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Space Image of the Week
1.0 Giant Sunspot Keeps Firing Off Huge Solar Flares

The largest sunspot observed on the sun in more than 20 years has been firing off powerful solar flares for the past week, and it's still producing strong solar storms. Today, the huge sunspot erupted with a large solar flare, peaking at around 10:47 a.m. EDT (1447 GMT). The flare caused a strong radio blackout on Earth, according to the National Weather Service's Space Weather Prediction Center. This solar flare is the fourth X-flare (the most powerful kind of solar storms) in as many days. On Sunday (Oct. 26), the giant sunspot unleashed a solar flare, which peaked at about 6:56 a.m. EDT (1056 GMT). The sunspot, called Active Region 12192 (also known as AR 2192), also shot out another powerful flare on Saturday. Today and Sunday's flares measured in at X2, while Saturday's is classified as an X1 flare. Sunday's X2-class flare was "the third X-class flare in 48 hours, erupting from the largest active region seen on the sun in 24 years," NASA spokesperson Karen Fox wrote in an update yesterday (Oct. 26). AR 2129 also shot out an X3.1-class flare on Friday (Oct. 24). The active region on the sun is also responsible for spewing out two big M-class flares — moderate solar storms — since Friday. The most recent M-class flare (categorized as an M6.7) peaked this morning at about 6:09 a.m. EDT (1009 GMT). "An X2 is twice as intense as an X1, an X3 is three times as intense, etc.," Fox added. Sometimes, big solar flares are followed by huge bursts of hot plasma known as coronal mass ejections (CMEs) shooting out from the sun. Large CMEs can cause geomagnetic storms or supercharge Earth's auroras, but according to astronomer Tony Phillips at Spaceweather.com, the earlier storms released by the current sunspot have not had any major accompanying CMEs. If aimed at Earth, X-class flares can be dangerous for astronauts and spacecraft orbiting the planet. The radiation can disrupt radio and communication signals, but solar flares cannot injure people on Earth's surface, according to Fox. The planet's atmosphere acts as a protective barrier from the harmful radiation. On Thursday (Oct. 23), skywatchers around North America got a chance to see the sunspot during an amazing partial solar eclipse. Many observers attempting to photograph the cosmic event were able to see the sunspot on the sun's face. WARNING: Never look directly at the sun through binoculars, a telescope or with your unaided eyes. Serious eye damage and even blindness can result. Scientists and experienced skywatchers use special filters and glasses to safely observe the sun. Do not use regular sunglasses to look at the sun. Although Friday's X3.1 flare is a powerful solar storm, it isn't the most powerful flare of the year. In February 2014, the sun discharged an X4.9-class tempest.

Source: Space.com
The comet passed by Mars at approximately 87,000 miles (about one-third of the distance between Earth and the Moon) at 2:28 p.m. EDT October 19, 2014. At that time, the comet and Mars were approximately 149 million miles from Earth. The comet image shown here is a composite of Hubble exposures taken between October 18, 8:06 a.m. EDT to October 19, 11:17 p.m. EDT. Hubble took a separate photograph of Mars at 10:37 p.m. EDT on October 18. The Mars and comet images have been added together to create a single picture to illustrate the angular separation, or distance, between the comet and Mars at closest approach. The separation is approximately 1.5 arc minutes, or one-twentieth of the angular diameter of the full Moon. The background star field in this composite image is synthesized from ground-based telescope data provided by the Palomar Digital Sky Survey, which has been reprocessed to approximate Hubble’s resolution. The solid icy comet nucleus is too small to be resolved in the Hubble picture. The comet’s bright coma, a diffuse cloud of dust enshrouding the nucleus, and a dusty tail, are clearly visible. This is a composite image because a single exposure of the stellar background, comet Siding Spring, and Mars would be problematic. Mars is actually 10,000 times brighter than the comet, and so could not be properly exposed to show detail in the Red Planet. The comet and Mars were also moving with respect to each other and so could not be imaged simultaneously in one exposure without one of the objects being motion blurred. Hubble had to be programmed to track on the comet and Mars separately in two different observations. The images were taken with Hubble’s Wide Field Camera 3.
3. Einstein's Gravity Waves Could Be Found with New Method

Gravitational waves, invisible ripples in the fabric of space and time, might be detected by looking for the brightening of stars, researchers say. These mysterious ripples were first proposed by Albert Einstein as part of his theory of general relativity. The waves' size depends on the mass of the objects creating them. "Gravitational waves are emitted by accelerating masses," said lead study author Barry McKernan, an astrophysicist at the American Museum of Natural History in New York. Really big waves are emitted by really big masses, such as systems containing black holes merging with each other.

Scientists have still not made direct observations of gravitational waves, although researchers continue to endeavor to detect them using experiments involving lasers on the ground and in space. The waves interact very weakly with matter, which partly explains why seeing these ripples in spacetime is difficult.

Now, McKernan and his colleagues suggest that gravitational waves could have more of an effect on matter than previously thought, with their influence potentially brightening stars. "It's neat that nearly 100 years after Einstein proposed his theory of general relativity, there are still interesting surprises it can turn up," McKernan told Space.com. "We're brought up as astronomers thinking the interaction between matter and gravitational waves is very weak, essentially negligible, and that turns out not to be true." The researchers suggest that stars that vibrate at the same frequency as gravitational waves passing through them can absorb a large amount of energy from the ripples. "You can imagine gravitational waves as sounds from a piano, and stars as a vibrating violin string held near that piano," McKernan said. "If the frequency of the sounds matches the frequency of the violin string, the string can resonate with the sound." If a star gets pumped up with large amounts of energy from gravitational waves in this way, "the star can puff up and look brighter than it normally would," McKernan said. One challenge is determining whether any star brightening astronomers detect is from gravitational waves or some other factor. The researchers suggest the key to spotting the effects of gravitational waves involves looking at large groups of stars. "When a population of stars is near a system of merging black holes and is getting pounded by gravitational waves, we think that the more massive stars will light up first," McKernan said. "It's like playing keys on a piano and starting with low pitches." As the black holes get closer together, the frequency of the gravitational waves they generate will increase, "and we'd expect to see brightening of smaller stars," he added. "If we see a population of stars where the smaller stars are brightening after the bigger stars in a collective way, that might be a sign of gravitational waves." This research also suggests a different way to indirectly detect gravitational waves. If scientists develop working gravitational wave detectors on Earth or in space, when a star passes in front of powerful sources of gravitational waves such as merging black holes, the detector may see a drop in the intensity of those waves. This will happen if the eclipsing star is vibrating at the right frequency. "You usually think of stars as being eclipsed by something, not the other way around," McKernan said in a statement. McKernan and his colleagues Saavik Ford, Bence Kocsis and Zoltan Haiman detailed their findings online Sept. 22 in the journal Monthly Notices of the Royal Astronomical Society: Letters.

Space.com
**The Night Sky**

**Tuesday, October 28**
This evening Mars is below the Moon at nightfall, as shown above.

**Wednesday, October 29**
The Ghost of Summer Suns. Halloween is approaching, and this means that Arcturus, the star sparkling low in the west-northwest in twilight, is taking on its role as "the Ghost of Summer Suns." What does this mean? For several days centered on October 29th every year, Arcturus occupies a special place above your local landscape. It closely marks the spot there where the Sun stood at the same time, by the clock, during warm June and July — in broad daylight, of course. So, in the last days of October each year, you can think of Arcturus as the chilly Halloween ghost of the departed summer Sun.

**Thursday, October 30**
First-quarter Moon (exactly so at 3:33 p.m. EDT). As twilight fades out, use binoculars to look a bit right of the Moon for Alpha Capricorni, a wide, lovely yellow double star. Look to Alpha's lower left for Beta Capricorni, a less wide, more difficult double for binoculars; the secondary star in this case is fainter. Mercury is now in its best dawn display for 2014. (The blue 10° scale is about the width of your fist held at arm's length.)

**Friday, October 31**
For Halloween after dark, the quarter Moon shines in the south. It's between Altair, very high to its upper right, and Fomalhaut, down to its lower left.

**Saturday, November 1**
This evening at nightfall, look for Fomalhaut almost straight below the Moon. Vega is the brightest star very high in the west-northwest. Capella, similarly bright, is rising in the northeast. Daylight-saving time ends at 2 a.m. Sunday morning for most of North America. Clocks fall back an hour.

Source: [Sky & Telescope](https://www.skyandtelescope.com/)

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ISS Sighting Opportunities
For Denver:

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Sighting information for other cities can be found at NASA’s [Satellite Sighting Information](#).

**NASA-TV Highlights** *(all times Eastern Daylight Time) edited list see web site*

12:25 p.m., Tuesday, October 28 - ISS Expedition 41 In-Flight interviews for NASA Flight Engineer Barry Wilmore with Nashville, TN Public Radio and WCYB-TV, Tri-Cities TV *(all channels)*

2:45 a.m., Wednesday, October 29 - Coverage of the Launch of the ISS Progress 57 Cargo Ship to the ISS from the Baikonur Cosmodrome, Kazakhstan *(all channels)*

8:30 a.m., Wednesday, October 29 - Coverage of the Docking of the ISS Progress 57 Cargo Ship to the ISS *(all channels)*

12:20 p.m., Wednesday, October 29 - ISS Expedition 41 In-Flight Interviews with Nashville Public Radio and WCBY-TV, Tri-Cities TV for Tennessee and Virginia with NASA Flight Engineer Barry Wilmore *(all channels)*

8:05 a.m., Thursday, October 30 - ISS Expedition 41 In-Flight Event for ESA with German Media and Flight Engineer Alexander Gerst (with English translation) *(NTV-1 (Public), NTV-2 (Education))*

10 a.m., Friday, October 31 - Video File of the ISS Expedition 42/43 Qualification Training Simulation Runs at Star City, Russia *(all channels)*

Watch NASA TV online by going to the [NASA website](#).
Space Calendar

- **Oct 28** - [Comet P/2014 M4 (PANSTARRS)] Closest Approach To Earth (1.422 AU)
- **Oct 28** - [Comet P/2009 WX51 (Catalina)] Closest Approach To Earth (2.021 AU)
- **Oct 28** - [Asteroid 2355 Nei Mongol] Occults HIP 109375 (6.4 Magnitude Star)
- **Oct 28** - [Oct 21] [Asteroid 2014 UG5 Near-Earth Flyby] (0.074 AU)
- **Oct 28** - [Asteroid 20469 Dudleymoore] Closest Approach To Earth (1.553 AU)
- **Oct 28** - [Progress M-25 Soyuz U Launch] (International Space Station 57P)
- **Oct 29** - [GPS 2F-8 Atlas 5 Launch]
- **Oct 29** - [Asteroid 78453 Bullock] Closest Approach To Earth (2.172 AU)
- **Oct 29** - [Centaur Object 54598 Bienor] At Opposition (15.116 AU)
- **Oct 30** - [Oct 26] [Meridian 7 Soyuz 2-1A-Fregat Launch]
- **Oct 30** - [Comet P/2013 N3 (PANSTARRS)] At Opposition (2.596 AU)
- **Oct 31** - [Oct 25] [Chang'e 5 T1 Return To Earth] (China Moon Orbiter), Successful
- **Oct 31** - [Comet 183P/Korlevic-Juric] At Opposition (3.832 AU)
- **Oct 31** - [Comet C/2012 K1 (PANSTARRS)] Closest Approach To Earth (0.953 AU)
- **Oct 31** - [Asteroid 188534 Mauna Kea] Closest Approach To Earth (1.603 AU)
- **Oct 31** - [Plutino 144897 (2004 UX10)] At Opposition (38.145 AU)
- **Nov 01** - [Mercury] At Its Greatest Western [Elongation] (19 Degrees)
- **Nov 01** - [Asteroid 2014 TL17 Near-Earth Flyby] (0.050 AU)
- **Nov 01** - [Oct 26] [Asteroid 2014 US34 Near-Earth Flyby] (0.055 AU)
- **Nov 01** - [Asteroid 878 Mildred] Closest Approach To Earth (0.932 AU)
- **Nov 01** - [Asteroid 12002 Sues] Closest Approach To Earth (1.975 AU)
- **Nov 01** - [Asteroid 1241 Dyson] Closest Approach To Earth (2.447 AU)

Source: [JPL Space Calendar]
Food for Thought

Google Exec Hands Silicon Valley the Stratospheric Jump Record

Just a little over two years since Felix Baumgartner broke USAF Colonel Joseph Kittinger’s stratospheric jump record, Alan Eustace from Google has independently smashed the high altitude skydiving record again. This brings home to Silicon Valley a record that might stand for a while. Eustace took a minimalist approach to the jump. His setup involved a helium filled balloon and just him hanging from the balloon in a spacesuit. Pure and simple, this permitted his system to reach 135,890 feet above the Earth, over 41 kilometers altitude, exceeding Baumgartner’s record by 7000 feet. The simple design of his balloon launch might remind one of a bungey jump. This one maxed out at 822 mph and created a sonic boom. How can anyone break his record now? Can someone rise to a higher altitude? What is next for the Google high flyers? Will Baumgartner take this as a challenge to retake the record?

The 57 year old Alan Eustace is a Senior Vice President at Google in its Knowledge department. He is a licensed pilot but not known for undertaking extraordinary feats of daredevil. Eustace grew up in Florida and recalls that his childhood was filled with trips to Cape Canaveral for NASA launches. Not a spur of the moment undertaking, Eustace had dreamt of accomplishing this feat and record for some time. This is the third successful balloon skydiving jump from over 100,000 feet. All three have been accomplished from Roswell, New Mexico. Kittinger’s was in 1961, Baumgartner in 2012, and now Eustace in 2014. A fourth jump was undertaken in 1966 from a height of 123,000 feet but ended in failure and the death of the skydiver, Nicholas Piantanida. The trip to the upper heights of the atmosphere took two hours. All this time he was forced to hang very still to avoid over-heating. His spacesuit had minimal ability to cool his body during the ascent. While the stratosphere reaches temperatures of 100 below zero, the atmosphere is exceedingly thin and body heat has no way to radiate away. Without a capsule like Baumgartner and Kittinger before him, he relied solely on a spacesuit custom built by Paragon Space Development Corporation, a designer of life support devices. The simple design exceeded Baumgartner by over 7000 feet, nearly a mile and a half more. Eustace’s new record is approaching the maximum that has ever been achieved by any lighter than air craft, manned or unmanned. The unmanned high altitude record for balloon flight was set in 2002 from Sanriku Balloon Center at Ofunato City, Iwate in Japan. This record stands at 173,900 feet. So there is plenty of room for record breaking but it will require pushing the limits of technology. In this day and age, there are many keen to push technological limits. Google execs are no strangers to high flying. At Moffett Field in Mountain View, California, just a couple of miles from executive headquarters of Google, a small group of executives utilize a German made Dornier Alpha jet. Collaboratively with NASA Ames, the jet is flown by the execs and other experienced pilots to study the upper atmosphere and quite possibly to take in the views around the San Francisco bay area. They are often seen making touch n’ go’s at Moffett to maintain skills and certification. Google, the corporation, clearly showed its interest in space applications with the purchase of Skybox, a microsatellite builder, in June of this year for a reported $500 million.
Space Image of the Week

Sunspots and Solar Eclipse

Image Credit & Copyright: Michael Bolte (UCSC)

Explanation: A New Moon joined giant sunspot group AR 2192 to dim the bright solar disk during Thursday's much anticipated partial solar eclipse. Visible from much of North America, the Moon's broad silhouette is captured in this extreme telephoto snapshot near eclipse maximum from Santa Cruz, California. About the size of Jupiter, the remarkable AR 2192 itself darkens a noticeable fraction of the Sun, near center and below the curved lunar limb. As the sunspot group slowly rotates across the Sun and out of view in the coming days its activity is difficult to forecast. But the timing of solar eclipses is easier to predict. The next will be a total solar eclipse on March 20, 2015.

Source: NASA APOD