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Spectral detection of Oxygenic and Anoxygenic Photosynthesis on Extrasolar Planets like Proxima Centauri b.

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Proxima Centauri (type –M5.5V, 3050K) is a red dwarf only 4 light yr away, whereas the Sun is type G2V (5780 K). Could oxygenic and/or anoxygenic photosynthesis exist on planet Proxima Centauri b and would we be able to detect it? The light regimes on Earth and Proxima Centauri b are compared to estimate the planet' s suitability for Chlorophyll a (Chl *a*) and Chl *d*-based oxygenic photosynthesis and for Bacteriochlorophyll (BChl)-based anoxygenic photosynthesis. Proxima Centauri b has low irradiance in the oxygenic photosynthesis range (400–749 nm: 64 to 132 μmol quanta m^{-2} s^{-1}) but larger amounts of light is available for BChl-based anoxygenic photosynthesis (350–1100 nm: 724 to 1538 μmol quanta m^{-2} s^{-1}). Remote sensing techniques are routinely used to monitor algal blooms and terrestrial vegetation on earth. Their spectral properties are well documented. If Proxima Centauri b can be visualized is should be possible to detect Chl *a* based photosynthesis on the planet based on the reflectance properties of any algae and vegetation present and the signatures of oxygenic photosynthesis such as the presence of oxygen and ozone. An integrating sphere spectrometer has been used to prepare reflectance spectra of oxygenic photosynthetic organisms (*Synechocystis* PCC6803, a blue green alga with only Chl *a*; the Chl *a* + *b* green alga *Chlorella vulgaris*, the diatom *Chaetoceros sp* with Chl *a* + Chl *c1+c2* and the unusual Chl *d+a* organism, *Acaryochloris marina*. Estimates are made of what their reflectance spectra would look like irradiated by Proxima Centauri. Anoxygenic photosynthetic organisms are much less familiar to astronomers, astrobiologists and biologist in general. Evolutionarily it is known that anoxygenic photosynthesis predated oxygenic photosynthesis and so it is likely to be more common in the universe than anoxygenic photosynthesis. *Rhodopseudomonas palustris* (BChl *a*), *Afifella marina* (BChl *a*), *Thermochromatium tepidum* (BChl *a*), *Chlorobaculum tepidum* (BChl *a* + *c*) and *Blastochloris viridis* (BChl *b*) were used as representative anoxygenic photosynthetic organisms to estimate their reflectance. Chlorophylls (Chl) absorb blue and red light but BChls use blue and infrared light for photosynthesis. The difference in their reflectance spectra could be used to distinguish oxygenic from anoxygenic photosynthesis.

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