



A little science...A touch of fiction...A lot of adventure...

News from the Den

Here in the den, we're recovering from turkey overload and hoping the snow continues as the El Niño current strengthens in the central Pacific Ocean. This portends a cooler, wetter winter. Fingers crossed.

Those living in the United States may have noticed fall seems delayed by more than six weeks. Autumnal colors were slow to appear, the first snows were late, the deer rut was over a month past due, temperatures in mid-November were more October-like, allowing hikes in sandals and shorts. All a result of continuing climate change and planet warming. So to cool off, I thought we'd tour the cosmos and learn how we investigate and observe this vast expanse.

Our word of the month in October was - antihydrogen.

Antihydrogen is the antimatter counterpart of hydrogen and was first detected in the 1990's in particle accelerator experiments. In 2010, researchers at CERN discovered its properties and structure - its made up of one positron and an antiproton. Normal hydrogen is made up of an electron and a proton. The existence of antimatter in the universe creates an enigma in physics. Why is there so much matter and so little antimatter? The Big Bang should have produced these two states of matter in equal amounts. Yet, there is vastly more matter than antimatter. Just another paradox in our amazing universe. And even though antihydrogen is the opposite of hydrogen - it still falls down within a gravitational field. Weirder and weirder.

Latest and Greatest - Science News - How do we observe the universe?

We've seen amazing photos from the James Webb Space Telescope as it looks back in time to the earliest universe using infra-red light, the amazing Hubble space telescope that searches the universe using visible light and the Chandra X-ray Observatory, detected gravitational waves at LIGO, listened to gravitational waves at the Green Bank Telescope in West Virginia, mapped the universe using neutrinos collected at the IceCube Neutrino Observatory at the South Pole, returned samples of the asteroid Bennu, began exploring the 'dark universe' using the new European Euclid space telescope, and now are watching the newly-launched spacecraft Psyche as it heads toward 16 Psyche asteroid. All these amazing devices and Earth-based, near-Earth and deep-space spacecraft are remarkable feats of engineering.

Sputnik was the first extraterrestrial vehicle to orbit the Earth when it launched in 1957. Since then space has been filled with all types of vehicles, those in orbit and those sent on far-flung missions, those sent to other planets.

We've spoken about JWST, LIGO, Hubble, and OSIRIS-REx. But lets explore an Earth-bound observatory and Euclid, the newest space telescope orbiting at the second LaGrange point with JWST.

The IceCube observatory was built at the South Pole. With 5,160 sensors buried 1.5 kilometers beneath the ice sheet, the observatory measures neutrinos. Neutrinos are the lightest of all the elemental particles. Most are created from fusion within our sun's core and the radioactive decay of rocks on Earth. Some are 'cosmic' neutrinos created from high-energy cosmic rays which travel across the universe. These cosmic neutrinos move the fastest and zip through Earth and you and I without leaving a trace, at a rate of 100 trillion neutrinos every second.

Each year, the huge IceCube detector records only a dozen or so cosmic neutrinos with high enough energy that they stand out from the pack. From these few particles, the energy levels and the direction the neutrino arrived from can be determined. Now, these high-energy particles give us critical information about the Milky Way's galactic core and the supermassive blackhole - Sagittarius A* which exists there. Neutrinos give us a bit of information about where they originated and what they encountered as they traveled to Earth. The IceCube observatory is now turning their studies to dark matter. [Read more.](#)

Orbiting at the second LaGrande point 1.5 million kilometers from Earth is the new European Space Agency space telescope Euclid. Euclid observes the universe using visible and near-infrared light instruments. Parts of the light spectrum not covered by JWST. Its mission is to map the 'dark side' of the universe at about 10 billion kilometers away, creating a 3D image of the universe.

Dark matter is the main objective. This form of matter does not react to light or EM fields but does interact with the gravitational fields within spacetime. It is calculated that dark matter constitute about 85% of all matter within the known universe. This, with its partner dark energy, are hypothesized to be the 'glue' that holds the universe together and the determining factor for where galaxies reside. This dark universe is the primary objective of this amazing observatory. [Read more.](#)

As we finished this month's newsletter, JWST found the oldest known black hole - 13.2 billion years old, just 450 million years after the Big Bang. In partnership with Chandra X-Ray Observatory it's size was revealed, 10 times larger than Sagittarius A* at the heart of the Milky Way.

Photo of the Month - IceCube Neutrino Observatory



In Memoriam - Sergey Gredeskul, Theoretical Physicist

Dr. Gredeskul was killed on 7 October 2023 in Israel during the initial day of the Hamas attack. He was a member of the faculty of Ben-Gurion University, which lost 84 students and faculty on that day. The 242 international post-doctoral students have left the country since the onset of the conflict. This conflict has shutdown teaching and research across Gaza and Israel. International collaborations have been halted. [Read more here](#) and [here](#).

Historical Foundations - Eugenio Calabi, Mathematician

Dr. Calabi died in September at the age of 100. He is one of the most significant geometers ever. His work conceived the geometric objects which became the fundamental basis for string theory. He literally sculpted the shape of space. String theory is one of the theoretical frameworks proposed to unite the quantum world of subatomic particles with gravity as defined by the Theory of General Relativity. String theory has impacted thinking from particle physics to cosmology. [Read more](#).

Book of the Month - *A Pale Blue Dot*, Carl Sagan

On 14 February 1990, we saw our planet from a new perspective. Carl Sagan asked NASA to focus Voyager 1 cameras back on our solar system as it left for interstellar space. From a distance of 6 billion kilometers, this little spacecraft captured a 'family photo' of the planets within our near space environs. Our planet occupied less than one pixel within the photo. This photo was the central tenant of Sagan's 1994 book *A Pale Blue Dot*. Absolutely puts things in perspective. [Available on Amazon](#).

Minutiae

Good news! Voyager 2 lives! The forty-six year old space craft, launched in August 1977, is currently traveling through interstellar space, having departed our solar system on 5 November 2018. It is still functioning. The craft's 'heartbeat' signal was re-acquired by NASA and NASA has extended its life by another 3.5 years with various power saving methods.

On a personal note, I read a startling bit of science fiction in [Nature's Futures](#) . This anxiety producing piece mixed the future of the human race, with AI and used the color of Cherenkov radiation as the lighting feature in a 'museum'. This hit me hard as I was immediately taken back to my time at Los Alamos National Labs. I worked in the Omega West Reactor site building, located in a deep arroyo canyon on the edge of the town. My office was 9 meters from and one floor above said reactor. Every office had a gamma ray detector outside the door, which clicked on a semi-regular basis. We all wore radiation dosimeters, which hopefully remained at zero. This 54 rod-high energy reactor was water cooled and used enriched uranium as the energy source.

One was able to walk across the top of the reactor and open an observation port to look down into the nuclear core. The entire core glowed with the shimmering blue of Cherenkov radiation.

In a vacuum, the speed of light c is constant but in other media the speed decreases from the maximum of $c=186,282$ miles per second. In water, the speed is approximately 75% of c . But matter can be accelerated to greater than 0.75% the speed of light as energized particles escape during a nuclear reaction. As the fast particles travel through the cooling water at greater than $0.75c$ they create a 'sonic boom' in the water, energizing the water molecules which then vibrate and create a blue glow. Beautiful, but sobering in the amount of energy so closely controlled but so easily uncontrolled.

Our words of the month are - natural selection. Question for you - Are you a dog person or a cat person?



keep being curious

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