Contribution ID: **54** Type: **not specified**

Black Mirror: The impact of rotational broadening on the search for reflected light from exoplanet atmospheres with high resolution spectroscopy

Tuesday 31 May 2022 11:45 (15 minutes)

The extreme contrast ratios between stars and their planets at optical wavelengths make it challenging to isolate light reflected by exoplanet atmospheres. Yet, these reflective properties reveal key processes occurring in the atmospheres, and also span wavelengths that include potential O2 biosignatures. High resolution cross-correlation spectroscopy (HRCCS) offers a robust avenue for detecting exoplanet reflection spectra, where it is boosted by the addition of the numerous lines that the exoplanet reflects from its host star. Here, we report the deep contrasts achieved by our search for the reflected light spectrum of the non-transiting hot Jupiter 51 Peg b, using ground-based optical HRCCS from HARPS & HARPS-N on 3.5 metre telescopes. We have made specific adaptations to techniques originally designed to remove tellurics from infrared HRCCS to instead remove optical stellar lines. Importantly, we demonstrate that the so far neglected impact of broadening due to the difference between the stellar rotation and the planet's orbital velocity can significantly impact the recovery of reflected light spectra. We detect no significant reflected light from 51 Pegasi b, in line with predictions, achieving deep, ground-based upper limits on the contrast ratio of 76 ppm (7.60 x 10^-5) when including broadening, and 24 ppm (2.40 x 10^-5) without. These upper limits stringently rule out radius and albedo combinations of previously claimed detections for reflected light from 51 Peg b. We find that broadening significantly hinders HRCCS in extracting the reflected light spectra of most hot Jupiters as well as Earth-size planets in the traditional habitable zones of some M-dwarfs and thus must be accounted for when determining the contrast ratio, radius, and albedo of the planet. Finally, we suggest that using synthetic, rather than observed templates in reflection HRCCS, enables greater exploration of the properties of the exoplanet atmosphere, including abundances and dynamics.

Presenter: SPRING, Eleanor (University of Amsterdam)

Session Classification: Parallel session