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ExoPhot: Phot0, a plausible primeval pigment on Earth and rocky exoplanets

Juan García de la Concepción and Pablo Marcos-Arenal
Centro de Astrobiología (CSIC-INTA), Ctra. de Ajalvir km. 4, Torrejón de Ardoz, 28850 Madrid, Spain

Photosynthesis, the metabolic route for conversion of solar to chemical energy, could be present in any planetary system provided with the only three required ingredients: a light source, water, and carbon dioxide.

The ExoPhot project aims to study the relation between photosynthetic systems and exoplanet conditions around different types of stars (i.e. stellar spectral types) by focusing on two aspects: Assessing the photosynthetic fitness of a variety of photopigments (either real or theoretical) as a function of stellar spectral type, star-exoplanet separation, and planet atmosphere composition; and delineating a range of stellar, exoplanet and atmospheric parameters for which photosynthetic activity might be feasible. In order to tackle this goals, this project is studying the evolutionary steps that led to the highly evolved chlorophylls and analogues, and assessing the feasibility or likelihood to trigger photosynthetic activity in an exoplanetary system.

Based on the Darwinian theory of common ancestors, the first (photosynthetic) organism should have had simple oligopeptides, oligonucleotides and alkyl amphiphilic hydrocarbons as primeval membranes. Therefore, it should have had simple pigments. We propose that there could exist geochemical conditions allowing the abiotic formation of a simple pigment which might become sufficiently abundant in the environment of an exoplanet. Besides, we show that the proposed pigment could also be a precursor of the more evolved pigments known today on Earth by proposing, for the first time, an abiotic chemical route leading to tetrapyrroles not involving pyrrole derivatives.

Juan García de la Concepcióna,* Pablo Marcos-Arenala, Luis Cerdánb, Mercedes Burillo-Villalobosc, Nuria Fonseca-Bonillaa,María-Ángeles López-Cayuelad, José A. Caballeroe, and Felipe Gómez Gómeza

aCentro de Astrobiología (CSIC-INTA), Ctra. de Ajalvir km. 4, Torrejón de Ardoz, 28850 Madrid, Spain; bInstituto de Ciencia Molecular (ICMoL), Universidad de Valencia, 46071 Valencia, Spain.;cInstituto Nacional de Técnica Aeroespacial, 28850 Torrejón de Ardoz, Madrid, Spain.; dÁrea de Investigación e Instrumentación Atmosférica,Instituto Nacional de Técnica Aeroespacial, 28850 Torrejón de Ardoz, Madrid, Spain.; eCentro de Astrobiología (CSIC-

INTA), ESAC, camino bajo del castillo, 28691 Villanueva de la Cañada, Madrid, Spain