BIOHAZE AS ATMOSPHERIC BIOSIGNATURE ON EXOPLANETS.

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Introduction: Unambigous detection of life on other planets requires multiple biosignatures to exclude false-positives. Recently, we have developed a polarimetry-based remote-sensing method for detecting and identifying photosynthetic life forms in distant worlds and distinguishing them from non-biological sources [1]. On Earth, the surface biosphere emits a substantial amount of bioaerosols to the atmosphere [2], where they comprise up to 25% of total airborne particle mass [3]. These bioaerols continuousy emitted into a planetary atmosphere may create biohaze and cloud droplets containing biopigments and other partially decomposed biomass.

Methods & Results: Using our bio-polarimetric experimental setup BioPol we have measured optical polarized spectra of various biological and non-biological samples and modeled intensity and polarized spectra of Earth-like planets having different surface coverage by photosynthetic organisms, deserted land, and ocean, as well as clouds. Here, we employ our measurements of photosynthetic bacteria (Fig. 1) for modeling planetary atmospheres polluted by bio-aerosols, such as living and partially degraded bacteria and biopigments. Some of our samples were actually collected from the Earth's atmosphere and subsequently grown in the lab.

We have studied both liquid and dry bacterial, living and partially degraded, samples and obtained reflected polarized spectra at various incident and scattering angles. In addition, we obtained transmission spectra for unpolarized and polarized light. Then, using our model for stellar light scattered by a planetary atmosphere [4] we compute polarized light-curves and spectra from planets with biohazes and cloud droplets containing bacteria and photosynthetic pigments. We estimate the minimum concentration of biomass in the atmosphere necessary for remote detection on distant Earth-like exoplanets.

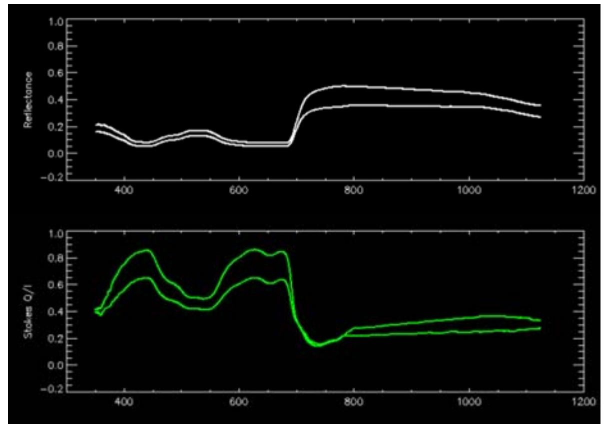

Figure 1: Reflectance (top) and linear polarization (bottom) spectra of cyanobacteria. Linear polarization peaks at the maximum absorption of biopigments.

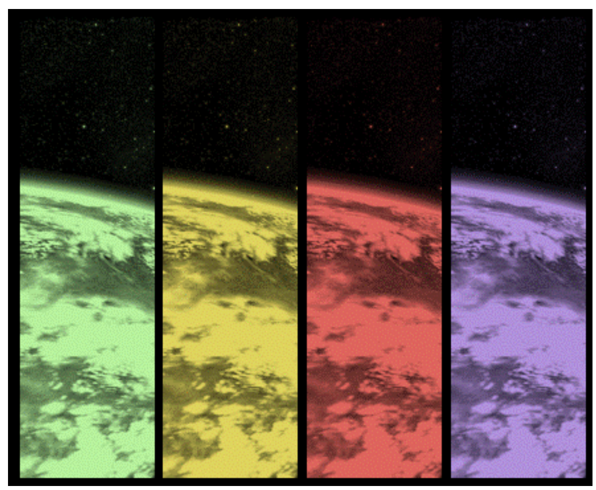

Figure 2: Biohaze: Can biopigments residing in atmospheric haze and cloud droplets be detected on Earth-like exoplanets?

References::

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