Respective capabilities of affordable Coronagraphs and Interferometers searching for Biosignatures

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Abstract

We describe an analytic model to estimate the capabilities of space missions dedicated to the search for biosignatures in the atmosphere of rocky planets located in the Habitable Zone of nearby stars. Relations between performance and parameters such as mirror diameter, distance to targets..., are obtained.
Two types of instruments are considered: Coronagraphs observing in the visible, and Nulling Interferometers observing in the thermal infrared. Missions considered are single-pupil coronagraphs with a 2.4 m primary mirror, and formation flying interferometers with 4 x 0.75 m collecting mirrors and baselines ranging from a few decametres to a few hectometres.

The numbers of accessible planets are calculated as a function of eta_earth, the mean number of Earth analogues and super-Earths in stellar Habitable Zones.

Based on current estimations, eta_earth=10% around FGK stars and 50% around M stars, the built-in (starshade) coronagraph could study in spectroscopy only _˜ 1.5 (2.0) relevant planets, and the interferometer _˜ 14 ones. These numbers are obtained under the major hypothesis that the exozodiacal light around the target stars is not an issue.
For the long-term future, building both types of spectroscopic instruments, and using them on the same targets, will be the optimal solution because they provide complementary information. But as a first affordable space mission, the interferometer looks the more promising in term of biosignature harvest.

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