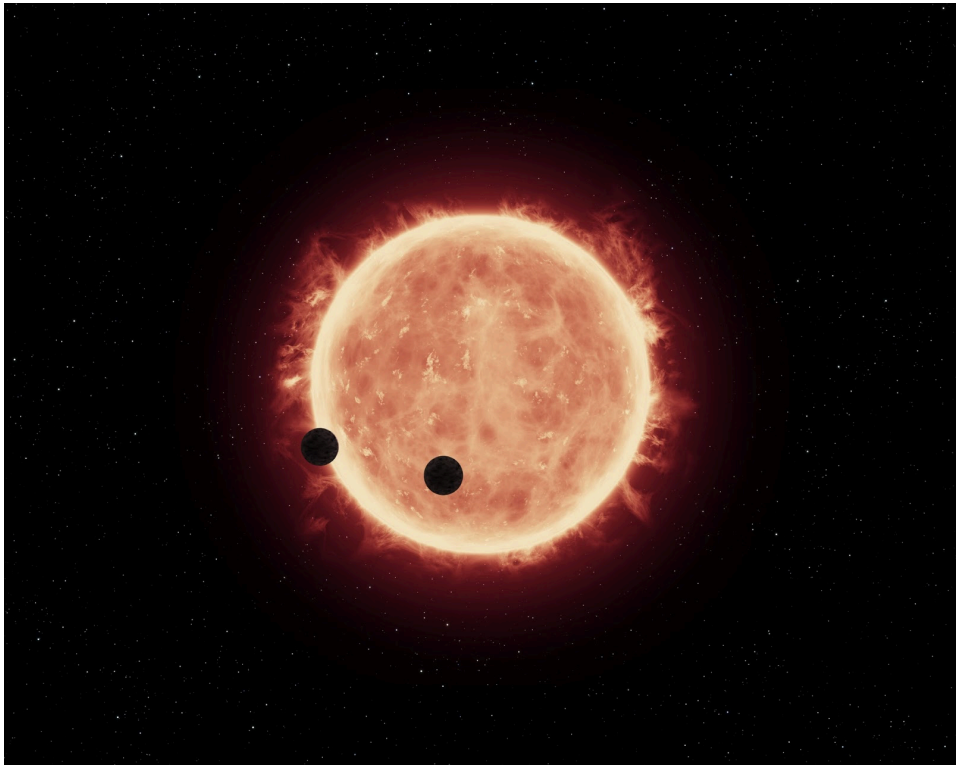
Exoplanetary transits



Michaël Gillon

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LIÈGE université

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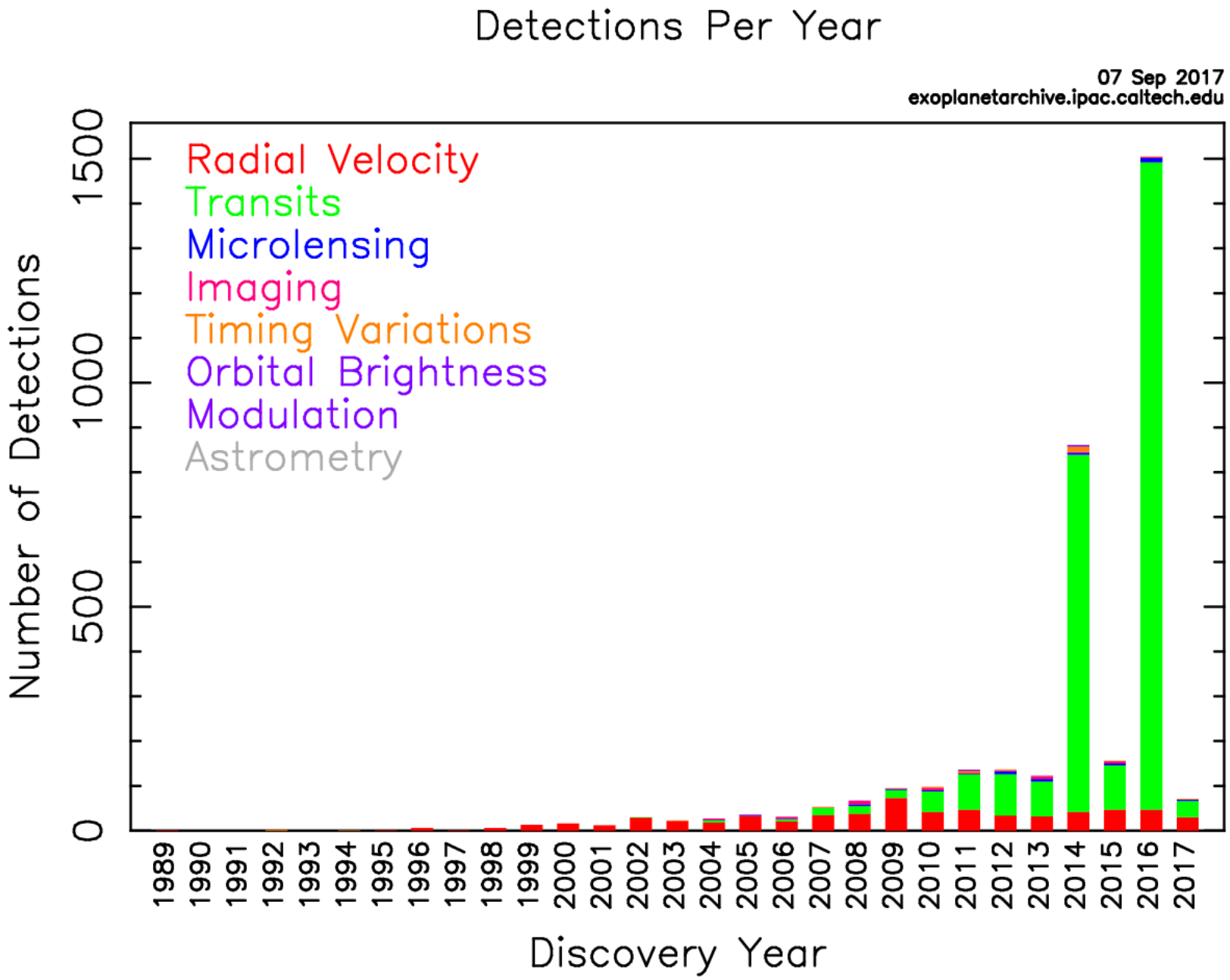
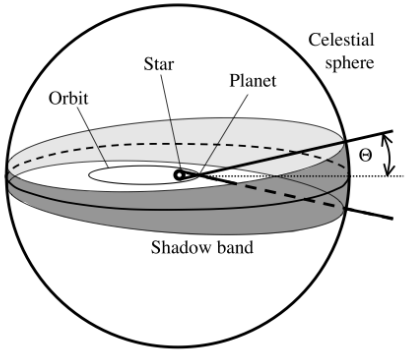
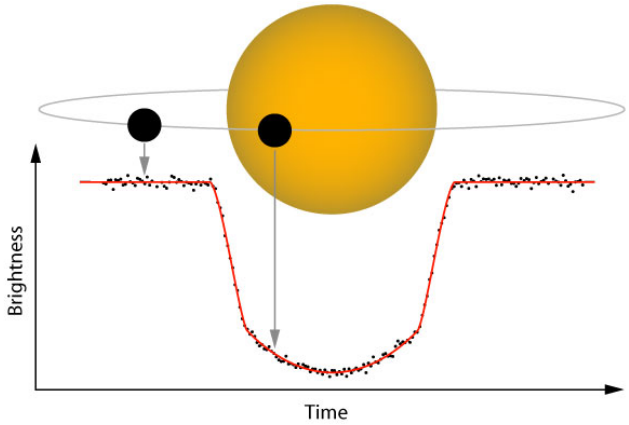
erc European Research Council Established by the European Commission

The era of exoplanets



Transiting planets: the basics





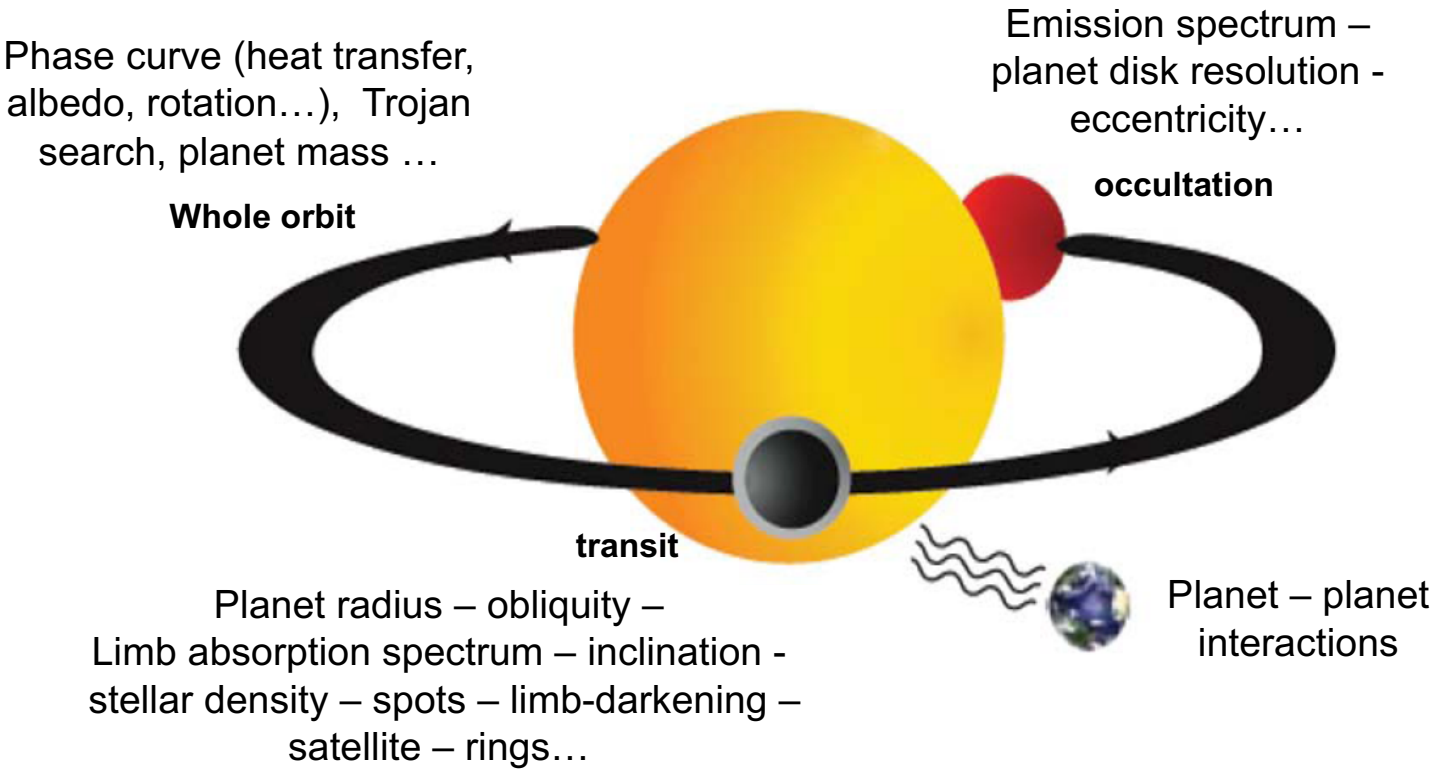
Probability? $\approx R_*/a$ *~0.5% for Earth+Sun, 0.1% for Jupiter+Sun*
~10% for a 'hot' planet (P < 5d)

Brightness drop? $\approx (R_p/R_*)^2$ *~1% for Jupiter+Sun*
~100ppm for Earth+Sun

Detection methods? *High-precision photometric survey of thousands of stars*
High-precision photometric monitoring of RV planets

Credits: Cook (2007); Jehin (2010); NASA (2011); Cortner (2011); Winn (2010); Johnson (2008);

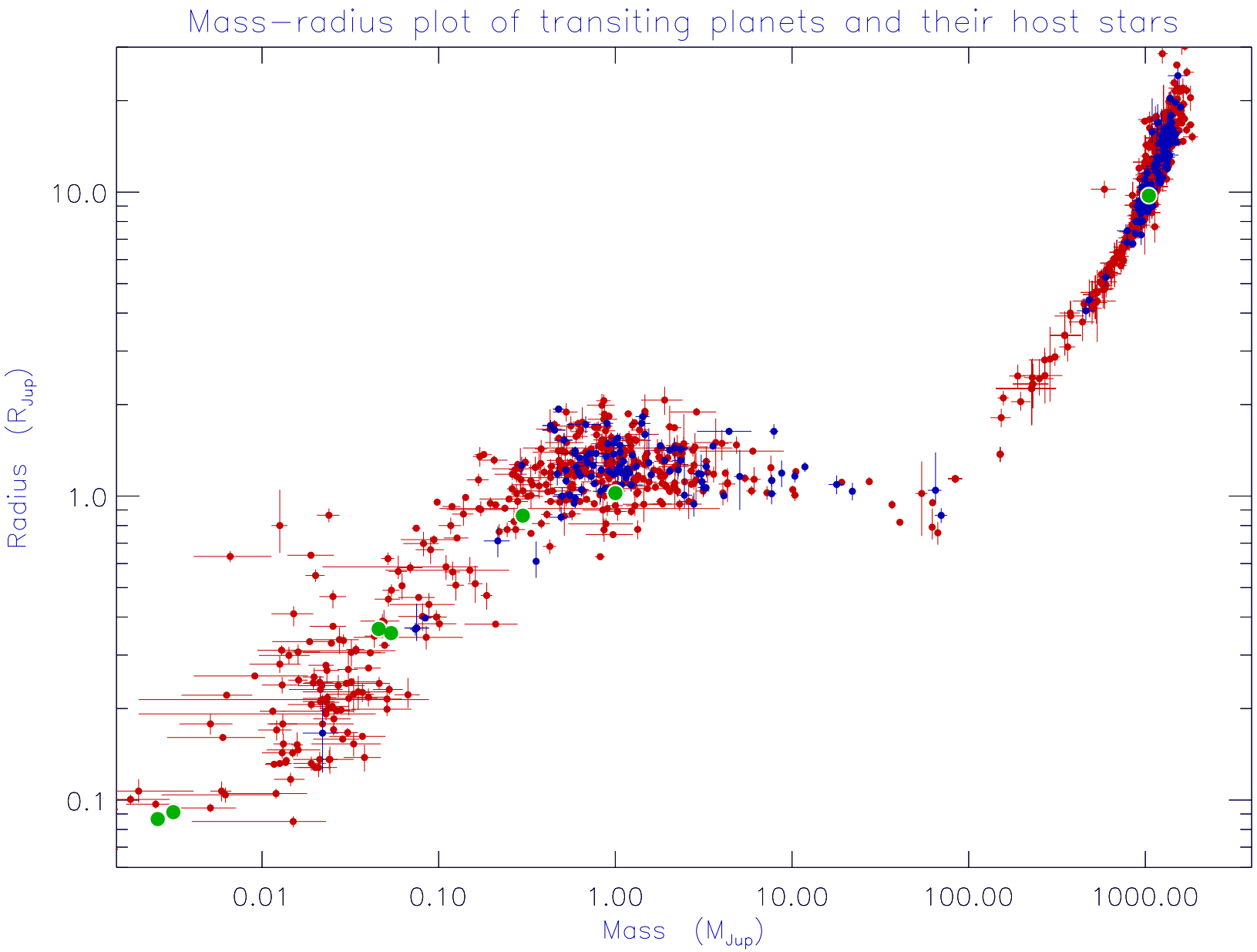
Transiting planets: treasures in the sky



Dynamic – structure – atmosphere
No need for ultra high resolution/contrast imaging

Credits: Deming & Seager (2009)

Transiting planets: mass-radius plot



Credits: TEPCat/J. Southworth

Our projects

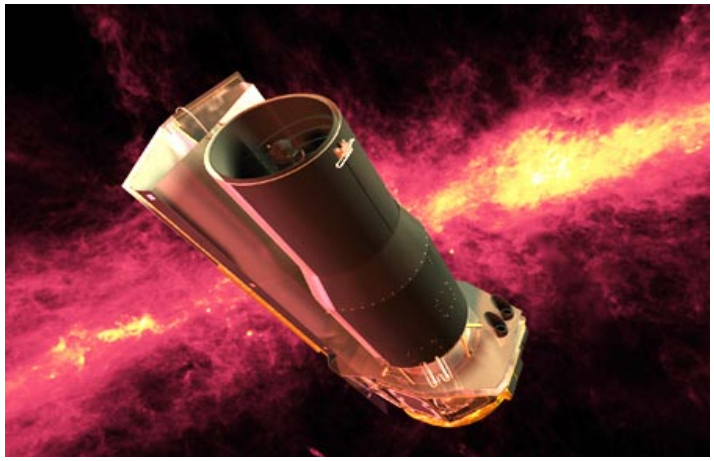
1. Search for transits of nearby exoplanets detected by RVs

From the ground

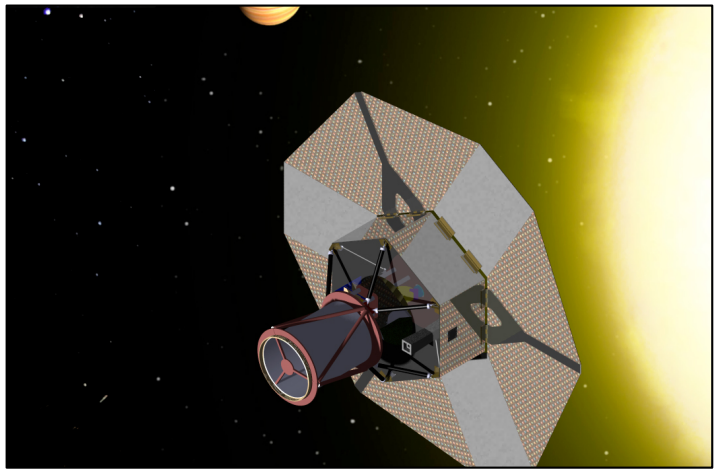
OFXB (2007)

TRAPPIST (2010 to now)

From space



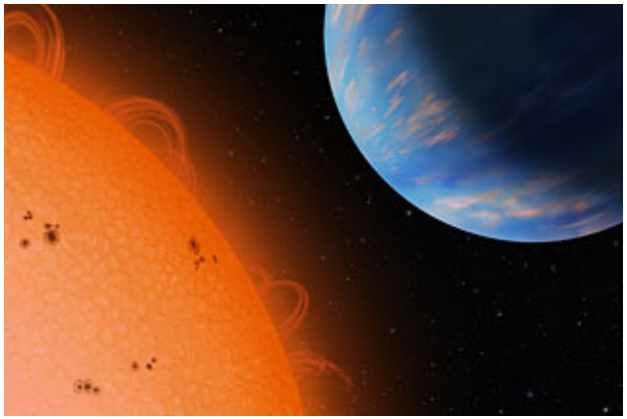
Spitzer (2009 to now)



CHEOPS (from 2018)

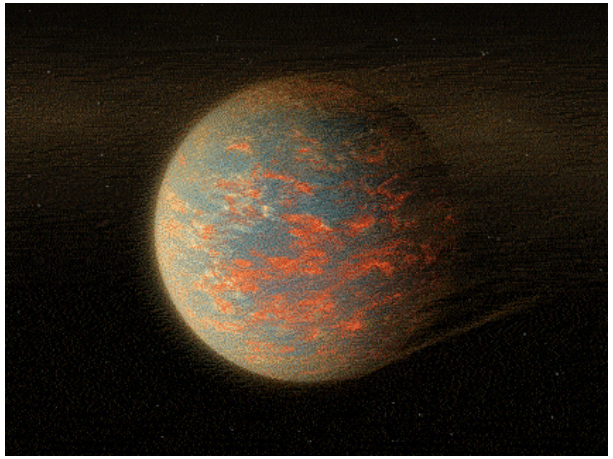
1. Search for transits of nearby exoplanets detected by RVs

GJ436b @ 10pc



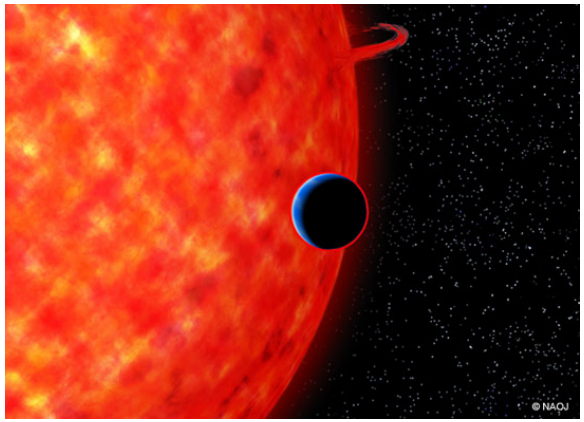
Gillon et al. (2007)

55 Cnc b @ 12pc



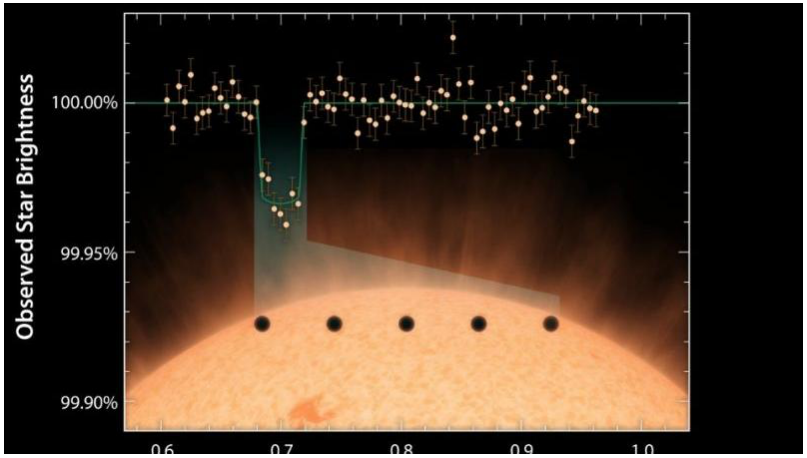
Demory et al. (2011)

GJ3470b @ 30pc



Bonfils et al. (2012)

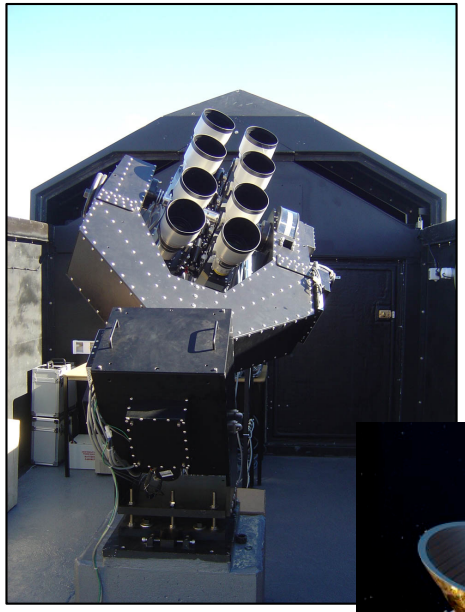
HD219134b and c @ 6.5pc



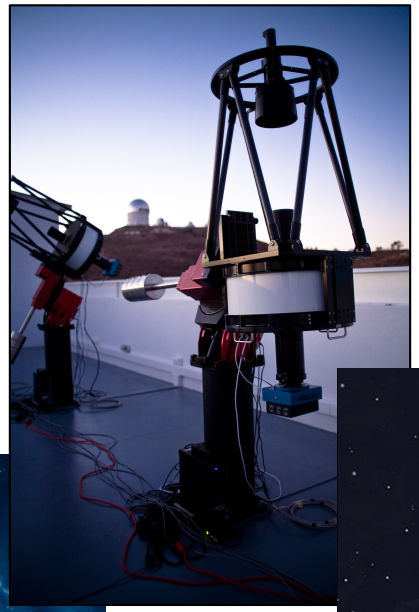
Motalebi et al. (2016); Gillon et al. (2017)

2. Follow-up of candidates found by wide-field transit surveys

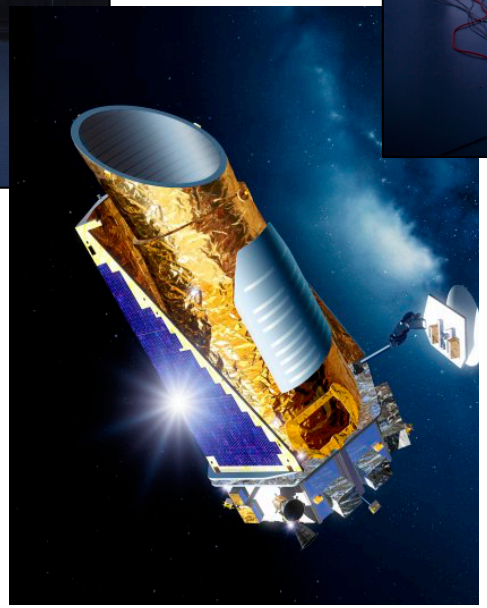
WASP



MEarth



Kepler/K2



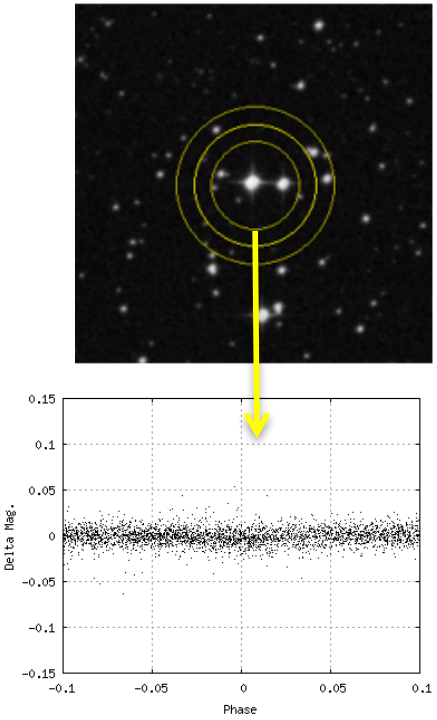
From 2018: TESS

Example: follow-up of of a WASP candidate with TRAPPIST

WASP

Pixel scale = 13.7’’

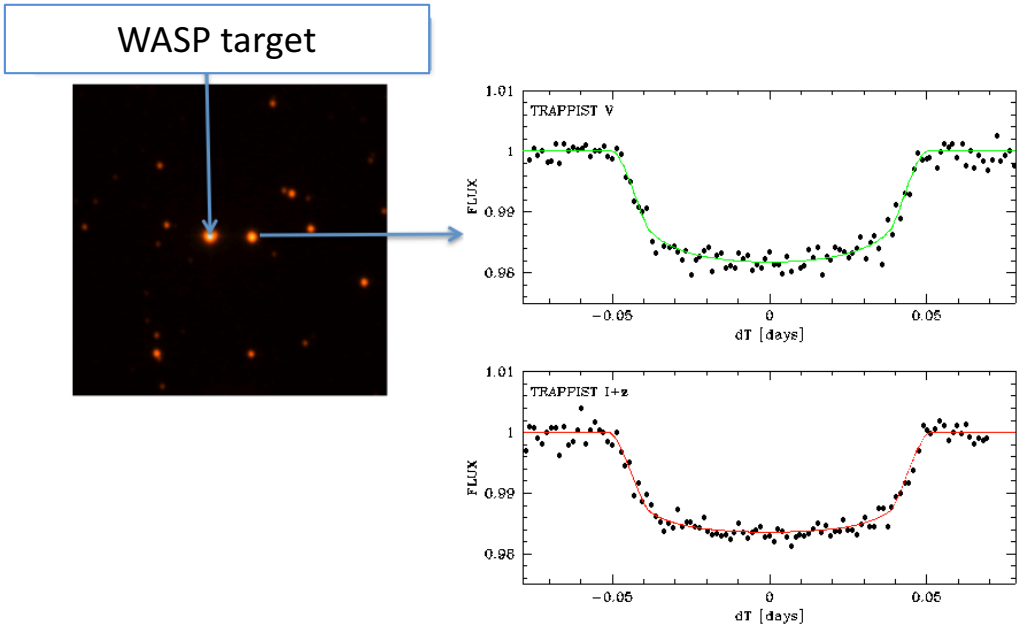
Typical precision ~ 1%



TRAPPIST

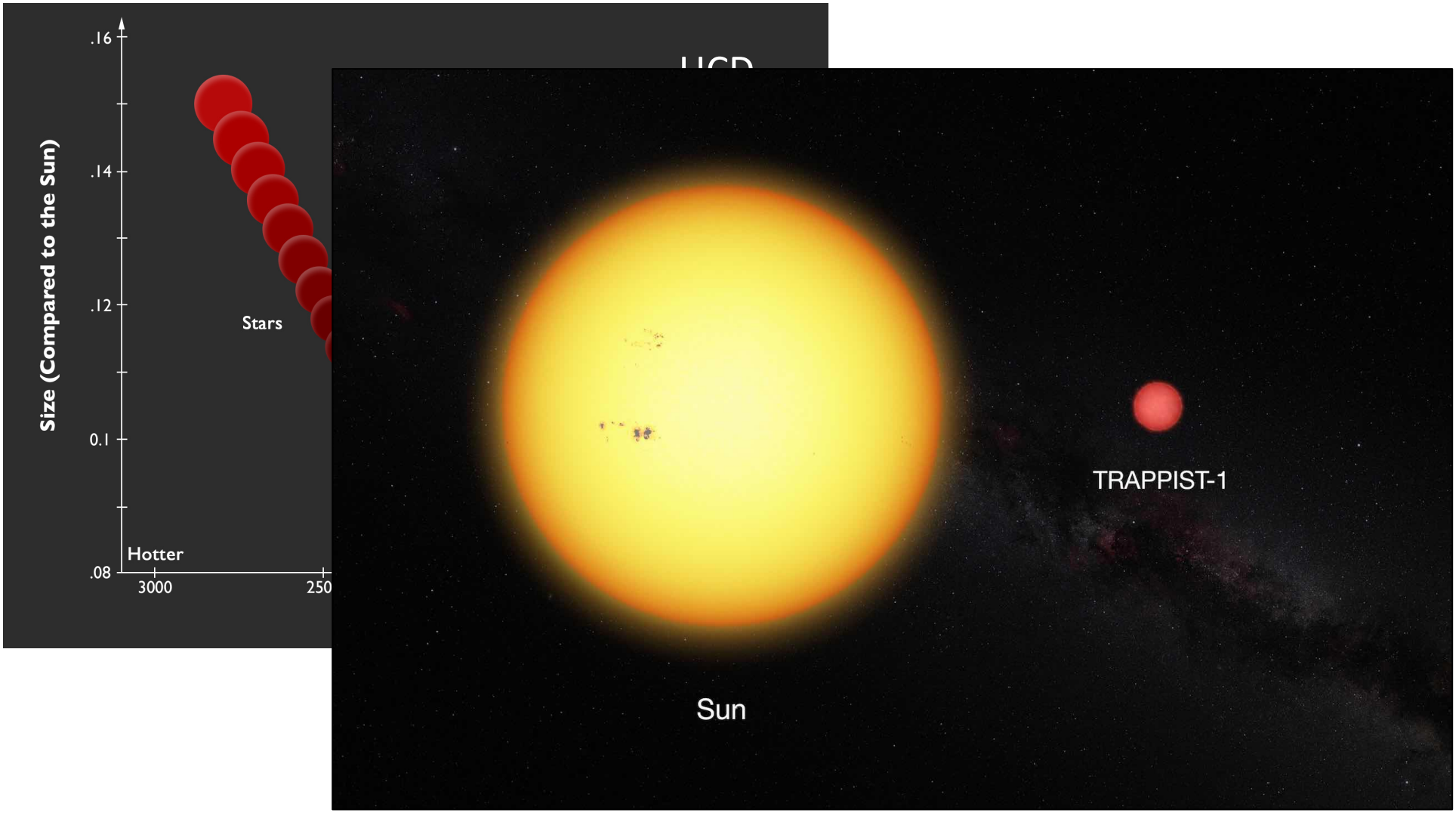
Pixel scale = 0.65’’

Typical precision ~0.1%



Example: a blend, but an interesting one;
this is an highly irradiated planet, WASP-64 *(Gillon et al. 2013)*

3. Search for transiting terrestrial planets around nearby ultracool dwarfs



SPECULOOS

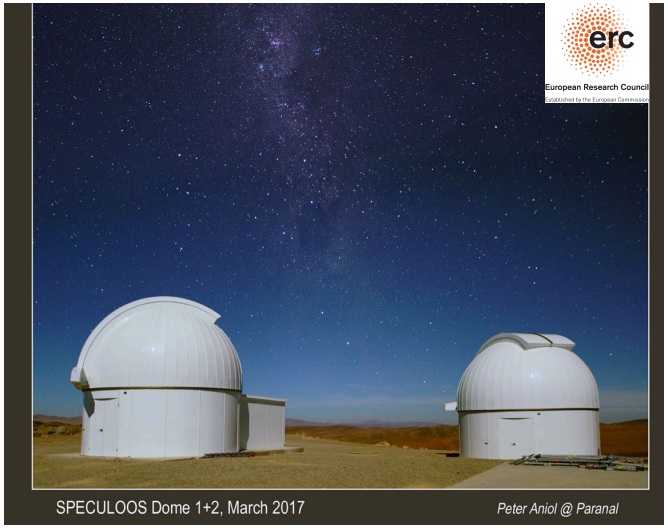
Southern hemisphere:

TRAPPIST-South (Chile)

Northern hemisphere:

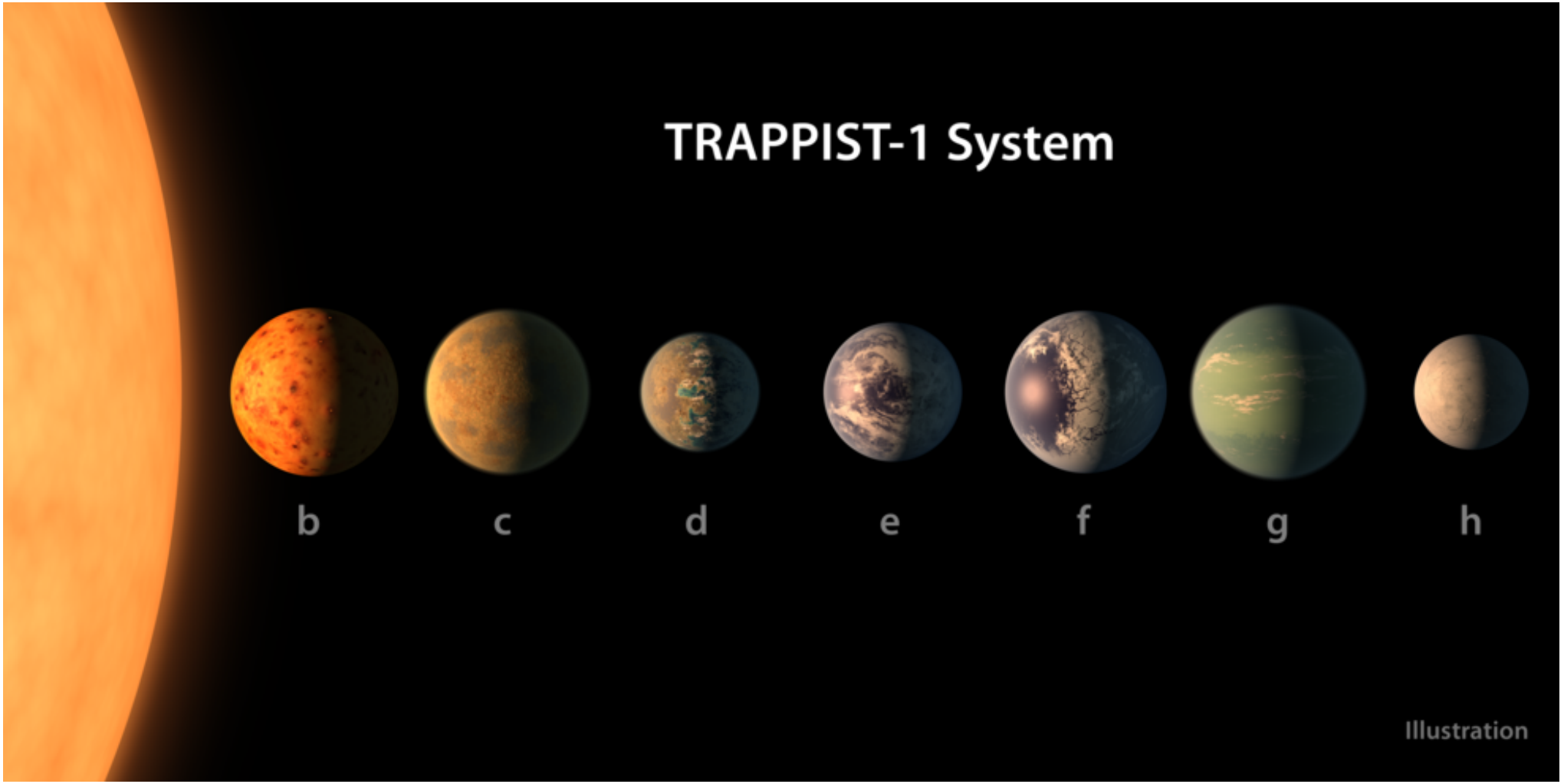
TRAPPIST-North (Morocco)

SSO – Paranal (Chile) – 4 x 1m telescopes



SNO – *Tenerife* – *?* x 1m telescopes

TRAPPIST-1



https://exoplanets.nasa.gov/trappist1/ www.trappist.one

Credits: NASA

4. Detailed characterization of known transiting planets

Radial velocities

High-precision transit photometry

Transit transmission spectroscopy

Occultation emission spectroscopy

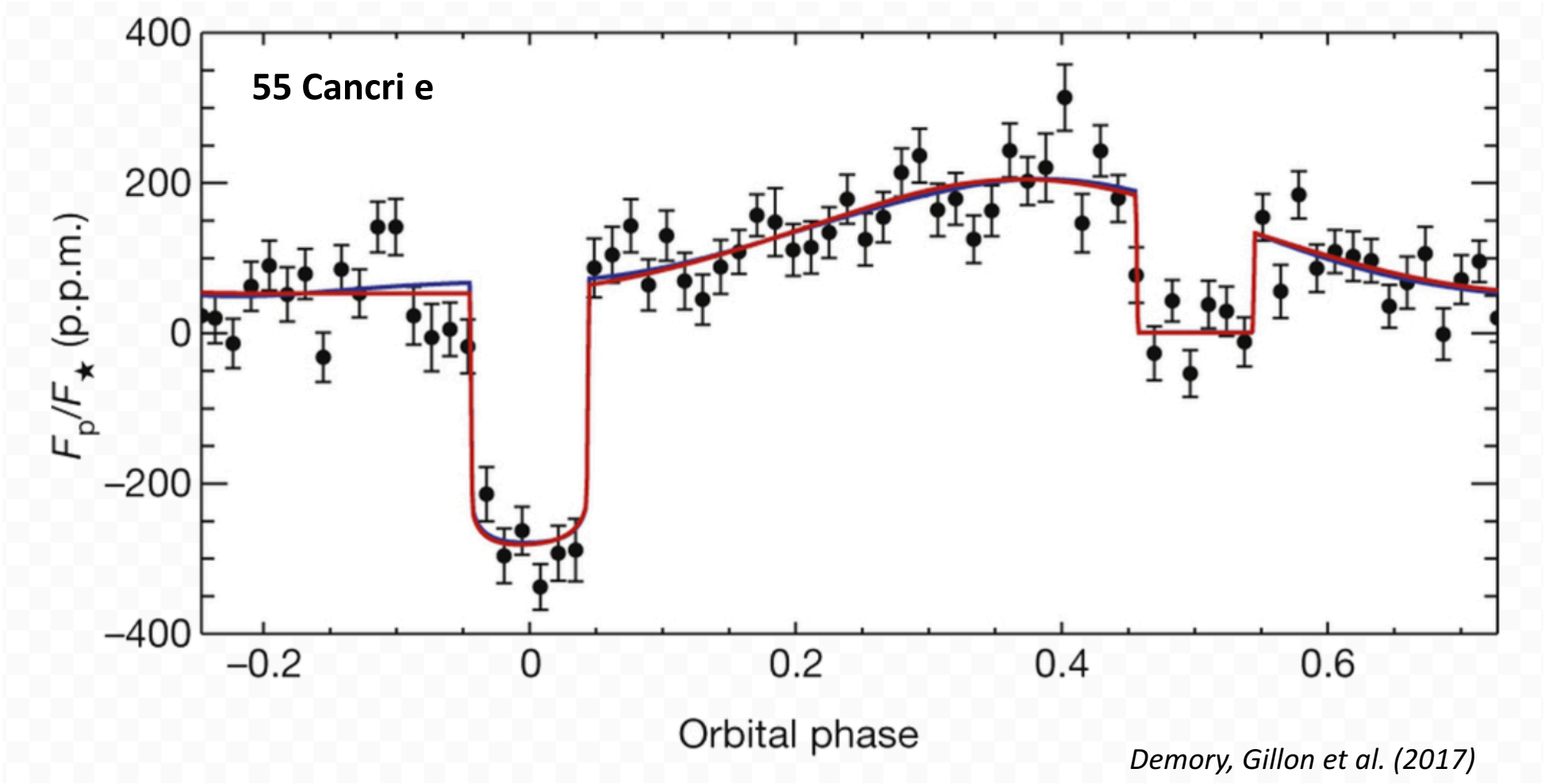
Phase curve

Occultation mapping

Host star characterization

Transit timing variations

4. Detailed characterization of known transiting planets



Demory, Gillon et al. (2017)

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CHARACTERISING EXOPLANET SATELLITE

CHEOPS consortium

TESS consortium