Space News Update

— February 24, 2017 —

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In the News

Departments

1. Seven Earth-Sized Planets Orbit Dim Star

The star TRAPPIST-1 is an unassuming, M8 red dwarf star. It lies 39 light-years away in the constellation Aquarius. With a diameter only one-tenth that of our star, the dwarf puts out less than a thousandth as much light as the Sun.

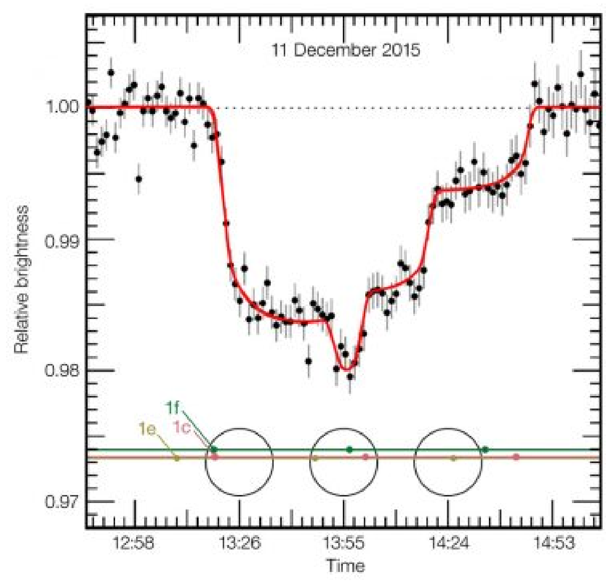
Last year, Michaël Gillon (University of Liège, Belgium) and colleagues announced that a trio of small exoplanets orbits this pipsqueak star (although the third world was of dubious reality). Now, after an intensive follow-up campaign, the team has discovered that there are actually *seven* planets, not three. All are likely rocky. Three lie in TRAPPIST-1's putative habitable zone — the region where, given an Earth-like composition, liquid water could be stable on the surface. But all, with enough hand-waving, might have a chance at liquid water.

From Three to Seven

The astronomers detected the exoplanets using the transit technique, which catches the tiny dip in starlight when a planet passes in front of its host star from our perspective. The discovery roller-coaster began when the team found that what it had thought was a combined transit of planets #2 and #3 was in fact the crossing of *three* planets.

The observers next assailed TRAPPIST-1 with an impressive flurry of ground-based observations. But the big breakthrough came with the Spitzer Space Telescope, which observed the star for 20 days. These data caught 34 clear transits. The team was then able to combine their ground- and space-based observations and slice and dice them to determine that the signals likely came from seven different planets.

Only six of those are firm detections, however. Number 7, or planet h, is iffy in its specs: The team only detected a single transit for it, and astronomers prefer



This plot is a light curve, showing how the brightness of the faint dwarf star TRAPPIST-1 varies as three of its planets pass across its face in a triple transit on December 11, 2015. Data come from the HAWK-I instrument on ESO's Very Large Telescope. All three planets are probably rocky, and e and f are in the star's habitable zone.
ESO / M. Gillon et al.

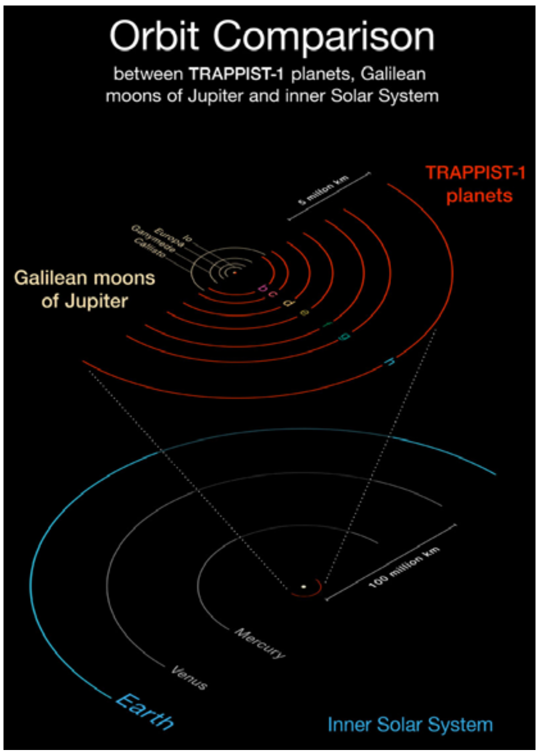
to see three transits before calling something a candidate planet. Expect astronomers to haggle over this one in months ahead.

Mini Solar System?

Let's assume for now that all seven exoplanets are real. All their orbits would easily fit inside Mercury's circuit around the Sun. The years of the inner six range from 1.5 to 12 Earth days long, with the period of outermost

(h)being anywhere between 14 to 35 days. The smallest two worlds are about three-fourths as wide as Earth, the largest 10% wider. The biggest orbit is less than 20% as large as Mercury's.

One of the wonderful things about this system is that the exoplanets' orbits are *resonant* with one another. This means that their orbital periods are rough integer multiples of one another — for example, in the same span of time that the innermost planet whips around the star eight times, the second planet takes five laps, the third three, and the fourth two. This setup gravitationally links the planets together and can lead to tiny shifts in their positions. Based on these shifts, the team could calculate the planets' gravitational influences on one another, and hence their approximate masses and densities. All are consistent with being rocky, the team concludes in the February 23rd *Nature*.



All of the seven exoplanets discovered around TRAPPIST-1 orbit much closer to their star than Mercury does to the Sun, as shown here in this comparison of the TRAPPIST-1 orbits with the Galilean moons of Jupiter and the planets of the inner solar system. But because TRAPPIST-1 is far fainter than the Sun, the worlds are exposed to similar levels of irradiation as Venus, Earth, and Mars.
ESO / O. Furtak

Such resonant orbits arise when worlds migrate from their original locations, Gillon explains. Astronomers think that when lightweight planets form far out in a star's planet-forming gaseous disk, gas drag and such will make them advance inward. During this inbound migration, the worlds catch one another in resonant orbits, such that they can form a kind of "chain of planets," he says. In this case, the migration landed the exoplanets in what the team calls the "temperate zone" — orbits with enough incoming starlight that, with the right conditions, the planets might at least sometimes have liquid surface water. It's a looser definition than that for "habitable zone."

The planets are also all likely tidally locked with their star, meaning they always point the same hemisphere at it, as the Moon does to Earth. So close to the star, the planets could experience huge tidal pulls, stretching and squeezing their interiors and spurring heating and even volcanism, similar to what we see on Jupiter's Galilean moons.

TRAPPIST-1 is quiet for an *M* dwarf — notably less active that Proxima Centauri, which also has a habitable-zone planet (although it's likely a desert world). But unfortunately, astronomers don't know how old the star is. It's also unclear whether the planets' orbits are stable: The researchers haven't determined the seventh planet's orbit, nor do they know if there are other worlds in the system mucking things up.

This kind of star, called an *ultra-cool dwarf*, is very common;

roughly 15% of stars in the nearby galaxy fall into this category, Guillon estimates. Ultra-cool dwarfs live for trillions of years.

Are These Worlds Habitable?

The next goal is to look at the exoplanets' atmospheres. If any of the worlds host life, then it might leave chemical fingerprints in the atmospheres. There's no single compound that's a smoking gun — for example, oxygen can come from life or from water molecules broken up by starlight into their constituent hydrogen and oxygen atoms. But certain combinations of chemical compounds (such as methane, carbon dioxide, and molecular oxygen) would be highly suggestive.

The team is developing a program to use the Hubble Space Telescope to look at the starlight passing through the planets' (maybe extant) atmospheres as they transit, to detect any compounds that might have absorbed light. Follow-up will come with the James Webb Space Telescope, which will be more apt for this project because it focuses on infrared wavelengths, and TRAPPIST-1 puts out most of its light in infrared.

Study coauthor Amaury Triaud (Institute of Astronomy, UK) favors planet f as the most promising for life. With a girth of 1.05 Earths and about 60% Earth's density, TRAPPIST-1f might be rich in water and/or ice. It receives about as much energy from its star as Mars does from the Sun, and with a good atmosphere it could be habitable. (Mars is technically in the Sun's habitable zone.)

During a press conference Triaud painted this picture of what we might see, were we to stand on one of these worlds:

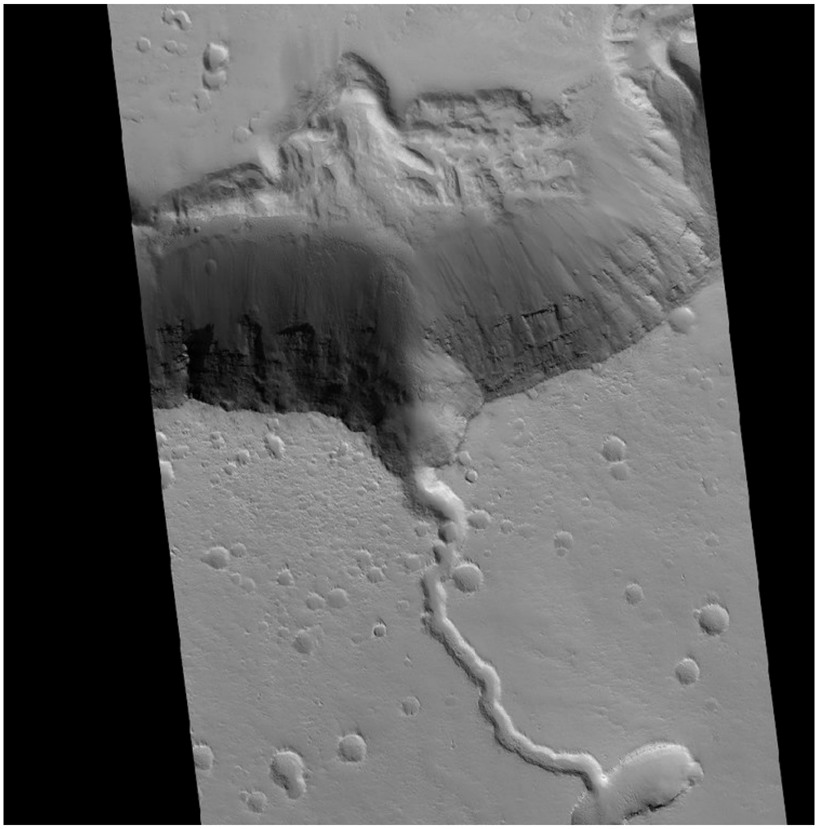
The amount of light reaching your eye would be something like 1/200 as much as you receive from the Sun on Earth — similar to what you experience at the end of sunset. However, it'd still be quite warm, because there's still about the same amount of energy reaching you from the star as Earth receives from the Sun — it's just that most of that comes in infrared, which you can't see but your skin can feel. The star would be a salmon-like color. On TRAPPIST-1f, he estimated, the star would be three times wider in the sky than the Sun is to us.

"The spectacle would be beautiful," he said.

Read more about the result in the European Southern Observatory's press release.

Source: Sky & Telescope Return to Contents

2. More Earth-like than moon-like



Mars' mantle may be more complicated than previously thought. In a new study published today in the Nature-affiliated journal *Scientific Reports*, researchers at LSU document geochemical changes over time in the lava flows of Elysium, a major martian volcanic province.

LSU Geology and Geophysics graduate researcher David Susko led the study with colleagues at LSU including his advisor Suniti Karunatillake, the University of Rahuna in Sri Lanka, the SETI Institute, Georgia Institute of Technology, NASA Ames, and the Institut de Recherche en Astrophysique et Planétologie in France.

They found that the unusual chemistry of lava flows around Elysium is consistent with primary magmatic processes, such as a heterogeneous mantle beneath Mars' surface or the weight of the overlying volcanic mountain causing different layers of the mantle to melt at different temperatures as they rise to the surface over time.

Elysium is a giant volcanic complex on Mars, the second largest behind Olympic Mons. For scale, it rises to twice the height of Earth's Mount Everest, or approximately 16 kilometers. Geologically, however, Elysium is more like Earth's Tibesti Mountains in Chad, the Emi Koussi in particular, than Everest. This comparison is based on images of the region from the Mars Orbiter Camera, or MOC, aboard the Mars Global Surveyor, or MGS, Mission.

Elysium is also unique among martian volcanoes. It's isolated in the northern lowlands of the planet, whereas most other volcanic complexes on Mars cluster in the ancient southern highlands. Elysium also has patches of lava flows that are remarkably young for a planet often considered geologically silent.

"Most of the volcanic features we look at on Mars are in the range of 3-4 billion years old," Susko said. "There are some patches of lava flows on Elysium that we estimate to be 3-4 million years old, so three orders of magnitude younger. In geologic timescales, 3 million years ago is like yesterday."

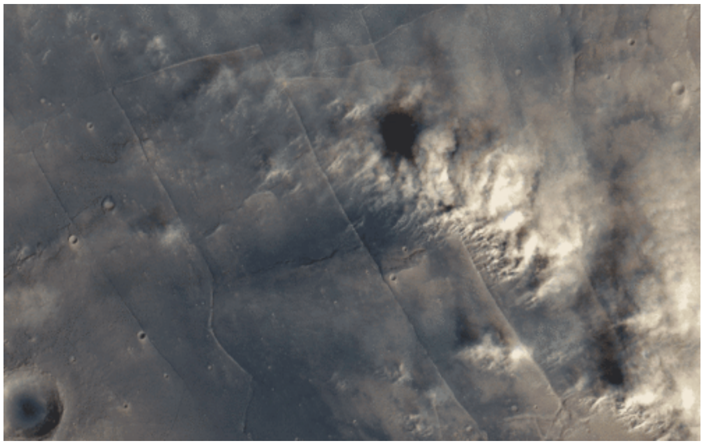
In fact, Elysium's volcanoes hypothetically could still erupt, Susko said, although further research is needed to confirm this. "At least, we can't yet rule out active volcanoes on Mars," Susko said. "Which is very exciting."

Susko's work in particular reveals that the composition of volcanoes on Mars may evolve over their eruptive history. In earlier research led by Karunatillake, assistant professor in LSU's Department of Geology and Geophysics, researchers in LSU's Planetary Science Lab, or PSL, found that particular regions of Elysium and the surrounding shallow subsurface of Mars are geochemically anomalous, strange even relative to other volcanic regions on Mars. They are depleted in the radioactive elements thorium and potassium. Elysium is one of only two igneous provinces on Mars where researchers have found such low levels of these elements so far.

"Because thorium and potassium are radioactive, they are some of the most reliable geochemical signatures that we have on Mars," Susko said. "They act like beacons emitting their own gamma photons. These elements also often couple in volcanic settings on Earth."

In their new paper, Susko and colleagues started to piece together the geologic history of Elysium, an expansive volcanic region on Mars characterized by strange chemistry. They sought to uncover why some of Elysium's lava flows are so geochemically unusual, or why they have such low levels of thorium and potassium. Is it because, as other researchers have suspected, glaciers located in this region long ago altered the surface chemistry through aqueous processes? Or is it because these lava flows arose from different parts of Mars' mantle than other volcanic eruptions on Mars?

Perhaps the mantle has changed over time, meaning that more recent volcanic eruption flows differ chemically from older ones. If so, Susko could use Elysium's geochemical properties to study how Mars' bulk mantle has evolved over geologic time, with important insights for future missions to Mars. Understanding the evolutionary history of Mars' mantle could help researchers gain a better understanding of what kinds of valuable ores and other materials could be found in the crust, as well as whether volcanic hazards could unexpectedly threaten human missions to Mars in the near future. Mars' mantle likely has a very different history than Earth's mantle because the plate tectonics on Earth are absent on Mars as far as researchers know. The history of the bulk interior of the red planet also remains a mystery.



Dust storm over Tempe Terra, Mars.
ESA / DLR / FU Berlin (G. Neukum) / Justin Cowart

Susko and colleagues at LSU analyzed geochemical and surface morphology data from Elysium using instruments on board NASA's Mars Odyssey Orbiter (2001) and Mars Reconnaissance Orbiter (2006). They had to account for the dust that blankets Mars' surface in the aftermath of strong dust storms, to make sure that the shallow subsurface chemistry actually reflected Elysium's igneous material and not the overlying dust.

Through crater counting, the researchers found differences in age between the northwest and the southeast regions of Elysium -- about 850 million years of difference. They also found that the younger southeast regions are geochemically different from the older regions, and that these differences in fact relate to igneous processes, not secondary processes like the interaction of water or ice with the surface of Elysium in the past.

"We determined that while there might have been water in this area in the past, the geochemical properties in the top meter throughout this volcanic province are indicative of igneous processes," Susko said. "We think levels of thorium and potassium here were depleted over time because of volcanic eruptions over billions of years. The radioactive elements were the first to go in the early eruptions. We are seeing changes in the mantle chemistry over time."

"Long-lived volcanic systems with changing magma compositions are common on Earth, but an emerging story on Mars," said James Wray, study co-author and associate professor in the School of Earth and Atmospheric Sciences at Georgia Tech.

Wray led a 2013 study that showed evidence for magma evolution at a different martian volcano, Syrtis Major, in the form of unusual minerals. But such minerals could be originating at the surface of Mars, and are visible only on rare dust-free volcanoes.

"At Elysium we are truly seeing the bulk chemistry change over time, using a technique that could potentially unlock the magmatic history of many more regions across Mars," he said.

Susko speculates that the very weight of Elysium's lava flows, which make up a volcanic province six times higher and almost four times wider than its morphological sister on Earth, Emi Koussi, has caused different depths of Mars' mantle to melt at different temperatures. In different regions of Elysium, lava flows may have come from different parts of the mantle. Seeing chemical differences in different regions of Elysium, Susko and colleagues concluded that Mars' mantle might be heterogeneous, with different compositions in different areas, or that it may be stratified beneath Elysium.

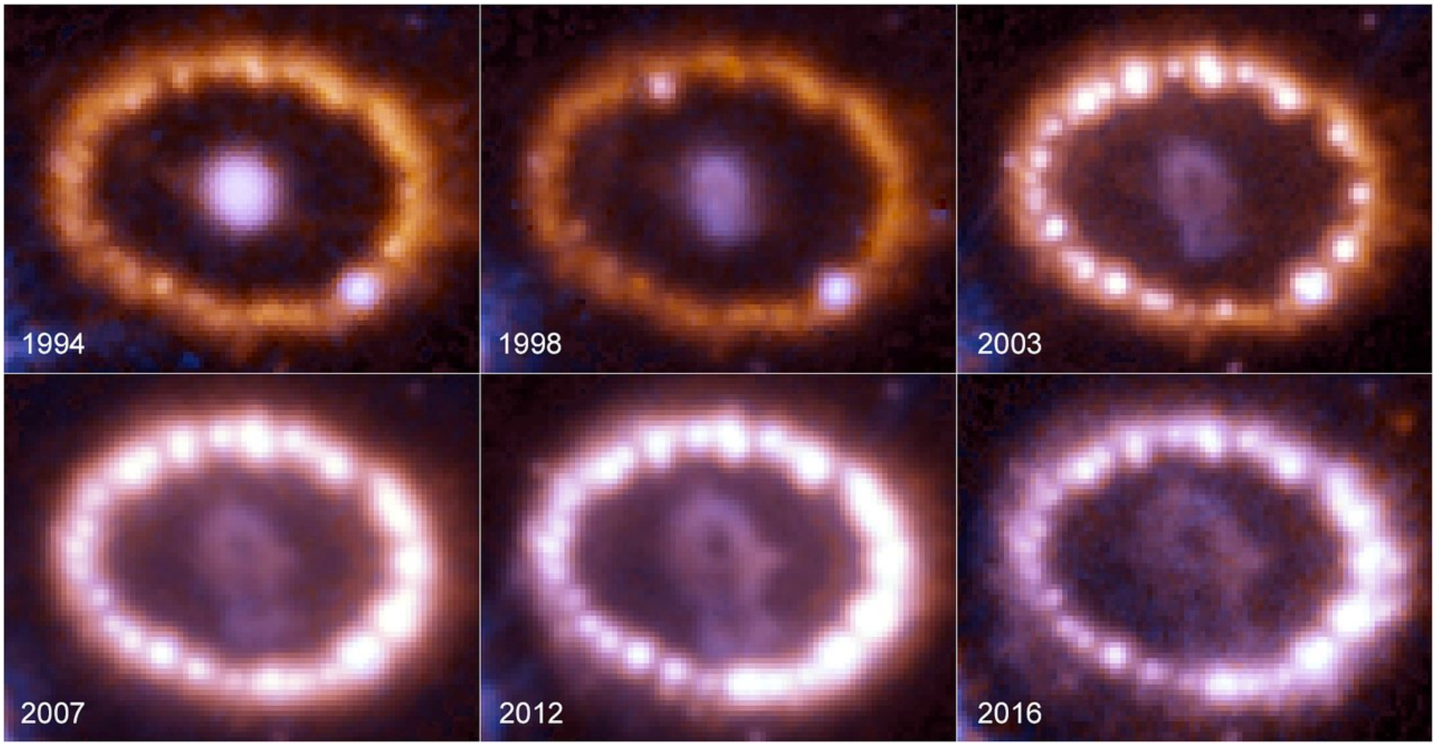
Overall, Susko's findings indicate that Mars is a much more geologically complex body than originally thought, perhaps due to various loading effects on the mantle caused by the weight of giant volcanoes.

"It's more Earth-like than moon-like," Susko said. "The moon is cut and dry. It often lacks the secondary minerals that occur on Earth due to weathering and igneous-water interactions. For decades, that's also how we envisioned Mars, as a lifeless rock, full of craters with a number of long inactive volcanoes. We had a very simple view of the red planet. But the more we look at Mars, the less moon-like it becomes. We're discovering more variety in rock types and geochemical compositions, as seen across the Curiosity Rover's traverse in Gale Crater, and more potential for viable resource utilization and capacity to sustain a human population on Mars. It's much easier to survive on a complex planetary body bearing the mineral products of complex geology than on a simpler body like the moon or asteroids."

Susko plans to continue clarifying the geologic processes that cause the strange chemistry found around Elysium. In the future, he will study these chemical anomalies through computational simulations, to determine if recreating the pressures in Mars' mantle caused by the weight of giant volcanoes could affect mantle melting to yield the type of chemistry observed within Elysium.

Source: EurekAlert Return to Contents

3. Supernova Blast Wave Still Visible after 30 Years



30 years ago today, a supernova explosion was spotted in the southern hemisphere skies. The exploding star was located in the Large Magellanic Cloud — a satellite galaxy of the Milky Way – and Supernova 1987A was the brightest and nearest supernova explosion for modern astronomers to observe. This has provided an amazing opportunity to study the death of a star.

Telescopes around the world and in space have been keeping an eye on this event, and the latest images show the blast wave from the original explosion is still expanding, and it has plowed into a ring expelled by the pre-supernova star. The latest images and data reveal the blast is now moving past the ring.

Got a 3-D printer? You can print out your own version of SN1987A! Find the plans here.

At right is the latest image of this supernova, as seen by the Hubble Space Telescope. You can see it in the center of the image among a backdrop of stars, and the supernova is surrounded by gas clouds.

Hubble launched in 1990, just three years after the supernova was detected, so Hubble has a long history of observations. In addition, the Chandra X-ray telescope – launched in 1999 – has been keeping an eye on the explosion too.

You can view a few animations and images of SN1987A over the years here.

Astronomers estimate that the ring material was ejected about 20,000 years before the actual explosion took place. Then, the initial blast of light from the supernova illuminated the rings. They slowly faded over the first decade after the explosion, until the shock wave of the supernova slammed into the inner ring in 2001, heating the gas to searing temperatures and generating strong X-ray emission.

The observations by Hubble, Chandra and telescopes around the world has shed light on how supernovae can affect the dynamics and chemistry of their surrounding environment, and continue to shape galactic evolution.

See additional images and animations at the Chandra website, ESA's Hubble website, and NASA.

Source: Universe Today Return to Contents

The Night Sky

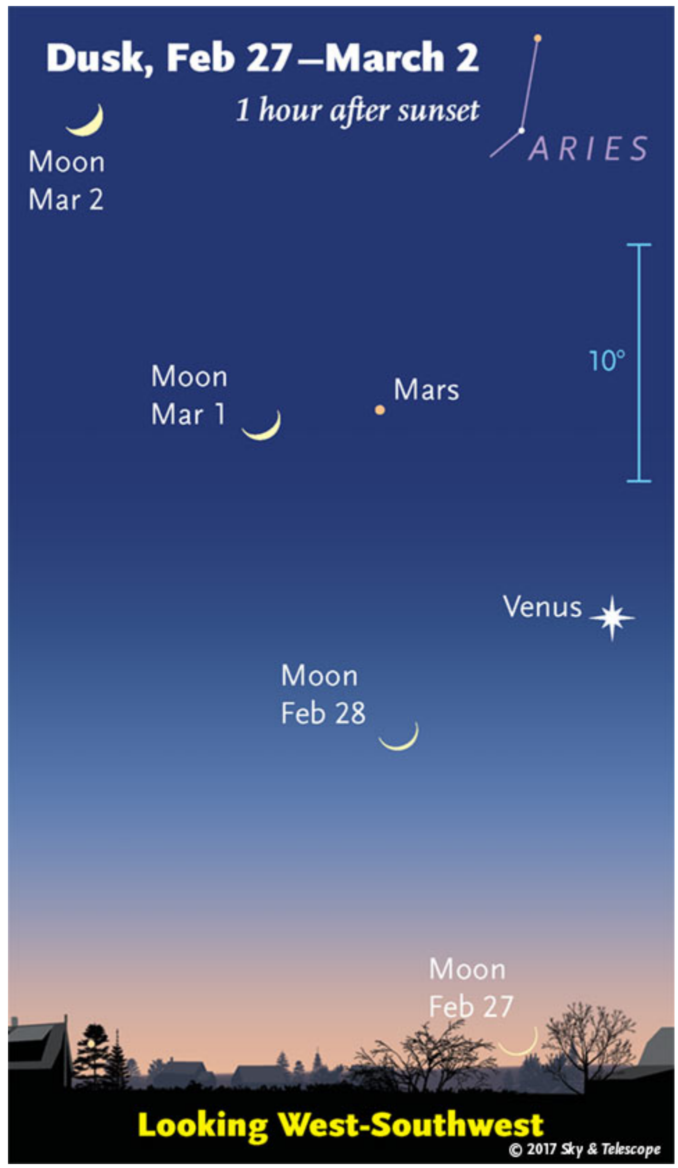
Friday, February 24

• Sirius blazes high in the south on the meridian by about 8 or 9 p.m. now. Using binoculars, examine the spot 4° south of Sirius (directly below it when on the meridian). Four degrees is somewhat less than the width of a typical binocular's field of view. Can you see a dim little patch of speckly gray haze? It shows especially well in the photo here. That's the open star cluster M41, about 2,200 light-years away. Sirius, by comparison, is only 8.6 light-years away.

Saturday, February 25

• Have you ever seen Canopus, the second-brightest star after Sirius? In one of the many interesting coincidences that devoted skywatchers know about, Canopus lies almost due south of Sirius: by 36°. That's far enough south that it never appears above your horizon unless you're below latitude 37° N (southern Virginia, southern Missouri, central California). And there, you'll need a very flat south horizon. Canopus crosses due south just 21 minutes before Sirius does.

When to look? Canopus is precisely due south when Beta Canis Majoris — Mirzam the Announcer, the star about three finger-widths to the right of Sirius — is at *its* highest point due south (roughly 8:00 p.m. now, depending on how far east or west you are in your time zone). Look straight down from Mirzam then.



Sunday, February 26

• Mars and Uranus are in conjunction this evening, 0.6° apart (as seen around the time of nightfall for the Americas). Outdoors, spot Mars to the upper left of Venus blazing in the west. Mars is magnitude 1.3; Uranus is only one-seventieth as bright at magnitude 5.9; you'll need at least binoculars. You'll find Uranus to Mars's left or upper left. They'll both fit in a telescope's low-power field of view. Nothing else that close to Mars is that bright.

• Look east after dark this week for the constellation Leo already climbing up the sky. Its brightest star is Regulus, and the Sickle of Leo extends upper left from there. As the saying goes, Leo announces spring — or at least the *approach* of spring.

• New Moon (exact at 9:58 a.m. EST). An annular eclipse of the Sun crosses parts of southernmost South America, the South Atlantic, and east-central Africa. Much larger areas of South America and Africa get a partial eclipse.

Monday, February 27

• Can you catch the thin crescent Moon far below Venus after sunset, as shown here? The best view may be more like 30 minutes after sunset. The Moon is only about 1½ days old at the time of dusk in the Americas. Binoculars will help find it in a bright sky.

Tuesday, February 28

• Now the thickening Moon in twilight forms a roughly fist-sized triangle with bright Venus and fainter Mars, as shown here.

Source: [Sky & Telescope]

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Mon Feb 27, 5:47 AM	< 1 min	12°	10° above SSE	12° above SE

Sighting information for other cities can be found at NASA's Satellite Sighting Information

NASA-TV Highlights

(all times Eastern Daylight Time)

9 a.m., Saturday, February 25 - Replay of NASA Science News Briefing on Discovery Beyond Our Solar System (all channels)

1 p.m., Saturday, February 25 - NASM'S "STEM in 30" – Taking the Fast Lane to Orbit: The Technology of Rockets and Racecars (NTV-1 (Public))

4 p.m., Saturday, February 25 - Replay of NASA Science News Briefing on Discovery Beyond Our Solar System (all channels)

6 p.m., Saturday, February 25 - NASM'S "STEM in 30" – Taking the Fast Lane to Orbit: The Technology of Rockets and Racecars (NTV-1 (Public))

8 a.m., Sunday, February 26 - Replay of NASA Science News Briefing on Discovery Beyond Our Solar System (all channels)

2 p.m., Sunday, February 26 - Replay of "STEM in 30" – Taking the Fast Lane to Orbit: The Technology of Rockets and Racecars (NTV-1 (Public))

9 p.m., Sunday, February 26 - Replay of "STEM in 30" – Taking the Fast Lane to Orbit: The Technology of Rockets and Racecars (NTV-1 (Public))

Watch NASA TV on the Net by going to the NASA website.

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Space Calendar

- Feb 24 - Comet 73P-AV/Schwassmann-Wachmann Closest Approach To Earth (1.404 AU)
- Feb 24 - Comet C/2014 R3 (PANSTARRS) Closest Approach To Earth (6.829 AU)
- Feb 24 - Apollo Asteroid 2017 CP1 Near-Earth Flyby (0.009 AU)
- Feb 24 - Aten Asteroid 5604 (1992 FE) Near-Earth Flyby (0.034 AU)
- Feb 24 - Amor Asteroid 2017 BN3 Near-Earth Flyby (0.065 AU)
- Feb 24 - Asteroid 3808 Tempel Closest Approach To Earth (0.979 AU)
- Feb 24 - Asteroid 9941 Iguanodon Closest Approach To Earth (1.078 AU)
- Feb 24 - Asteroid 4134 Schutz Closest Approach To Earth (1.187 AU)
- Feb 24 - Asteroid 11365 NASA Closest Approach To Earth (1.260 AU)
- Feb 24 - Asteroid 6600 Qwerty Closest Approach To Earth (1.488 AU)
- Feb 24 - Asteroid 26733 Nanavistor Closest Approach To Earth (1.997 AU)
- Feb 24 - Asteroid 3623 Chaplin Closest Approach To Earth (2.095 AU)
- Feb 24 - Asteroid 17744 Jodiefoster Closest Approach To Earth (2.143 AU)
- Feb 24 - Asteroid 881 Athene Closest Approach To Earth (2.164 AU)
- Feb 24 - Asteroid 7749 Jackschmitt Closest Approach To Earth (2.750 AU)
- Feb 24 - Brian Schmidt's 50th Birthday (1967)
- Feb 25 - Comet 73P-AS/Schwassmann-Wachmann At Opposition (1.224 AU)
- Feb 25 - Comet 73P/Schwassmann-Wachmann Closest Approach To Earth (1.380 AU)
- Feb 25 - Comet 73P-C/Schwassmann-Wachmann Closest Approach To Earth (1.381 AU)
- Feb 25 - Comet 315P/LONEOS Closest Approach To Earth (1.597 AU)
- Feb 25 - Comet 234P/LINEAR At Opposition (1.905 AU)
- Feb 25 - Comet 202P/Scotti At Opposition (1.964 AU)
- Feb 25 - Comet 331P/Gibbs Closest Approach To Earth (2.089 AU)
- Feb 25 - Comet 37P/Forbes At Opposition (2.689 AU)
- Feb 25 - NEW [Feb 18] Apollo Asteroid 2017 CQ32 Near-Earth Flyby (0.068 AU)
- Feb 25 - Apollo Asteroid 2005 QB5 Near-Earth Flyby (0.093 AU)
- Feb 25 - Atira Asteroid 418265 (2008 EA32) Closest Approach To Earth (1.418 AU)
- Feb 25 - Asteroid 5860 Deankootz Closest Approach To Earth (1.594 AU)
- Feb 25 - Asteroid 3229 Solnhofen Closest Approach To Earth (1.677 AU)
- Feb 25 - Asteroid 24102 Jacquecassini Closest Approach To Earth (1.691 AU)
- Feb 25 - Asteroid 12760 Maxwell Closest Approach To Earth (2.363 AU)
- Feb 25 - Asteroid 21564 Widmanstatten Closest Approach To Earth (2.501 AU)
- Feb 25 - 10th Annivesary (2007), Rosetta, Mars Flyby
- Feb 26 - HOT [Feb 21] Annular Solar Eclipse (Visbile from Chile, Argentia, West Africa)
- Feb 26 - Comet 73P-N/Schwassmann-Wachmann Perihelion (0.974 AU)
- Feb 26 - Comet 73P-G/Schwassmann-Wachmann Closest Approach To Earth (1.373 AU)
- Feb 26 - Comet 18D/Perrine-Mrkos Perihelion (1.646 AU)
- Feb 26 - Comet 331P/Gibbs At Opposition (2.090 AU)
- Feb 26 - Apollo Asteroid 2016 FU12 Near-Earth Flyby (0.042 AU)
- Feb 26 - Apollo Asteroid 2014 HP4 Near-Earth Flyby (0.073 AU)
- Feb 26 - Asteroid 70715 Allancheuvront Closest Approach To Earth (1.317 AU)
- Feb 26 - Asteroid 6442 Salzburg Closest Approach To Earth (1.745 AU)
- Feb 26 - Asteroid 2097 Galle Closest Approach To Earth (2.928 AU)
- Feb 27 - Mars Passes 0.6 Degrees From Uranus
- Feb 27 - Comet 73P-B/Schwassmann-Wachmann Closest Approach To Earth (1.348 AU)
- Feb 27 - Comet 73P-K/Schwassmann-Wachmann Closest Approach To Earth (1.350 AU)
- Feb 27 - Comet P/2016 A2 (Christensen) At Opposition (3.482 AU)
- Feb 27 - Comet 17P/Holmes At Opposition (4.110 AU)
- Feb 27 - Apollo Asteroid 2017 BM123 Near-Earth Flyby (0.032 AU)
- Feb 27 - Asteroid 79896 Billhaley Closest Approach To Earth (1.399 AU)

- Feb 27 - Asteroid 3780 Maury Closest Approach To Earth (2.057 AU)
- Feb 27 - Plutino 90482 Orcus At Opposition (47.127 AU)
- Feb 27 - Online Seminar: In-Situ Resource Utilization (ISRU) - Atmospheric Capture on Mars
- Feb 27 - 75th Anniversary (1942), James Hey's Discovery of Radio Emissions from the Sun
- Feb 27 - Bernard Lyot's 120th Birthday (1897)
- Feb 27 - Pyotr Nesterov's 130th Birthday (1887)
- Feb 28 - Tiankong-1 Kaituozhe-2A Launch
- Feb 28 - Cassini, Distant Flyby of Janus & Pandora
- Feb 28 - Comet 73P-BQ/Schwassmann-Wachmann Perihelion (0.974 AU)
- Feb 28 - NEW [Feb 23] Comet 73P-BC/Schwassmann-Wachmann At Opposition (1.111 AU)
- Feb 28 - Comet 73P-H/Schwassmann-Wachmann Closest Approach To Earth (1.338 AU)
- Feb 28 - Comet P/2010 H2 (Vales) Closest Approach To Earth (2.267 AU)
- Feb 28 - Comet 147P/Kushida-Muramatsu At Opposition (2.330 AU)
- Feb 28 - Comet 306P/LINEAR At Opposition (3.969 AU)
- Feb 28 - Comet C/2014 R3 (PANSTARRS) At Opposition (6.831 AU)
- Feb 28 - NEW [Feb 24] Apollo Asteroid 2017 DJ16 Near-Earth Flyby (0.010 AU)
- Feb 28 - Asteroid 7672 Hawking Closest Approach To Earth (1.314 AU)
- Feb 28 - Asteroid 17942 Whiterabbit Closest Approach To Earth (1.350 AU)
- Feb 28 - Asteroid 17656 Hayabusa Closest Approach To Earth (2.016 AU)
- Feb 28 - 10th Anniversary (2007), New Horizons, Jupiter Flyby
- Feb 28 - 160th Anniversary (1857), Parnallee Meteorite Fall in India
- Feb 28 - Jost Burgi's 465th Birthday (1552)

Source: JPL Space Calendar

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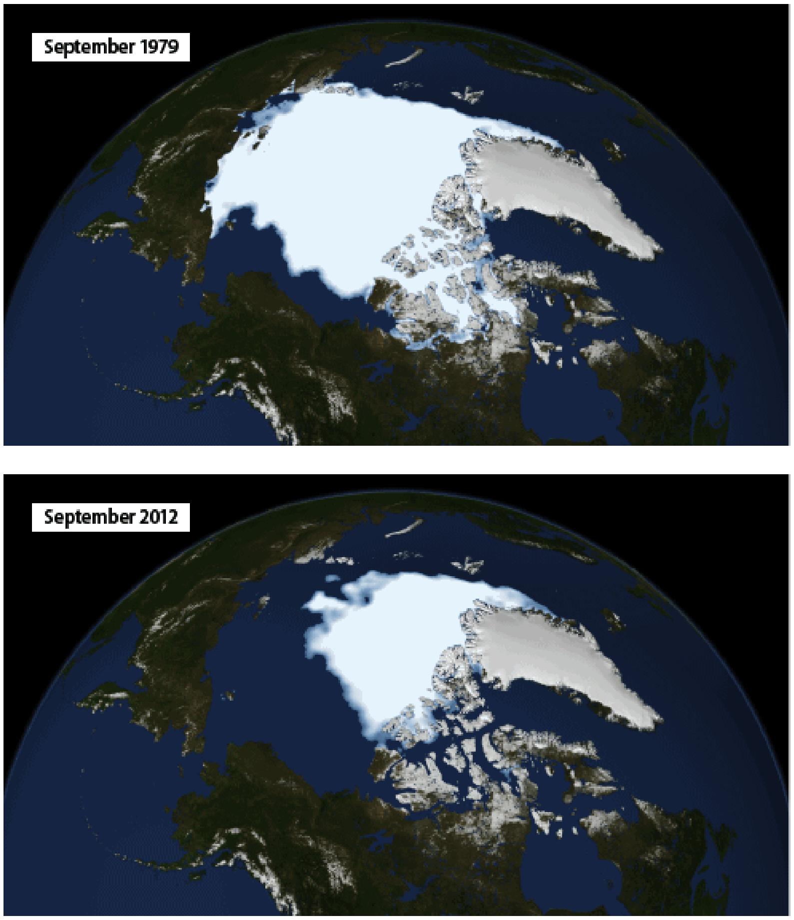
Food for Thought

It Might Be Possible to Refreeze the Icecaps to Slow Global Warming

Dwindling Arctic Sea Ice



One of the most worrisome aspects of Climate Change is the role played by positive feedback mechanisms. In addition to global temperatures rising because of increased carbon dioxide and greenhouse gas emissions, there is the added push created by deforestation, ocean acidification, and (most notably) the disappearance of the Arctic Polar Ice Cap.

However, according to a new study by a team of researchers from the School of Earth and Space Exploration at Arizona State University, it might be possible to refreeze parts of the Arctic ice sheet. Through a geoengineering technique that would rely on wind-powered pumps, they believe one of the largest positive feedback mechanisms on the planet can be neutralized.

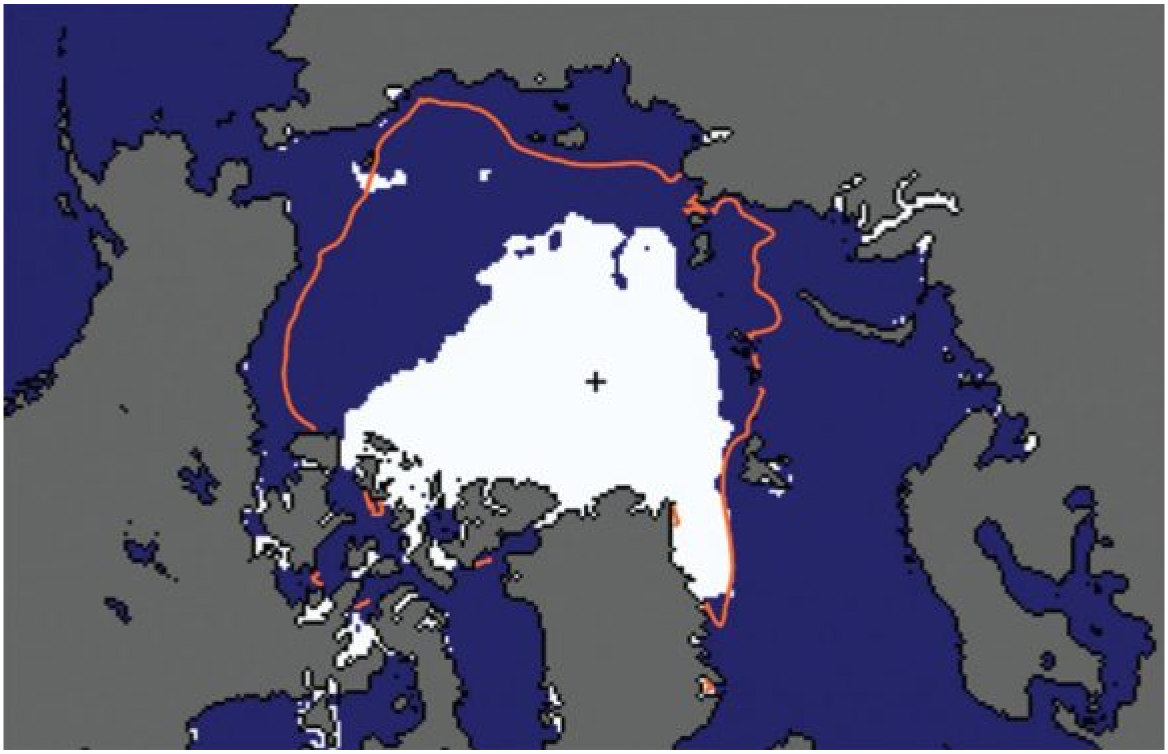
Their study, titled "Arctic Ice Management", appeared recently in Earth's Future, an online journal published by the American Geophysical Union. As they indicate, the current rate at which Arctic ice is disappearing it quite disconcerting. Moreover, humanity is not likely to be able to combat rising global temperatures in the coming decades without the presence of the polar ice cap.

Of particular concern is the rate at which polar ice has been disappearing, which has been quite pronounced in recent decades. The rate of loss has been estimated at being between 3.5% and 4.1% per decade, with in an overall decrease of at least 15% since 1979 (when satellite measurements began). To make things worse, the rate at which ice is being lost is accelerating.

From a baseline of about 3% per decade between 1978-1999, the rate of loss since the 2000s has climbed considerably – to the point that the extent of sea-ice in 2016 was the second lowest ever recorded. As they state in their Introduction (and with the support of numerous sources), the problem is only likely to get worse between now and the mid-21st century:

"Global average temperatures have been observed to rise linearly with cumulative CO_2emissions and are predicted to continue to do so, resulting in temperature increases of perhaps 3°C or more by the end of the century. The Arctic region will continue to warm more rapidly than the global mean. Year-round reductions in Arctic sea ice are projected in virtually all scenarios, and a nearly ice-free ($<10^6$ km^2 sea-ice extent for five consecutive years) Arctic Ocean is considered "likely" by 2050 in a business-as-usual scenario."

One of the reasons the Arctic is warming faster than the rest of the planet has to do with strong ice-albedo feedback. Basically, fresh snow ice reflects up to 90% of sunlight while sea ice reflects sunlight with albedo up to 0.7, whereas open water (which has an albedo of close to 0.06) absorbs most sunlight. Ergo, as more ice melts, the more sunlight is absorbed, driving temperatures in the Arctic up further.



Arctic sea-ice extent (area covered at least 15% by sea ice) in September 2007 (white area). The red curve denotes the 1981–2010 average. Credit: National Snow and Ice Data Center

To address this concern, the research team – led by Steven J. Desch, a professor from the School of Earth and Space Exploration – considered how the melting is connected to seasonal fluctuations. Essentially, the Arctic sea ice is getting thinner over time because new ice (aka. "first-year ice"), which is created with every passing winter, is typically just 1 meter (3.28 ft) thick.

Ice that survives the summer in the Arctic is capable of growing and becoming "multiyear ice", with a typical thickness of 2 to 4 meters (6.56 to 13.12 ft). But thanks to the current trend, where summers are getting progressively warmer, "first-year ice" has been succumbing to summer melts and fracturing before it can grow. Whereas multiyear ice comprised 50 to 60% of all ice in the Arctic Ocean in the 1980s, by 2010, it made up just 15%.

With this in mind, Desch and his colleagues considered a possible solution that would ensure that "first-year ice" would have a better chance of surviving the summer. By placing machines that would use wind power to generate pumps, they estimate that water could be brought to the surface over the course of an Arctic winter, when it would have the best chance of freezing.

Based on calculations of wind speed in the Arctic, they calculate that a wind turbine with 6-meter diameter blades would generate sufficient electricity so that a single pump could raise water to a height of 7 meters, and at a rate of 27 metric tons (29.76 US tons) per hour. The net effect of this would be thicker sheets of ice in the entire affected area, which would have a better chance of surviving the summer.

Over time, the negative feedback created by more ice would cause less sunlight to be absorbed by the Arctic ocean, thus leading to more cooling and more ice accumulation. This, they claim, could be done on a relatively modest budget of $500 billion per year for the entire Arctic, or $50 billion per year for 10% of the Arctic.

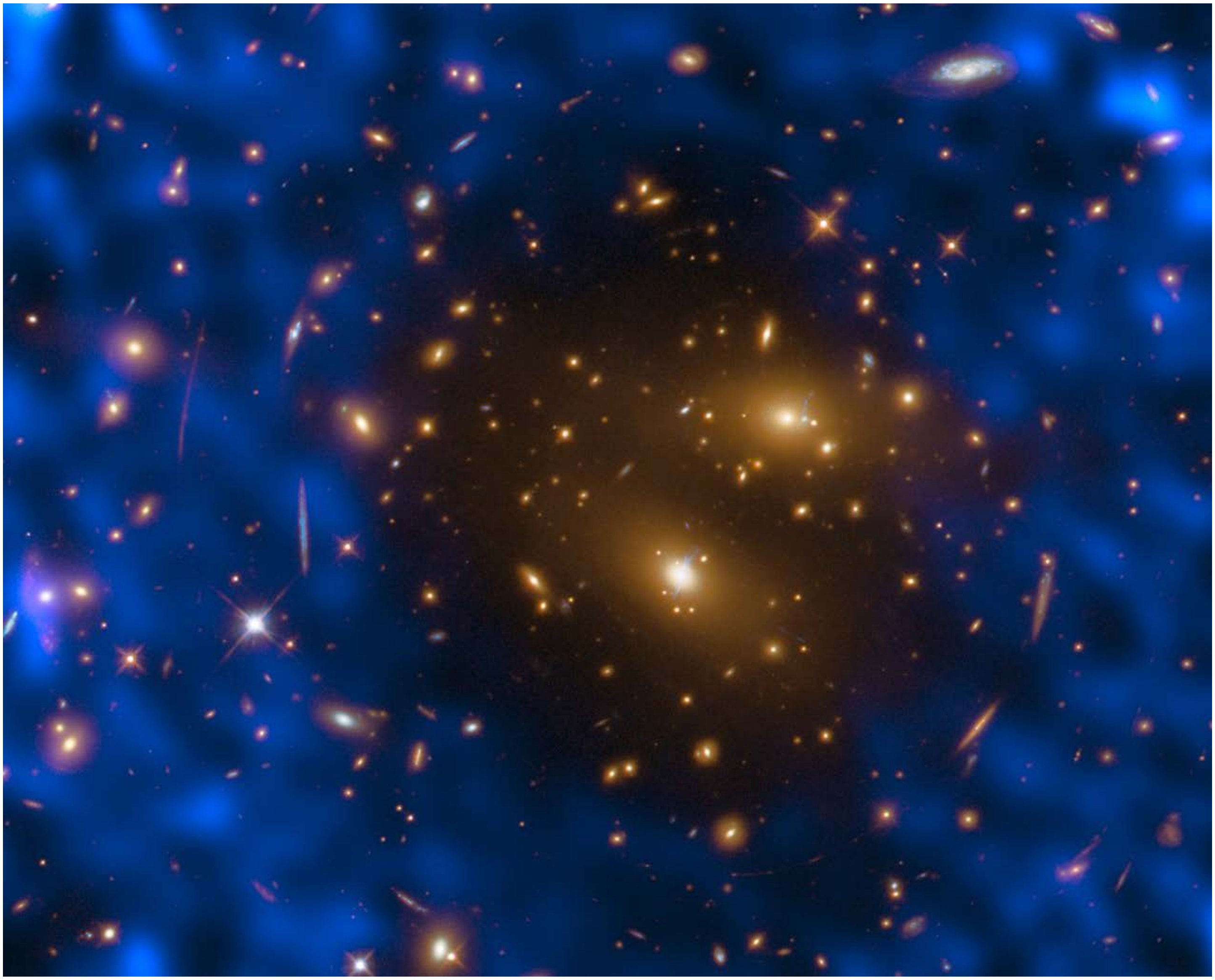
While this may sounds like a huge figure, they are quick to point out that the cast covering the entire Arctic with ice-creating pumps – which could save trillions in GDP and countless lives- is equivalent to just 0.64% of current world gross domestic product (GDP) of $78 trillion. For a country like the United States, it represents just 13% of the current federal budget ($3.8 trillion).

And while there are several aspects of this proposal that still need to be worked out (which Desch and his team fully acknowledge), the concept does appear to be theoretically sound. Not only does it take into account the way seasonal change and Climate Change are linked in the Arctic, it acknowledges how humanity is not likely to be be able to address Climate Change without resorting to geoengineering techniques.

And since Arctic ice is one of the most important things when it comes to regulating global temperatures, it makes perfect sense to start here.

Source: Universe Today Return to Contents

Space Image of the Week



Hubble Cooperates on Galaxy Cluster and Cosmic Background

The events surrounding the Big Bang were so cataclysmic that they left an indelible imprint on the fabric of the cosmos. We can detect these scars today by observing the oldest light in the universe. As it was created nearly 14 billion years ago, this light — which exists now as weak microwave radiation and is thus named the cosmic microwave background (CMB) — permeates the entire cosmos, filling it with detectable photons.

The CMB can be used to probe the cosmos via something known as the Sunyaev-Zel'dovich (SZ) effect, which was first observed over 30 years ago. We detect the CMB here on Earth when its constituent microwave photons travel to us through space. On their journey to us, they can pass through galaxy clusters that contain high-energy electrons. These electrons give the photons a tiny boost of energy. Detecting these boosted photons through our telescopes is challenging but important — they can help astronomers to understand some of the fundamental properties of the universe, such as the location and distribution of dense galaxy clusters.

The NASA/ESA (European Space Agency) Hubble Space Telescope observed one of most massive known galaxy clusters, RX J1347.5–1145, seen in this Picture of the Week, as part of the Cluster Lensing And

Supernova survey with Hubble (CLASH). This observation of the cluster, 5 billion light-years from Earth, helped the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile to study the cosmic microwave background using the thermal Sunyaev-Zel'dovich effect. The observations made with ALMA are visible as the blue-purple hues.

Image credit: ESA/Hubble & NASA, T. Kitayama (Toho University, Japan)/ESA/Hubble & NASA

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