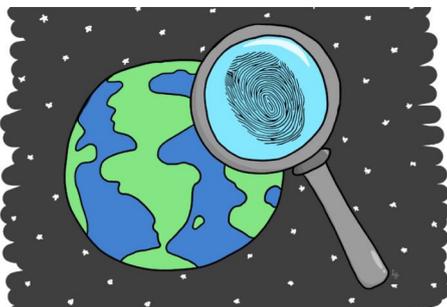


The Fingerprint of Life in the Transit Spectrum of Earth

Evelyn Macdonald recently completed a BSc in Honours Physics with a Minor in German at McGill University and began a PhD in Physics at the University of Toronto fall 2019. **Nicolas Cowan** is an Associate Professor in the departments of Earth & Planetary Sciences and Physics, and the Canada Research Chair in Planetary Climate.

Why this is important

Soon, we will be searching for life on exoplanets with transit spectroscopy using the James Webb Space Telescope. Macdonald and Cowan's transit spectrum of Earth could serve as a benchmark in the search for exoplanets that are habitable.



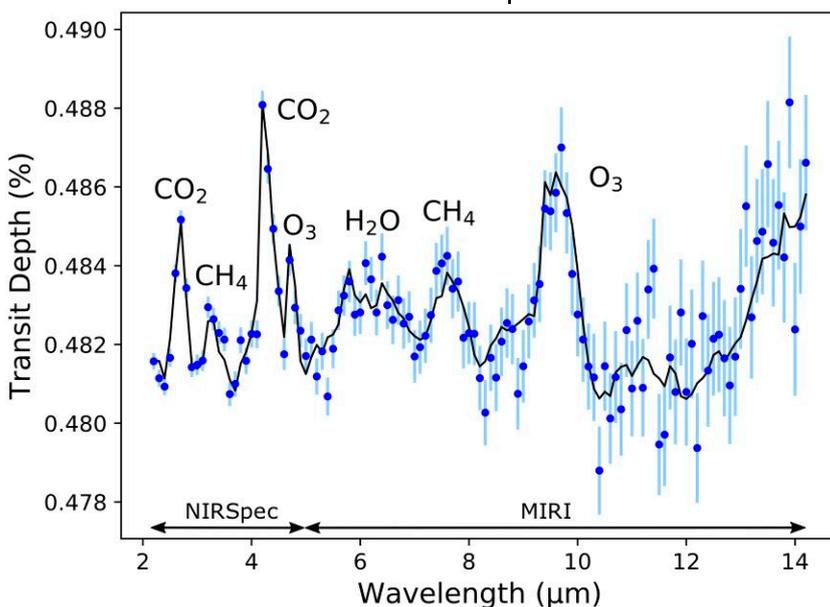
We will soon search for life on exoplanets with transit spectroscopy using the James Webb Space Telescope, but how would Earth's infrared transit spectrum appear to distant observers?

Evelyn Macdonald and Prof. Nicolas Cowan used data from SCISAT — a Canadian satellite launched in 2003 to help scientists understand the depletion of the ozone layer — to construct a transit spectrum of Earth in infrared light. Astronomers can tell what molecules are in a planet's atmosphere by looking at how starlight is filtered through the atmosphere, but they must wait for a planet to pass — or transit — in front of the star to make this observation. Macdonald and Cowan's transit spectrum of Earth could serve as a benchmark in the search for exoplanets that are habitable, or even inhabited.

The idea of drawing a link between data gathered by a satellite orbiting the Earth and telescope observations of a distant planet emerged when exoplanet specialist Cowan spoke with Yi Huang, a McGill Professor of Atmospheric and Oceanic Sciences and fellow member of the MSI, at an interdisciplinary [Planet Lunch](#). Cowan was describing transit spectroscopy of exoplanets when Huang pointed out a striking resemblance to SCISAT's viewing geometry of the Earth. "I thought this sounded great," Cowan recalls. "And, like you always do with these things, jotted it down on a piece of paper and forgot about it — until I had an undergrad student who wanted to do her thesis with me."

That student was Evelyn Macdonald, a Montrealer whose childhood interest in space had led her to pursue an honours physics degree at McGill. Such was her motivation that Macdonald completed her thesis a full year before she had finished her other degree requirements. Cowan recognized

the manuscript's potential for publication and encouraged Macdonald to develop it further. Backed by an undergraduate research award from McGill and a Trottier Excellence Grant from the Institute for Research on Exoplanets, Macdonald spent the following summer doing just that.



Top left: Whimsical art (Credit: Leanne Young / The McGill Tribune) Bottom left: Infrared transit spectrum of Earth showing atmospheric biosignatures (Source: Macdonald, E. J., & Cowan, N. B. (2019). *An empirical infrared transit spectrum of Earth: opacity windows and biosignatures*. *Monthly Notices of the Royal Astronomical Society*, 489(1), 196-204.