UV light on Early Earth and on M-dwarf Exoplanets: Implications for Prebiotic Chemistry

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Recent experimental and theoretical work suggests UV radiation may have played a key role in the origin of life on Earth, and especially the origin of RNA [1,2,3]. UV radiation interacts with postulated prebiotic chemistry (chemistry relevant to the synthesis of life's building blocks) in ways that are wavelength and intensity dependent [4,5]. We use radiative transfer models to constrain the surface UV environment on early Earth. We compare this UV irradiation to those required by postulated prebiotic chemistries, evaluate their plausibility, and explore ways of improving their verisimilitude [6]. We compare the terrestrial prebiotic UV environment to those available on planets orbiting M-dwarfs, and find that M-dwarf planets have access to much less UV radiation than planets orbiting Sunlike stars. We consider whether UV-dependent prebiotic chemistry can occur on M-dwarf planets [7,8]. Our work explores 1) the initial conditions under which life emerged on Earth, 2) the inhabitability of planets orbiting M-dwarfs, and 3) the possibility of using exoplanet observations to empirically test proposed origin-of-life scenarios.

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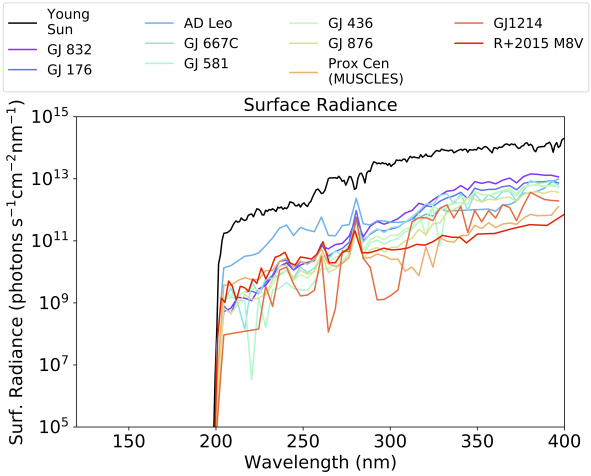

Figure 1: Surface UV environment on prebiotic Earth versus prebiotic Earth-analog worlds orbiting M-dwarfs. The surfaces of M-dwarf planets are UV-poor environments compared to early Earth.