
# ON THE HABITABILITY OF PROXIMA CENTARURI B : AN UPDATE

Varnana.M.Kumar [1],T.E.Girish [2],P.E.Eapen [3],Thara.N.Sathyan [4],Biju Longhinos [5],Sony.K.S [6], Binoy.J 7

1Department of Physics ,Cambridge Institute of Technology KR Puram Banaglore-560036

2 Department of Physics, University College, Trivandrum 695034, INDIA

3 Department or Physics, SG College, Kottarakkara 691531 , Kerala, INDIA

4 Department of Physics, University College of Engineering, Kariavattom, Trivandrum 695581

5 Geology Section, Department of Civil Engineering, College of Engineering, Sreekaryam, Trivandrum -695016


## 1 Introduction

It will be worthwhile to confirm the habitability of our nearest exoplanet Proxima Centauri-b. In this paper we have presented our investigations on this topic from a synthesis of current observations and inferences in divergent angles.

## 2.Data related to Proxima Centauri-b

Mass : 1.07 to 1.27Me
Orbital Period:11.2 days
( possibly tidally locked with the host star).
Age : 4.85 Gyrs

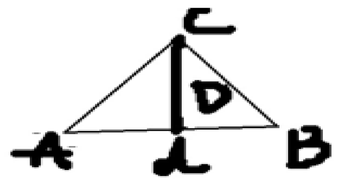


**Figure 1; Triple star system**
**A ( alpha centuari A)**
**B ( alpha centauri B )**
**C ( Proxima Centauri)**
**Here mean values of d= 23.4 AU and D =13000 AU.**

## 3.Observations and Inferences related to Proxima Centauri-

**Part of tripe star system**
**Mass : 1.07 to 1.27 earth masses**
**Orbital Period: 11.2 days ( possibly tidally locked with the host star).**
**Age : 4.85 Gyrs**

### 2.3 Long night periods and possibility of plant life

**1.If the planet is tidally locked then we can infer that it is a slowly rotating planet with a rotation period of 11.2 days (day and night last 5.5 days each)**
**2. Normal angiosperms are ruled in this planet out due to absence of photosynthetically active radiation (PAR) during planetary night time.**
**3.Night sky in Proxima Centauri b is not well illuminated by companion stars alpha cent A and B due to large distance (13000 AU) of these stars.**
**4.Existence of shade tolerant plant life with possibly long biorhythms can not be ruled out if continental water bodies are present in this exoplanet. Alternatively primitive life like bacteria can be thought of if large water bodies like oceans are present in this exoplanet.**
**5.Presence of oceans will also make possible plate tectonics like earth which is favourable for the emergence of advanced life in rocky planetary bodies.**

### 2.5 Radio Observations of Proxcentauri b and its astrobiological significance

**→Smith et al ( 2021) reported narrow band radio emission ( around 982 MHz) from Proxima Centauri from SETI type observations using the Parkes Murriyang radio telescope. This result suggests one of the following possibilities. This can be from a technologically advanced civilization present in Proxcent b.**
**→ Radio emission from Jupiter magnetosphere is observed to be in the range 10 kHz to 3 GHz. So the observed radio signals can be due to presence of magnetosphere and strong magnetic fields in Proxcentauri b.**
**→ Detection of wide band radio emission from Proxcentauri b can confirm this possibility. Both results are of astro biological significance. The second possibility seem to be more logical.**

**Results**
**1.Right age ( star-planetary system) and mass will ensure life favouring geophysical conditions in Proxima cent -b**
**2.The possibility of sufficiently strong magnetic fields in this exoplanet as suggested by recent radio emission observations may provide required shielding from hazardous space weather conditions.**

## 2.2 Inferred Dynamic Geophysical Conditions

**In a recent paper ( Varnana et al, 2023a),we have inferred dynamic geophysical conditions of 52 potentially habitable exoplanets including Proxima Centauri-b using a model based on relevant data related to rocky planets in the inner solar system. The volcanism in solar system rocky planets( Earth, Venus, Mars, Moon and Mercury) is found to show four distinct phases. Rocky exoplanets like Proxima Centauri b is also expected to follow this which decides its habitability ( see Table 1).**

**Table 1 Dynamic probability of finding certain life favoring geophysical conditions in geological evolution of rocky exoplanets ( Probability indications; L: low, M: moderate, H: high) during different phases of volcanism in these planets.(Varnana et al.,2023a)**

| Phase of Volcanism | Water | Oxygen | Ozone | Mag field shielding (Dynamic) |
|---|---|---|---|---|
| Early Ascending | L | L | L | L |
| Late Ascending | L | M | L | L |
| Peak | H | H | L | H |
| Declining | H | H | H | H |
| Cessation | M | M | M | L |
| Post Cessation | L | M | M | L |

**We could infer from the above model and also using basic data**
**→The peak phase of volcanism in Proxima Centauri b : 4.51 Gyrs since formation**
**→ Cessation phase of volcanism in Proxima Centauri b : 5.07 Gyrs since formation**

**→Since the estimated age of our planet is 4.85 Gyrs Proxima Cent b is currently in the declining phase of volcanism with high probability of finding water, oxygen, ozone and dynamic magnetic field conditions ( similar to Mars in the geological past)**

**→ The static magnetic moment M of Proxima Centauri estimated ( Varnana et al, 2023a) with the above mass of 1.27 earth masses and inferred roation period of 11.2 days ( due to tidal locking with host star)**

$$M \text{ ( Proxima Centauri b)} = 3.15 \times 10^{21} \text{ Am}^{-2} = 0.04\ M_E$$

**Where $M_{Ei}$ is the magnetic moment of Earth.**

### 2.4 Threats to life forms from hazardous space weather

**→No super flares are so far detected from Proxima Centauri.**
**→ Inferred energy of flares from this M star star is in the range $10^{30}$ to $10^{32}$ ergs. This is comparable to the energy of most intense solar flares.**
**→ Dynamical magnetic fields presence ( similar to Mars during peak or active phase volcanism due to a thermal dynamo ) now in ProximaCent b can ensure some shielding from hazardous energetic particles from the host star during intense stellar flare events.**
**→ EUV radiation from flares is threat to life in our exoplanet Presence of UV absorbing layers like ozone can prevent this whose probability is high for Proxima Cent b as inferred from our geophysical model.**
**→ Space weather hazard index α ( Varnana et al, 2018) of an exoplanet depend on the distance d of the planet from the host star. It is inferred that**

$$\alpha = 1/d^2 \qquad (1)$$

**where d is the mean distance ( in AU) of the exoplanet from the host star for Proxima Centauri b we find that**

$$\alpha = 0.043 \times 10^4 \qquad (2)$$

**→ This implies that space weather hazard in Prox cent b is at least 400 times that of Earth.**

References
Smith et al ( 2021) A radio technosignature search towards ProximaCentauri resulting in a signal of interest, *Nature Astronomy*, 5, https://doi.org/10.1038/s41550-021-01479-w

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