SYNERGIES BETWEEN PLATO AND HWO

Giampaolo Piotto

Dipartimento di Fisica e Astronomia

Centro di Studi e Attivita' Spaziali (CISAS)

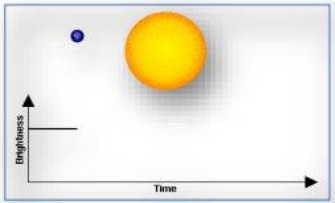
Universita' di Padova

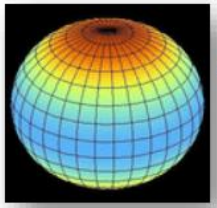
Science Goals and Methods

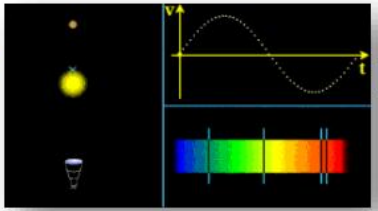
PLATO: PLAnetary Transits and stellar Oscillations

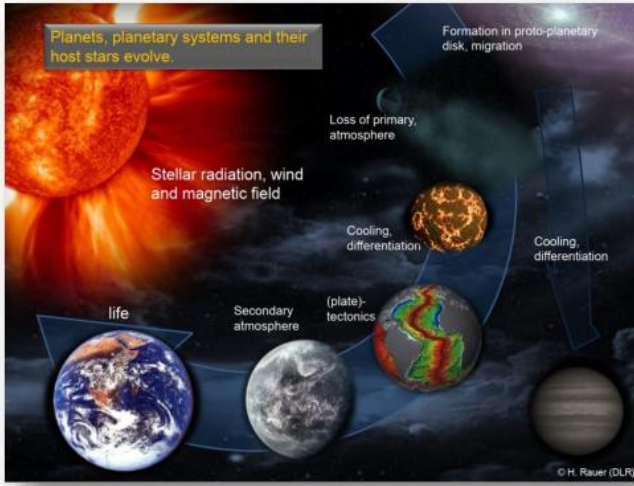
Prime mission goals:

- Detect a large number of extrasolar transiting planets, including **Earth-sized planets in the habitable zone of solar-like stars**
- Determine precise **planetary radii, masses**, hence **mean densities**
- Investigate seismic activity in stars, enabling the precise characterisation of the planet host star, including its **age**









Transit detection

→ Planet/star radius ratio

→ Inclination

Asteroseismology

→ Stellar radius, mass

→ Stellar age

Ground-based observations

→ Planet mass

→ Mean density

→ Age

Science Objectives

Architecture, formation, evolution of planetary systems, and correlation with stellar parameters

Our Solar System in Context

Planet evolution with age

Additional planetary science (exo-moons, planets around evolved stars, albedo studies via secondary transits…)

Identification of good targets for spectroscopic follow-up of planet atmospheres

Internal structure of stars

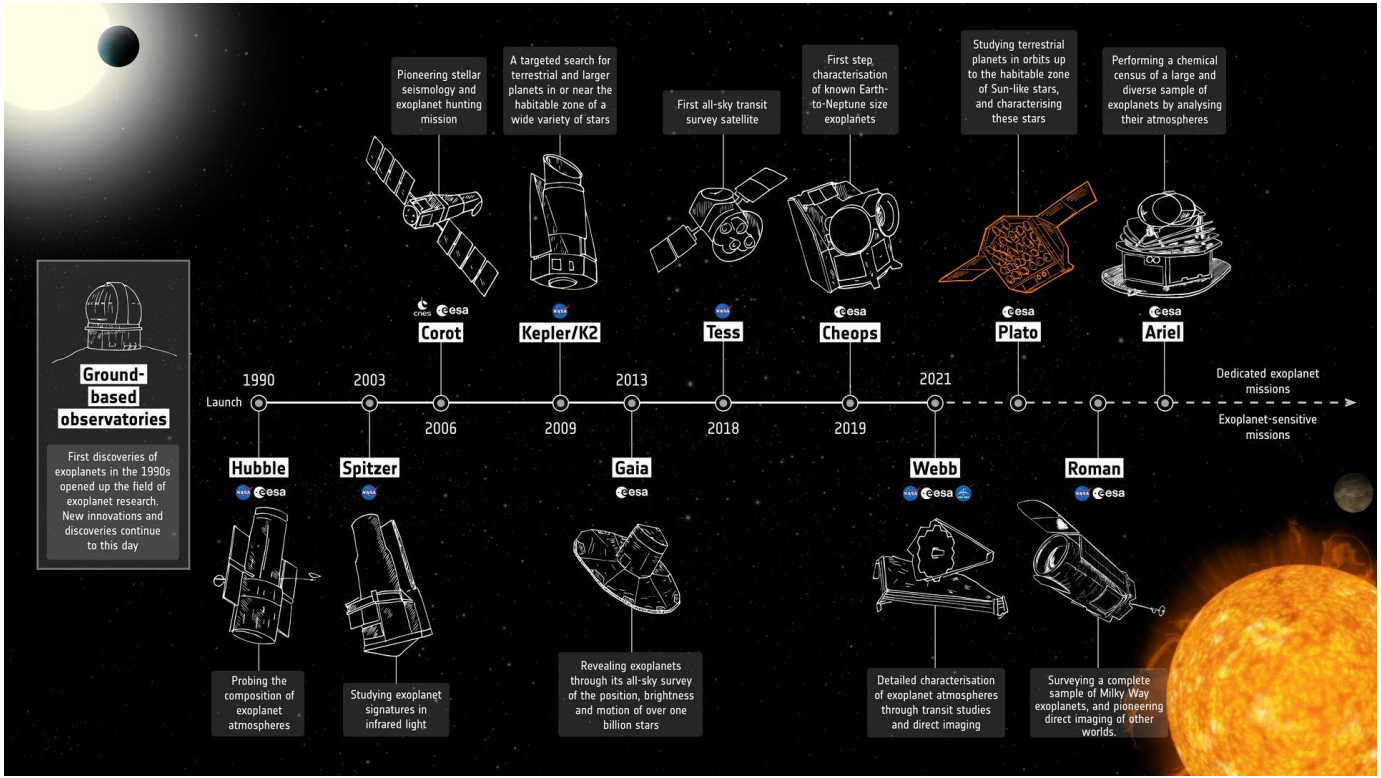
Determination of bulk properties of thousands of exoplanets, including terrestrial planets in the habitable zone of Sun-like stars

Required planet properties accuracies:

- radius, 3% (5%)
- mass, 10%
- age, 10%

for an Earth-size planet orbiting a G0 dwarf star with $V < 10$ (11)

PLATO schedule



2000…… Eddington

……

2007: PLATO 1

……

2014:PLATO selected as M3

2017: mission adoption

2018: industrial contracts signed

2019: first CCD delivered

2022: Critical Milestone success

2024: first FMs integrated in S/C

2025: Mission CDR, PLATO modules integration

…

2026: launch Ariane 6

2027: start nominal operations

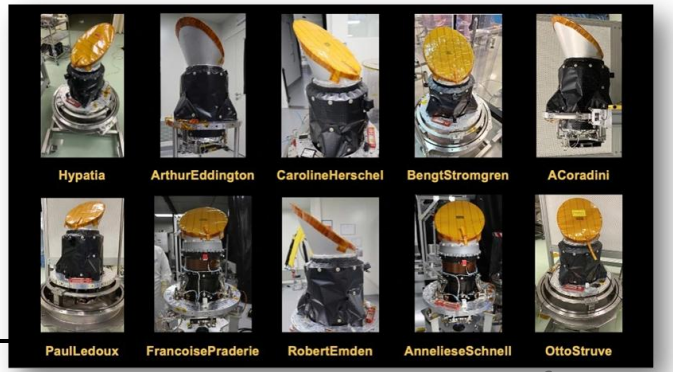
2028: first calibrated data

Status Spacecraft

- **All 26 FM cameras delivered**
- **All cameras integrated** on the optical bench
- **Satellite platform complete**
- **Optical bench and satellite merged end June 2025**
- Next: attach solar panels and final testing.

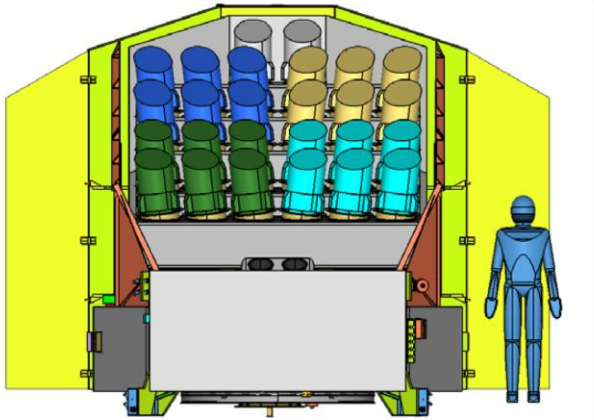
Credit: DLR (CC BY-NC-ND 3.0)

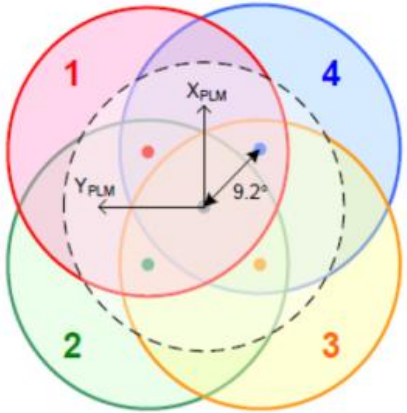
- **Project in schedule** for **launch date end 2026**.
- Contract with Arianespace signed for Ariane 6 launcher.

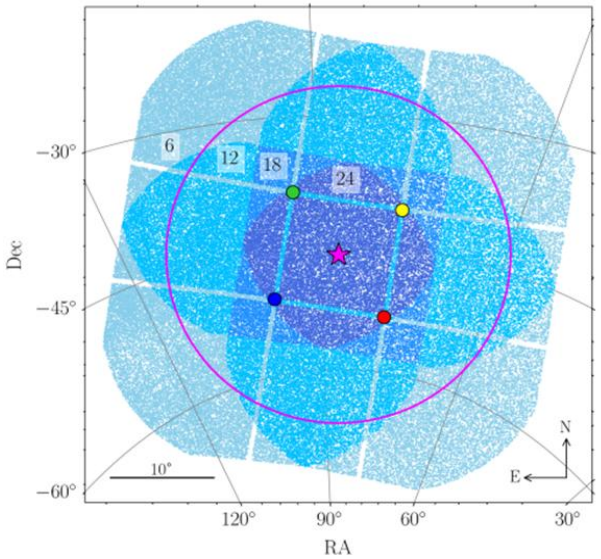


Camera gallery…

The Field-of-View





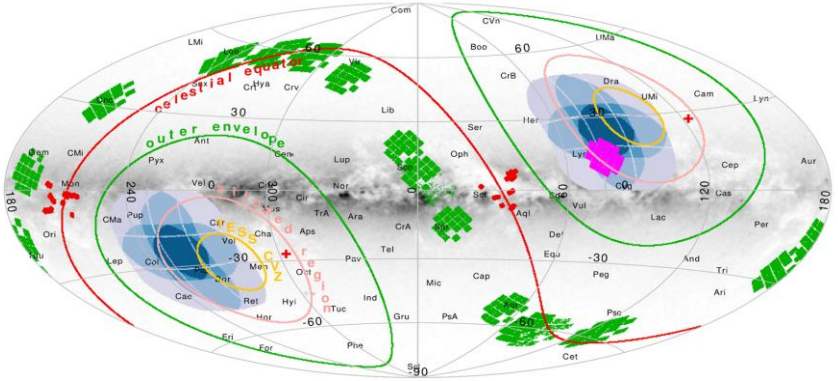


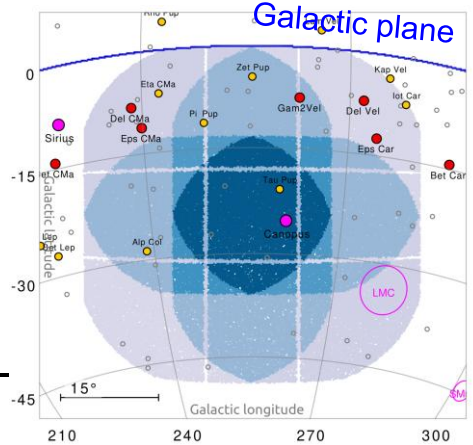
The ~2300 square degree field-of-view is covered by different numbers of cameras.

Field of View simulation with PLATOSim
Janssen et al. (2014) A&A, 681, A18
Credit: Juan Cabrera

The first PLATO field

- The first field will be “LOPS2”, centered at α~6h21m, δ~ −48°, in the southern hemisphere (Nascimbeni et al. 2025, A&A).
- *Includes m*ost of the TESS continuous viewing zone and JWST CVZ.
- Includes 544 TESS planetary candidates and 108 already confirmed planets, and:
  - the Large Magellanic Cloud,
  - 367 open clusters,
  - ~300k known variable stars,
  - 77 non-transiting exoplanets,
  - some benchmark objects such as γDor and the Kapteyn’s star
  - …





LOPS2 location

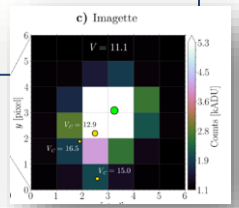
parameter	value	notes
α [deg]	95.31043	ICRS
α [hms]	06:21:14.5	ICRS
δ [deg]	−47.88693	ICRS
δ [dms]	−47:53:13	ICRS
l [deg]	255.9375	IAU 1958
b [deg]	−24.62432	IAU 1958
λ [deg]	101.05940	Ecliptic
β [deg]	−71.12242	Ecliptic
P1 targets	8 235	SciRD req. 7 500
P2 targets	699	SciRD req. 500
P4 targets	12 415	SciRD req. 2 500
P5 targets	167 149	SciRD req. 122 500

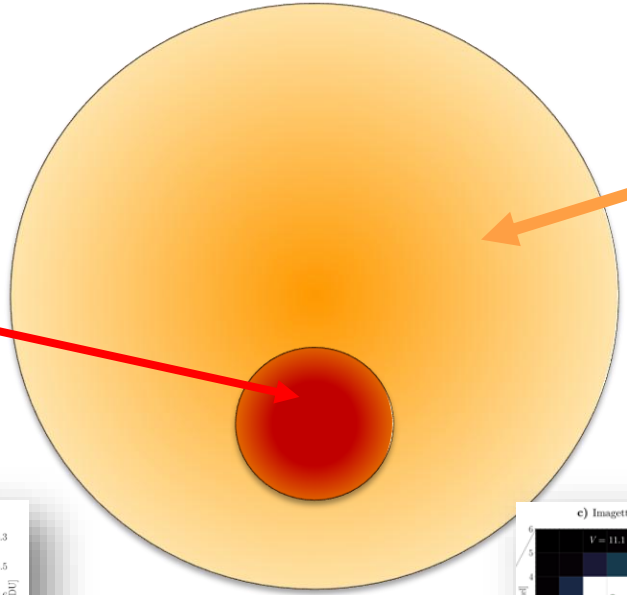
PLATO Stellar Samples

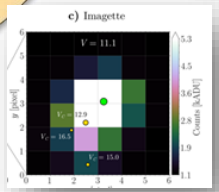
Assuming 2 long pointings:

P1/P2 samples:

- ~15 000 dwarf and subgiant stars (F5 to K7)
- V < 11 mag
- NSR (random) < 50 ppm in one hour

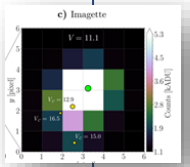


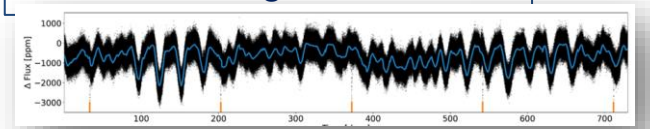




P4/P5 Statistical sample

- > 245 000 dwarf and subgiant stars
- V < 13 mag
- V < 16 mag for M stars





Sub-samples from these are:

- Prime sample (priority targets)
- Propriety sample (PMC)

In addition: guest observer targets

Planet Yield

Number of **planet detections** per spectral type: TESS vs PLATO (2 years only)

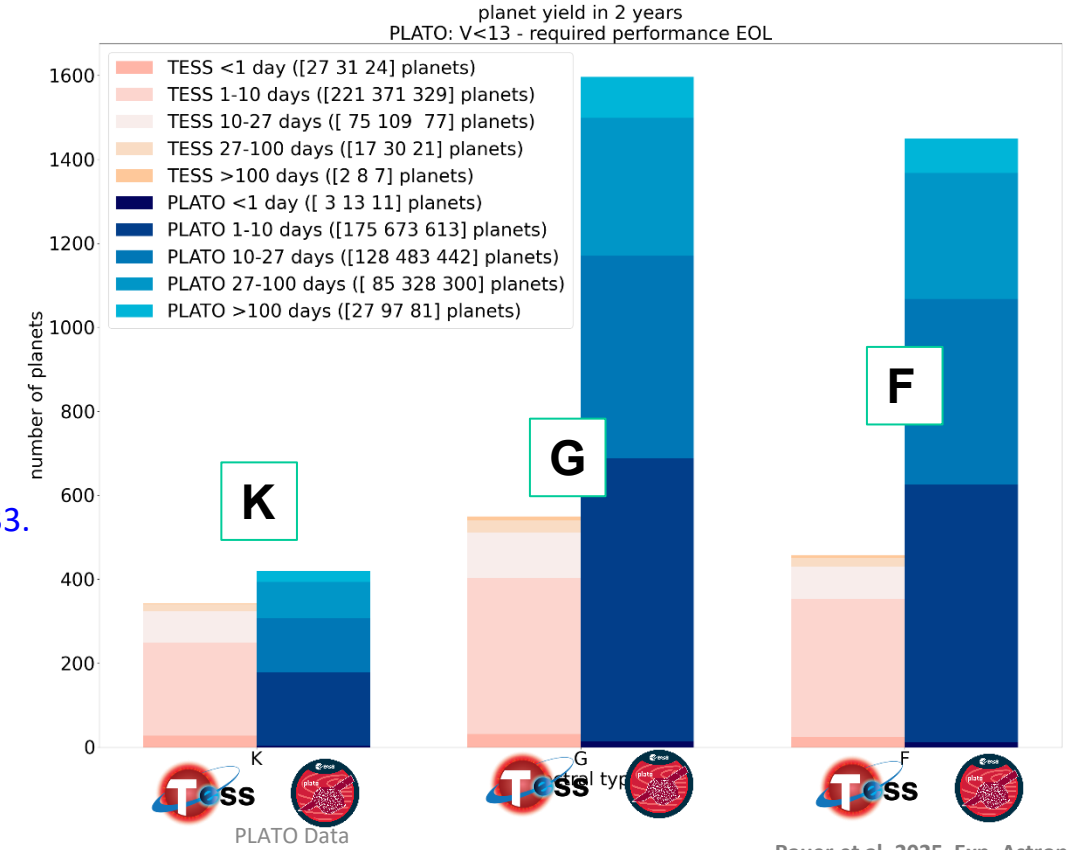
TESS Guerrero et al (2021, their Fig. 7)
PLATO: see Rauer et al. 2024

PLATO dominates for **G stars** and for long orbital periods (up to the **HZ** of solar-like stars)

See also:

- Matuszewski et al. (2023) A&A, 677, A133.

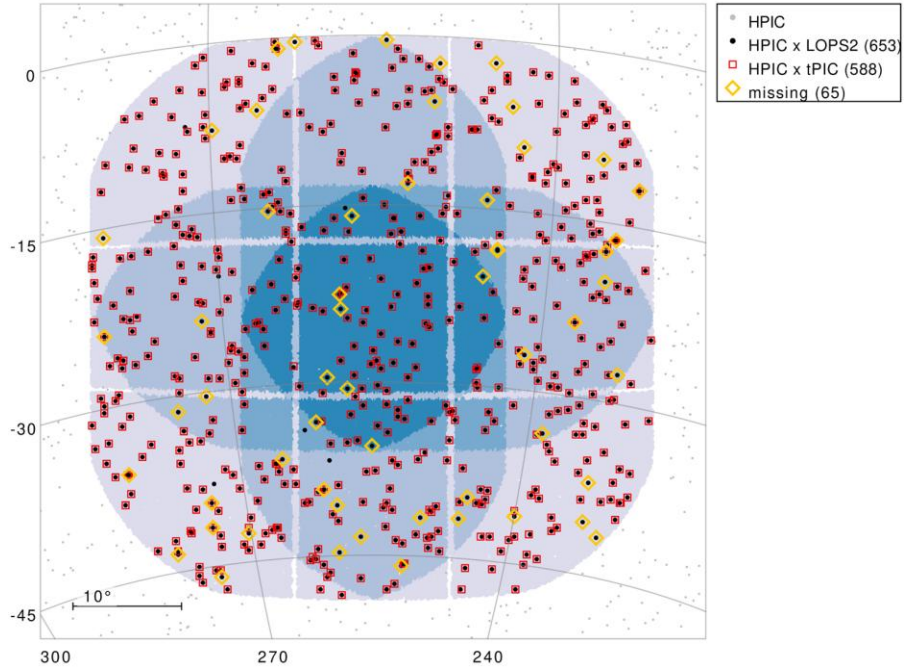
PLATO numbers: for one single long pointing of 2 years



Rauer et al. 2025, Exp. Astronomy

Crossmatch between tPIC (LOPS2) and HPIC

- Starting point: HPIC v1.0, **12 944** potential targets for HWO (Tuchow+ 2024), all-sky. tPIC v.2.0.0, the current “stable” version of the Plato Input Catalog (Montalto+ 2021).
- Among those, **653** geometrically fall within the footprint of LOPS2 (the first long-duration PLATO field).
- Among those, **588** stars (~90%) are already included in the current version of tPIC, so they will be monitored by PLATO
- The remaining 10%, **65** stars, are missing and will NOT be observed unless they are forced in tPIC (still possible), or requested by the community through a GO program (first GO call March 2026, for 8% of PLATO telemetry)
- What kind of targets are these missing stars?



What is missing in the tPIC?

- The vast majority of the 65 missing stars are either **early-type dwarfs** (late-A to mid-F), or **evolved K-type subgiants**. Such targets are not included in the tPIC because of the science requirements for tPIC (selection limits in SpT and absolute magnitude)
- These are stars for which **detecting and/or confirming a transiting habitable planet is difficult/ impossible** or insanely expensive ($P_{HZ} \gg 2$ yr, large mass/radius, large vsini, pulsations, granulation, strong activity in general). *Is it worth forcing them in the tPIC?*
- A handful of stars (~6) look compatible with the tPIC selection limits but were not included nevertheless. They are worth some more investigation to understand where the problem is [*in progress*].