James Webb Space Telescope produces most detailed signature of the atmosphere of a planet beyond the Solar System

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A recent study published using data collected by the James Webb Space Telescope (JWST) has reported the most detailed study of the atmosphere of a planet beyond the Solar System yet, including tentative but tantalizing evidence for two chemical compounds, dimethyl sulfide (DMS) and dimethyl disulfide (DMDS), on the exoplanet K2-18b, found on Earth primarily as a result of biological processes but also found in the universe from non-biological sources.

The exoplanet orbits around a red dwarf star, which is smaller, cooler and redder than our Sun. The system is about 120 light years from Earth and one of many that have been or are being studied by astronomers working with the JWST.

The work was carried out by Nikku Madhusudhan, a professor of astrophysics at the University of Cambridge. His team consisted of researchers in the United Kingdom and the United States and was supported by the thousands of scientists, engineers and technicians all over the world who operate the JWST.

Media coverage has largely centered on the potential biological implications of the sulfur compounds. To be clear, what has been discovered is both significant and very preliminary. While the results indicate that there is a 99.7 percent chance the data show the existence of both chemicals, a "3 sigma significance," even that high level of confidence is not sufficient to rule out other possibilities. The paper itself notes that "more observations are needed to increase the robustness of the findings." Other scientists have also pointed out that a limited number of chemical compounds were surveyed as potential matches, so while something was almost certainly detected, there is less certainty of its identification.

The data are not any indication, definite or otherwise, of extraterrestrial life on another world, despite the initial sensationalized headlines in the corporate media. Even if the presence of DMS and DMDS were confirmed, a great deal more work would need to be carried out to rule out other processes through which the chemicals could be produced. There also needs to be more study of the general chemistry of K2-18b and the atmospheric chemistry of so-called "hycean" worlds as a whole.

The more refined study of the chemistry of K2-18b builds off of previous work done using observations from the Kepler and Hubble space telescopes over the past ten years. The exoplanet was first discovered by the Kepler mission in 2015, which detected that the light from the planet's star, K2-18, dimmed in a periodic fashion, suggesting a large body was transiting between the star and our vantage point on Earth. Subsequent observations allowed astronomers to determine that the exoplanet has a mass 8.6 times that of Earth and a radius about 2.6 times that of our planet.

The calculated size and mass of the object highlighted the planet for further study. Most early detections of exoplanets were those the size of Jupiter (or larger) because their large size made them easier to detect. The enormous amount of data collected by Kepler from 2009 to 2018, as well as constantly improving computational techniques, have made finding worlds smaller than Neptune a more regular occurrence.

Follow-up studies with Hubble were then undertaken in 2019 in an attempt to determine the chemical composition of the exoplanet's atmosphere. Several scenarios exist for such worlds: a small gas giant (a mini-Neptune), a rocky planet with a thin hydrogen atmosphere (gas dwarf) or a world with a vast liquid water ocean covered in a hydrogen atmosphere (a hycean planet).

The analysis using Hubble was inconclusive. Initial

spectral data from its Wide Field Camera 3 instrument inferred the presence of water vapor or methane in K2-18b's atmosphere, but the spectral resolution was not fine enough to completely differentiate between the two.

Using the higher resolution of data from the JWST, Madhusudhan found much stronger evidence for methane than water vapor in the planet's atmosphere. The data also indicated the presence of carbon dioxide. The studies did not rule out the existence of water, but instead suggested it wasn't present in the atmospheric layers the telescope is able to probe.

The most recent JWST data were also what provided the possible indications of DMS and DMDS. The pursuit of life on other worlds has always been guided by so-called "biosignatures," chemicals found on Earth that emerge only as the result of biological processes, and DMS in Earth's atmosphere is found largely as a result of marine biological activity. It has also been found in giant molecular clouds in the Universe, however, so if this detection is confirmed, it is a tantalizing indication of the scope of chemical and biological studies opened up by the new techniques made possible by JWST.

The new data also provided more tests of the models of hycean worlds, a new class of worlds that has been hypothesized for many years. Current models suggest they will be larger than Earth and have a hydrogen-rich atmosphere. The planets' most important feature is that they orbit their parent stars at a distance which allows for liquid water on their surface.

No such world exists in our own Solar System, and not even K2-18b is a confirmed hycean world. Among the difficulties of confirming such a status, which includes detailed studies of the atmosphere, is that most hycean worlds are suspected to orbit red dwarf stars.

Essentially every bit of interesting data about exoplanets beyond their radius and mass is determined through studying the colors of light, their spectra, that are seen as the light of their parent star transmits through different atmospheric layers and detected with extraordinarily precise instruments like Hubble or the JWST. From experiments on Earth going back more than a century, it is an established scientific fact that every atom and molecule has a distinct spectral signature that can be used to identify them.

What makes detecting molecular signatures difficult in a planet orbiting a red dwarf, however, is that the background from the star itself is usually extremely active. One of the defining features of this class of star is that their surface is constantly changing, meaning the light they are emitted is constantly changing. Accordingly, it is difficult to subtract out the emissions from the star and isolate the chemical signatures of a given planet's atmosphere.

That JWST is able to do this at all is an extraordinary triumph of careful engineering and scientific thought. It proves once again that the decades-long effort to design, build and launch the telescope, including against an attempt by the US Congress to axe the project entirely, was entirely justified. The material world is law-governed and knowable, and the centuries of human inquiry to understand this world are among the pinnacles of human culture.

The boundless potential of astronomical discovery contrasts sharply with the backwardness and reaction promoted by Trump and the entire American oligarchy. This was most recently highlighted by the Trump administration's removal of all official references to the virology and biology of the deadly COVID-19 pandemic, instead using the office of the presidency to promote the anti-scientific lab-leak hoax.

Such retrograde attitudes are also present in the recently leaked 2026 budget for NASA, which strips away essentially all new science that the agency was planning on carrying out. In effect, when the current missions, including the JWST, reach the end of their lifespan, Trump and his acolytes would render NASA a defunct organization and ultimately scuttle it, while any space operations that prove profitable would be handed over to Elon Musk and other billionaire cronies.

There is, however, enormous support for science and human progress in the broad masses of workers and youth in the US and internationally. Developments in materials science, agriculture, thermodynamics, chemical engineering, biology and more, as well as the recent developments in artificial intelligence, have improved the lives of millions. And the world's population will experience even greater heights as a result of these advances when capitalism, the social order that Trump, the Democrats and their ilk defend, is finally swept away.