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ExoTETHyS: Tools for Exoplanetary Transits around Host Stars

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Abstract

1. Introduction

Characterization of the atmospheres of transiting exoplanets relies on accurate measurements of the extent of the optically thick area of the planet at multiple wavelengths with a precision of the order of 100 parts per million (ppm). Next-generation instruments onboard the James Webb Space Telescope (JWST) are expected to achieve $\sim$10 ppm precision for several tens of targets. A similar precision can be obtained in modelling only if other astrophysical effects, including the stellar limb-darkening, are accounted for properly.

2. ExoTETHyS: Tools for Exoplanetary Transits around Host Stars

ExoTETHyS is a python package than contains several functions which are useful to model the exoplanetary transits. The first release includes a function to calculate the limb-darkening coefficients for specific stars and passbands with a a few user-defined options. The basic output files contain only the requested limb-darkening coefficients and a quality index (that can be safely ignored in most cases). Alternatively, the user can request to have the various intermediate products of the calculations as output. This option is intended for debugging in case of anomalous results or for peculiar studies. Another advantage compared to the other existing limb-darkening calculators is the use of an optimised fitting strategy, which is particularly important when using stellar models calculated with the spherical geometry (e.g., PHOENIX). We found that the use of less optimal fitting algorithms which are adopted in other calculators may introduce a bias in the measured transit depth at the level of tens ppm, which is comparable with the error bars obtained with *HST*/WFC3 or expected with future instruments.

ExoTETHyS is being implemented in both the ARIEL and JWST/MIRI instrument simulators. Other uses of the ExoTETHyS software will be described by Morello et al., in prep.