Strategies to photometric follow-up transiting exoplanets

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Abstract

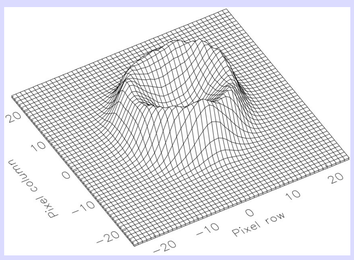
Our project aims to obtain ultra-high-precision photometry of transit events, which are analyzed to accurately measure the physical properties of know planetary systems. For this purpose, we are using an array of medium-class telescopes located in both the hemispheres.
Besides measuring and refining the physical properties of the planets and their parent stars, we also try to obtain additional information from the light curves, by identify particular features of the systems (e.g. stellar activity) and investigating the composition of the planetary atmosphere by transmission photometry. In this poster we present several observational strategies that we use to achieve these goals.

Defocussing technique

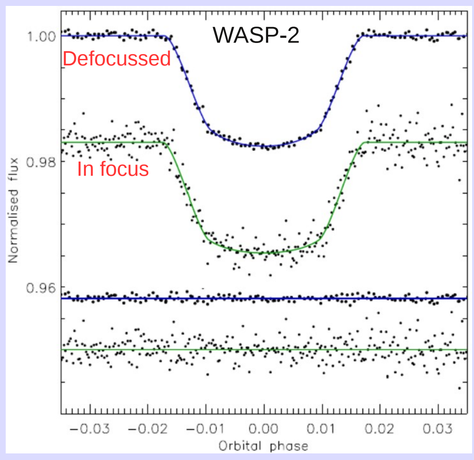
The defocussing technique consists in using the telescope out of focus, obtaining doughnut-shaped stars. In this way the photons are spread out over many more pixels, allowing to observe bright targets with a longer exposure time and collecting more signal.

Improvement:

- Increase the S/N
- Lower noise from atmospheric and seeing variations
- Decrease flat-field errors

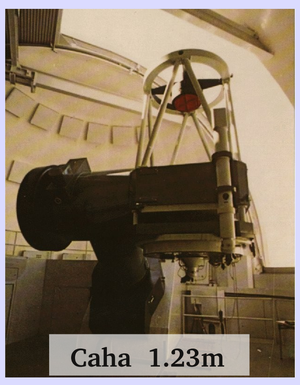


Southworth et al. 2009 MNRAS, 399, 287



Southworth et al. 2010 MNRAS, 408, 1680 & Charbonneau et al. 2007 ApJ, 658,1322

Two-site simultaneous observations



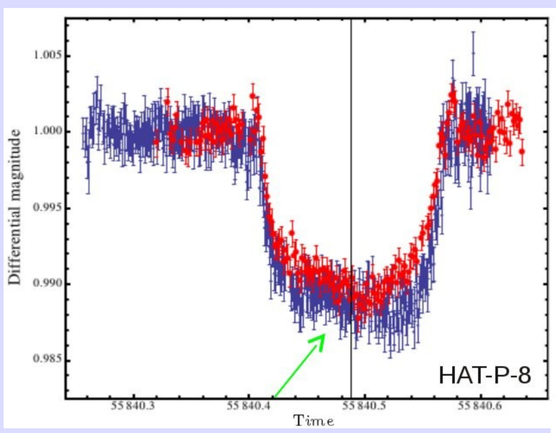
Irregularities in transit light curve's shape can have different causes difficult to disentangle:

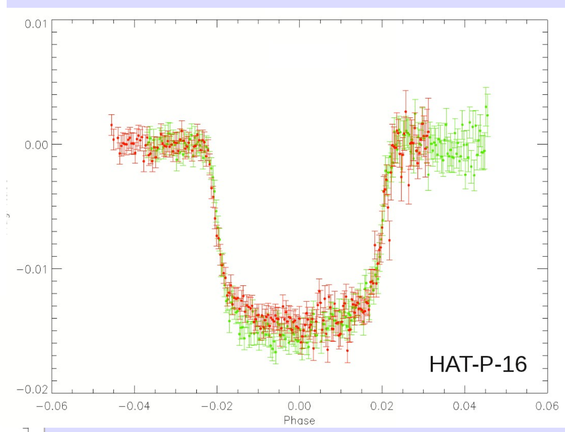
- Atmospheric variations and instrumental systematic
- Astrophysical phenomena

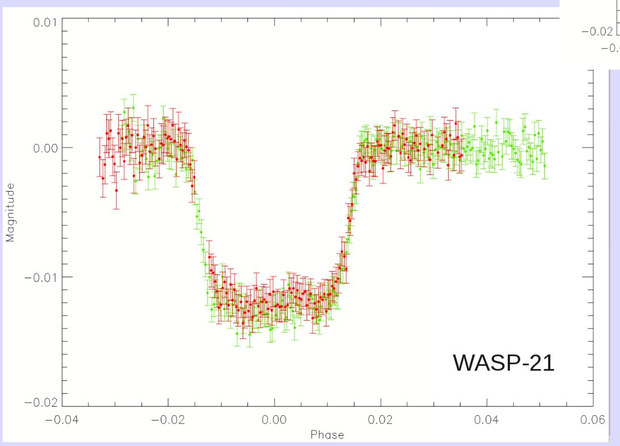
Possible solution: two telescopes!

We observe the same transit contemporaneously with two different telescopes from two observatories. In this way we can discriminate instrumental or atmospheric noise from real astrophysical signals. The two telescopes must be:

- Not too close: to have independent atmospheric condition
- Not too far: to be able to observe the same transit event







Possible astrophysical cause for the anomaly in HAT-P-8:

- Star-spots
- Stellar pulsation
- Exomoon

Mancini et al. 2013 A&A 551, A11 & Ciceri et al. 2013 A&A 557, A3

Multi-band observations

During a planetary-transit event, the light coming from the star could be absorbed or scattered at particular wavelengths by the atmosphere of the planet in a weak or strong fashion, depending by the atmospheric opacity.

Similarly to the transmission spectroscopy, by observing a planetary transit at different band-passes simultaneously, it is possible to look for variations in the value of the planet's radius measured as a function of the wavelength, and probe the composition of its atmosphere.

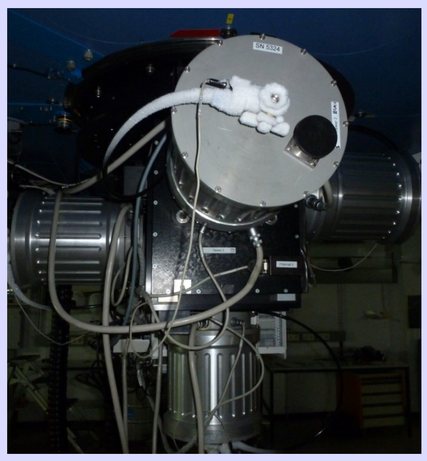
Instruments

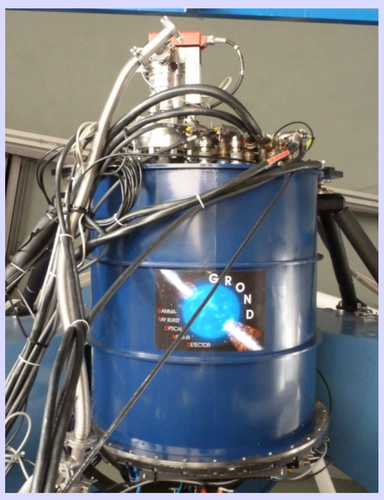
BUSCA

- @ 2.2m in Calar Alto
- 4 optical bands:
  - u, g, r, z (broad bands)
  - u, y, b, z (narrow bands)

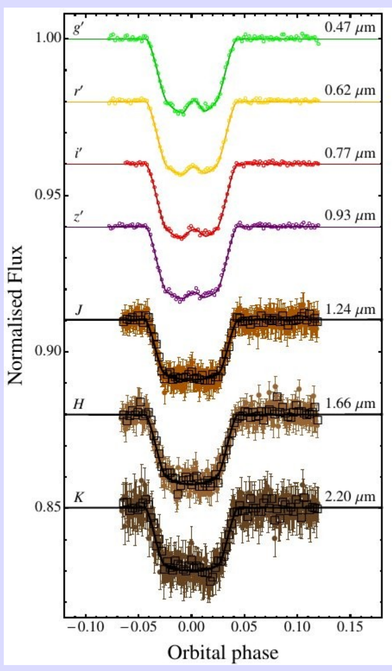
GROND

- @ 2.2m in La Silla
- 4 optical bands: Sloan g', r', i', z'
- 3 NIR bands: J, H, K



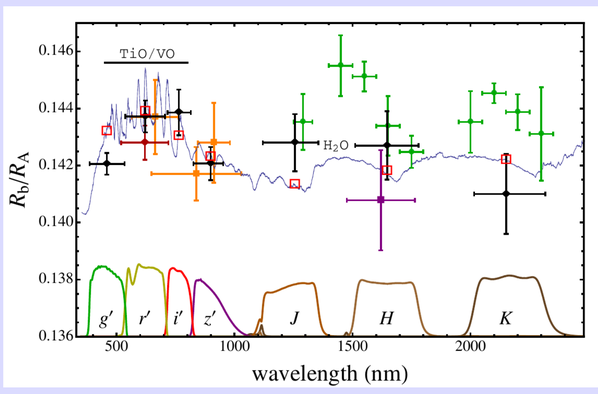


We investigate the theoretically-predicted variation of the planetary radius as a function of wavelength



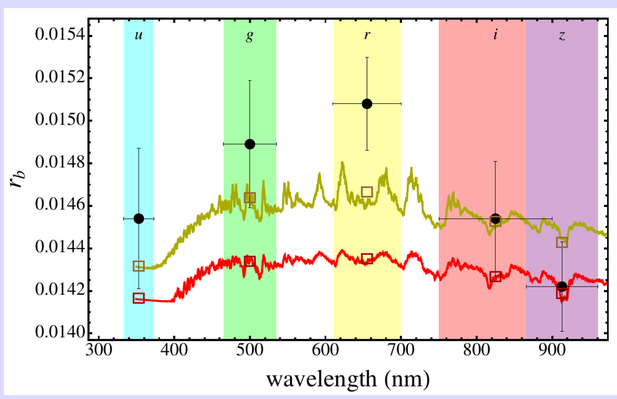
WASP-19

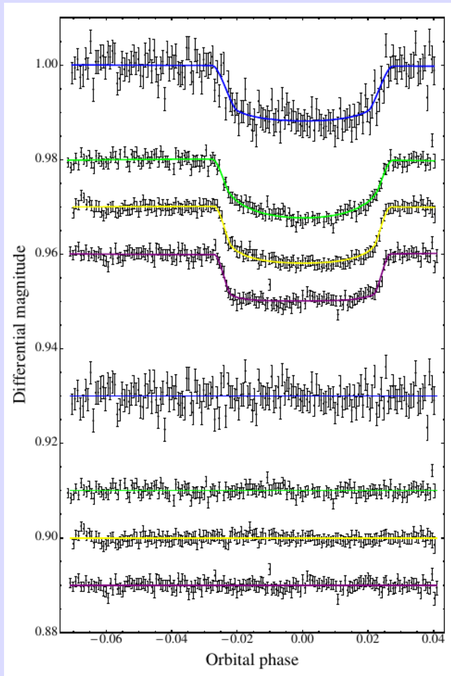
Observed with GROND



HAT-P-8

observed with BUSCA





Mancini et al. 2013 A&A 551, A11 & MNRAS 430, 2932