EXOPLANETS

An infrared selfie

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Credit: NASA/Reid Wiseman

With more than 4,000 known exoplanets — and counting — it's becoming clear that exoplanets are highly diverse. In the search for biosignatures, we have to start by looking for life as we know it. Evelyn Macdonald and Nicolas Cowan use satellite data to produce a transit spectrum of Earth. They show how our planet (pictured) would look at infrared wavelengths from afar.

When a planet passes in front of its star, it's possible to measure the effective thickness of the atmosphere and its molecular constituents from the fraction of starlight passing through the atmosphere. Detection of CO_2 and H_2O is enough to confirm the presence of an atmosphere but not of life. The addition of methane and oxygen would strongly suggest life. To see if these molecules can be detected, Macdonald and Cowan make a mock transit spectrum of TRAPPIST-1e (which is Earth-sized, with a compact atmosphere and in the temperate zone of its ultra-cool red dwarf star, where liquid water could exist on the surface) as observed by the near- and mid-infrared spectrographs on the James Webb Space Telescope (JWST). They show that CO_2 and H_2O can be robustly detected in the near-infrared with fewer than 10 transits, but for O_3 and CH_4 it would take 40 to 80 transits in the near-infrared and 80 to 150 transits in the mid-infrared. In JWST's planned five-year life span, TRAPPIST-1e can only make 81 transits. Thus, biosignature detection is possible but not guaranteed even if it is present.

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