OBSERVING BIOMARKERS AND GREENHOUSE GASES IN THE ATMOSPHERES OF EXO-EARTHS WITH THE JWST AND THE EXTREMELY LARGE TELESCOPES

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Introduction: For the very first time in human history, we are only a few years away from being capable of characterizing habitable worlds beyond Earth — worlds that may host extraterrestrial life. We now stand at the brink of answering two paradigm-changing questions: Do other planets like Earth exist, and do any of them harbor life?

Within the next ten years, the landscape of observational astrophysics will completely change: TESS, being an space-bound all-sky survey to detect thousands of exoplanets will be launched in 2017 and will reveal hundreds of potentially habitable rocky planets slightly larger than Earth: super-Earths. In 2018, the largest space observatory ever built will become operational: the James Webb Space Telescope (JWST). In the mid-2020ies, the three ground-based extremely large telescopes (ELTs) with diameters beyond 24 m will become operational.

Feasibility studies: With both the JWST and the ELTs, we will be able to inspect the atmosphere of (transiting) rocky exoplanets via transmission spectroscopy for the very first time. Fig. 1 shows the simulated transmission spectrum of our planet; O_2, CO_2, H_2O and CH_4 produce the most prominent molecular absorption features in the optical and near-infrared wavelength regime.

How much observing time do we need to detect molecules in the atmosphere of an exo-Earth? Here we present our latest feasibility studies for the JWST and the ELTs, and we furthermore discuss strategies to increase and optimize the efficiency of observations. Preliminary results show that in just 30 hours observing time it will be possible to measure oxygen in the atmosphere of an exo-Earth [1].

[1] Rodler, F. and López-Morales, M. (2014), ApJ, 781, 54

Fig. 1: Transmission spectrum of an exo-Earth, taken with JWST