Universal Life

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1. Introduction

The only known method to form the building blocks of life selectively and at high yields is via photochemistry [1,2]. We concentrate on the formation of sugars and RNA precursors from hydrogen cyanide and solvated electrons. The amount of light is critical to determining whether these reactions succeed, and the amount of light necessary can be connected to the star. If there is not enough light, the hydrogen cyanide is locked into an inert adduct that is not of prebiotic interest. If there is enough light, the reaction of hydrogen cyanide with the photochemically produced solvated electrons will produce simple sugars.

2. Methods

We take hydrogen cyanide and two prebiotically relevant anions which can produce simple sugars that lead to RNA precursors [2]. We perform these measurements with two different numbers of lamps and with different exposure times to estimate the photochemical cross-section for these reactions. We also take the hydrogen cyanide and these anions and leave them in the dark at different temperatures. In the dark, they react to form an inert adduct. We compare the rates in the light and dark to see which wins.

3. Results

Our primary results are that stars below a certain effective temperature with planets greater than a certain period provide insufficient flux for generating the building blocks of life. Life cannot originate photochemically on these worlds [3]. Planets for which the ultraviolet irradiation is sufficient to generate these building blocks of life are within what we term the ‘abiogenesis zone’ [3], which is distinct from the ‘liquid water habitable zone’ [4]. For more active M-dwarfs, flares of sufficient energy, at sufficient frequency, can drive the chemistry forward.

4. References

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