

CANADIAN ASTRONOMERS DEVELOP FINGERPRINT OF EARTH'S ATMOSPHERE

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Astronomers at Canada's McGill University have made a "fingerprint" for the Earth, which could be used to identify a potentially life sustaining planet beyond the solar system.

Using over a decade of observations of the Earth's atmosphere taken by the SCISAT satellite, McGill Physics student Evelyn Macdonald, and her supervisor Prof Nicolas Cowan have constructed a transit spectrum of Earth — a detail on the fingerprint-like unique composition of our planet's atmosphere.

The findings of the work were published in the science journal *Monthly Notices of the Royal Astronomical Society* on August 28, and can help scientists determine the kind of signals called 'biosignatures' that astronomers need to look out for in order to find Earth-like planets outside our solar system.

The fingerprint includes the simultaneous occurrence of both ozone and methane, which happens only when there is an organic source of these compounds on the planet, says the study.

"A handful of researchers have tried to simulate Earth's transit spectrum, but this is the first empirical infrared transit spectrum of Earth," says Prof Cowan. "This is what alien astronomers would see if they observed a transit of Earth."

The SCISAT satellite was developed by the Canadian Space Agency to help scientists understand the depletion of the Earth's ozone layer by looking at particles in the atmosphere as sunlight passes through them. With its help, the study says, astronomers can tell what molecules are found in a planet's atmosphere by observing the changes in starlight as it shines through the atmosphere.

For making this observation, the satellite's instruments must wait for a planet to pass over the star. If the telescopes are sensitive enough, astronomers can potentially identify chemicals in such planets like carbon dioxide, oxygen, or water vapour which are molecules that improve the chances that a planet is habitable, or even inhabited, said Cowan.

A very promising solar system that might hold Earth-like planets is the TRAPPIST-1, which is a target for the upcoming James Webb Space Telescope (JWST) - scheduled for launch in 2021. Working with NASA, the Canadian Space Agency, and the European Space Agency, Macdonald and Cowan built a simulated signal of what an Earth-like planet's atmosphere might look like through the eyes of JWST.

The TRAPPIST-1 solar system, which is 40 light years away, houses seven planets, three or four of which are in the goldilocks zone - the place around a star where the temperature is just right, and is not too hot and not too cold, allowing liquid water to exist on the planet.

The McGill University astronomers add that this system might be a promising place to search for a fingerprint similar to Earth's since the planets here are orbiting a star which is smaller and

colder than our Sun.

“TRAPPIST-1 is a nearby red dwarf star, which makes its planets excellent targets for transit spectroscopy. This is because the star is much smaller than the Sun, so its planets are relatively easy to observe,” explains Macdonald. “Also, these planets orbit close to the star, so they transit every few days. Of course, even if one of the planets harbours life, we don’t expect its atmosphere to be identical to Earth’s since the star is so different from the Sun.”

Macdonald and Cowan are hopeful that the JWST will be sensitive enough to detect carbon dioxide and water vapour using its instruments, and may even be able to detect the biosignature of methane and ozone if enough time is spent observing planets.

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