## Astrobiology News April 2023: Taking an Exoplanet's Temperature

Studying the properties of exoplanets is high on the list of JWST's science objectives.<sup>1</sup> In the coming months, we should be hearing a lot about the planets that orbit the red dwarf star TRAPPIST-1. Measuring the temperature of the innermost (TRAPPIST-1b) of the seven Earth-sized worlds in this system is a milestone achievement that was first reported late last month. Indeed, the measurement marked the first detection of any form of light emitted from a small, rocky exoplanet.<sup>2</sup>

At first blush, you might ask, so what? TRAPPIST-1b is about 450 degrees Fahrenheit, so it's hardly a good candidate to support life! However, what's so remarkable is *how* its temperature was measured and *what* the temperature indicates about this exoplanet's atmosphere (or lack thereof). TRAPPIST-1b's temperature was measured from what's known as a secondary eclipse, when the exoplanet passes *behind* its star. Although the exoplanet doesn't emit visible light, both exoplanet and star emit infrared light, and the small dip in the infrared light output of the system when TRAPPIST-1b passed behind its star enabled a precise measurement of its dayside temperature. That temperature was higher than expected if the exoplanet had an atmosphere to distribute heat evenly around the world, but was in good accord with no appreciable atmosphere.

Red dwarf stars are about ten times more common than stars like our Sun, but they are also likely to experience flares and bursts of x-rays that can erode a planet's atmosphere. Red dwarf stars are also likely to host rocky worlds. Twenty-two of the 24 exoplanets listed under the conservative sample of *potentially* habitable exoplanets on the website of Arecibo's Planetary Habitability Laboratory<sup>3</sup> orbit red dwarf stars, including four in the TRAPPIST-1 system (d, e, f, & g), so assessing whether any of these worlds is in fact habitable is a high priority!

Given the progress towards determining exoplanet habitability, it is fitting that much of today's science and religion dialog focuses on the prospects for discovering extraterrestrial life. On April 22 (Earth Day), CLP member and astrotheologian Rev. Dr. Ted Peters, together with aerospace engineer and historian Paul Segura, will present a webinar sponsored by the Institute for Theological Encounter with Science and Technology (ITEST),<sup>4</sup> *Finding God in Space Exploration and Extraterrestrial Life*.<sup>5</sup> The webinar is free for ITEST members, clergy, seminarians, and consecrated religious (\$10 for others), and registrants will receive private links to the archived presentation whether or not they tune in for the actual event.

Finally, by the time you read this column, the program for this summer's Parliament of the World's Religions in Chicago<sup>6</sup> should be available to the public – I encourage you to check

<sup>&</sup>lt;sup>1</sup> https://jwst.nasa.gov/content/science/origins.html

<sup>&</sup>lt;sup>2</sup> https://www.nasa.gov/feature/goddard/2023/nasa-s-webb-measures-the-temperature-of-a-rocky-exoplanet

<sup>&</sup>lt;sup>3</sup> https://phl.upr.edu/projects/habitable-exoplanets-catalog

<sup>&</sup>lt;sup>4</sup> https://faithscience.org/

<sup>&</sup>lt;sup>5</sup> https://faithscience.org/apollo-8/

<sup>&</sup>lt;sup>6</sup> https://parliamentofreligions.org/

out the Science & Religion track among the exciting 700+ events that have been scheduled. CASIRAS will also have an exhibit booth, so please come say 'hi' to us if you'll be in town for this incredible conference!

Until next month,

Grace

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