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The legacy of HST/WFC3: First insights into the nature of super-Earths

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Abstract

Today, more that 3900 exoplanets have been detected, with super-Earths being the most common in our galaxy. We still know very little about these planets, with their basic parameters such as radius and mass – when available – suggesting a great variety among them. However, the density alone does not reveal the chemical composition and climate of these planets, nor casts light into their formation history. To answer those questions, we need to observe their atmospheres. Currently, the WFC3 camera on-board the Hubble Space Telescope is the most powerful instrument to perform infrared transit spectroscopy of exoplanets. In particular, the use of the spatial scanning technique has given the opportunity for even more efficient observations of the brightest targets, achieving the necessary precision of 10 to 100 ppm to the flux of the star.

Atmospheric characterisation of super-Earths is within reach of the WFC3 but such observations have been very limited so far, with no confirmed detection of molecules. Three targets with radii above 1.5 Earth radii – GJ-1214 b, HD 97658 b and 55 Cnc e – have been studied so far. The first two show only flat spectra, suggesting an atmosphere covered by thick clouds or made of heavy molecular species, while only the spectrum of 55 Cnc e has revealed a light-weighted atmosphere, suggesting H/He still being present. In addition, the transit observations of six planets around TRAPPIST-1 – planets b, c, d, e, f, and g – have not shown any molecular signatures and have excluded the presence of cloud-free, H/He atmospheres around them.

In this presentation, I will discuss the main characteristics of the WFC3/IR instrument, the process followed to develop an automatic analysis pipeline, and the lessons learnt from this process, focusing on the parallel development of both data analysis and simulation software. I will also present the result of reanalysis of previously published spectra of super-Earths as well as new results from recent observing campaigns with HST.