**Exophotosynthesis, a Letter of Intent for a Human Frontier Science Program research grant**

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One of the main objectives of EAI is to catalyze new scientific collaborations aiming at generating project proposals to be submitted for funding acquisition. An example of the importance of the work done by the Institute is the Letter of Intent entitled “Exophotosynthesis: Photosynthetic biosignatures in Earth-like exoplanets”, recently presented by José A. Caballero (CAB, Madrid) as PI and Nicoletta La Rocca (UNIPD, Padova), Mickael Baqué (DLR, Berlin), and Michele Maris (INAF, Trieste) as co-PIs to obtain a Human Frontier Science Program research grant.

The initiative to propose the project started, indeed, from José A. Caballero during the last meeting of the EAI Working Group “Biosignatures and the detection of life beyond Earth”, and later involved a large part of the participants in the discussion on its feasibility and in the definition of the final research team.

The project proposed by the Letter of Intent starts from the consideration that to understand whether Earth-like exoplanets in their habitable zone could harbour photosynthetic life with stars providing different illumination regimes than our Sun, laboratory and numerical simulations are absolutely necessary.

With the project we propose to carry out the most comprehensive and interdisciplinary work to date on the detectability of biosignatures produced by photosynthetic organisms (either by their reflectance or the effect of their metabolites in atmospheres) as a function of exoplanet host star spectral type (i.e. effective temperature and luminosity), star-exoplanet separation (semimajor axis), and main atmospheric parameters (composition, albedo, temperature-pressure profile). In general, previous research on the astrobiological topic of photosynthesis on exoplanets has focused on the different parts of the problem separately. Our four teams are at the forefront of each respective discipline: astrophysics at CAB, exoclimatology and exoatmosphere modelling at INAF and photosynthesis at both UNIPD and DLR. The two biology teams are needed as we want to explore a huge grid of stellar spectral energy distributions, planet properties, atmospheric compositions, and photosynthetic organisms (from cyanobacteria, through algae and lichens, to flowering plants), which are impossible to analyse at only one laboratory. The combined capabilities of simulations chambers from UNIPD and DLR will provide a wide range of organisms and environments to match observations and numerical simulations best. What really makes our research proposal novel and unique is its genuine interdisciplinarity by taking into account all the different parts of the problem simultaneously and giving them the same weight. The combination of biology, atmospheric science and astrophysics is, in our opinion, the only way to answer one of the fundamental questions: “Is there life on other planets?”. Soon, astronomers will have facilities with which to detect biosignatures on planets around nearby stars. We think that all astrobiologists will have to work together for uncontrovertibly demonstrating that these biosignatures are, without any doubt, the proof of life outside our Solar System.

This research project will be developed under the umbrella of the EAI. However, its development implies a wider international collaboration (including USA) beyond our four teams.