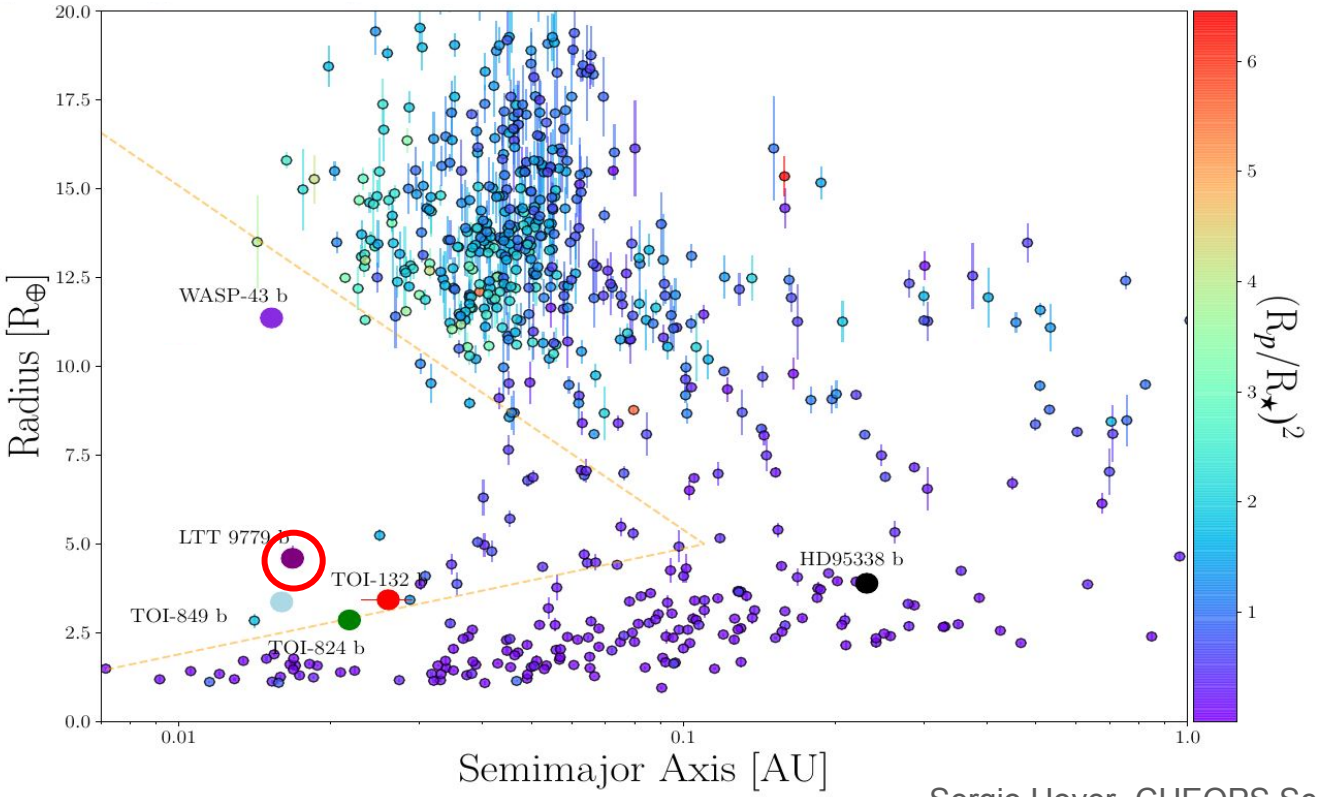
Secondary eclipses of LTT9779b observed with CHEOPS

CHEOPS Science Workshop VI

Sergio Hoyer, James Jenkins, Matías Diaz, Magali Deleuil, Vivien Parmentier, Tom Wilson, Gaetano Scandariato, Tiffany Kataria, Ian Crossfield, Diana Dragomir, Monika Lendl, Kevin Heng, Enric Palle, Valerie Van Grootel, Ricardo Ramirez, Pablo Rojas, Jose Vines.

Context

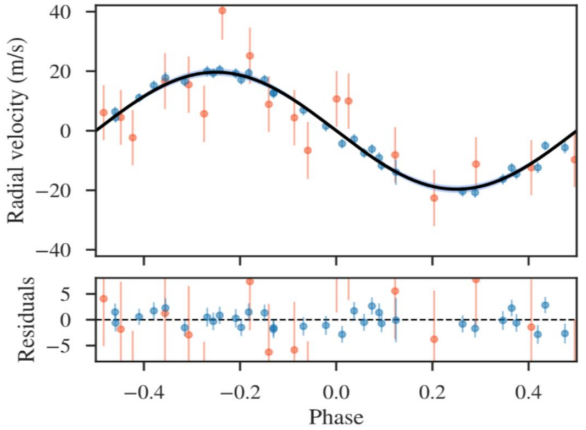
LTT9779b is the first ultrahot Neptune in the desert (Jenkins+2020)

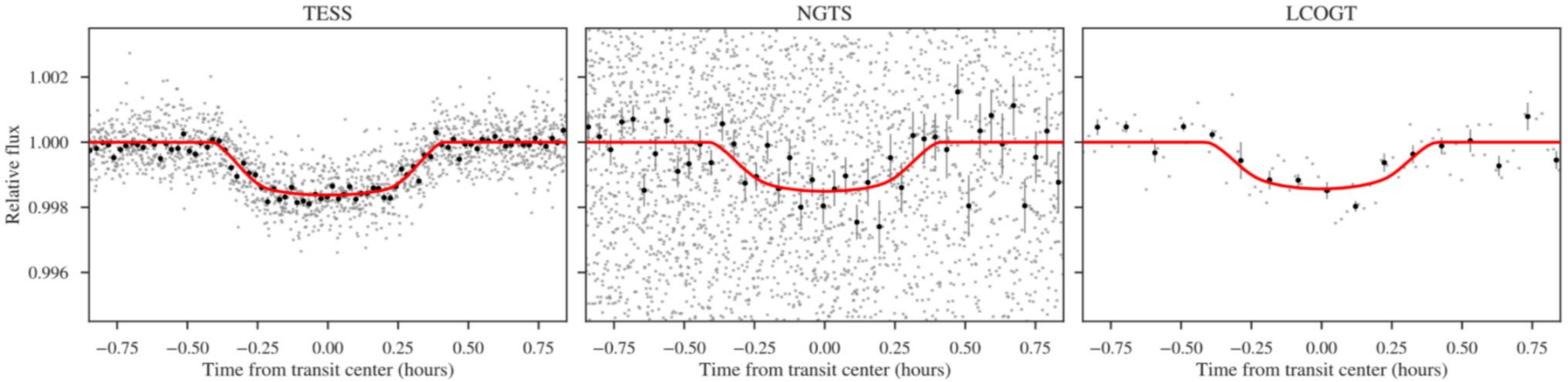


LTT9779b

Joint modelling (Jenkins+2020):
Photometry: TESS+NGTS+LCOGT
RVs: HARPS

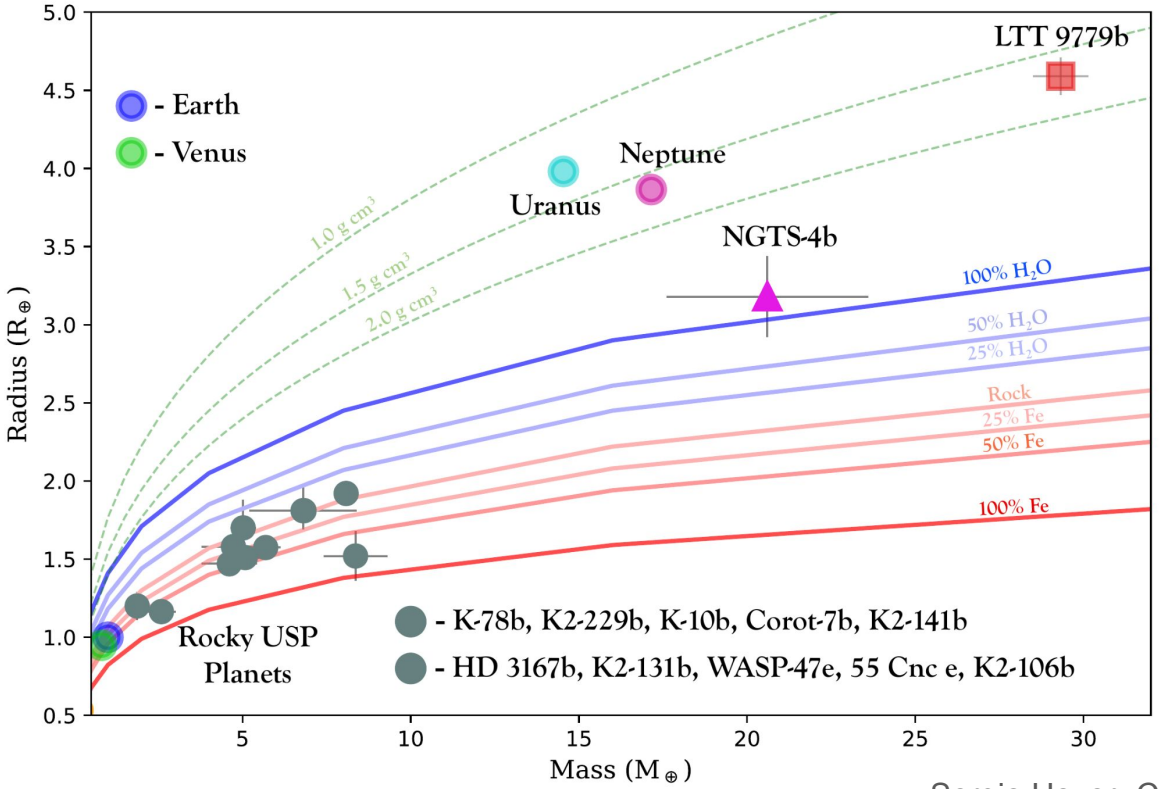
- P = 0.792052 +/- 0.000009 d
- Rp = 4.59 +/- 0.23 R⊕
- Mp = 29.32 +/- 0.8 M⊕
- ρ = 1.677 +/- 0.128 g/cm3





LTT9779b

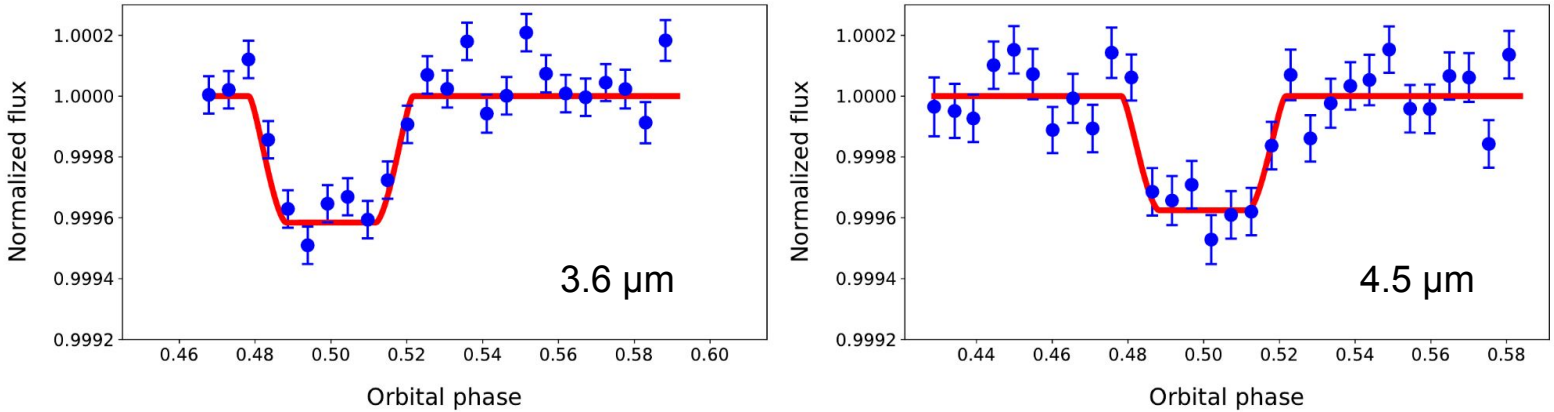
LTT9779b vs known USPs



Jenkins+2020

Context

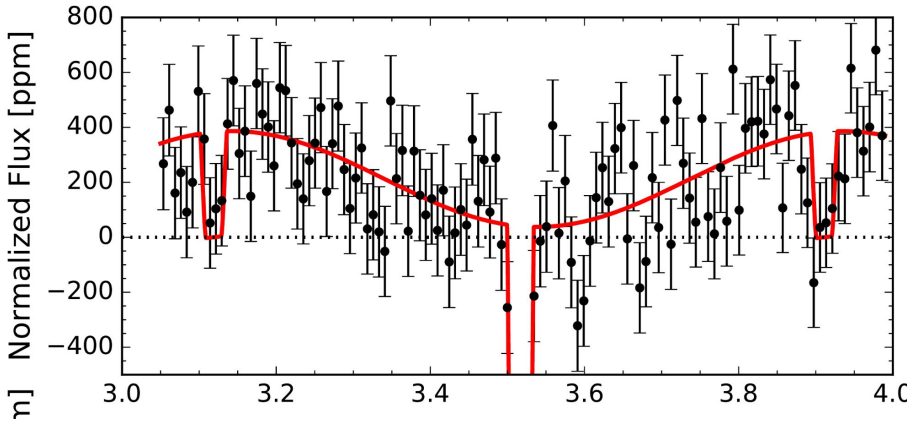
Eclipses of LTT9779b observed by IRAC@Spitzer (Dragomir+2020)



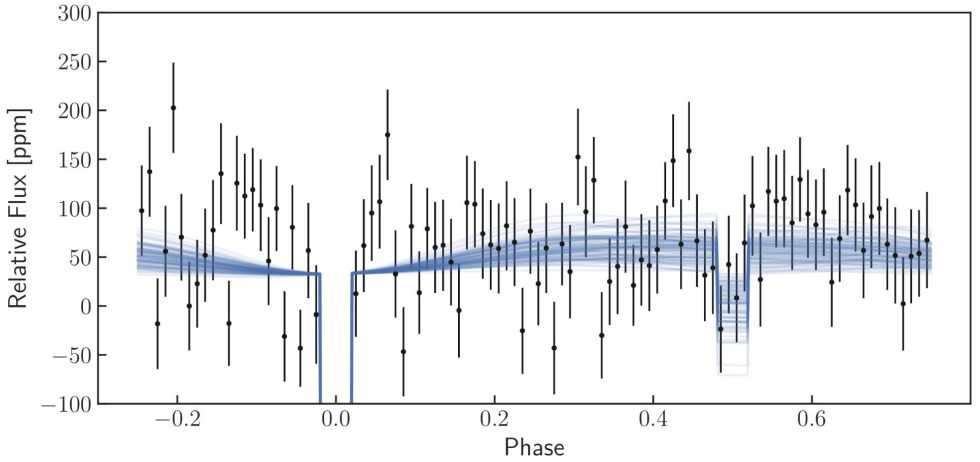
- Dayside Temperature = 2305 +- 141 K (from 3.6 μm eclipse)
- Model with CO preferred over a blackbody
- No evidences of thermal inversion

Context

Phase Curves observed by IRAC@Spitzer and comparison to what is measured by TESS (Crossfield+2020)

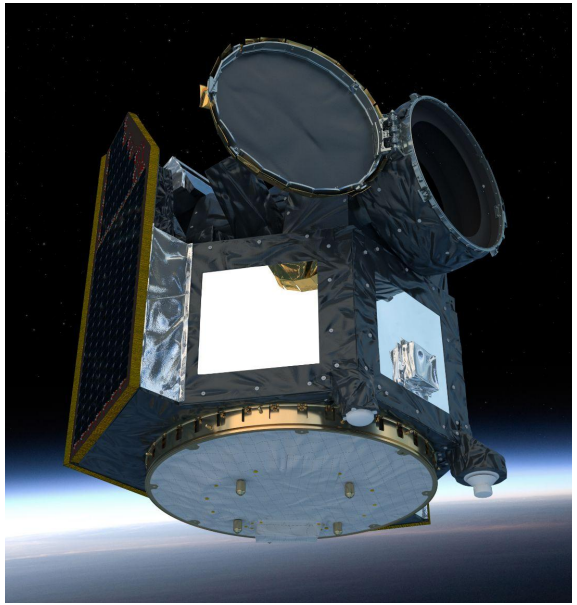


IRAC 4.5 μm



TESS

LTT9779b's eclipses seen by CHEOPS

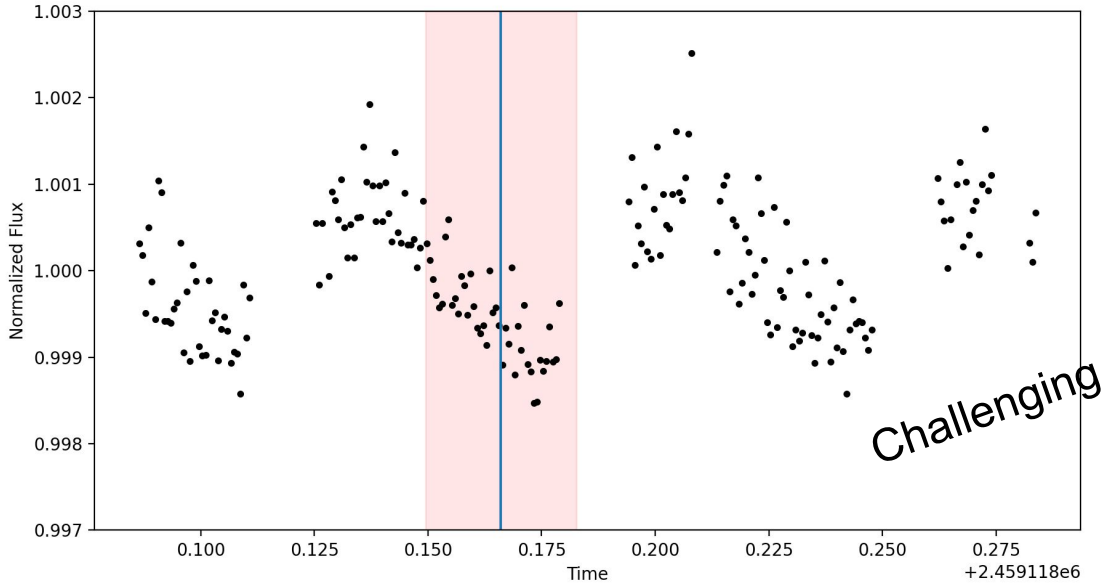


10 Occultations observed by CHEOPS:

- First DTT proposal granted by ESA.
- LTT9779b → *G*-mag=9.6
- 5 hours long visits (3 CHEOPS orbits) with >60% of efficiency.

LTT9779b's eclipses seen by CHEOPS

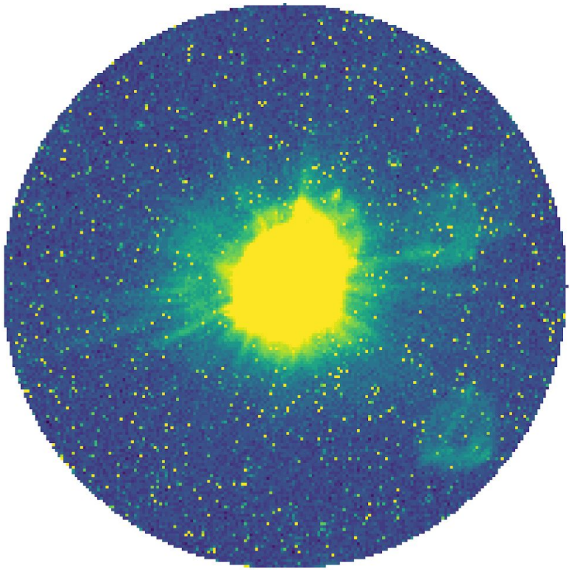
Example of a raw CHEOPS light curve



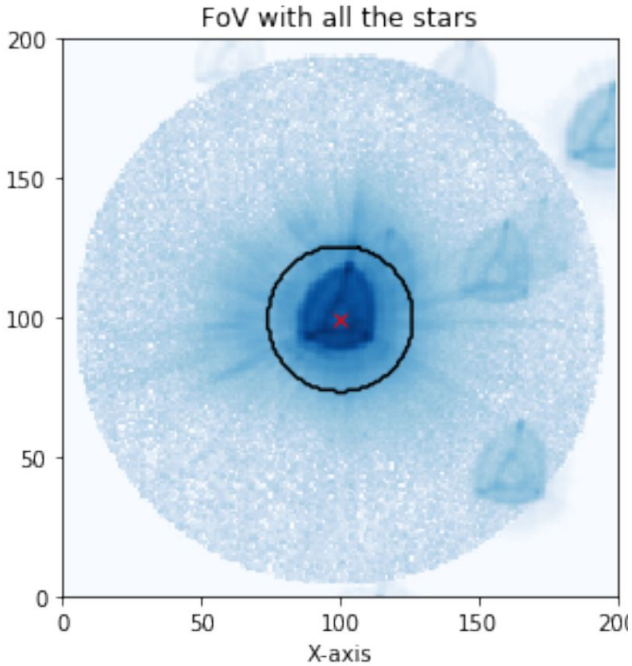
Challenging analysis!

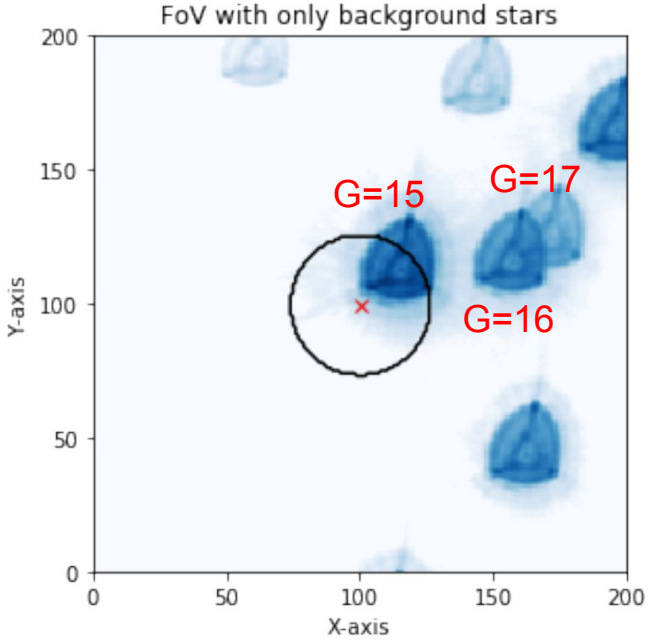
LTT9779b's eclipses seen by CHEOPS

LTT9779b in CHEOPS Field of View



CHEOPS Subarray image

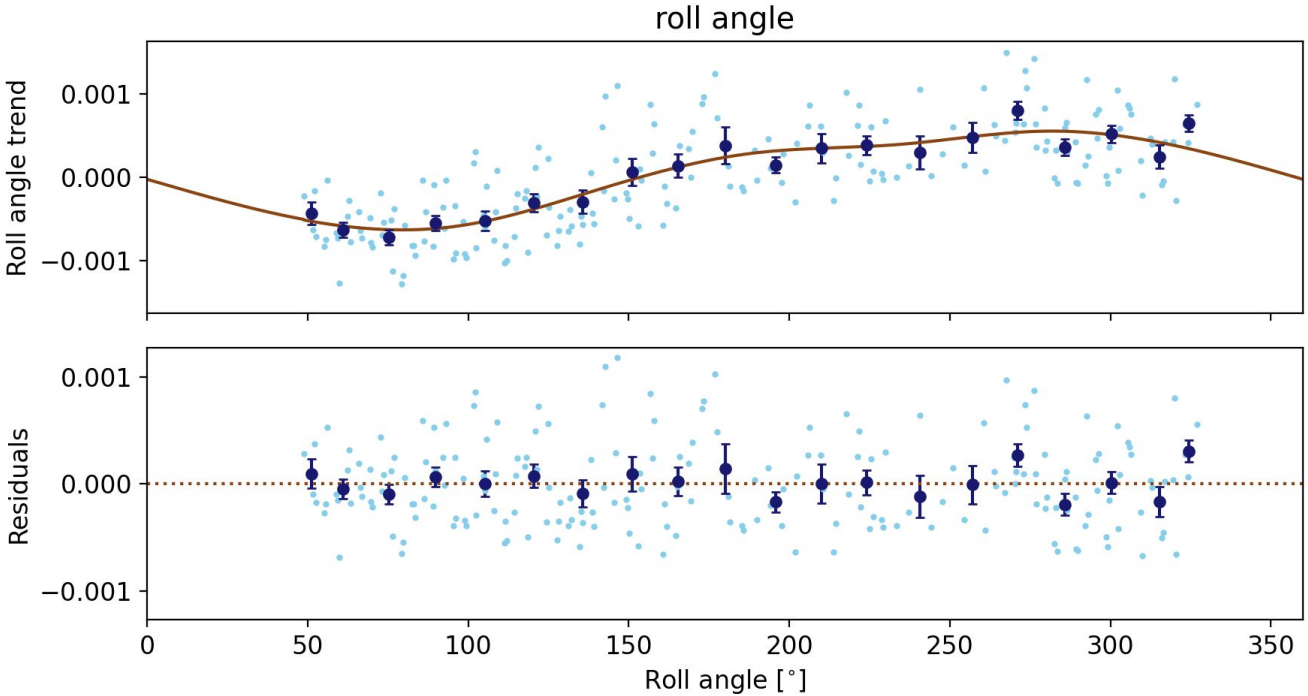




CHEOPS DRP simulations (with/out target)

LTT9779b's eclipses seen by CHEOPS

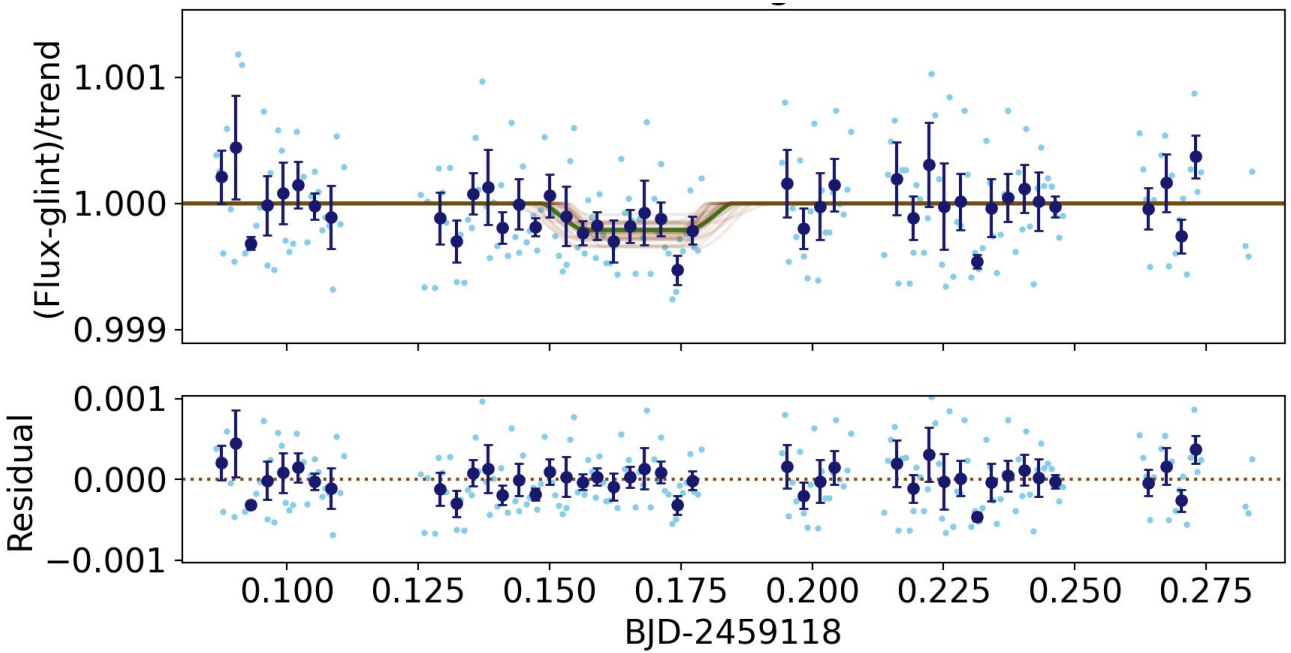
Flux vs roll angle



pycheops (Maxted et al. Accepted)

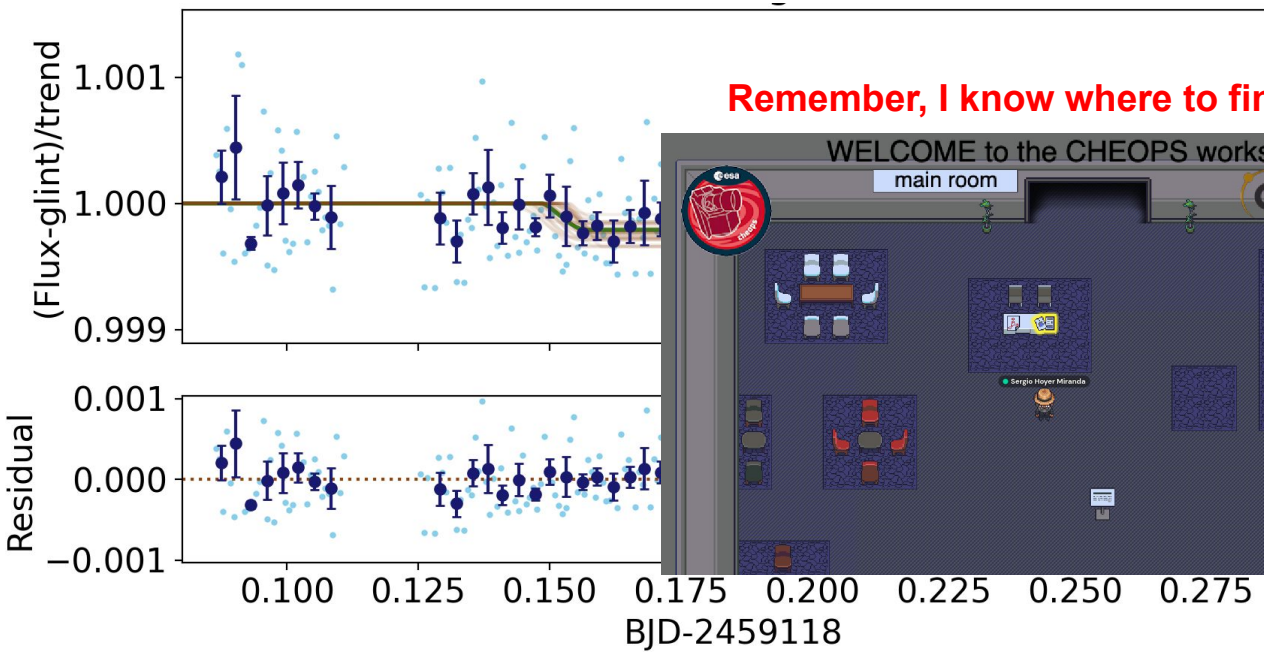
LTT9779b's eclipses seen by CHEOPS

Example of a detrended CHEOPS light curve



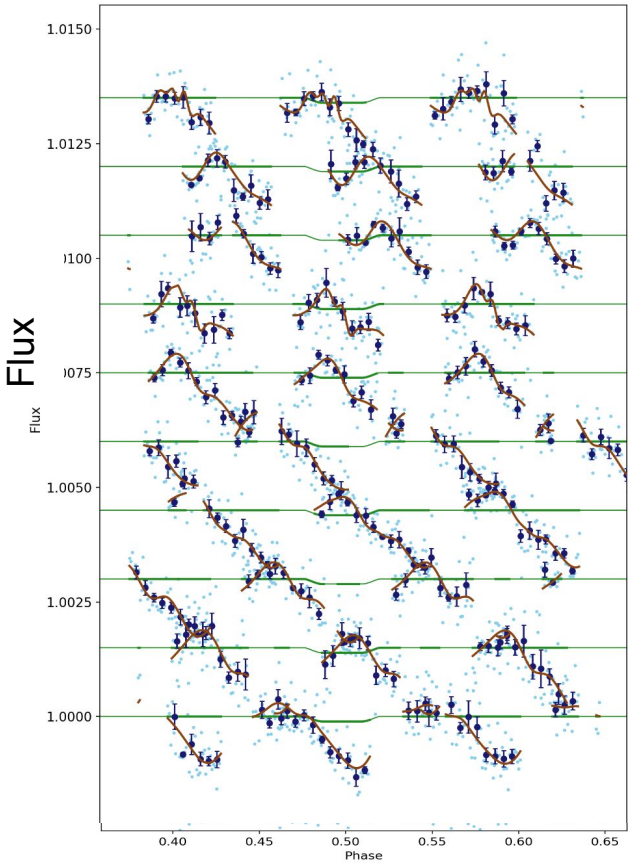
LTT9779b's eclipses seen by CHEOPS

Example of a detrended CHEOPS light curve



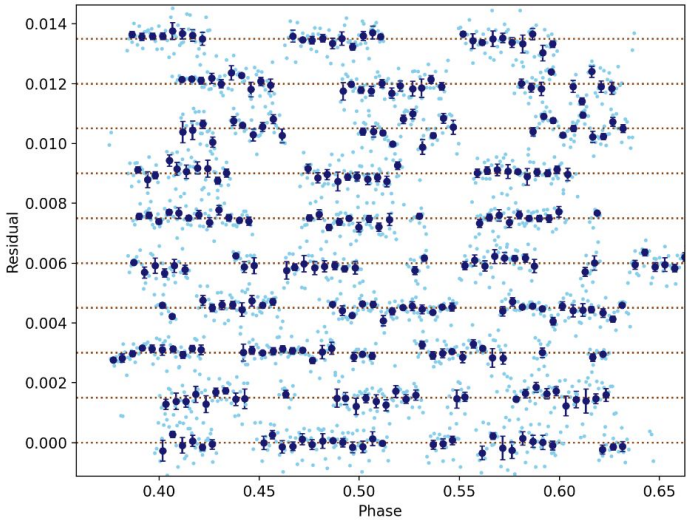
Remember, I know where to find you !!

LTT9779b's eclipses seen by CHEOPS



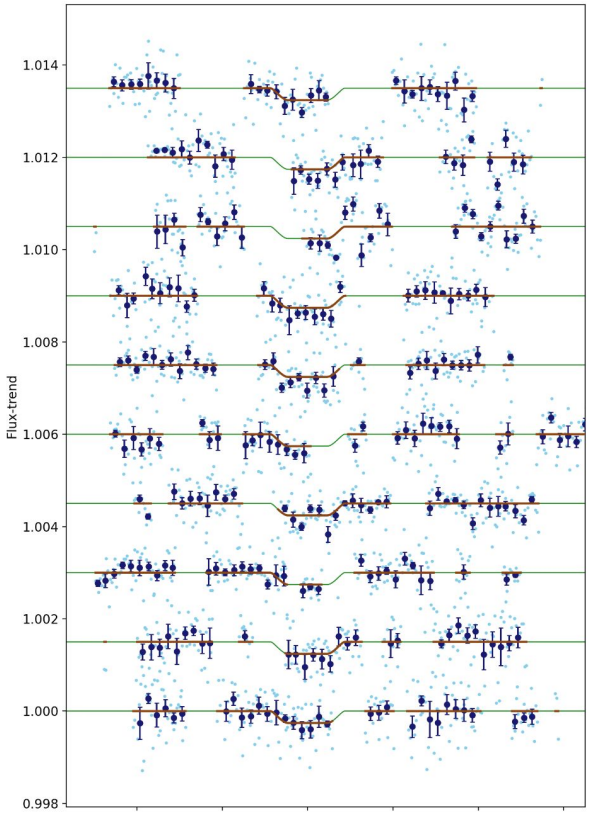
Joint modelling of the 10 visits

residuals



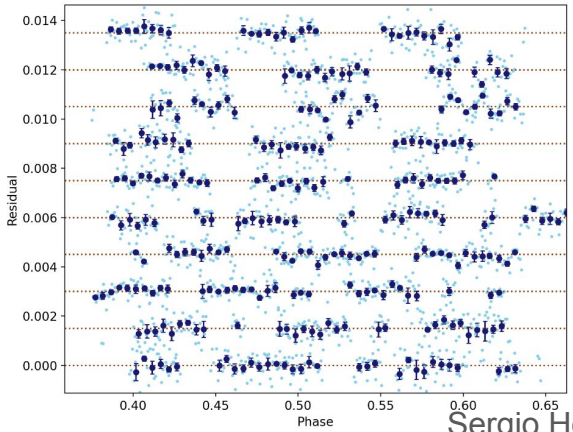
LTT9779b's eclipses seen by CHEOPS

Individual light curves of the occultations

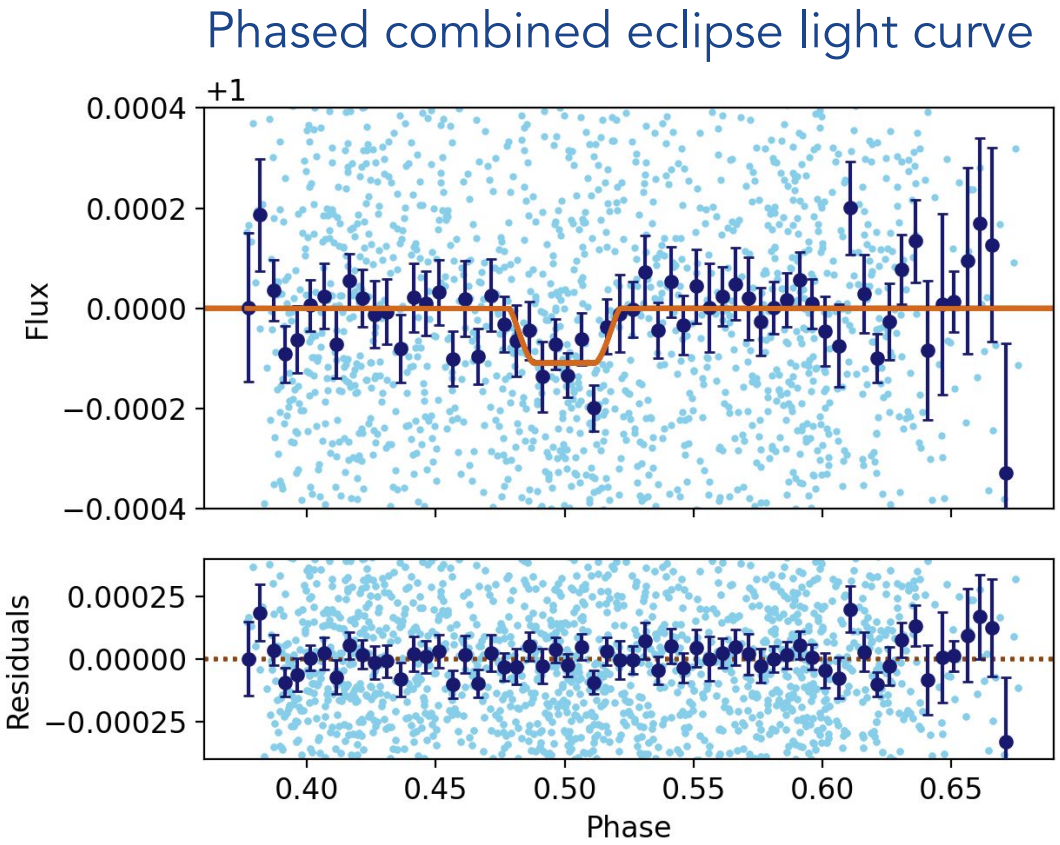


residuals

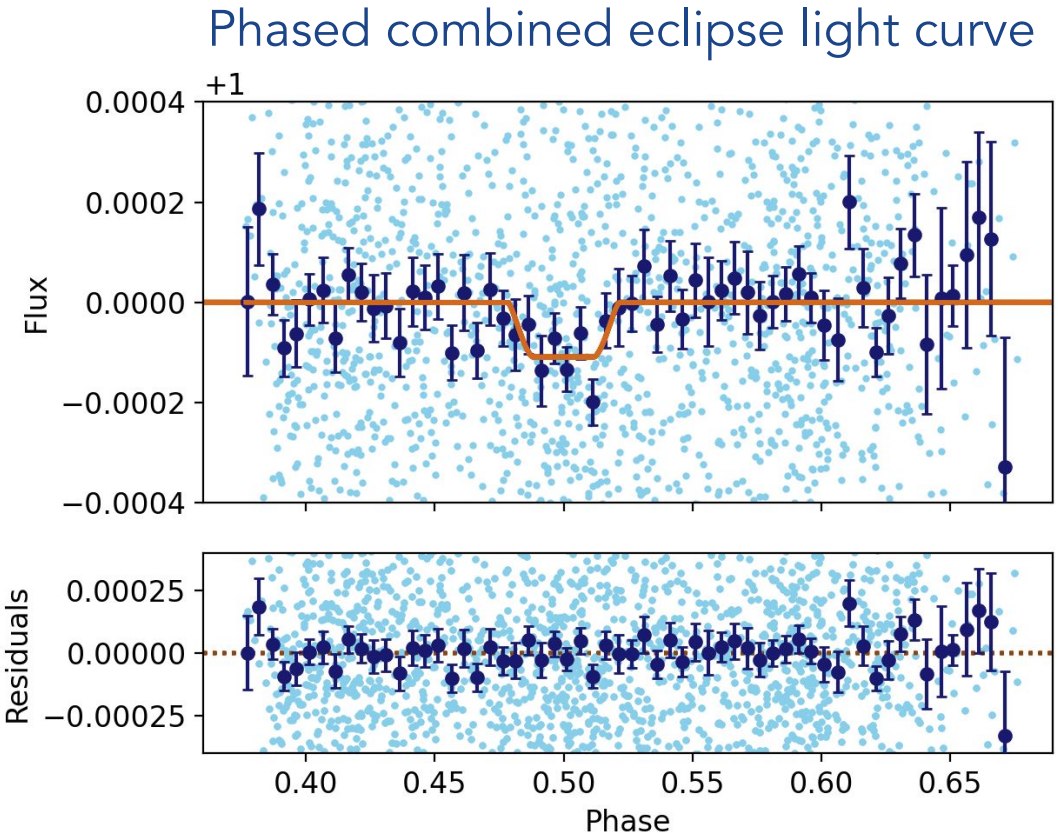
Unbinned: 300-700 ppm
Binned (7 min): 120-288 ppm



LTT9779b's eclipses seen by CHEOPS



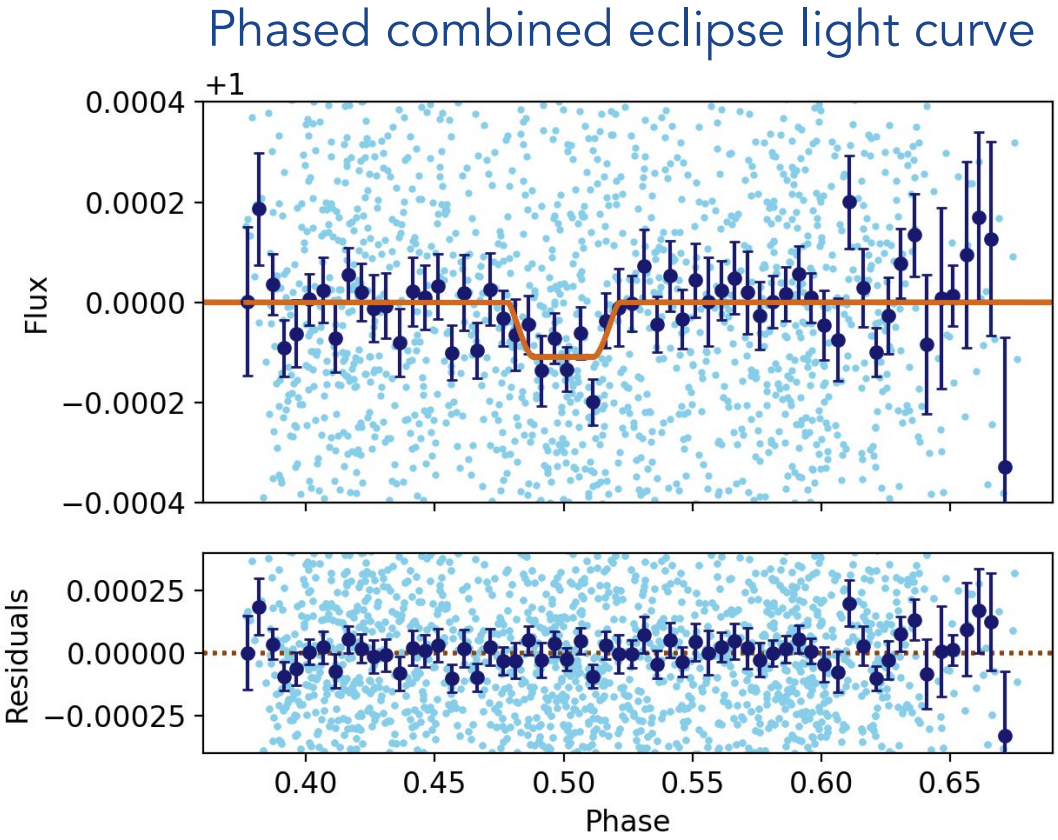
LTT9779b's eclipses seen by CHEOPS



Eclipse depth = 112 +/- 27 ppm

Residuals RMS = 84 ppm
Residuals RMS (phase < 0.6) = 46 ppm

LTT9779b's eclipses seen by CHEOPS



Eclipse depth = 112 +/- 27 ppm

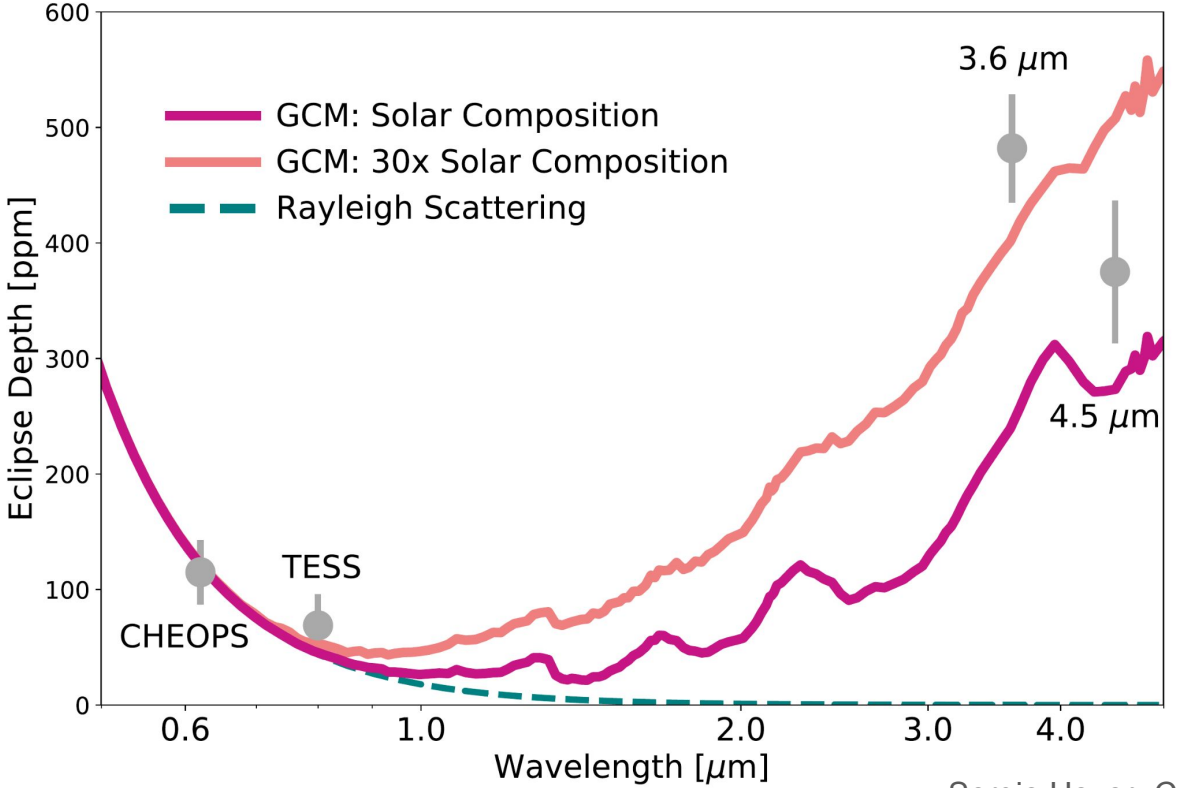
→ Ag = 0.78 +/- 0.19

Assuming a thermal contribution of ~20 ppm:

→ Ag= 0.64 +/- 0.19

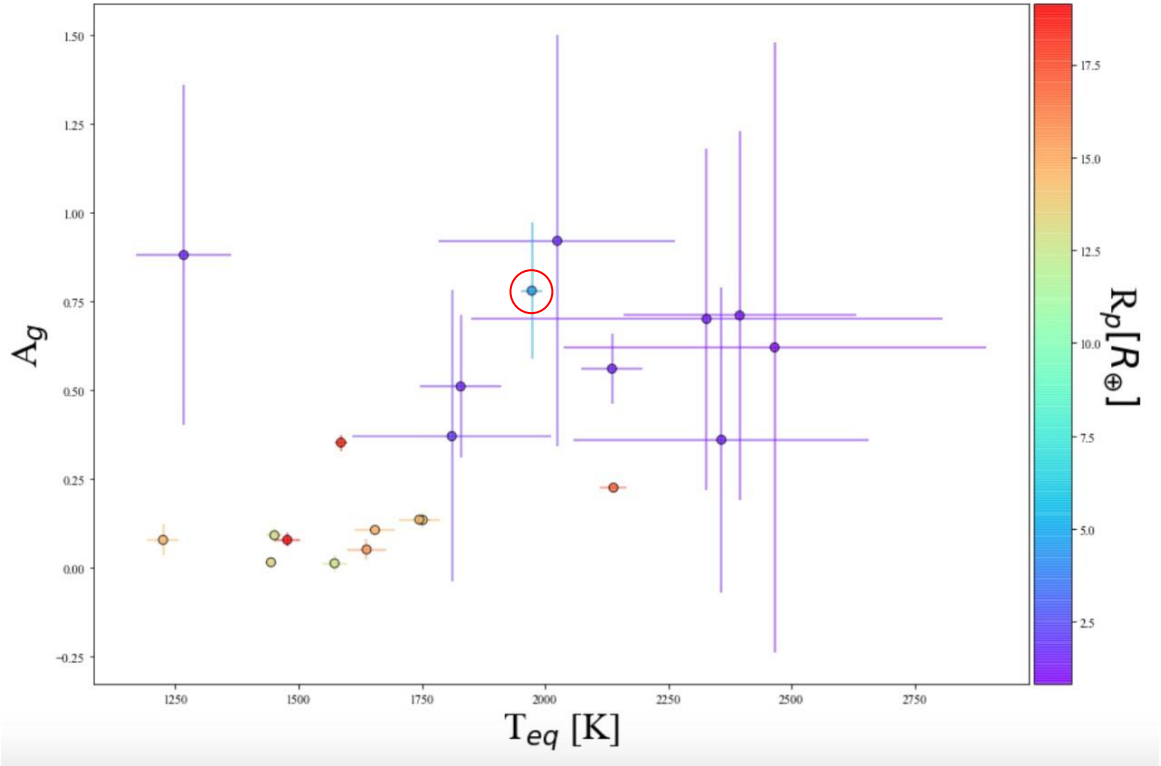
LTT9779b - Atmospheric properties

Global picture



LTT9779b - Atmospheric properties

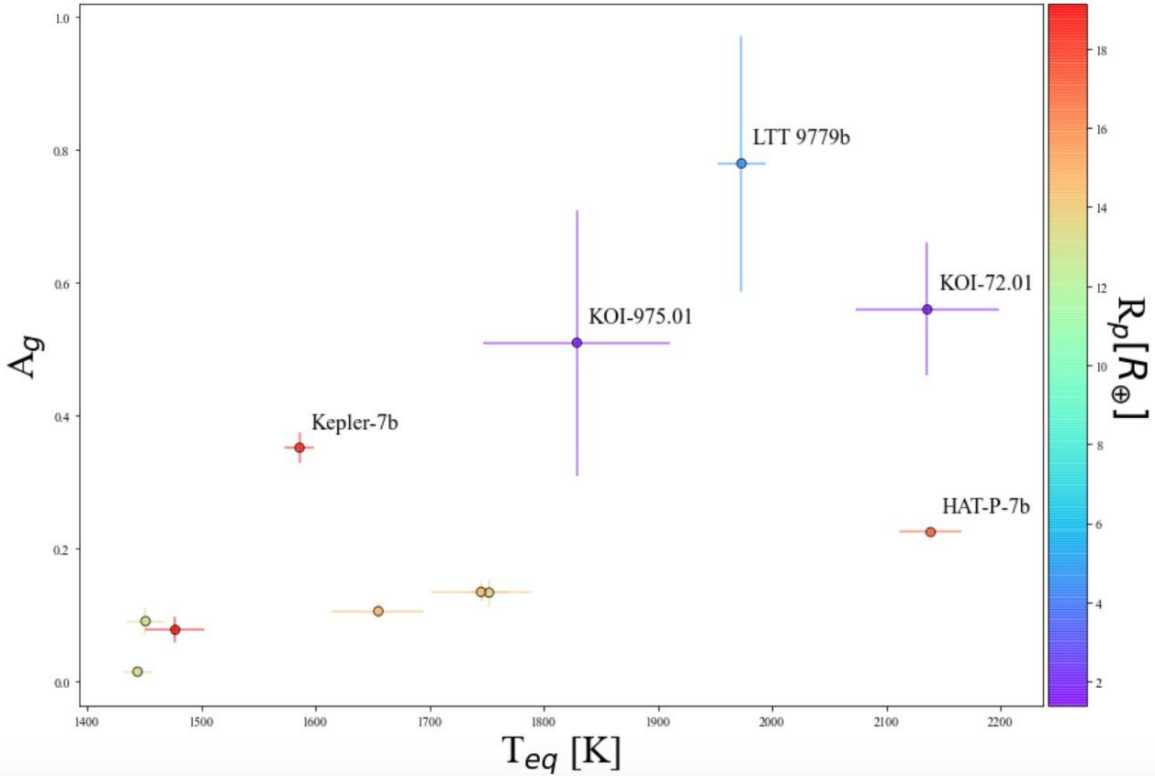
In comparison



data:
Heng & Demory (2013)
Rowe et al. (2008)
Kipping & Speigel (2011)

LTT9779b - Atmospheric properties

In comparison



Albedos with $1\sigma < 50\%$

data:
Heng & Demory (2013)
Rowe et al. (2008)
Kipping & Speigel (2011)

LTT9779b's eclipses seen by CHEOPS

Summary

- With CHEOPS, we measure the LTT979b's eclipse depth at high level of significance by combining 10 light curves.
- The eclipse seems to be deeper in CHEOPS bandpass when compared to the value measured by TESS, suggesting that Rayleigh scattering is at play.
- The estimated geometric albedo of the planet is among the highest currently known for exoplanets:
    - LTT9779b is more reflective than Venus (Ag=0.689) or,
    - Unexpected high temperatures in the atmospheric layers probed by CHEOPS.