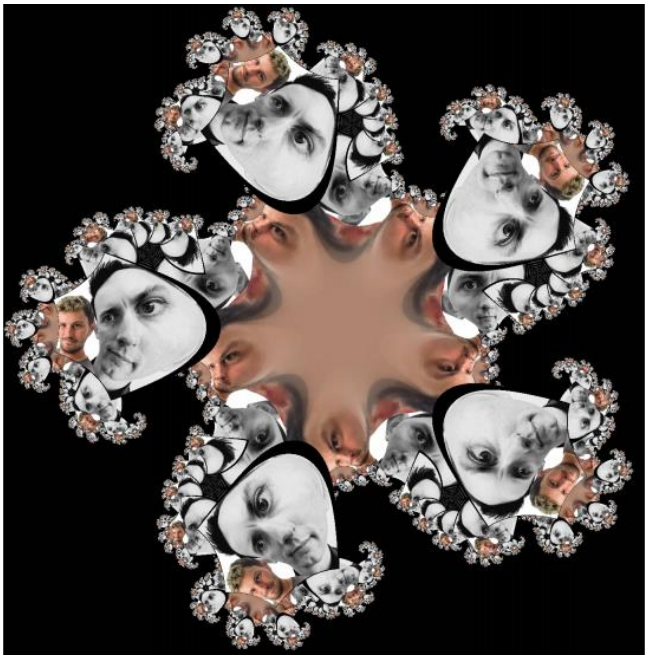
After a hiatus of 5 years, Scott and Frolop posted a paper on March 31, 2014. "The CMB Flexes its BICEPs while Walking the Planck"[9] written shortly after the previously noted claim that evidence for cosmic infla-

[5] https://arxiv.org/pdf/astro-ph/0604011.pdf
[6] https://arxiv.org/abs/astro-ph/0703783
[7] Ockham's Razor is properly *Entia non-sunt multiplicanda praeter necessitatem,* which translates as "Entities must not be multiplied beyond necessity."
[8] https://arxiv.org/pdf/0803.4378v1.pdf
[9] https://arxiv.org/pdf/1403.8145.pdf

tion had been found in B-modes of CMB polarization. The abstract reads "Recent microwave polarization measurements from the BICEP2 experiment may reveal a long-sought signature of inflation. However, these new results appear inconsistent with the best-fit model from the Planck satellite. We suggest a particularly simple idea for reconciling these data-sets, and for explaining a wide range of phenomena on the cosmic microwave sky." The explanation invokes the holographic principle and they propose that the CMB is actually a holographic projection of the surface of a star from another dimension. "The conformal invariance of the Weyl projection operators across the boundary means that tachyonic fields suffer a conjugation, leading to a reciprocal Lyapunov entropy….or something like that."

April 1, 2015, saw "A Farewell to Falsifiability."[10] It notes the problem of fitting proofs of string theory and the multiverse within the generally accepted paradigm articulated by Karl Popper that any valid scientific theory must be falsifiable. Since string theory and multiverse theory simply can't be falsified, Scott and Frolop suggest dispensing with the concept of falsifiability altogether. "Moreover, the idea of falsifiability has always had a basic flaw. This is an obvious problem of the "strange loop" sort [referring to Douglas Hofstader's *Godel, Escher, Bach*], i.e., if we take Proposition A to be 'All correct theories contain falsifiability', but then add Proposition B, which states 'Proposition A is itself a theory', then we realize that we're in trouble." In addition to simply rejecting Falsifiability, the authors suggest rejecting Fidelity (that repeated experiments give the same result) and Frugality (Ockham's Razor). They turn Ockham on his head: "Given the enormous successes of string theory, it becomes clear that the best scientific theories should be as complicated as possible. Mathematical complexity and unfathomability should be criteria to apply when deciding what makes good science. In the same way, the idea of the multiverse is the very opposite of economy, proposing a fecundity of universes instead of just one parsimonious sphere of existence. On top of that, string theory requires many more physical dimensions than are accessible to the human senses, and yet there can be no doubt that these exist. Hence we should also give up on Frugality." Finally, the authors reach the ultimate conclusion: give up on Factuality and reject the notion that a valid theory has to be correct at all. It's a concise send-up of string theory, humorously complementing Lee Smolin's anti-string theory book *The Trouble with Physics (*2006).

String theory is an easy target because of its fantastic claims and famously impenetrable mathematics. David Marsh, Assistant Professor at The Oskar Klein Centre for Cosmoparticle Physics at Stockholm University, looked at his own field and came up with "The Marshland Conjecture",[11] posted on March 29, 2019. Writing with an alter ego named J.E. David Marsh, he claims to have found the boundary between the string theory "landscape" proposed by Bousso and Polchinski in 2000 (those pesky 10^{500} solutions everyone's talking about) and the "swampland" of string theories that don't quite fit into quantum gravity, as proposed by Vafa in 2005. Marsh notes that "It has become really popular to try to delineate the boundary between the landscape and the swampland [he gluttonously lists 149 references to support this], and to speculate about the possible consequences." He proposes a new field, Quantum Gravitational Conjecturology. The Marshland has a fractal structure (see image below) and he can make "loads of pretty pictures that may or may not help us visualize aspects of the string landscape," which is essentially infinite.



The man in the picture is Marsh, of course.

[10] https://arxiv.org/pdf/1504.00108.pdf

[11] https://arxiv.org/pdf/1903.12643.pdf

Marsh (or both Marshes) concludes "Despite the heroic efforts in the attempts to conjecture the deep secrets of quantum gravity, the origin of the neutrino masses, the solution to the cosmological constant problem, and the meaning of life, it has generally been felt that something is still lacking. We have shown that the answer is in the Marshland. In an infinite Universe everything that is possible, no matter how rare, happens an infinite number of times. In an infinite theory space, similar things happen. For example, there are infinite variations of this paper posted to the arXiv on days other than April 1st."

On March 31, 2016, the Frolop and Scott submitted "Pi in the Sky"[12] arguing that whatever process was responsible for the variations in the cosmic microwave background also created the specific pattern of digits of π.[13] This is a nine-page paper with a lot of riffs on statistics and coincidence, some funny footnotes and a delicious conclusion: "If the AAAs [analogous anisotropy anomalies, variances in the CMB that the authors correlate with the digits of π][14] mean that the CMB information is somehow *already* encoded in π, then perhaps in future we can avoid all the fuss and bother of building real CMB experiments, minimizing systematic effects while operating them, painstakingly analyzing the data, and debating the statistical interpretation of the results – and instead simply look more carefully at the digits of π, or in any other random string of digits."

On March 29, 2019, Scott and Frolop[15] published "A new kind of radio transient: ERBs".[16] This paper plays on recent interest in fast radio bursts (FRBs) by proposing "early-riser bursts," astronomical events that "literally happen just before you look for them." Asimov's thiotimoline is specifically cited as a historical analogue. In a cute dig at the prolific Abraham Loeb, chair of astronomy at Harvard, who mused that 'Oumuamua might have been an alien vessel, the authors note that FRBs have been proposed as alien in origin, but since no SETI-like signals were detected coming from 'Oumuamua, "the null results of these experiments are easily explained by the fact that no one thought to look for ERBs that would appear before the search even started."

Michael Lund, originally from Vanderbilt and now at Caltech, has posted a spoof paper each year starting in 2015. These are formatted to look like reprints of articles from a journal called, appropriately, *Acta Prima Aprila*, which lets the cat out of the bag right away. Nevertheless, the papers use valid scientific principles and data to send up their subjects.

In "Beyond the New Horizon: The Future of Pluto"[17] Lund notes that estimates of Pluto's mass have decreased over time (the first estimate was in 1909 by Henry and William Pickering), and, facetiously taking these guesses to be actual data, he proposes that the New Horizons probe (which would pass by Pluto 3 months after the paper was posted) will answer the question of whether Pluto will continue to shrink until it has negative mass. However, if it regains enough mass and fattens up, Lund suggests that the IAU may allow it to be a planet again.

In the 2016 submission "Astrology in the Era of Exoplanets"[18] Lund observes that astrology depends on the position of planets in the constellations of the zodiac. There is no reason to assume that exoplanets in those constellations wouldn't also impact astrological predictions. Using the NASA Exoplanet Archive database, Lund calculates (as of 2016) the number of exoplanets in each of the zodiacal constellations. Looking at the distribution, he reports that "The first immediate result is the paucity of planets in the constellation Libra. Libra is described as representing 'manners and the social graces, things which make cooperation and civil society possible,' [so] the rise in planets in the other signs also would represent a comparative decline in these qualities. It is also worth noting that the number of planets that have been discovered has sharply increased in the last 10 years, and this is also a time frame where political polarization has greatly increased in the United States, and numerous ongoing civil wars and other conflicts have begun in the last several years worldwide." Lund recommends that we search for more exoplanets in Libra, particularly in the globular cluster

[12] https://arxiv.org/pdf/1603.09703.pdf
[13] Which of course have no *specific* pattern.
[14] For example, the string "999999" occurs after the 762nd digit of π.
[15] By now it should not surprise you that "Ali Frolop" is an anagram for "April Fool."
[16] https://arxiv.org/pdf/1903.12412.pdf
[17] https://arxiv.org/pdf/1504.00630.pdf
[18] https://arxiv.org/pdf/1603.09496.pdf

NGC 5897, in order to strengthen Libra's beneficent influence on humanity.

Lund's 2017 contribution, "Detecting the Ultimate Power in the Universe with LSST",[19] asks whether an Earth-like planet could be destroyed with a mega-laser and whether the destruction of the planet (not ours, not yet) could be detected by the Large Synoptic Survey Telescope (now the Vera Rubin Telescope), which is set to see first light in the next few years. It had previously been calculated that it takes $2x10^{32}$ Joules of energy to destroy an Earth-like planet. Lund models the effects of that amount of energy on the Earth. He calculates whether the ignition of the planet's material would outshine its sun, and whether the LSST would be capable of making a detection. Ultimately, he concludes that only if the planet was orbiting a red dwarf star would LSST be able to see the event.

A propos of planetary destruction, a paper posted on March 29, 2019 by four Canadian astronomers entitled "Fast Radio Bursts from Terraformation"[20] proposes that FRB's are in fact evidence of an advanced civilization's nefarious activity. The authors write "We propose that FRBs are signatures of an alien weapon of mass destruction, capable of vaporising an Earth size planet. The required radiant energy at the right frequency range can be produced using astrophysical maser, composed primarily of volatile compounds. We refer to this apparatus as the Volatile Amplification of a Destructive Emission of Radiation (or VADER)." The power source would be a Wolf-Rayet star surrounded by a Dyson sphere, and the paper features appropriate calculations. 'Oumuamua is proposed as a remnant of such a destructive act. The authors ultimately "thank George Lucas, Douglas Adams, Isaac Asimov, Gene Roddenberry, and Ridley Scott for their inspirational works." Douglas Adams, author of *The Hitchhiker's Guide to the Galaxy*, seems to be frequently cited in these spoof papers.

Lund's paper "Independent Discovery of a Sub-Earth in the Habitable Zone Around a Very Close Solar-Mass Star"[21] was posted on April 2, 2018. It describes a finding with the Kilodegree Extremely Little Telescope (KELT), a pair of real instruments (one in Arizona and one in South Africa) consisting of a medium-format telephoto lens of 4.2 cm aperture mounted in front of a 16-megapixel Apogee CCD. Basically, the paper is a riff on the prematurely-announced discovery of an optical transient by Peter Dunsby of the University of Cape Town in 2018 that turned out to be the planet Mars. Dunsby withdrew the announcement 40 minutes after he made it, and later said it was "an honest mistake arising from simply not checking what else was in my camera frame during an automated astrophotography session, and of very little consequence in the scheme of things." He went on to say "The world needs to smile more, so that's something good that has come out of this episode." Lund's paper is, in effect, what Dunsby would have written had he not immediately recognized his error. Let's hope Dunsby maintained his good humor in spite of Lund rubbing his nose in the goof one more time.

In 2019, Lund submitted "Worlds in Migration".[22] It explores the commonly accepted but incompletely understood idea that the planets of the solar system did not form in the locations they currently occupy. To tweak the debate, Lund invokes the Russian pseudoscientist Immanuel Velikovsky (*Worlds in Collision*, 1950) who believed that Venus was ejected from within Jupiter's atmosphere by electromagnetic forces. Assuming Velikovksy to be correct, Lund runs 500 computer simulations applying Newtonian mechanics to the problem. He concludes that "Our results show that it is quite possible that a Jovian-mass planet can lose sufficient mass and energy to migrate inward to the semi-major axis regime of Hot Jupiters while still maintaining sufficient mass to fit our observations." Lund then calculates that there could be between 2 and 40 billion of these planets in the Milky Way. But only if Velikovsky was right in the first place, which he wasn't. But what if we find all those planets?

Lund's papers are "straighter" than Scott & Frolop. Although he cites authors such as Heinlein, Hesiod and Giordano Bruno, Lund don't provide goofy footnotes such as "Perhaps the Universe just hates us; this is known as the Misanthropic Principle" and "Images of the microwave sky are usually called 'CMB maps,' while diagrams showing the digits of π are referred to as 'π charts" and, after quoting Einstein,

[19] https://arxiv.org/abs/1703.10432
[20] https://arxiv.org/pdf/1903.12186.pdf
[21] https://arxiv.org/pdf/1804.00419.pdf
[22] https://arxiv.org/pdf/1903.12437.pdf

"Not really relevant, but we realized we hadn't quoted Einstein yet."

"Conspiratorial Cosmology—the Case Against the Universe"[23] was posted on April 1, 2013 by Jorg P. Rachen of the Max Planck Institute (although for this spoof paper he gives his affiliation as Institut fur Zahlenmystik, Rautavistische Universitat Grafenhausen, Germany, no such place of course) and Ute G. Gahlings, who may not actually be a real person. The paper is allegedly a reprint from the *Journal of Comparative Irrelevance*. The authors allege that the entire universe is actually a conspiracy, created by a mysterious Them, which is revealed by close attention to three numbers: 23, 42 (Adams, again) and π. Twenty-three is the smallest prime number that is the sum of three consecutive primes (5+7+11) and apparently it's a favorite number of conspiracy theorists. Rachen manages to combine these numbers to make up all the other important numbers in cosmology. The paper sends up conspiracy theories as much as it laughs at cosmological numerology.

A paper that's both humorous and completely scientific is "Super-Earths In Need For Extremely Big Rockets"[24] by Michael Hippke, who describes himself as a "gentleman scientist" doing astrophysics research in his free time. He is affiliated with the Sonneberg Observatory in central Germany, and actually has published quite a few serious papers. He begins the article by admitting that "while the subject of this paper is silly, the analysis actually does make sense. This paper, then, is a serious analysis of a ridiculous subject, which is of course the opposite of what is usual in astrophysics." The question is simple: how much rocket propulsion is needed to reach escape velocity on planets with high surface gravity? Hippke uses Newtonian mechanics and the known chemical energy content of rocket fuel to calculate what it would take to reach escape velocity from the surface of Kepler-20b, the largest super-Earth (at least as of 2018), with a mass of 9.7 times the Earth. For a rocket carrying the Apollo payload, the rocket would have to carry 400,000 tons of fuel, and it would weigh just a little less than the Great Pyramid of Cheops. Hippke concludes "For a payload of one ton to escape velocity, the required amount of chemical fuel is $\sim 3.3 \exp(g_0)$. The situation is not that bad for medium-sized Super-Earths, but quickly escalates due to the nasty exponential function (who likes these anyways?). On worlds with a surface gravity of $\geq 10\ g_0$, a sizable fraction of the planet needs to be used up as chemical fuel per launch, limiting the total number of flights. We show in Figure 3 how ridiculous the amount of fuel is for worlds with even higher surface gravity. On such worlds it is cheaper to destroy the planet rather than convert it into fuel."

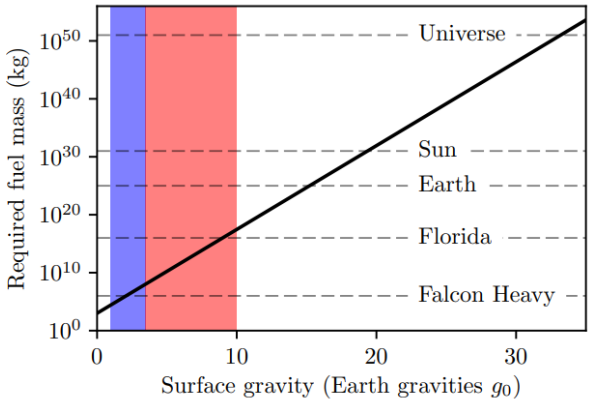


Figure 3. Chemical fuel required for different surface gravities on Super-Earths and more heavy planets (blue and red shades). Very massive planets do not pose the question "Will it go up?" but "How much of Florida go with it?"

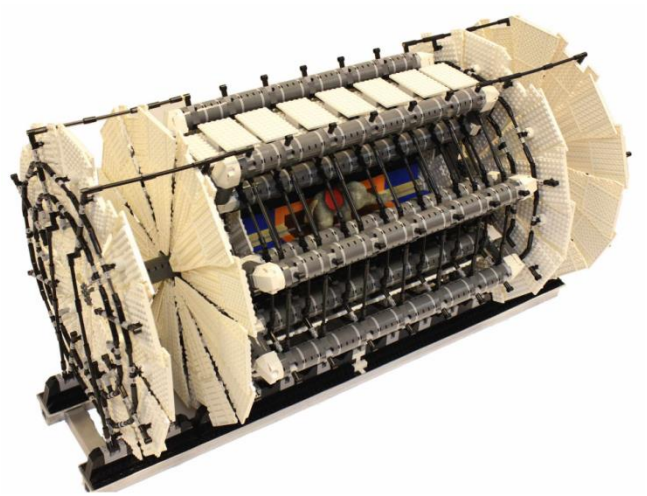
Hippke concludes that super-Earthlings are not likely to be space-faring unless they discover new forms of propulsion.

James Davenport, from the University of Washington, submitted a paper in 2013 "Unidentified Moving Objects in Next Generation Time Domain Surveys"[25] that proposed using the LSST to track UFOs. The arguments are purely scientific, until he discusses the implication of a null search, which leads to some gentle paranoia. Nevertheless, we should accept the challenge: "We are called to rise up by the rooster of knowledge, crowing at the dawn, to awaken and learn as much from our wealth of data as possible."

Particle physics gets a few knocks, among them "A Search for Direct Heffalon Production Using the ATLAS and CMS Experiments at the Large Hadron Collider" by Alan J. Barr and Christopher G. Lester, particle physicists from Oxford and Cambridge, respectively. The heffalon particle (mass 4×10^{30}

[23] https://arxiv.org/pdf/1303.7476.pdf
[24] https://arxiv.org/pdf/1803.11384.pdf
[25] https://arxiv.org/pdf/1303.7433.pdf

GeV/c^2, about 7 tons) is named after the heffalump, an elephant-like character in A.A. Milne's *Winnie the Pooh* stories that only appears in Pooh's dreams. The authors present a simulation of what the heffalon would look like in the ATLAS detector of the Large Hadron Collider. Can you see it?



Although assiduously looked for, the heffalon particle could not be found, and Barr and Lester include this illuminating table:

	Sub-detector:	Inner	Calorimeter	Muon
ATLAS	Data	0†	0	0
	SM	0	0	0
	Non-collision	0	0	0
CMS	Data	0	0	0
	SM	0	0	0
	Non-collision	0	0	0

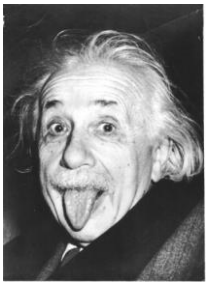
TABLE I: The number of characteristic pathological data-loss events recorded in each layer of the ATLAS and CMS detectors. († One candidate event was recorded, however it was subsequently ascribed to a cable mapping error, and hence was removed from the analysis.)

This is a send-up of the many papers that report negative results.

Finally, in 2019, there appeared a contribution from the Scientists Undertaking Preposterous Etymological Research (SUPER) Collaboration. This paper, "Superfluous Physics"[26] simply "supers" everything in physics to hilarious and telling effect. "Direct detection of superpartners of familiar particles, with nonzero supermass, was a potential discovery at the Superconducting Super Collider, superior to the LHC due to its souped-up center-of-mass and supercenter-of-supermass collision energy, partly due to the stupefying radius of its hoop. When the superexpensive Superconducting Super Collider was superseded in the Congressional budget by the International Superspace Superstation, physicists' superegos were superficially bruised and a superb opportunity to supersize our superintelligence was lost." This is perhaps the least technical, but most poetic, of the spoof papers on arXiv, fundamentally true throughout. Super true, in fact.

One might argue that science is a really serious endeavor and should not be subject to ridicule, either because it demeans the loftiness of the quest or feeds negative views of science in certain ill-informed or simply stupid segments of our society. Plato would agree, at least to the extent that he saw laughter as subversive. "Taken generally," he says, "the ridiculous is a certain kind of evil"[27] because it overrides rational self-control. In the *Republic*, he asked the guardians of the state to avoid laughter,[28] because "a fit of laughter which has been indulged to excess almost always produces a violent reaction." But we can look at it another way, for as Oscar Wilde said, "It is a curious fact that people are never so trivial as when they take themselves seriously." No scientist wants to be trivial. Creating and appreciating humor requires substantial intellect, and it's not surprising that some of our most accomplished astronomers and physicists try to glimpse the nature's plan better by turning their perspectives upside down. Not to mention how good it feels to laugh after a long day at work.

By the time you read this, some spoof papers may have been posted on arXiv to celebrate April Fool's Day 2020. Take a look. Your quarks may get a tickle.



If he can laugh, so can you! ☺

[26] https://arxiv.org/pdf/1903.12201.pdf

[27] *Philebus*

[28] *Republic*, III

Multidimensionality Solved? Larry Faltz

How many dimensions are there in our universe? We're naturally familiar with three-dimensional space, and with time, which could be considered a dimension. Einstein unified time and space into four-dimensional "space-time," defined by the equations of general relativity. But the universe is thought by many to be quite a bit more complex. Quantum mechanics doesn't have a good theoretical fit with general relativity. The possibility of non-locality, as exemplified by entanglement, might suggest additional dimensions. Many unsolved problems of cosmology and particle physics also seem to call for extra dimensions. In 1919 Theodor Kaluza sent Albert Einstein equations that extended general relativity into 5 dimensions. With fifteen differential equations rather than the ten that Einstein needed for general relativity, Kaluza was able to derive Maxwell's equations of electromagnetism. At first, Einstein liked this idea, which was expanded upon in 1926 by Oskar Klein and is now known as the Kaluza-Klein theory. Attention turned in the late 1920's to quantum mechanics and academic interest in general relativity declined until its revival in the 1960's. In the 1970's, string theory was proposed in order to unify general relativity and quantum mechanics into a single theoretical entity. It requires ten, eleven or possibly twenty-six dimensions in order to be mathematically consistent (recall that mathematics has no problems with as many dimensions as you want, including an infinite number of them). Lisa Randall, in her book *Warped Passages*, describes that gravity may be weak compared to the other three forces (electromagnetism, strong and weak) because gravitons split their existence with another space dimension that is forbidden to other fundamental particles. However, an analysis of the neutron star merger GW170817 seems to rule out any additional dimensions, at least for the gravitons (https://arxiv.org/abs/1801.08160).

Anyway, where could more spatial dimensions be located? These dimensions would have to exist at every point in space, just like the x, y and z that we are familiar with, but be "rolled up" at the Planck length, the smallest unit of meaningful physical reality, 1.61×10^{-35} meters. How could we ever detect them? The answer comes from quantum mechanics, which states that physical realities only have probabilities. It ought to be possible for these dimensions on occasion to bloat into macroscopic sizes, perhaps for just an instant, or perhaps even to cause another universe's Big Bang. While this is a problem that has perplexed physicists and cosmologists like Brian Greene and Lee Smolin, it has serendipitously fallen to me to find the evidence that these extra dimensions exist.

You've all had this experience: From time to time, a sock goes missing from the wash. It went into the washing machine, but never came out of the dryer. Searched for diligently, it can't be found. And then, hours or even days later, there it is, lying in plain sight. Where did it go? It seems clear to me that one of the rolled-up Planck-length dimensions has an affinity for socks, and randomly from time to time it enlarges, grabs a sock and shrinks down again. At a later time it re-enlarges, regurgitates the sock, and shrinks back down. What other explanation could there be for those mysterious sock disappearances?

And it's not just socks that seem to have this extra-dimensional interaction. Consider the following rather frequent exchange in my house:

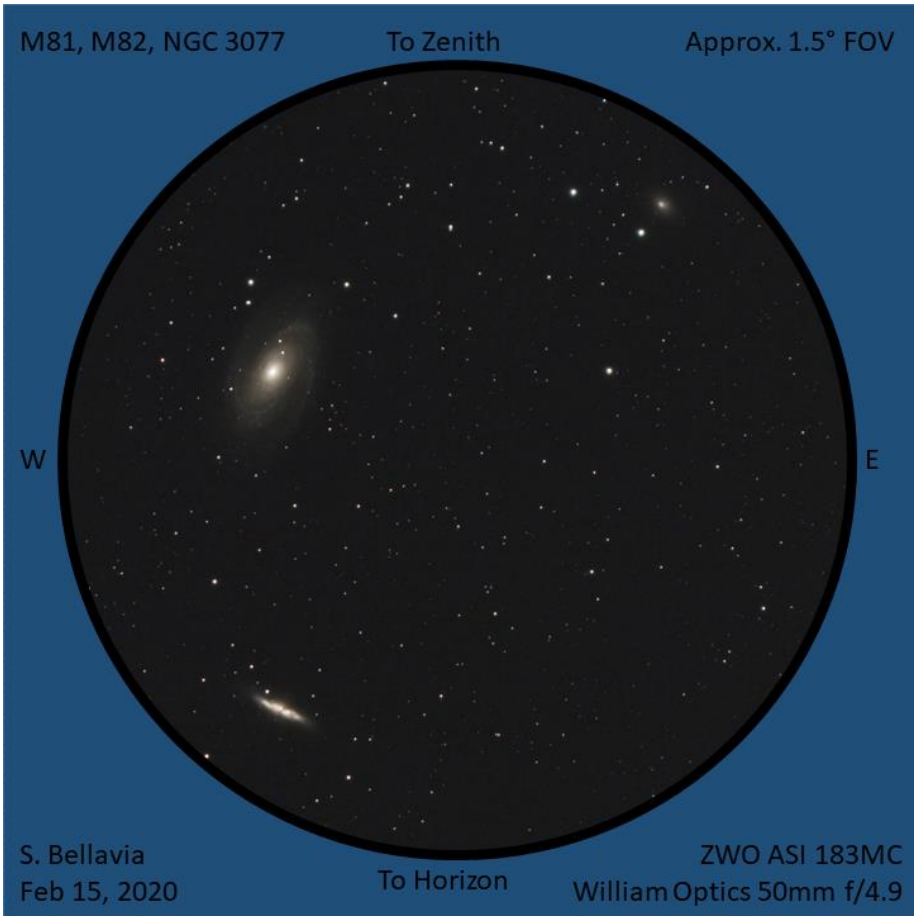
> Larry, loudly, from the living room: "Elyse, did you see my glasses?"
> Elyse, from the kitchen: "They're on the piano."
> Larry: "No they're not. I just looked."
> Elyse: "Look again."
> Larry: "Oh, there they are."
> Elyse (under her breath): "Idiot."

But I'm not an idiot. The glasses were not there! They were obviously hiding in the dimension that has an affinity for glasses, folded temporarily at the Planck length, and reappearing in due time. And so on for the dimension that attract umbrellas, car keys, pens and now, in what may be the creation of a new dimension in the universe within our very lifetimes, cell phones. It's clear that there's a separate dimension for each of these items, since you never put down your glasses and come back to find an umbrella in its place. I fear, however, that if science is ever able to artificially enlarge those extra dimensions, we won't know what to do with all the socks, car keys, umbrellas, glasses, pens and cell phones that will come tumbling out. ☺

Images

Greg Borrelly drove up to Fahnestock State Park on a frigid February evening to snap this wide-field view of Orion.

Canon Rebel T6i on a fixed tripod, 10 exposures of 10 seconds each. Stacked and edited with Adobe Lightroom.

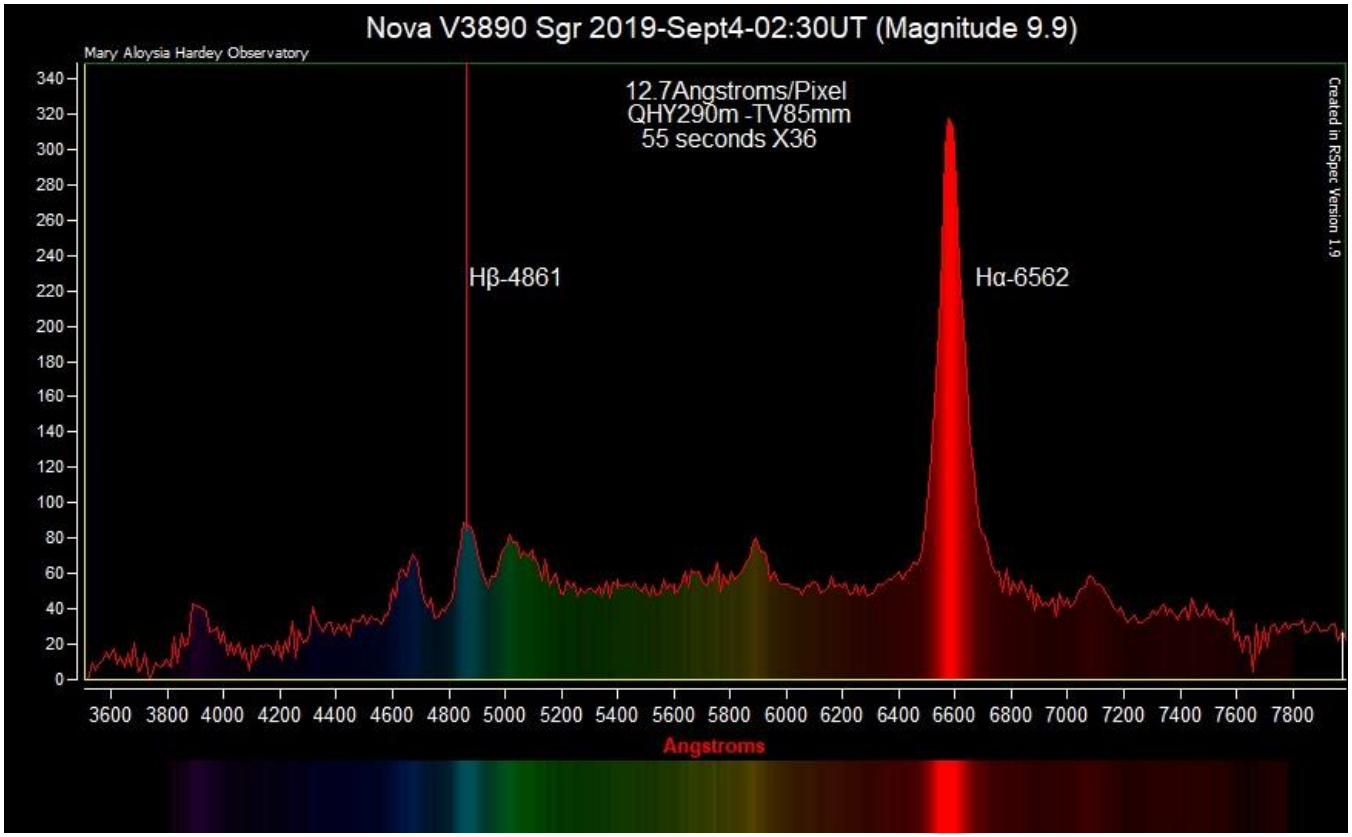


Steve Bellavia sometimes formats his images to reproduce an eyepiece view, a very interesting and revealing way to present the objects. Here are Bode's Nebula, the Cigar Galaxy and their smaller companion NGC 3077, all in the constellation Ursa Major, imaged through the small but fine William Optics RedCat 51 mm f/4.9 APO refractor.

Thor's Helmet by Mauri Rosenthal

Thor's Helmet (NGC 2359 in Canis Major) is some 11,000-15,000 light years off in space. It is an emission nebula energized by a super-hot Wolf Rayet star in the center. Mauri Rosenthal wrote about planning for imaging this distinctive target in the June and July 2018 issues of SkyWAAtch. Thor's Helmet can only be viewed from his yard on February evenings, and even then there's just a two-hour window between the time it rises over his roof and sets in the neighboring treetops. Good weather this year allowed him to add one night of H-alpha imaging and one night of OIII captures to data initially collected in February 2019. The narrowband image shown now has a total integration time of 143 minutes of Hα and 170 minutes of OIII data, collected in 15 second exposures using SharpCap 3.2 and processed with PixInsight. Borg 71FL telescope with a 2X Powermate; QHY 163 camera; iOptron Cubepro mount guided with PHD2. Mauri's yard is in the City of Yonkers, a Bortle "Red Zone", but by adding data over time he hopes to end up with an image that resembles one obtained in much darker sites. Stay tuned!

Spectrum of Nova V3890 — Rick Bria



Novas can occur in binary systems where one of the stars is a hot white dwarf and the other a main sequence star or a giant star. If the stars get close enough in their orbits, hydrogen from the cooler star falls onto the surface of the white dwarf, forming an atmosphere. The atmosphere is heated by the intense energy of the white dwarf until it reaches a critical fusion temperature and undergoes a thermonuclear explosion. Material is ejected into the surrounding interstellar medium. The total amount of matter ejected is only about 0.0001% of the white dwarf's mass, and only about 5% of the ejected gas forms heavier elements by fusion or the r-process. This is different from a Type Ia supernova, in which infalling matter from the companion star causes the white dwarf to reach a mass limit at which point gravitation and radiation are no longer balanced. The entire star collapses and then explodes, forming either a neutron star from the core of the dwarf or completely obliterating the star and releasing large amounts of heavy elements into space.

There are ten novas in the Milky Way that have been found to be recurrent. Classical novas, those that are not recurrent, brighten by up to 12 magnitudes, while recurrent novas brighten by about 8.5 magnitudes. Novas have been found in the Andromeda Galaxy, and a nova in M31 erupts about every 12 months.

Nova V3890 is a binary system in Sagittarius that underwent outbursts in 1962 and 1990. On August 27, 2019, another was observed by Alfredo Pereira of Carnaxide, Portugal. The star brightened from magnitude from 18.4 to 8.1.

Rick Bria used a Televue 85 scope and QHY290m camera at Mary Aloysia Hardey Observator at Sacred Heart University in Greenwich to record the spectrum of Nova V3890. He employed a StarAnalyzer 100 transmision grating and then processed the spectrum with RSpec.

The spectrum shows a large amount of hydgrogen emission at the H-alpha wavelength, typical of novas.

Research Finding of the Month

A population of dust-enshrouded objects orbiting the Galactic black hole

Ciurlo, A, *et. al*., *Nature* 2020; 577: 337-340, published 16 January 2020

For the past 20 years the 10-meter Keck telescopes on Mauna Kea have been studying the black hole at the center of the Milky Way, known as Sgr A* ("Sagittarius A-star"). Andrea Ghez of the UCLA Galactic Center Group has been the lead investigator of the group, which includes other astronomers from UCLA and from cooperating institutions. In addition to tracking the orbits of stars close to Sgr A*, which revealed its mass and position, observations were made of two diffuse objects that appeared to share the same orbit, called G1 and G2. They were thought to be gas and were expected to be sucked into the black hole in 2014. G2 underwent tidal interaction but both G1 and G2 survived and now are thought to be stars surrounded by dust clouds.

In the January 16, 2020 issue of *Nature*, Ann Ciurlo, a post-doc at UCLA, led a team that discovered four new objects surrounding Sgr A*. Data from 13 years of observations with the near-infrared OSIRIS integral field spectrometer on Keck were correlated and the proper motions of the objects, named G3 through G6, were determined.

The authors note that "(1) G3, G4 and G6 have orbits with modest eccentricities (*e*=0.15, 0.3 and 0.3, respectively) whereas G5 has a very eccentric orbit (*e*=0.9); (2) the orbital periods range between 170 years (for G3) and 1,600 years (for G5); (3) all orbits lie on different planes, none of which contains G1 and G2 orbits or the clockwise stellar disk; and (4) the orbits all have periods much longer than the 13 years of observations, which implies a small orbital phase coverage (-9% and -2% in true anomaly for G3 and G5, respectively)."

These G objects are likely to be members of a new class of objects surrounding Sgr A*, distinct from the previously tracked stars that pirouette around the black hole.[29]

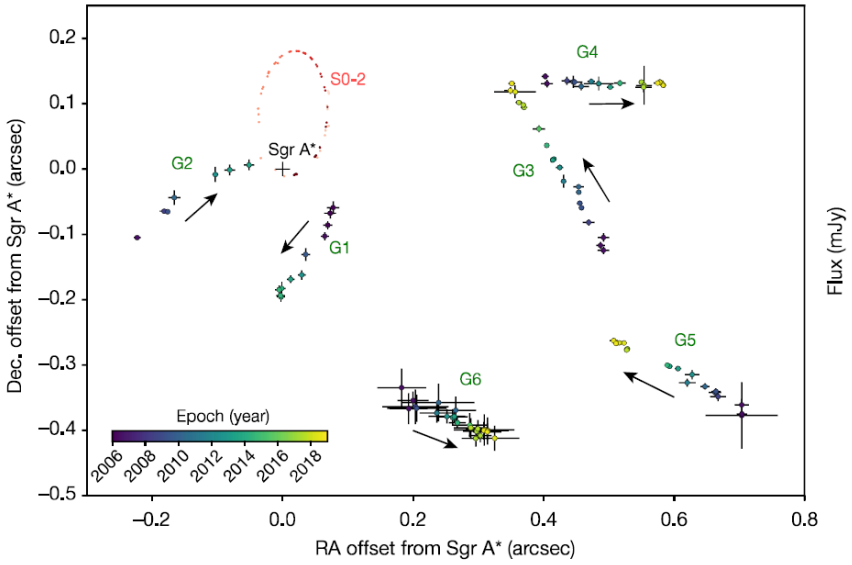


Fig. 2a from Ciulo *et. al*. The proper motion of the G objects and the star S0-2 on the plane of the sky.

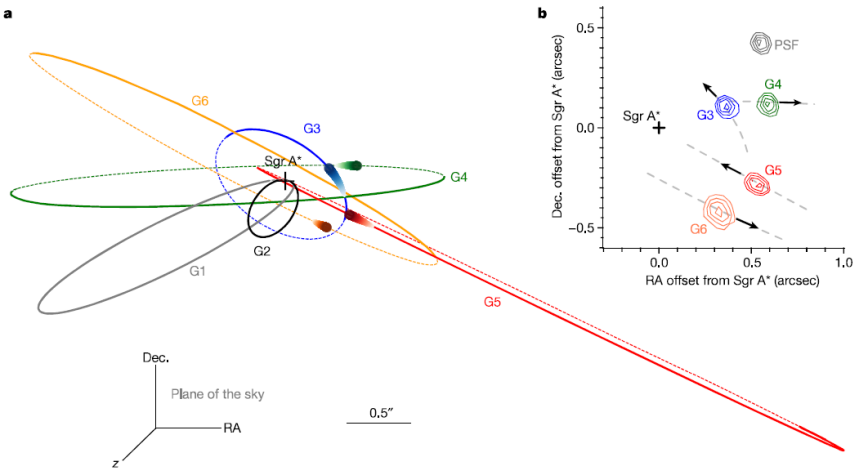


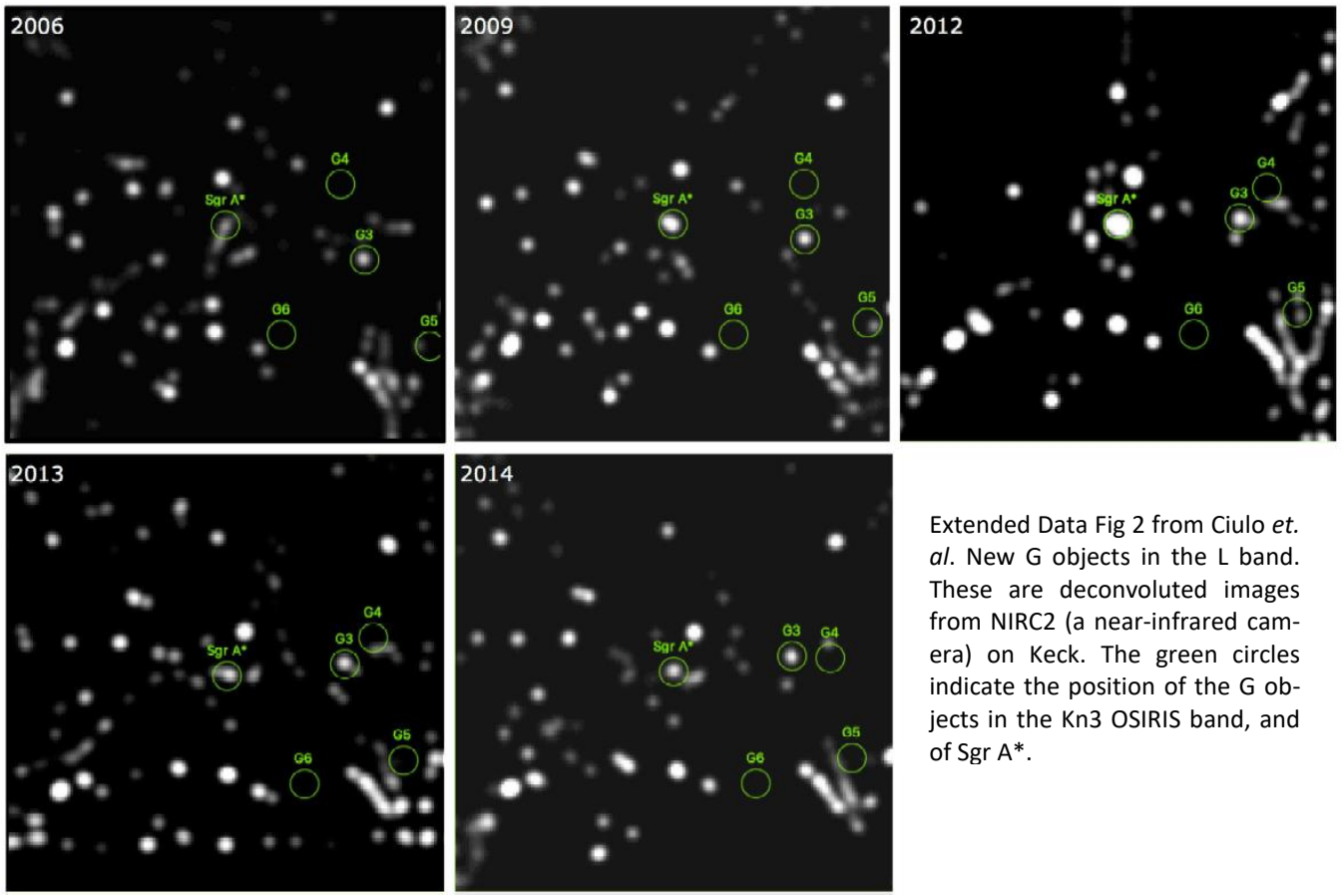
Fig. 3 from Ciulo *et. al*. Orbits of the G Objects in 3 dimensions. The inset shows the countor plots of intensity in the Kn3 band of the objects in 2018.

[29] See the animations at http://www.astro.ucla.edu/~ghezgroup/gc/animations.html

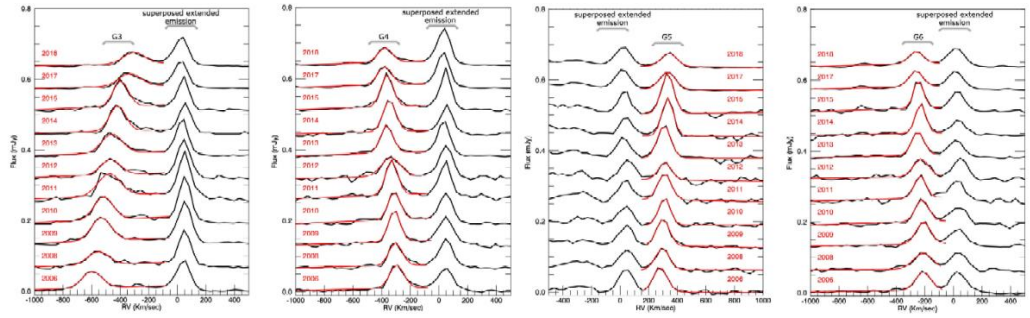
The new G objects seem to be very red, which indicates that they are most likely enshrouded by dust.

One interpretation of these objects is that they are relatively long-lived, distended objects resulting from mergers of binary stars. The authors suggest that they formed during the last major star-formation event at the galactic center, which happened between 4 and 6 billion years ago. The evidence for this claim is three-fold: three-body dynamics that are "necessarily at play in a dense stellar environment," the wide range of orbital eccentricities, and the known star formation history and observed stellar population that exists close to the galactic center.

The authors conclude: "The random distribution of the orbital planes and the broad range of eccentricities of the G objects very closely resemble the characteristics of the orbits of the S stars, which more or less occupy the same volume. In all of the star-centered hypotheses for the G-objects, the stellar object must have a relatively small mass (less than a few solar masses). At present, in the central parsec [of the Milky Way, containing Sgr A*], we can directly detect stars with masses down to 1.5 solar masses. Therefore, the G objects could be offering a unique window on the low-mass, currently undetectable part of the S-star cluster."



Extended Data Fig 2 from Ciulo *et. al*. New G objects in the L band. These are deconvoluted images from NIRC2 (a near-infrared camera) on Keck. The green circles indicate the position of the G objects in the Kn3 OSIRIS band, and of Sgr A*.



Extended Data Fig 3 from Ciulo, *et. al*: The infrared emission from the four G objects over the 13-year observation period (red), showing the Doppler velocity changes compared with the fixed background.

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
Celestron CPC800 8" SCT (alt-az mount)	Like new condition, perfect optics. Starizona Hyperstar-ready secondary, allows inter-changeable conversion to 8" f/2 astrograph if you buy a Hyperstar from Starizona. ADM top rail, Starizona counterweight bottom rail. Telrad finder with dew shield. Several coun-terweights for ADM rail. 2" visual back. SCT-to-T adapter with Canon EOS No eyepieces or diagonal.	$950	WAA ads@westchesterastronomers.org
Meade 395 90 mm achromatic refrac-tor	Long-tube refractor, f/11 (focal length 1000 mm). Straight-through finder. Rings but no dovetail. 1.25" rack-and-pinion focuser. No eyepiece. Excellent condition. A "planet killer." Donated to WAA.	$100	WAA ads@westchesterastronomers.org
Meade LX-70 Equa-torial Mount	Dual Axis Drive and Polar Scope - Brand New. Bought during the closeout sale of these mounts. Owner thought he might like to have a light GEM, but decided to stick with alt-az mounts. Set up once in the garage to be sure it all works, and it does, but never saw first light in the field. Price paid: $365.	$240	Eugene Lewis genelew1@gmail.com
Sky-Watcher 10" f/5 reflector OTA	Brand new in box. Newtonian optical tube, 2" focuser, tube rings. No eyepieces, finder or dovetail. Would make a great Dobsonian or use on a decent sized GEM. These listed at over $500 when new. Donated to WAA.	$250	WAA ads@westchesterastronomers.org
Celestron 6-inch f/5 reflector OTA	Same tube as the Orion 6" StarBlast. 1¼" rack-and-pinion focuser, Celestron 25 mm EP, tube rings, dovetail plate. 6x30 straight through finder. Dark canvas carrying case with com-partments, room for accessories. Excellent condition, unblemished optics. This size OTA is hard to find without a mount. An Orion Star-Blast 6 with 1¼" focuser and table-top Dob-sonian mount lists for $379. Meade's 6" f/5 OTA, admittedly with a 2" Crayford focuser but no case, lists for $339. Donated to WAA.	$175	WAA ads@westchesterastronomers.org

Want to list something for sale in the next issue of the WAA newsletter? Send the description and asking price to ads@westchesterastronomers.org. Member submissions only. Please submit only serious and useful astronomy equipment. WAA reserves the right not to list items we think are not of value to members.

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