EPSC Abstracts
Vol. 15, EPSC2021-700, 2021
https://doi.org/10.5194/epsc2021-700
Europlanet Science Congress 2021

Novel methods to probe exoplanet atmospheres using ground-based spectrophotometry

Vatsal Panwar[1], Jean-Michel Desert[1], Kamen Todorov[1], Jacob Bean[2], Catherine Huitson[3], Kevin Stevenson[4], Jonathan Fortney[5], and Marcel Bergmann[6]

[1]University of Amsterdam, Amsterdam, Netherlands
[2]Department of Astronomy and Astrophysics, University of Chicago, Chicago, USA
[3]CASA, University of Colorado, Boulder, USA
[4]Applied Physics Laboratory, Johns Hopkins University, Laurel, USA
[5]Department of Astronomy and Astrophysics, University of California, Santa Cruz, USA
[6]NOAO Gemini Observatory, present address Palo Alto, CA, USA

Ground-based spectrophotometric observations of transiting exoplanet atmospheres conventionally rely on correcting for instrumental and telluric systematics in the light curves by using reference stars that are simultaneously observed. However, this approach often leads to sub-optimal corrections due to multiple accounts on which the target and reference star spectra can be affected by systematics differently through the night, ultimately limiting the achievable precision and accuracy on the measurement of planetary atmospheric signatures. We introduce a new method based on Gaussian Processes regression to address this challenge by extracting the transmission or emission spectrum without relying explicitly on the reference stars. Our new method overcomes the necessity of using reference stars and opens up the doors to ground-based atmospheric observations of exoplanets orbiting bright host stars (e.g. those discovered by TESS) that intrinsically lack proper reference stars. We present results from the application of our method to a broad sample of exoplanets observed in the optical and near-infrared using Gemini/GMOS and Keck/MOSFIRE. We also discuss the challenges and possible solutions arising from stellar variability towards combining high precision ground-based low-resolution spectroscopy observations in complementarity with future infrared observations from HST and JWST.