Exonoodle: Synthetic time-series spectra generator for transiting exoplanets

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Summary

`exonoodle` is a Python 3 package which generates time-series spectra for transiting exoplanet systems. The package reads modelled spectral contributions for a given planet and star (or generates a black-body spectrum) and creates the expected spectral variation of the star-planet system as the planet is orbiting around the star.

The details of the package algorithm along with the scientific background can be found in a companion paper (Martin-Lagarde et al., 2020) including example use cases. Technical usage and a detailed user manual are available on GitLab.

The main calculation of the transit spectral light-curve is adapted from the model of (Mandel & Agol, 2002). The novelty of this code compared to those that are already available to the community (see Table. 1) is that it includes the planetary contribution, and computes the spectra directly. This means the algorithm solutions are different compared to existing codes, because it does not directly provide light-curves, it provides the actual time-series spectral data. Hence, the computation is almost fully vectorial in wavelength, and the output is a folder containing a set of spectral files. Flexibility and efficiency in the input of the package is due to extensive use of the `Astropy` package (Astropy Collaboration, 2013) (and especially `astropy.units`). Computing the complete light curve in parallel, using 4 CPU on a laptop (Intel i7-6820HQ CPU @ 2.70GHz) take approximately ~5 minutes and scale with the number of CPUs used and their individual specifications.

The `exonoodle` package has been developed in the framework of preparations for the James Webb Space Telescopes Early Release Science (ERS) observations, and is already used along with the MIRI instrument simulator to produce synthetic MIRI Low Resolution Spectroscopic data. These data will be used in ERS data challenges planned ahead of launch in late 2020.

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