

Astronomers in Japan are searching for the Universe's first stars. Specifically, they're looking for the deaths of the first stars, the earliest supernovae.

## Scientists measure Earth's rotational forces with underground laser gyroscope

Scientists are preparing to measure the inertial rotation of Earth using an underground laser-based gyroscope.



Scientists recently installed a new single-axis, laser-based gyroscope in a subterranean laboratory in Italy. UPI

The goal is to reveal fluctuations in Earth's rate of rotation and confirm a component of the theory of relativity known as the Lense-Thirring effect, UPI reported.

Jacopo Belfi, researcher at the Italian National Institute for Nuclear Physics (INFN), said, "This effect is detectable as a small difference between Earth's rotation rate value measured by a ground based observatory and the value measured in an inertial reference frame."

"This small difference is generated by Earth's mass and angular momentum and has been foreseen by Einstein's general theory of relativity."

"In order for scientists to directly observe the Lense-Thirring effect, they must measure Earth's rotation rate vector with extreme precision — with a relative accuracy better than one part per billion."

Astronomers at the INFN's Laboratori Nazionali del Gran Sasso hope their Gyroscopes in General Relativity program will allow them to do just that.

Eventually, the program will boast several ring laser gyroscopes buried beneath Earth's surface. So far, just one — the single-axis GINGERino instrument — has been installed in the subterranean lab. The installation was detailed this week in the journal Review of Scientific Instruments.

The gyroscopes, or RLGs, will be able to measure the rotation of Earth's surface with unprecedented precision — and without interference from surface-level disturbances like those from hydrology, temperature or barometric pressure changes.

Initially, GINGERino and its companions will be focused on measuring Earth's rotational forces within an astronomical and relativistic context.

But scientists say the instruments could be used for research in geophysics and volcanology.

Belfi added, "One peculiarity of the GINGERino installation is that it's intentionally located within a high seismicity area of central Italy."

"Unlike other large RLG installations, GINGERino can actually explore the seismic rotations induced by nearby earthquakes."

## Humans may have triggered desertification of the Sahara

The desertification of the Sahara, which began 10,000 years ago, may have been at least partially caused by humans.



The Sahara Desert may have formed with the help of human activity in the Nile Valley. UPI

aged the Sahara's formation.

David Wright, a researcher at Seoul National University, said, "In East Asia, there are long established theories of how Neolithic populations changed the landscape so profoundly that monsoons stopped penetrating so far inland."

The spread of scrublands have previously been linked to the desertification of North Africa.

When Wright surveyed archeological data from the region, he found the movement of early pastoral communities in the Nile Valley tracked closely with the proliferation of scrub vegetation.

Wright and his colleagues suggest the introduction of livestock in North Africa, more than 8,000 years ago, altered the region's vegetation, suppressing the growth of larger bushes and trees.

Less vegetation left the region's surface more exposed and reflective, altering the atmospheric conditions.

These changes diminished the impact and reach of Africa's seasonal monsoons, further encouraging the development of scrub vegetation and desert — a feedback loop of desertification.

Wright, whose latest analysis was published in the journal *Frontiers in Earth Science*, believes lakebed sediments will further illuminate the role humans played in the Sahara's desertification.

Wright added, "There were lakes everywhere in the Sahara at this time, and they will have the records of the changing vegetation."

"We need to drill down into these former lake beds to get the vegetation records, look at the archeology, and see what people were doing there."

# First dairy drink produced in Iran

### Science Desk

Researchers from Sharif University of Technology in Tehran managed to produce the first dairy drink made from milk. This drink will strengthen the bones and prevent osteoporosis.

One of the biggest dairy companies has rolled it out in the market.

Dairy drink, which was first produced in Europe in the 1950s, is a popular drink in Switzerland.

Dairy drink has the taste of ordinary drinks, but instead of artificial colors and essences, milk is used in its production.

This drink boasts calcium, protein and mineral salts.

Lactose has also been used in this drink.

There is real scope for innovation in the dairy drinks category, with product development currently focusing on health.

Dairy drinks are ideal for adding value in terms of nutrition and functional additives. Thanks to their naturally high calcium content, they are perceived by consumers as nutritious, 'good for me' products.



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## Oldest plants on Earth discovered

The origins of plants may go back hundreds of millions of years earlier than previously thought, according to fossil evidence.

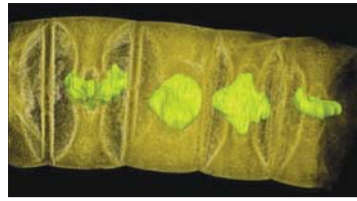
Ancient rocks from India suggest plants resembling red algae lived 1.6 billion years ago in what was then shallow sea, according to BBC.

The discovery may overturn ideas of when relatively advanced life evolved, said scientists in Sweden.

They identified parts of chloroplasts, structures within plant cells involved in photosynthesis.

The earliest signs of life on Earth are at least 3½ billion years old.

The first single-celled microscopic life forms evolved into larger multi-cellular



Synchrotron-based X-ray tomographic microscopy revealed structures typical of red algae. bbc.com

eukaryotic organisms (made up of cells containing a nucleus and other structures within a membrane).

These Sallstedt of the Swedish Museum of Natural History discovered some of the fossils. She described them as the

oldest fossil plants that we know of on Earth in the form of 1.6 billion year old red algae.

She said, "They show us that advanced life in the form of eukaryotes (like plants, fungi and us humans/animals) have

a much deeper history on Earth than what we previously have thought."

### Tree of life

The scientists found thread-like fossils and more complex 'fleshy' colonies in sedimentary rock from central India. Both have characteristics of modern red algae, a type of seaweed.

Co-researcher Professor Stefan Bengtson of the Swedish Museum of Natural History added: "You cannot be 100 percent sure about material this ancient, as there is no DNA remaining, but the characters agree quite well with the morphology and structure of red algae."

The oldest known red algae before the present discovery

date back 1.2 billion years. The Indian fossils are 400 million years older, suggesting that the early branches of the tree of life began much earlier than previously thought.

Claims of ancient life are always controversial. Without DNA evidence, confirmation must rest on whether more fossils can be found.

There is also debate over whether red algae belong in the plant kingdom or in a class of their own.

Modern red algae is perhaps best known for two commercial products — gelatinous texturing agents used in making ice cream — and nori — the seaweed used to wrap sushi.

The research was published in the journal, *PLOS Biology*.

## Estimates of emissions from natural gas-fueled plants much too low

Power plants that burn natural gas produce significantly less pollutants and greenhouse gases than coal-burning plants, according to current estimates of how much methane escapes from such power plants, as well as from oil refineries, and estimates could be off by a wide margin, a new Purdue University study found.

For the past decade, natural gas has been replacing coal as a fuel for electric power plants, phys.org reported.

It's become relatively inexpensive, and it's much less damaging to the environment if — and it's an important 'if' — it doesn't leak out of the system before it is burned to make power.

Paul Shepson, Purdue's Jonathan Amy Distinguished Professor of analytical and atmospheric chemistry, said, "That's because although burning natural gas is much cleaner than coal or oil, methane (which is mostly what natural gas consists of) has the potential to be even more damaging over the short term than coal or oil if it isn't handled properly. "Methane is a 34 times more potent greenhouse gas than is carbon dioxide. "It's a better fuel all around as long as you don't spill it. But it doesn't take much methane leakage to ruin your whole day if you care about climate change."

The breaking point for natural gas leakage is about three percent. If more than that leaks, the fuel has a bigger climate effect than burning coal.

Shepson said, "The good news from our study is that while emissions are greater than anticipated, natural gas-burning power plants are still cleaner, relative to burning coal. "This pilot study found that the amount of methane escaping from the plants was only 0.3 percent on average." Even taking into account previous



Purdue researchers flew an airborne chemistry laboratory over natural gas-fueled power plants and refineries to measure greenhouse gases. phys.org

estimates of methane leakage in the supply chain of 1.7 percent, the total methane emissions are still below the three percent threshold, the study found.

The study also found that methane emission rates were significantly higher than two sets of estimates reported by the Environmental Protection Agency; the EPA's Greenhouse Gas Inventory of Emissions and Sinks estimated that total methane emissions from all US refineries and natural gas power plants was negligible in 2014.

However, this study estimated that annual methane emissions may actually be 11-90 times higher for refineries and two to 120 times higher for natural gas power plants than those calculated from data provided by facility operators and reported to the EPA's Greenhouse Gas Reporting Program, and used in the Greenhouse Gas Inventory of Emissions

and Sinks. Shepson added, "There is much more methane being released into the atmosphere by leaky compressors, valves, and industrial hardware. "But the good news here is that you can take a specialized infrared camera around the plant to find the leaks and then patch the them with a wad of bubblegum. I'm joking about that, of course, but the point is that it's a relatively easy thing to fix."

The study's paper was released by the journal *Environmental Science and Technology*, which is produced by the American Chemical Society.

The study conducted in collaboration with the New York-based Environmental Defense Fund, with funding provided by the Alfred P. Sloan Foundation.

Joseph Rudek, a lead senior scientist at the Environmental Defense Fund and

a coauthor on the paper, said that natural gas power plants and refineries could be a significantly unaccounted-for source of methane emissions.

"More measurements are needed to better understand the methane emissions from these sectors."

Steve Hamburg, chief scientist at the Environmental Defense Fund, said that the leaking methane will especially diminish the environmental effects of using natural gas over the first few critical decades.

He said, "There is the capacity to cost-effectively reduce methane emissions associated with use and production of natural gas, so there's no excuse for the waste and serious long-term impacts."

The study was conducted using Purdue's flying atmospheric chemistry laboratory, the Airborne Laboratory for Atmospheric Research, or ALAR.

The ALAR is a modified Beechcraft 76 Duchess that flies at a height of two to four kilometers collecting air samples and conducting sophisticated measurements.

Shepson added, "ALAR is a unique machine, and it was created by combining three of Purdue's major strengths: atmospheric sciences, analytical chemistry, and aviation technology."

Shepson added the benefit of this research is that everyone involved will be able to improve the emission factor formulas used in calculating the amount of methane entering the atmosphere based on the total emissions of the plants, not just the amount going up the smokestacks.

He said, "But the important overall message of the study is to say while natural gas power plants appear to provide a climate benefit, it can still be easily improved."