High-resolution imaging follow-up for PLATO

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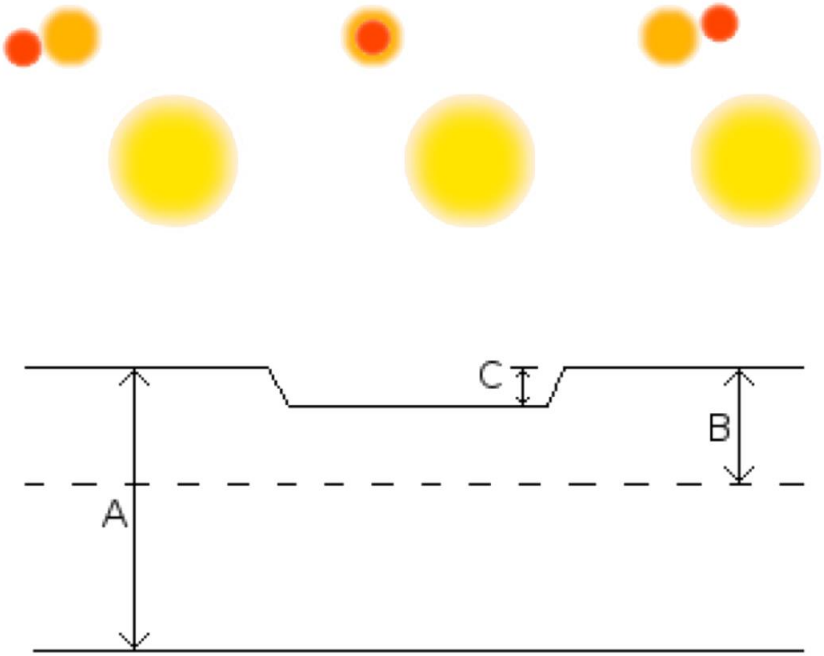
PLATO science requirements

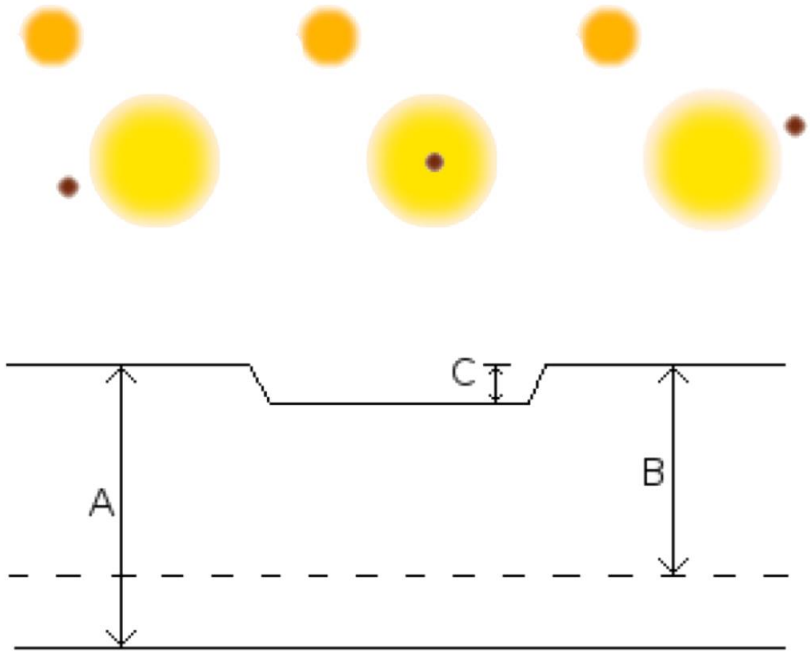
R-SCI-L0-01: PLATO shall detect and characterise hundreds of planets around dwarf and subgiant stars of spectral types from F5 to K7, orbiting at distances up to the stellar habitable zones.

R-SCI-L0-05: PLATO shall provide photometric data to determine the radius of a planet of the same size as the Earth and orbiting a G0V star of V=10 (goal V=11) with an accuracy better than 3%.

Issues with unresolved blends

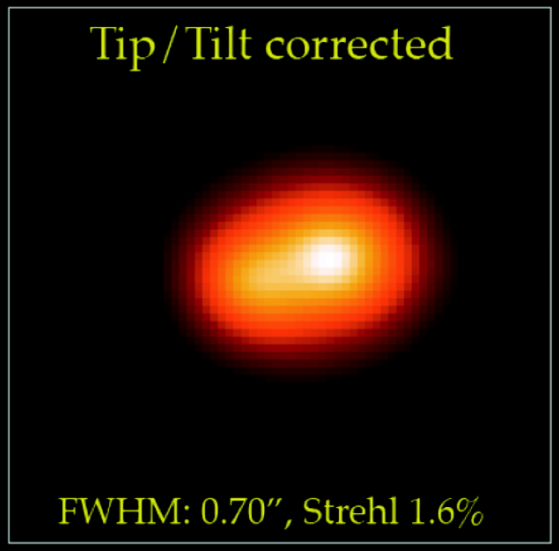


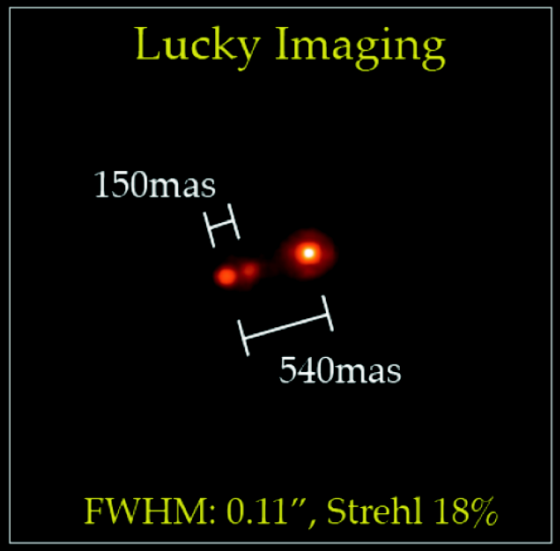
A: Blended continuum
B: Background binary continuum
C: Observed dimming
C/A: Apparent fractional transit depth
C/B: Actual fractional eclipse depth



A: Blended continuum
B: Actual stellar continuum
C: Observed dimming
C/A: Apparent fractional transit depth
C/B: Actual fractional transit depth

High-resolution imaging
(with modestly sized telescopes)





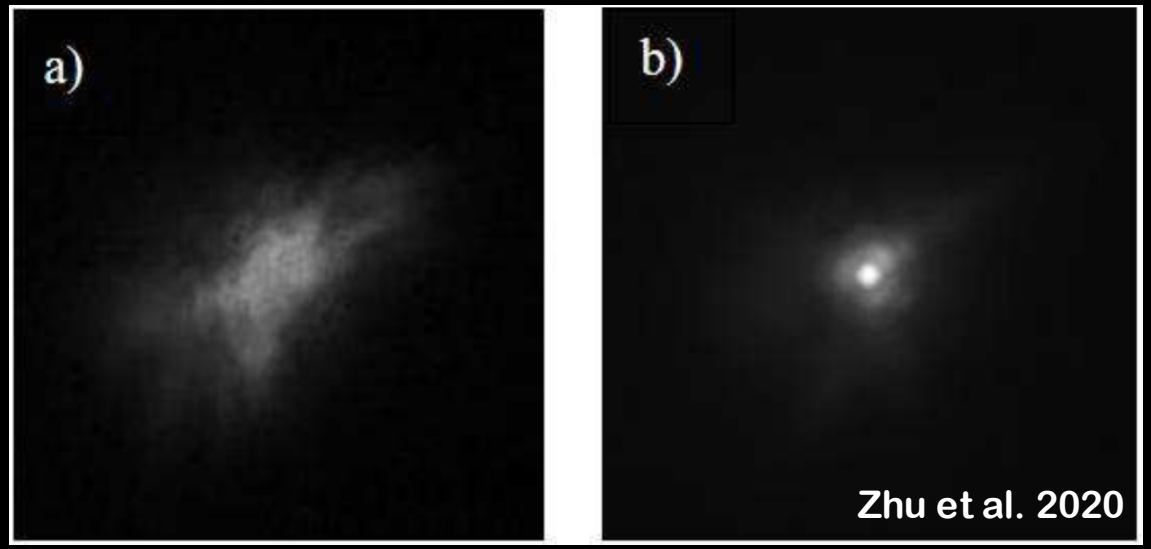
Hippler et al. 2009

Lucky imaging:

Operates in the VIS/NIR (~*iz*-band) on 2-4 m telescopes, e.g. AstraLux Sur (NTT visitor instrument).

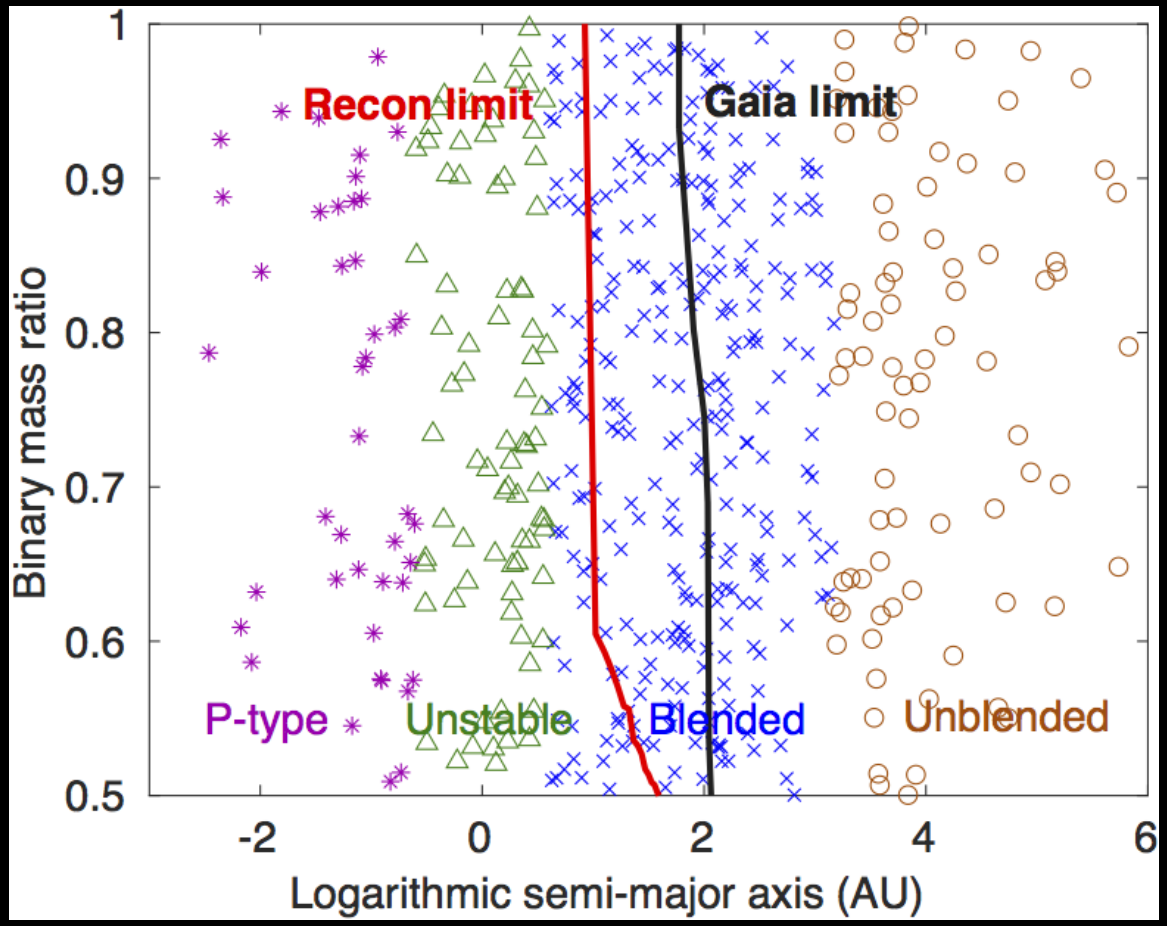
Adaptive optics:

Operates in the NIR (~izJ*HK*-band) on 2-4 m telescopes, e.g. PAO (NTT visitor instrument).



Zhu et al. 2020

Example performance



Template star is G2V at 91.5 pc distance.

~10 min per target => ~40 targets per night, including all necessary calibrations

Gaia performance calculated in Brandeker & Cataldi (2019).

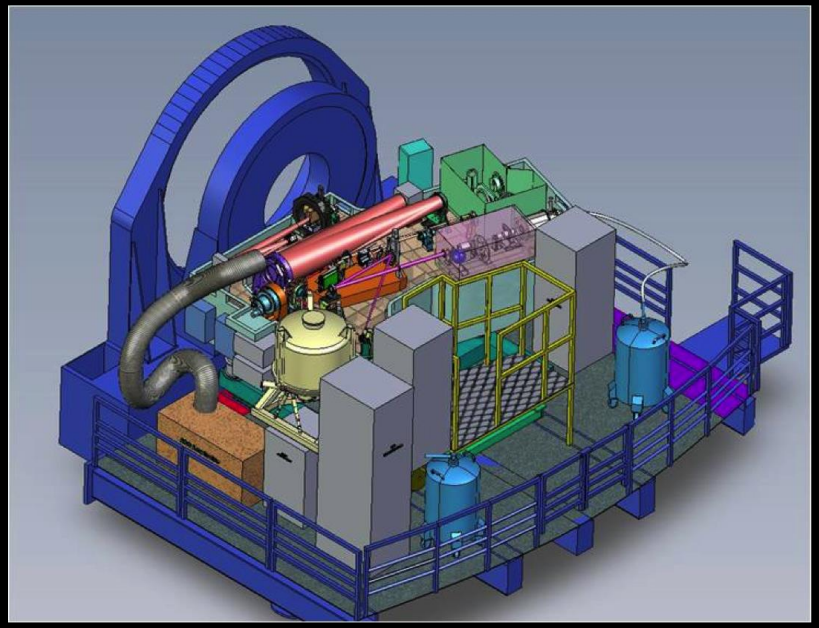
Suitable facilities

Name	Telescope	Aperture	Owner	Hemisphere
SONG Lucky Imager	SONG	1.0	Aarhus/Copenh	N
KALAO	Swiss /La Silla	1.2	Geneva	S
Lucky Imager	Danish/La Silla	1.54	Denmark/ESO	S
AstraLux	Calar Alto	2.2	CSIC	N
ROBOAO	Hawaii	2.2	UH	N
AstraLux South	NTT/La Silla	3.5	ESO/MPIA	S
SPHERE-IRDIS	VLT/Paranal	8.2	ESO	S
SPHERE-IFS	VLT/Paranal	8.2	ESO	S
SPHERE-ZIMPOL	VLT/Paranal	8.2	ESO	S
SHARK-NIR	LBT/M. Graham	8.4	LBTO	N
LMIRCam	LBT/M. Graham	8.4+8.4	LBTO	N

The sensitivity of ~2m-class facilities is generally well matched to primary sample, though performance decreases at the faintest end.

Heavy artillery
(for particular cases)

ESO

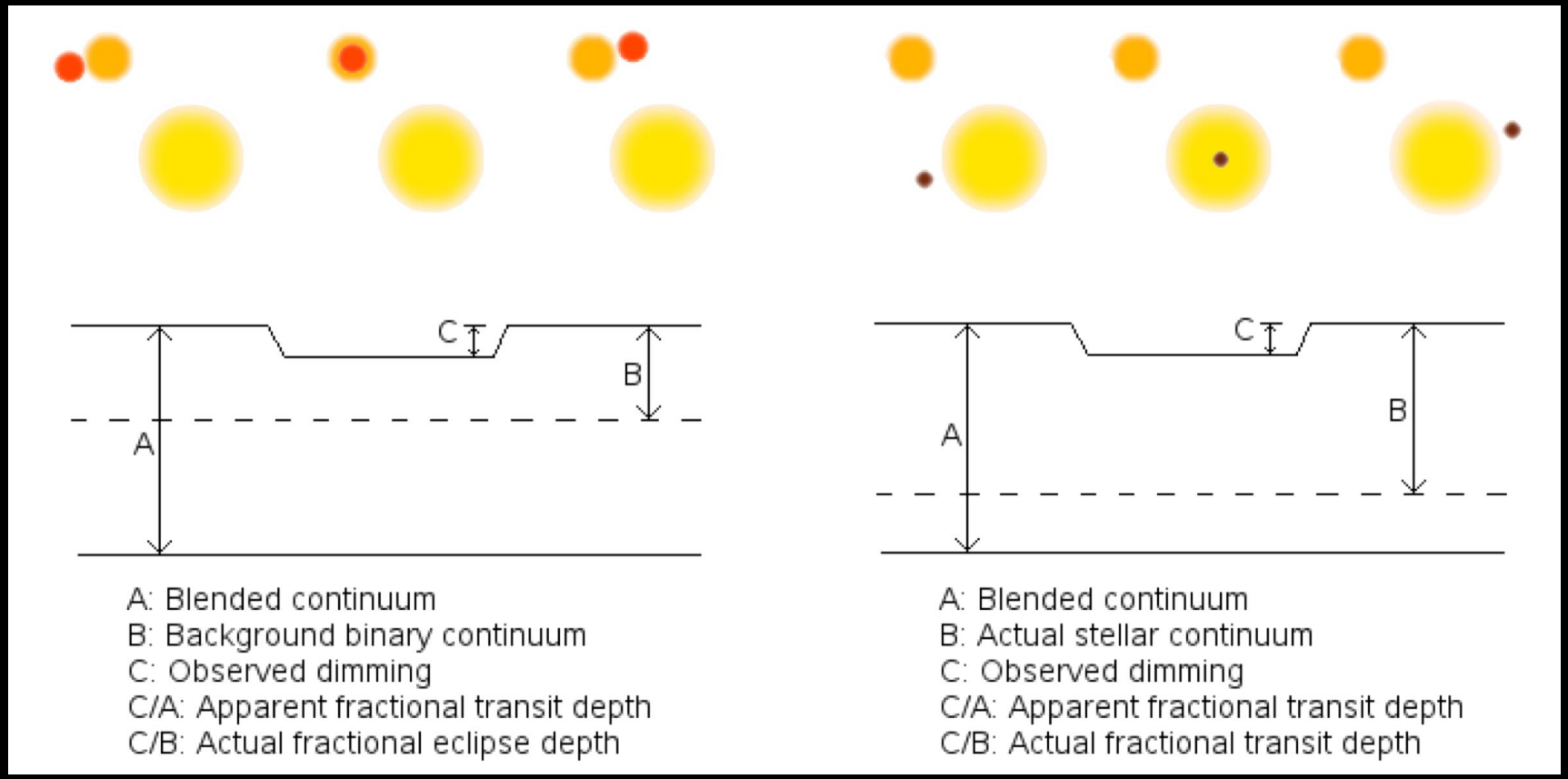


SPHERE: Extreme AO, star-hopping RDI, 8m telescope

GRAVITY: Interferometry, ~2 mas resolution for reasonably bright targets

ESO

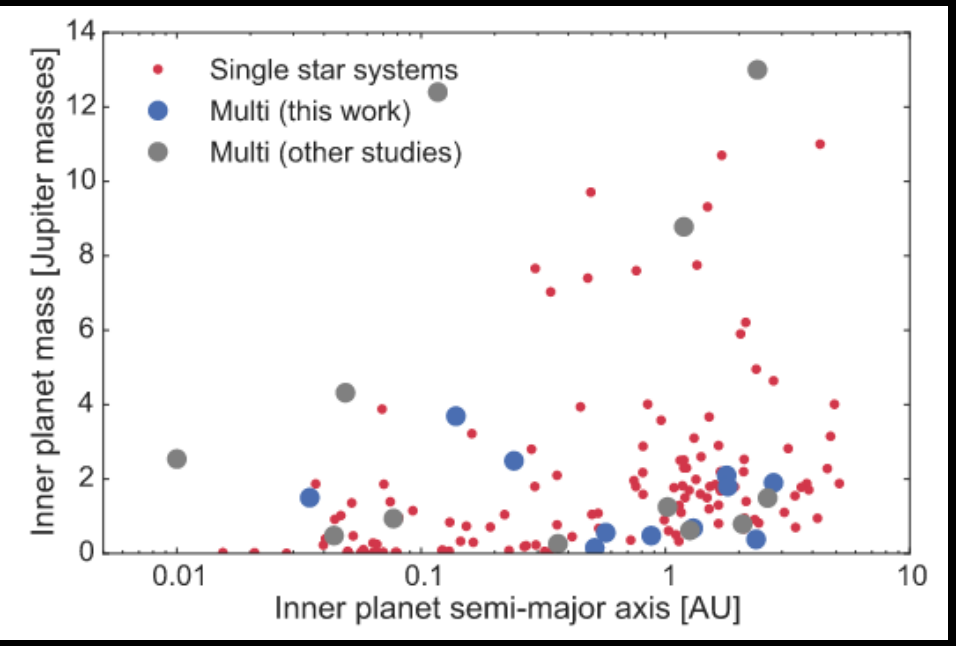
Prospects for combining high-resolution and time-critical photometry



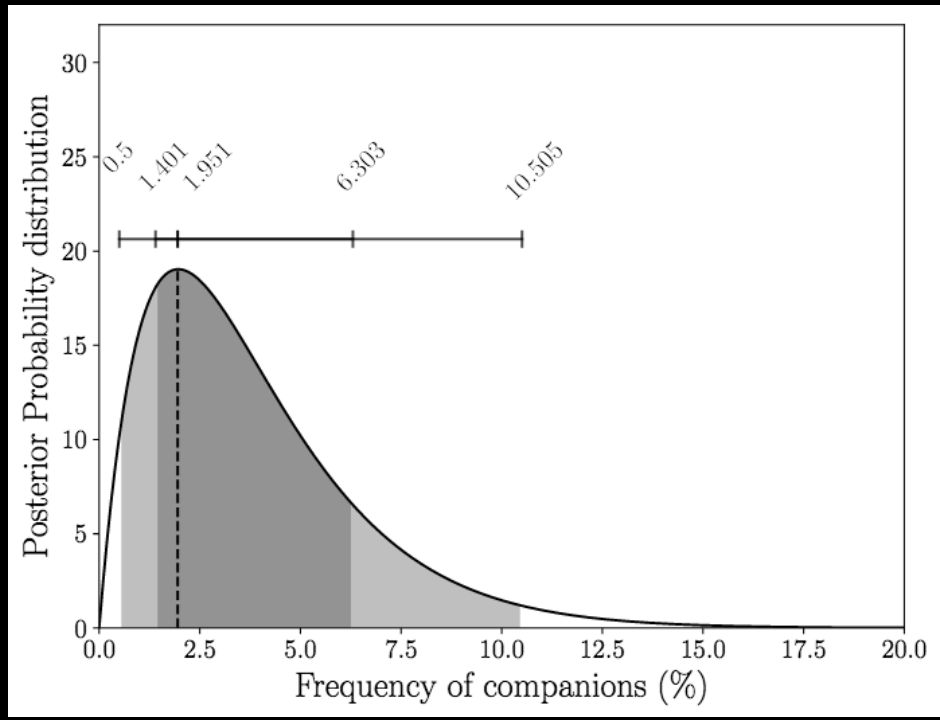
Resolving a system during eclipse can distinguish pathological cases (but requires timed observations)

Ancillary science

Ngo et al. 2017



Approximately half of all Sun-like stars are in binary systems



How planetary systems depend on parent multiplicity is an important aspect for planet formation and habitability.

Asensio-Torres et al. 2018