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1. NASA's Great Observatories Begin Deepest-Ever Probe of the Universe

NASA's Hubble, Spitzer and Chandra space telescopes are teaming up to look deeper into the universe than ever before. With a boost from natural "zoom lenses" found in space, they should be able to uncover galaxies that are as much as 100 times fainter than what these three great observatories typically can see.

In an ambitious collaborative program called The Frontier Fields, astronomers will make observations during the next three years peering at six massive clusters of galaxies, exploiting a natural phenomenon known as gravitational lensing, to learn not only what is inside the clusters but also what is beyond them. The clusters are among the most massive assemblages of matter known, and their gravitational fields can be used to brighten and magnify more distant galaxies so they can be observed.

"The Frontier Fields program is exactly what NASA's Great Observatories were designed to do; working together to unravel the mysteries of the universe" said John Grunsfeld, associate administrator for NASA's Science Mission Directorate in Washington. "Each observatory collects images using different wavelengths of light with the result that we get a much deeper understanding of the underlying physics of these celestial objects."

The first object they will view is Abell 2744, commonly known as Pandora's Cluster. The giant galaxy cluster appears to be the result of a simultaneous pile-up of at least four separate, smaller galaxy clusters that took place over a span of 350 million years.

Astronomers anticipate these observations will reveal populations of galaxies that existed when the universe was only a few hundred million years old, but have not been seen before.

"The idea is to use nature's natural telescopes in combination with the great observatories to look much deeper than before and find the most distant and faint galaxies we can possibly see," said Jennifer Lotz, a principal investigator with the Space Telescope Science Institute in Baltimore, Md.

Data from the Hubble and Spitzer space telescopes will be combined to measure the galaxies' distances and masses more accurately than either observatory could measure alone, demonstrating their synergy for such studies.

"We want to understand when and how the first stars and galaxies formed in the universe, and each great observatory gives us a different piece of the puzzle," said Peter Capak, the Spitzer principal investigator for the Frontier Fields program at NASA's Spitzer Science Center at the California Institute of Technology, Pasadena. "Hubble tells you which galaxies to look at and how many stars are being born in those systems. Spitzer tells you how old the galaxy is and how many stars have formed."

The Chandra X-ray Observatory also will peer deep into the star fields. It will image the clusters at X-ray wavelengths to help determine their mass and measure their gravitational lensing power, and identify background galaxies hosting supermassive black holes.
High-resolution Hubble data from Frontier Fields will be used to trace the distribution of dark matter within the six massive foreground clusters. Accounting for the bulk of the universe's mass, dark matter is the underlying invisible scaffolding attached to galaxies.

Hubble and Spitzer have studied other deep fields with great success. The Frontier Fields researchers anticipate a challenge because the distortion and magnification caused by the gravitational lensing phenomenon will make it difficult for them to understand the true properties of the background galaxies.

For images and more information about The Frontier Fields, visit: http://hubblesite.org/news/2013/44.

Source: JPL
2. Titan’s North Pole is Loaded With Lakes

A combination of exceptionally clear weather, the steady approach of northern summer, and a poleward orbital path has given Cassini — and Cassini scientists — unprecedented views of countless lakes scattered across Titan’s north polar region. In the near-infrared mosaic above they can be seen as dark splotches and speckles scattered around the moon’s north pole. Previously observed mainly via radar, these are the best visual and infrared wavelength images ever obtained of Titan’s northern “land o’ lakes!”

Titan is currently the only other world besides Earth known to have stable bodies of liquid on its surface, but unlike Earth, Titan’s lakes aren’t filled with water — instead they’re full of liquid methane and ethane, organic compounds which are gases on Earth but liquids in Titan’s incredibly chilly -290º F (-180º C) environment.

While one large lake and a few smaller ones have been previously identified at Titan’s south pole, curiously almost all of Titan’s lakes appear near the moon’s north pole.

For an idea of scale, the large lake at the upper right above (and the largest lake on Titan) Kraken Mare is comparative in size to the Caspian Sea and Lake Superior combined. Kraken Mare is so large that sunlight was seen reflecting off its surface in 2009. Punga Mare, nearest Titan’s pole, is 240 miles (386 km) across.

Besides revealing the (uncannily) smooth surfaces of lakes — which appear dark in near-infrared wavelengths but would also be darker than the surrounding landscape in visible light — these Cassini images also show an unusually bright terrain surrounding them. Since the majority of Titan’s lakes are found within this bright region it’s thought that there could be a geologic correlation; is this Titan’s version of karst terrain, like what’s found in the southeastern U.S. and New Mexico? Could these lakes be merely the visible surfaces of a vast underground hydrocarbon aquifer? Or are they shallow pools filling depressions in an ancient lava flow?

Or, are they the remains of once-larger lakes and seas which have since evaporated? The orange-hued regions in the false-color mosaic may be evaporite — the Titan equivalent of salt flats on Earth. The evaporated material is thought to be organic chemicals originally from Titan’s haze particles that were once dissolved in liquid methane.

“Is this an indication that with increased warmth, the seas and lakes are starting to evaporate, leaving behind a deposit of organic material,” wrote Carolyn Porco,
Cassini Imaging Team Leader, in an email earlier today. “…in other words, the Titan equivalent of a salt-flat?”

The largest lake at Titan’s south pole, Ontario Lacus, has been previously compared to such an ephemeral lake in Namibia called the Etosha Pan. (Read more here.)

These observations are only possible because of the extended and long-term study of Saturn and its family of moons by the Cassini spacecraft, which began with its establishing orbit in 2004 and has since continued across multiple seasons over a third of the ringed planet’s year. The existence of methane lakes on Titan is undoubtedly fascinating, but how deep the lakes are, where they came from and how they behave in Titan’s environment have yet to be discovered. Luckily, the changing season is on our side.

“Titan’s northern lakes region is one of the most Earth-like and intriguing in the solar system,” said Linda Spilker, Cassini project scientist, based at NASA’s Jet Propulsion Laboratory, Pasadena, Calif. “We know lakes here change with the seasons, and Cassini’s long mission at Saturn gives us the opportunity to watch the seasons change at Titan, too. Now that the sun is shining in the north and we have these wonderful views, we can begin to compare the different data sets and tease out what Titan’s lakes are doing near the north pole.”

The images shown above were obtained by Cassini’s visual and infrared mapping spectrometer (VIMS) during a close flyby of Titan on Sept. 12, 2013.

Read more on the Cassini Imaging Central Laboratory for Operations (CICLOPS) site here and on the NASA site here.

“But how thrilling it is to still be uncovering new territory on this fascinating moon… a place that, until Cassini’s arrival at Saturn nearly 10 years ago, was the largest single expanse of unseen terrain we had remaining in our solar system. Our adventures here have been the very essence of exploration. And it’s not over yet!”

Source: Universe Today
3. Light from farthest galaxy yet discovered breaks through cosmic fog

Researchers have observed a galaxy just 700 million years after the Big Bang and now some 30 billion light years (9 billion parsecs) from Earth, the farthest yet seen.

The galaxy, z8_GND_5296, is the closest yet observed to the cosmic ‘dark ages’ — a period when space was filled with neutral hydrogen gas. This epoch lasted for a few hundred million years after the Big Bang, until the first stars and galaxies began to emit light. As they shuddered to life, this fog dissipated as it was gradually ionized, but when that process started and how long it took is unclear.

One way to find out is to spot galaxies from many different cosmic eras and “figure out what the neutral fraction of gas is at each”, says Steven Finkelstein, an astrophysicist at the University of Texas in Austin and a co-author of the z8_GND_5296 findings, published today in *Nature*.

Light from z8_GND_5296 has a redshift — a measure of how much the light is stretched as it travels through the expanding Universe — of a record-breaking 7.51. About 100 galaxies seem to have a redshift of 7 or more, indicating they formed within 770 million years of the Big Bang. But only a handful of these have had their distances confirmed via the redshift of their spectra, which is nearly always done using a spectral line called Lyman-α. Light of this wavelength is usually the brightest emitted by hydrogen atoms, and it can be absorbed or scattered by any hydrogen atoms it strikes.

**Era of light**

There are relatively few galaxies at such eras that detectably emit Lyman-α lines, which Finkelstein says may be an indication of neutral gas surrounding the galaxies at redshifts of about 7 or more. “The difficulty we’ve been having [detecting the line], and the increasing difficulty as we move farther away, could be us entering this era of reionization,” he says.

If that is the case, how did the light from z8_GND_5296 break through the fog? One possibility is that it ionized its immediate surroundings, says Finkelstein, creating a way for photons to escape the fog. Indeed, its colour and brightness suggest that it is forming stars at the furious rate of 330 solar masses per year. That is about 30 times higher than expected, the researchers say, and suggests that active stellar nurseries may be more common than thought in the early Universe.

Finding other galaxies at similar distances will be tough, however, because their Lyman-α lines have been shifted to infrared wavelengths similar to those produced by molecules in Earth’s atmosphere. Finkelstein hopes to spot perhaps 20 more using the spectrograph — on the Keck I telescope at the W. M. Keck Observatory in Hawaii — that turned up z8_GND_5296.

But future telescopes should do much better, including the James Webb Space Telescope, which is planned to launch in 2018. “There is a bright future for studies of the first galaxies in the Universe,” writes Dominik Riechers, an astronomer at Cornell University in Ithaca, New York, in a commentary accompanying the research.

Source: [Nature News](#)
The Night Sky

Friday, October 25  
- Staying out late tonight? Keep an eye low to the east-northeast for Jupiter rising around 11 or midnight (depending on your location). Lesser Castor and Pollux shine to its left. About 45 minutes later, the waning gibbous Moon follows Jupiter up. And then once the Moon is well up, look to the Moon's lower right for Procyon.

Saturday, October 26  
- Last-quarter Moon (exact at 7:40 p.m. EDT). The Moon rises around midnight or 1 a.m. local time tonight, in dim Cancer below Jupiter and Gemini. To the right of the Moon and Jupiter, Procyon forms a nearly equilateral triangle with them.

By dawn on Sunday they're all high in the southeast to south, with Procyon now on the bottom and Regulus and Mars off to their lower left.

Sunday, October 27  
- **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." For several days centered on October 29th every year, Arcturus occupies a special place above your local landscape. It closely marks the spot in your sky 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.

Monday, October 28  
- ** Algol in Perseus,** the prototype eclipsing binary star, should be in one of its periodic dimmings, magnitude 3.4 instead of its usual 2.1, for a couple hours centered on 1:46 a.m. Tuesday morning EDT (10:46 p.m. Monday evening PDT). Algol takes several additional hours to fade and to rebrighten. Use the comparison-star chart at right.

- Through the early morning hours and into dawn Tuesday morning, the waning crescent Moon forms a triangle with Mars and Regulus in the eastern sky — for the second time this month. By dawn it's high in the southeast.
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)

October 28, Monday

4:45 a.m. - Coverage of the Undocking of the “Albert Einstein: Automated Transfer Vehicle-4 from the ISS (Undocking scheduled at 4:59 a.m. ET) - JSC (All Channels)

10 a.m. - Video File of the ISS Expedition 38/39 Crew Departure from Star City, Russia for Baikonur, Kazakhstan and other Baikonur crew activities - JSC (All Channels)

2 p.m. - NASA News Briefing on the Mars Atmosphere and Volatile Evolution (MAVEN) Mission - HQ (All Channels)

October 29, Tuesday

1 p.m. - ISS Expedition 37 In-Flight Event with NASA Flight Engineer Michael Hopkins and the University of Illinois - JSC (All Channels)

3 p.m. - IceBridge Mission Google+ Hangout - GSFC (Public and Education Channels)

Watch NASA TV online by going to the NASA website.
Space Calendar

- Oct 25 - **NEW** [Oct 25] Shijian 16 CZ-4B Launch (China), Successful
- Oct 25 - **NEW** [Oct 23] Sirius FM-6 Proton M-Briz M Launch
- Oct 25 - Asteroid 1 Ceres Occults TYC 0865-00911-1 (10.0 Magnitude Star)
- Oct 25 - Asteroid 41 Daphne Occults HIP 97157 (6.7 Magnitude Star)
- Oct 25 - Asteroid 9777 Enterprise Closest Approach To Earth (1.439 AU)
- Oct 25 - Asteroid 6154 Stevesynnot Closest Approach To Earth (1.520 AU)
- Oct 25 - Asteroid 32096 Puckett Closest Approach To Earth (1.462 AU)
- Oct 26 - Comet P/2013 N5 (PANSTARRS) Closest Approach To Earth (1.404 AU)
- Oct 26 - Comet C/2013 S1 (Catalina) Closest Approach To Earth (2.007 AU)
- Oct 26 - Comet 119P/Parker-Hartley At Opposition (2.148 AU)
- Oct 26 - Asteroid 2013 TY5 Near-Earth Flyby (0.082 AU)
- Oct 27 - European Summer Time Ends - Set Clock Back 1 Hour (European Union)
- Oct 27 - 40th Anniversary (1973), Canon City Meteorite Fall (Hit Garage)
- Oct 28 - Mercury Passes 4.1 Degrees From Saturn
- Oct 28 - **NEW** [Oct 23] Comet P/2013 T2 (Schwartz) Closest Approach To Earth (1.111 AU)
- Oct 28 - Comet P/2011 S1 (Gibbs) Closest Approach To Earth (5.957 AU)
- Oct 28 - Comet P/2011 S1 (Gibbs) At Opposition (5.957 AU)

The Cañon City Meteorite crashed into a garage roof in Cañon City, CO at 6:30 p.m., Oct. 27, 1973. The meteorite was recovered and is part of the Geology Collection at the Denver Museum of Nature & Science. Click here for information on Cañon City’s anniversary event.

Source: JPL Space Calendar
Food for Thought

Just 2 weeks in orbit causes changes in eyes

Just 13 days in space may be enough to cause profound changes in eye structure and gene expression, report researchers from Houston Methodist, NASA Johnson Space Center, and two other institutions in the October 2013 issue of *Gravitational and Space Research*.

The study, which looked at how low gravity and radiation and oxidative damage impacts mice, is the first to examine eye-related gene expression and cell behavior after spaceflight.

"We found many changes in the expression of genes that help cells cope with oxidative stress in the retina, possibly caused by radiation exposure," said Houston Methodist pathologist Patricia Chévez-Barrios, M.D., the study's principal investigator. "These changes were partially reversible upon return to Earth. We also saw optic nerve changes consistent with mechanical injury, but these changes did not resolve. And we saw changes in the expression of DNA damage repair genes and in apoptotic pathways, which help the body destroy cells that are irreparably damaged."

Since 2001, studies have shown astronauts are at increased risk of developing eye problems, like premature age-related macular degeneration. Experts suspect the cause is low gravity, heightened exposure to solar radiation, or a combination of the two.

In Nov. 2011, a NASA-sponsored Ophthalmology study of seven astronauts showed that all seven had experienced eye problems after spending at least six months in space. Doctors saw a flattening of the back of the eyeball, folding of the choroid (vascular tissue behind the retina), excess fluid around and presumed swelling of the optic nerve, or some combination of these.

High-energy radiation from the Sun can cause nasty, extremely damaging chemical reactions in cells, collectively called oxidative stress. Earth's atmosphere reflects or absorbs much of this radiation and is, ironically, a much better shield than the thick metal hulls of space shuttles and the International Space Station.

Damage to eyes isn't merely a long-term health issue for some astronauts back on Earth -- it could interfere with future missions in which any loss of focus or vision makes it difficult for humans to complete long missions, such as round-trip travel to Mars (12 to 16 months) or to the moons of Jupiter (about two years). If both
radiation exposure and gravity loss are to blame, one solution to save astronauts' eyes might be a spacecraft with a more protective hull and inside, a spinning hamster wheel that simulates gravity similar to those envisioned by futurist author Arthur C. Clarke and realized in Stanley Kubrick's film, 2001: A Space Odyssey.

To determine the impact of radiation exposure on eyes, Chévez-Barrios and lead author Susana Zanello, Ph.D., a space life scientist at NASA Johnson Space Center, examined mouse retinal gene expression on the 1st, 5th, and 7th days following a 13-day trip aboard space shuttle Discovery (STS-133), measuring indicators of oxidative and cellular stress. The researchers also examined the eyes and surrounding tissues for broad changes in structure and shape that could relate to low gravity. They maintained two controls on Earth -- one in which mice were kept in the same general conditions as those aboard the shuttle, and one in which mice were maintained in typical, Earth-based care facilities.

Mice returning to Earth showed immediate evidence of oxidative stress in their retinas. But the increased expression of six oxidative stress response genes appeared to return to normal by the seventh day on Earth. An indicator of oxidative stress in the cornea was also elevated one day after mice had returned from orbit, but returned to near-normal levels by the seventh day.

"This suggests oxidative stress in the retina and lens are at least partially reversible under the circumstances of the experiment," Chévez-Barrios said. "This was after a relatively short time in orbit. We don't know if damage caused by longer periods of oxidative stress will be more severe. Only more studies with longer exposure times may help answer this question."

In the mice that had been to orbit, the researchers also found an increase in beta-amylloid in their optic nerves, and this increase persisted after seven days on Earth. Beta-amylloid is associated with traumatic brain injury in humans, and was not detected in the mice that remained on Earth. The researchers also found an increased number of glial cells -- cells that respond to injury -- in the optic nerves of mice that had been to space. It is not known whether the deposit of beta-amylloid and increased glial cells were caused by sustained low gravity or during the trips to or from Earth orbit. The researchers also found orbiting mice were expressing elevated levels of caspase-3 in the retinal pigment epithelium. Caspaces are enzyme precursors that help the immune system destroy damaged cells in a process called apoptosis. Abnormalities of the epithelium are associated with development of age-related macular degeneration.

Chévez-Barrios and colleagues found changes in cell and tissue shape and fluid balance similar to what has been reported from previous studies, specifically studies of astronauts who had experienced optic nerve changes.

The study described in the Gravitational and Space Research paper was small -- 18 mice in nine different condition groups. Space is limited aboard orbital missions.

"We say in the paper these results should be thought of as preliminary, like a pilot study," Chévez-Barrios said. "We think our results are plausible based on what we know from previous studies of structural changes and damage caused by oxidative stress and changes in the eyes of astronauts returning to Earth, but additional experiments are needed to confirm what we are reporting about gene expression, cellular behavior and mechanisms of damage."

Chévez-Barrios also said the strain of mice used in the study are known to be unusually sensitive to light, and that the severity of oxidative, cellular, and tissue problems her group saw would probably be milder in healthy human eyes.

Source: EurekaAlert
Sun Emits Third Solar Flare in 2 Days

UPDATE: Another solar flare erupted from the same area of the sun on Oct. 25, 2013, which peaked at 11:03 a.m. EDT. This flare is classified as an X2.1 class.

The sun emitted a significant solar flare, peaking at 4:01 a.m. EDT on Oct. 25, 2013. Solar flares are powerful bursts of radiation. Harmful radiation from a flare cannot pass through Earth's atmosphere to physically affect humans on the ground, however -- when intense enough -- they can disturb the atmosphere in the layer where GPS and communications signals travel. This disrupts the radio signals for as long as the flare is ongoing, anywhere from minutes to hours.

To see how this event may impact Earth, please visit NOAA's Space Weather Prediction Center at http://spaceweather.gov, the U.S. government's official source for space weather forecasts, alerts, watches and warnings.

Source: NASA