Potential for Life on Trappist-1 and other Red Dwarf Star Planets

J. Gale[1], A. Wandel[1]

[1]The Hebrew University, Jerusalem, Israel

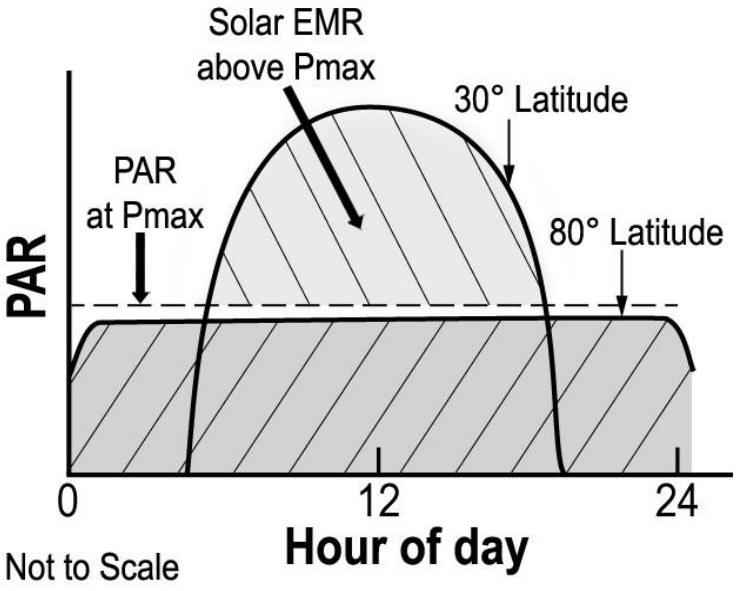
1. The Trappist-1 system

The To date seven planets have been detected orbiting the “nearby” Red Dwarf star Trappist-1 [1], but the number may be significantly greater. The star is relatively small (0.12 Rsun) and cool (2,550K) compared to our Sun (5,780K). Consequently its radiation flux is low (0.05% that of the Sun), mainly in the infrared, with a spectral peak at ~1□m, well above the Photosynthetically Active Radiation (PAR) waveband of 400 – 700nm, used by Earth vegetation.

2. Habitability and Oxygenic Photosynthesis

To date seven planets have been detected orbiting the “nearby” Red Dwarf star Trappist-1, but the number may be significantly greater than that obtained so far, by the transit, occultation method. The star is relatively small (0.12 Rsun) and cool (2,550K) compared to our Sun (5,780K). Consequently its radiation flux is low (0.05% that of the Sun), mainly in the infrared, with a spectral peak at ~1□m, well above the Photosynthetically Active Radiation (PAR) waveband of 400 – 700nm, used by Earth vegetation [2].

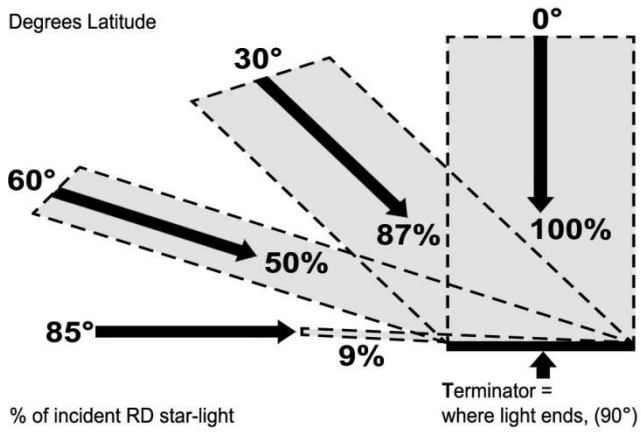
Figure 1: Diagram of the summer radiation regimes in mid and high latitudes on Earth.



3. The potential for life

The XUV radiation from Trappist -1 is much higher that of the Sun. This radiation could (possibly, but not necessarily) erode the primary atmosphere and oceans, and directly endanger life, unless life evolves in water or under a dense atmosphere. Dry land plants on Trappist-1 and other RDS planets could possibly evolve to utilize the infrared radiation between 700 and 1,000nm, which is energetically sufficient to drive water splitting oxygenic photosynthesis, an important precursor of complex life. These considerations and the abundance of RD stars, enhance the chance of finding other life clement abodes in the Milky Way [3].

Figure 2. Fig 2. Percentage incident radiation on Tidally Locked Planets as a function of Geographic Latitude.



4. References

[1] Gillon, M. et al. 2017, Seven temperate terrestrial planets around the nearby ultracool dwarf star TRAPPIST-1, Nature. 542 (7642): 456-460.

[2] Gale, J. and Wandel A., 2017, The Potential of Planets orbiting Red Dwarf stars to support Oxygenic Photosynthesis and Complex Life, International Journal of Astrobiology 1: 1-8 (2017)

[3] Wandel A., 2016, in "Search for Life: from early Earth to Exoplanets", XII rencontres du Vietnam, https://www.youtube.com/watch?v=gJaz6jim4vs, and in this meeting.

Short Summary

Many Earth Sized planets orbiting Red Dwarf stars have been reported in the last few years. From considerations of the radiation incident on these planets, both continuous and flaring, and by analogy to certain regions of Earth, we conclude that life, oxygenic photosynthesis and hence complex life could be supported.