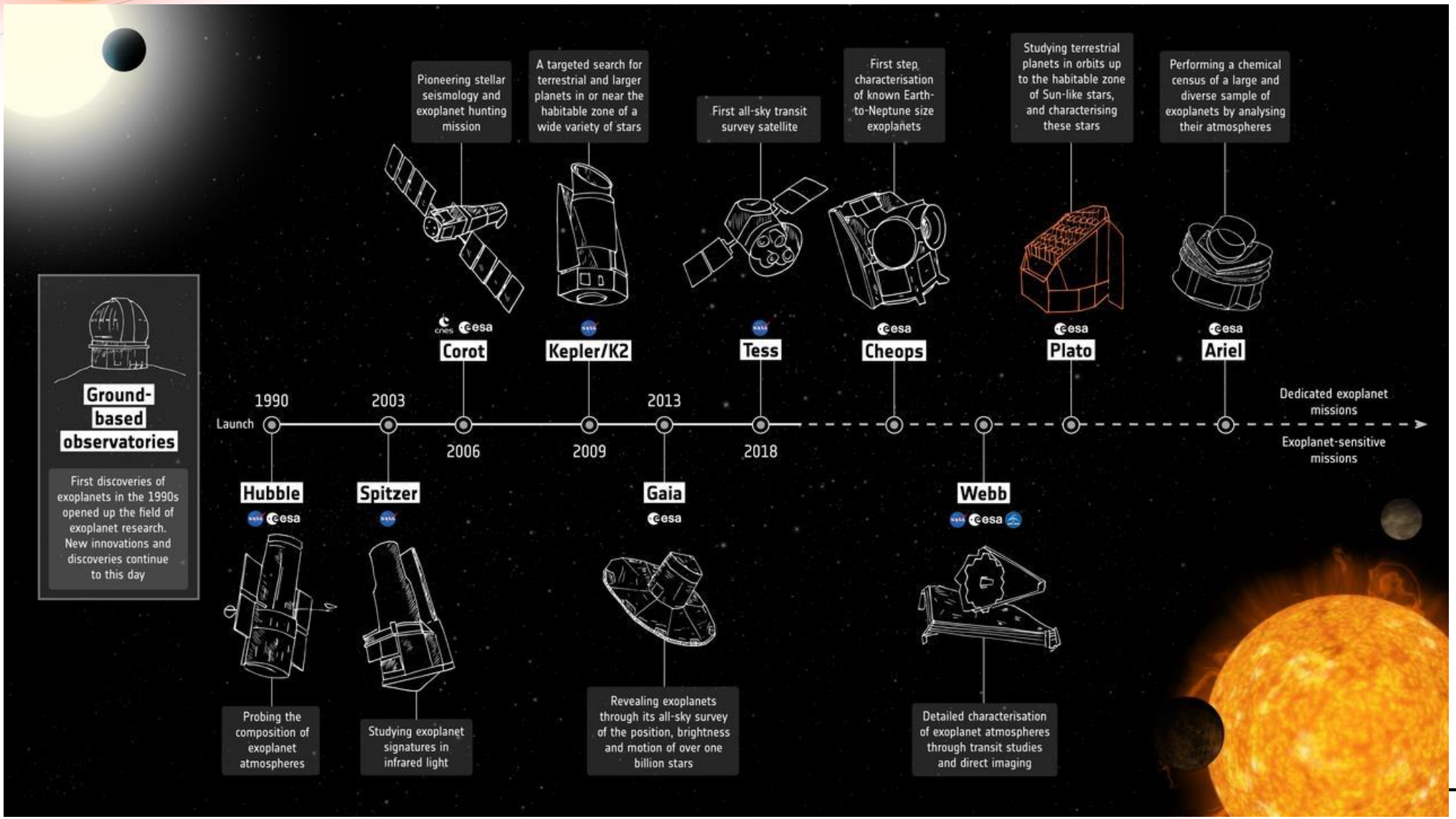
PLATO SCIENCE OBJECTIVES AND PLATO MISSION CONSORTIUM

H. Rauer, ESA SWT, and the PMC

PLATO Mission Conference 2021

11-15 October 2021

Exoplanet Missions



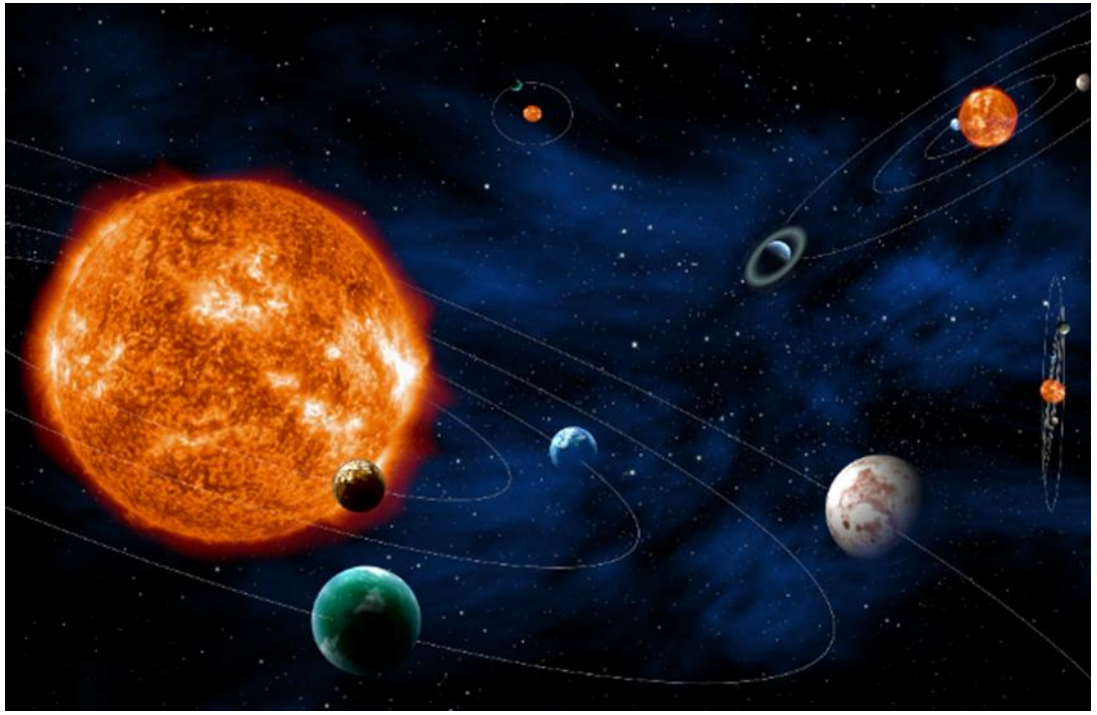
- PLATO is ESA's M3 Mission.
- Launch planned for end of 2026.

PLATO Scientific Questions

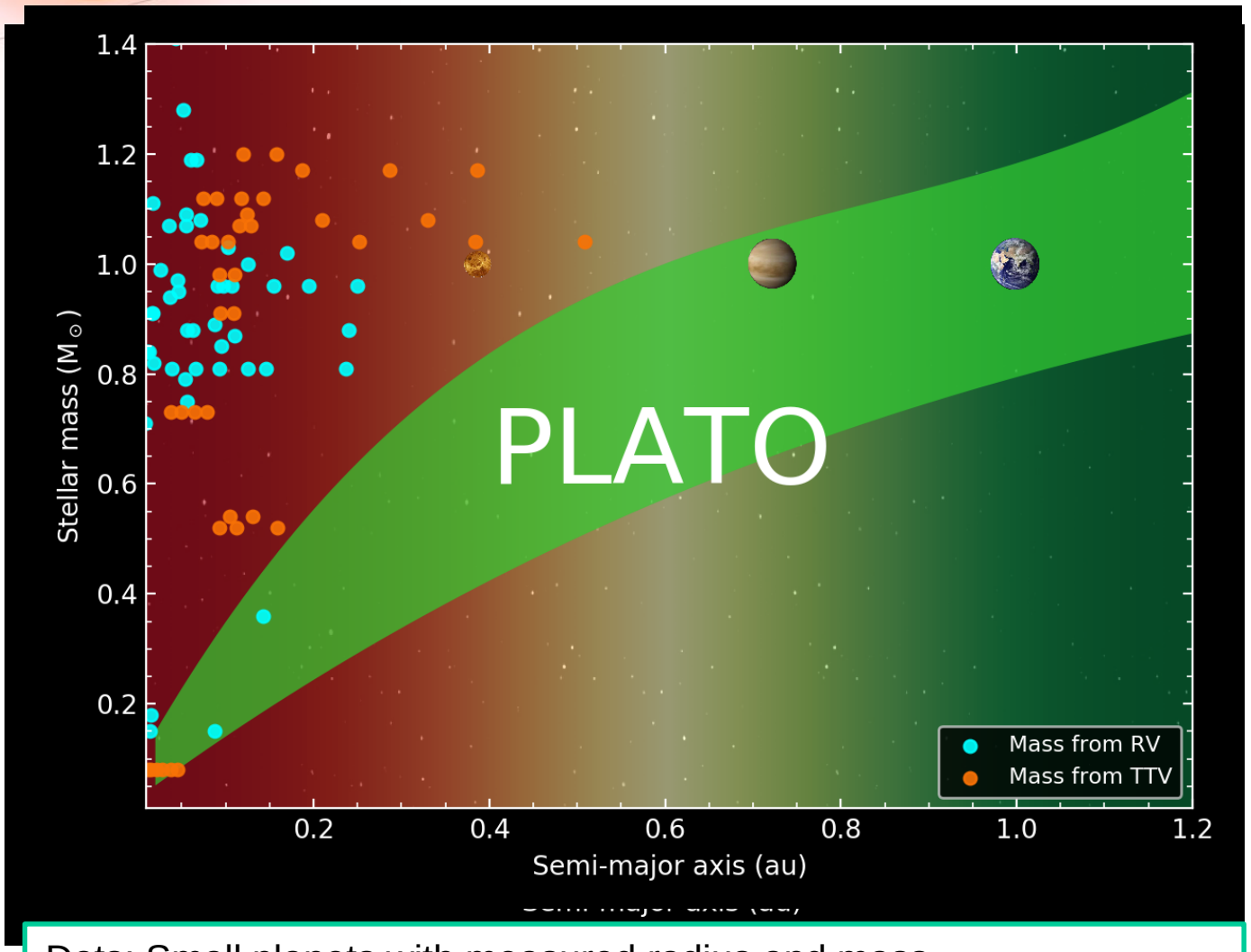
PLAnetary Transits and Oscillations of stars (PLATO) is a mission to detect and characterise exoplanets and study their host stars

Focus on Earth-size planets in orbits up to the habitable zone of bright Sun-like stars to address these main questions:

1. How do planets and planetary systems form and evolve?
2. Is our Solar system special or are there other systems like ours?
3. Are there potentially habitable planets?



Characterisation of super-Earths around sun-like stars

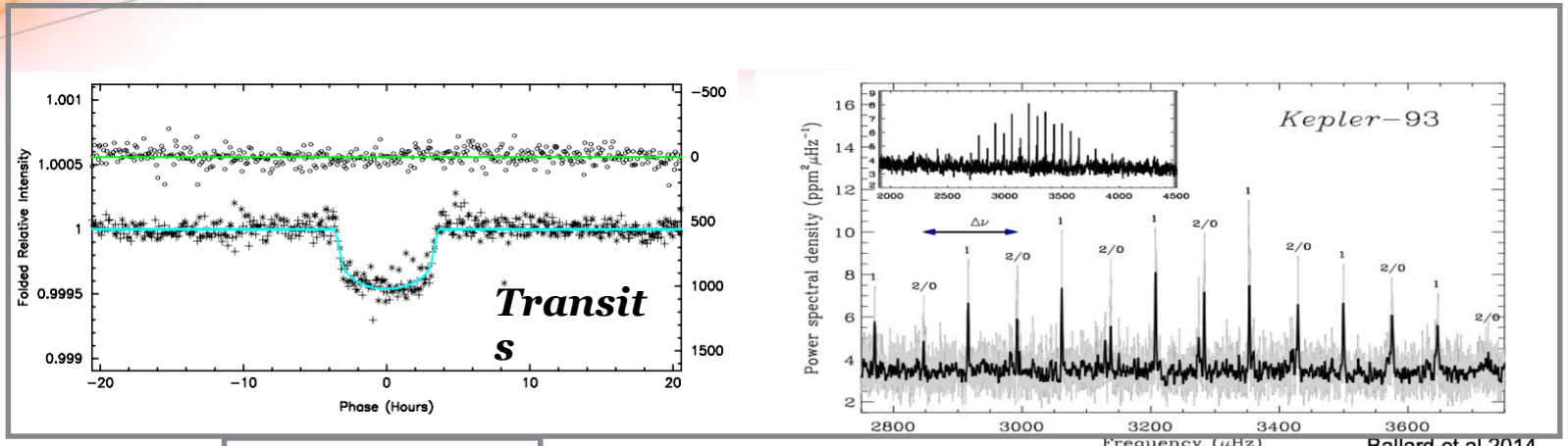


Dots: Small planets with measured radius and mass.
(less than twice the Earth and less than 10 Earth masses)

PLATO objectives address:

- Determination of bulk properties of exoplanets (radius, mass), including terrestrial planets in the habitable zone of Sun-like stars
- Planet evolution with age
- Architecture, formation, evolution of planetary systems, and correlation with stellar parameters
- Identification of good targets for spectroscopic follow-up of planet atmospheres
- Internal structure of stars
- Complementary science through a Guest Observer's programme

Methods

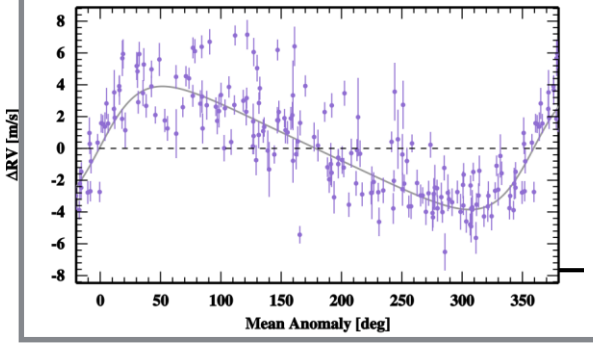


High-precision photometry

Planet radius
Period,
inclination

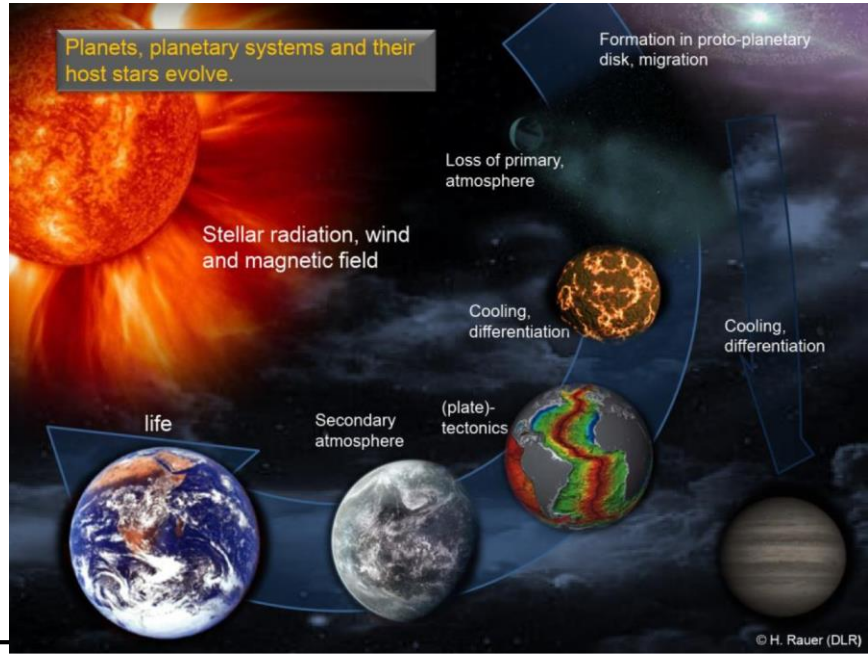
R⋆, M⋆
age

High precision
radial velocity



Planet mass
Eccentricity

- Radius ~3%
- Mass ~10%
- Age ~ 10%

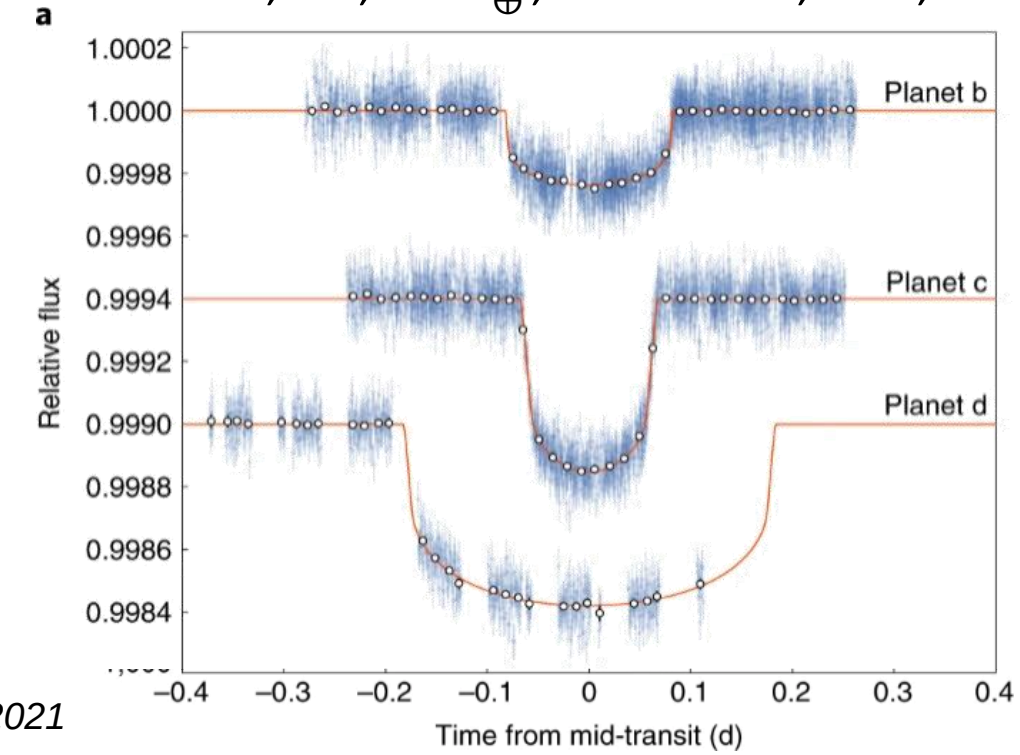


+ orbital parameters + architecture

For example: A PLATO related recent highlight

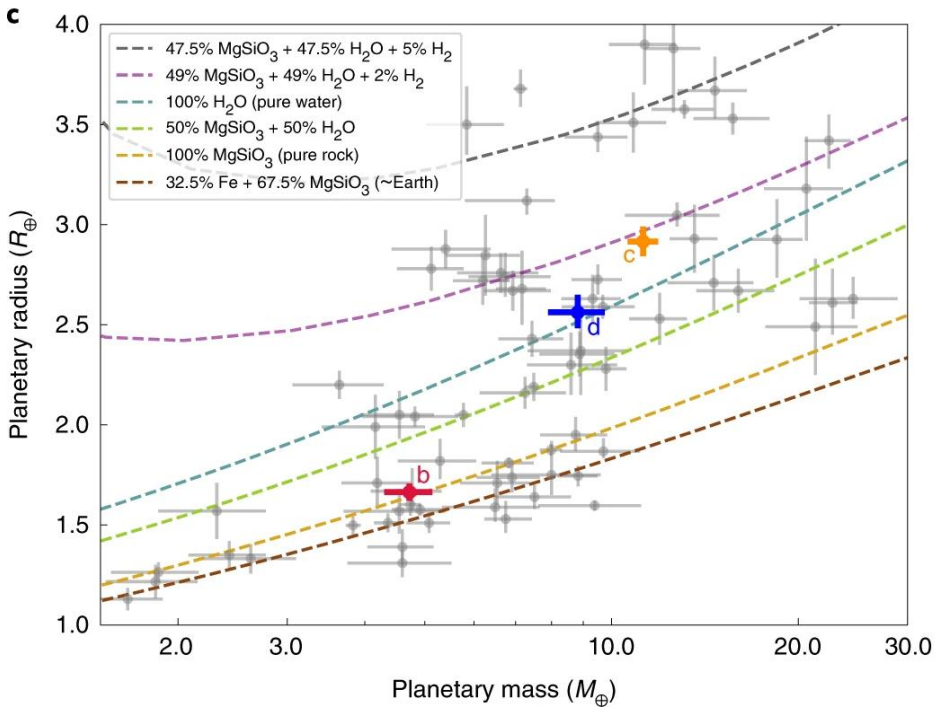
ν2 Lupi with CHEOPS – a case study for PLATO

- Naked eye host star with 3 small planets; periods 11.6, 27.6, 107.3 d
- Radii 1.7, 2.9, 2.6 $R_\oplus$, Masses 4.7, 11.3, 10.1 $M_\oplus$ (RV semi-amplitude 1.5-2.6m/s)



Delrez et al 2021

CHEOPS lightcurves (gaps due to low earth orbit)



PLATO data will be capable of doing a similar analysis **for hundreds of planets**, with much better temporal coverage

Stellar Core Science with PLATO

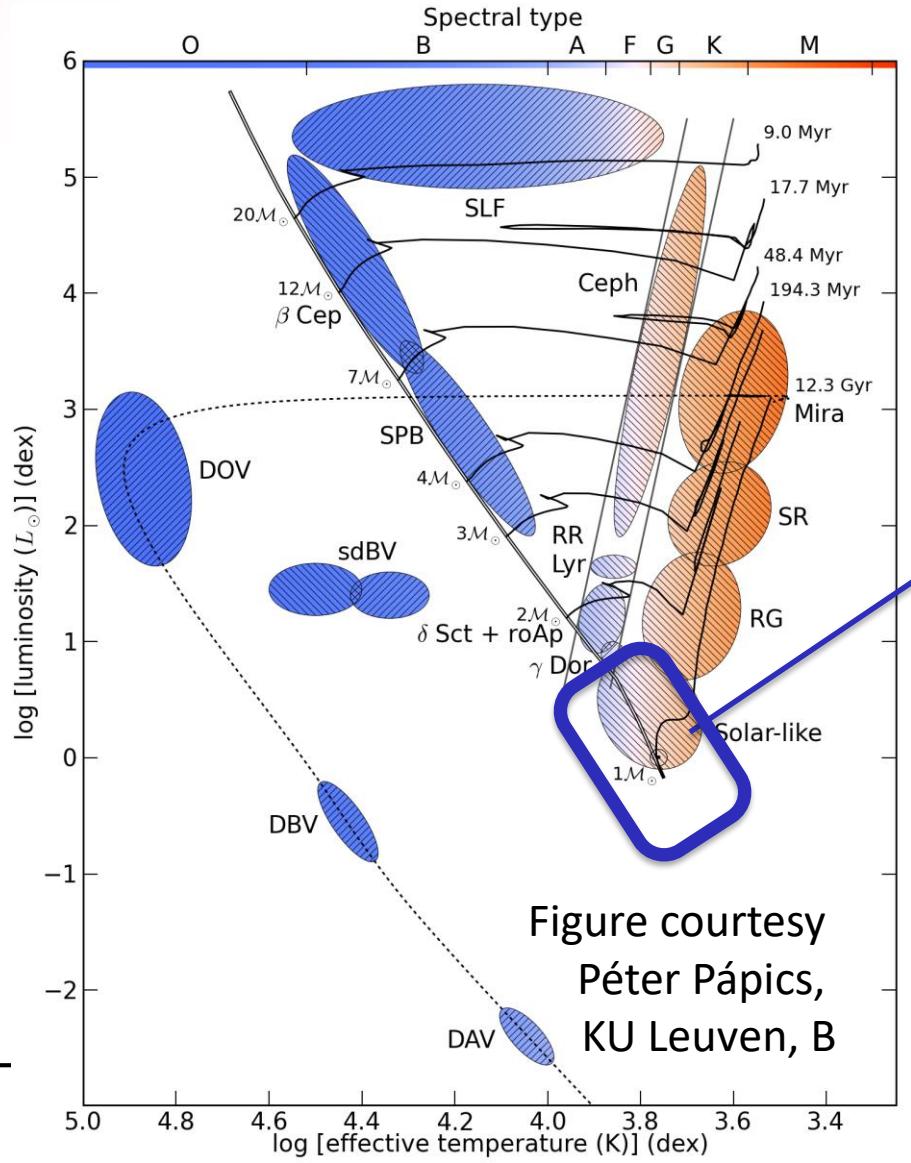


Figure courtesy
Péter Pápics,
KU Leuven, B

Core Science:
asteroseismology of exoplanet hosts & F5-K7 stars @ 2%Radius, 10% Age for 1000s of dwarfs & subgiants

Complementary Science with PLATO

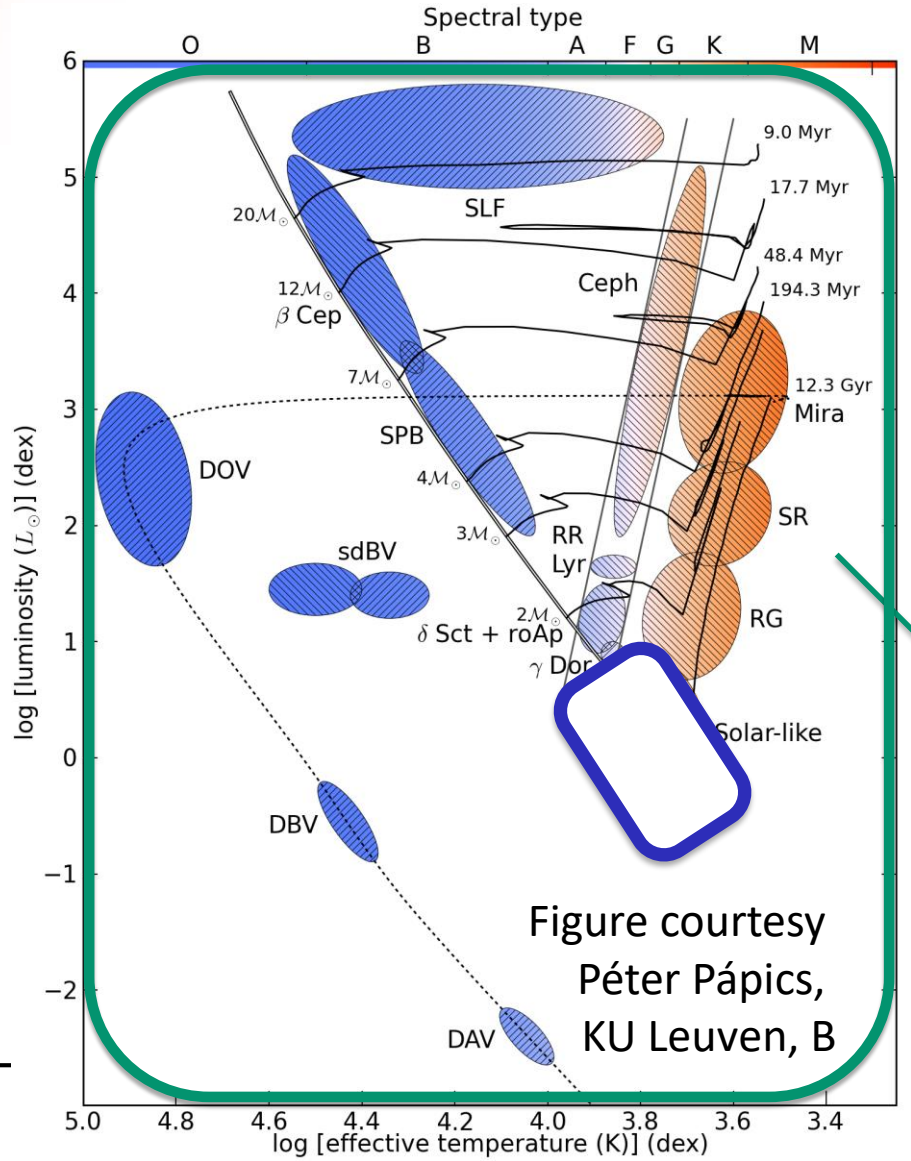


Figure courtesy
Péter Pápics,
KU Leuven, B

Core Science:
asteroseismology of exoplanet hosts & F5-K7 stars @ 2%Radius, 10% Age for 1000s of dwarfs & subgiants

GO (8%) allows asteroseismology
+ magnetism/activity/flares
+ binarity/tides + rotation
+ distance scales + clusters
+ galactic archeology
+ transients (GRB, BH, GW,…)
+ …

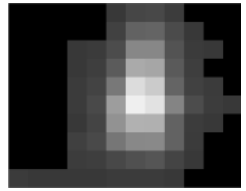
→ ESA Call: 9 months prior to launch

Stellar samples

- PLATO has a set of lightcurve samples defined with different precision.
- The main samples are:
  - **Core sample:** ~15 000 dwarf and sub-giant stars (F5 to K7) with <11 mag
    - 34 ppm in 1 hour for <10mag; 50 ppm for <11 mag

    → high precision planet and stellar parameters (radii, asteroseismology)

    → **Key sample for core science goals**



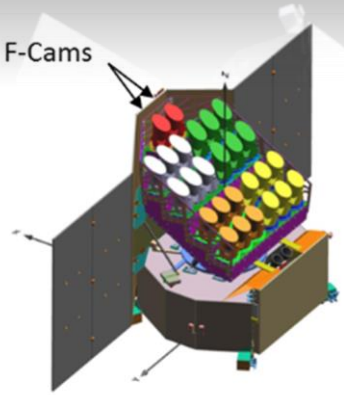
  - **„Statistical“ sample**: >245 000 dwarf and sub-giant stars with <13 mag

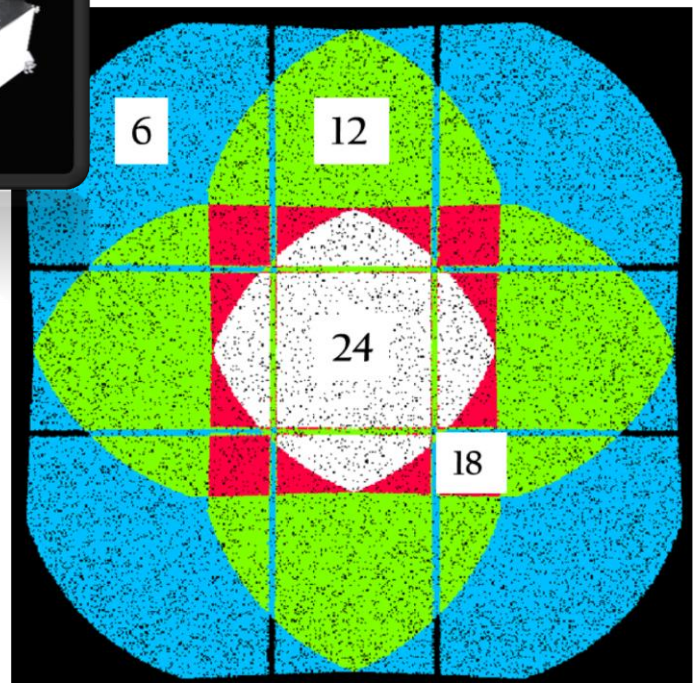
    → statistics, good planet radii precision; but no asteroseismology, no RV

  - >5 000 **late type stars (M dwarfs)**

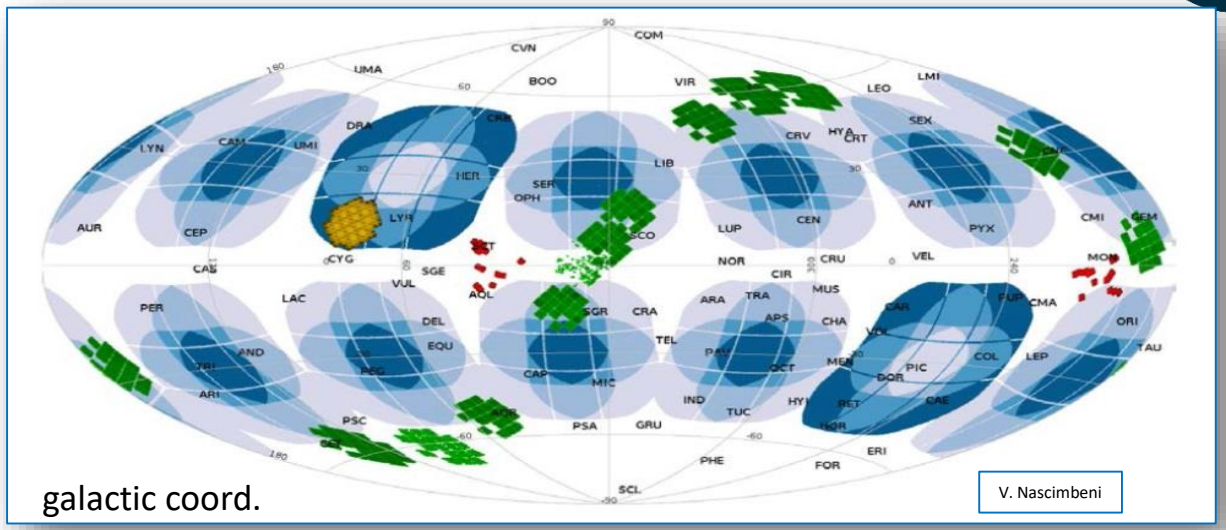
- **Expected Planets**
  - >4 000 (goal 7 000) detected planetary systems
  - >100 with highest planet parameter precisions, **including habitable zone planets**

PLATO: field of view





Total FOV ~2132 deg^2
(vs 105 deg^2 Kepler)



Observation of 245 000 F-G-K dwarf and sub-giant stars with V-mag < 13. PLATO Input Catalogue derived from GAIA results.

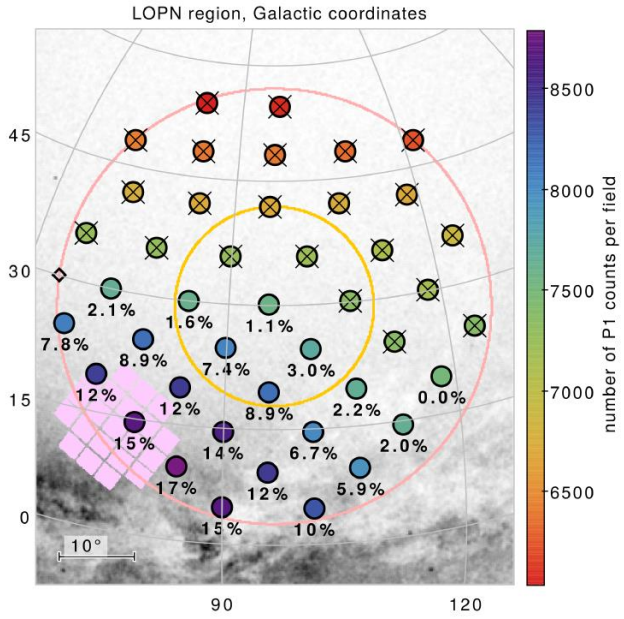
Current baseline: 2 long pointings of 2 years each.
Consumables onboard for 8.5yr

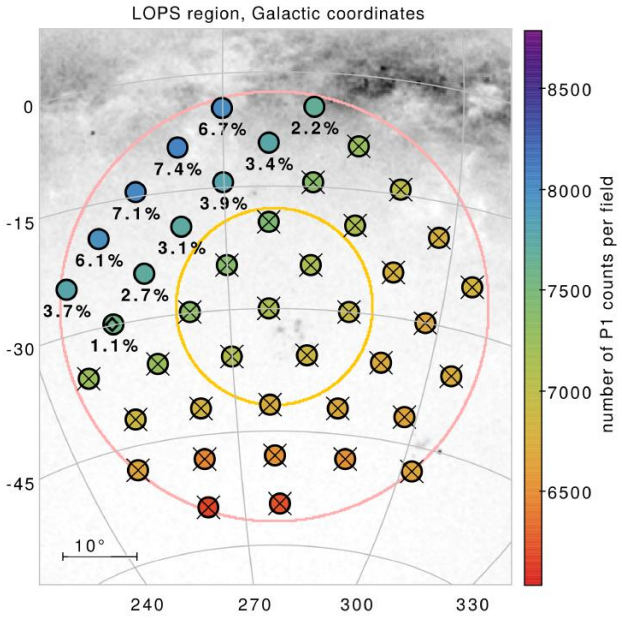
Alternative scenarios such as 1 long pointing lasting 4 years e.g. are possible.

The final observing strategy will be fixed 2 years before launch and can be adapted during the mission.

The PLATO Input Catalogue

Preparation for the definition of the PIC, and on the selection of the long pointing fields ongoing – **see presentation by G.P. Piotto**





Astronomy & Astrophysics manuscript no. output
June 22, 2021

In press

The all-sky PLATO input catalogue⋆

M. Montalto[1,2,⋆⋆], G. Piotto[1,2], P. M. Marrese[3,4], V. Nascimbeni[1,2], L. Prisinzano[5], V. Granata[1,2], S. Marinoni[3,4], S. Desidera[2], S. Ortolani[1,2], C. Aerts[14,15,16], E. Alei[6], G. Altavilla[3,4], S. Benatti[5], A. Börner[7], J. Cabrera[8], R. Claudi[2], M. Deleuil[12], M. Fabrizio[3,4], L. Gizon[17,18,19], M. J. Goupil[9], A. M. Heras[10], D. Magrin[2], L. Malavolta[1,2], J. M. Mas-Hesse[13], I. Pagano[11], C. Paproth[7], M. Pertenais[7], D. Pollacco[20,21], R. Ragazzoni[1,2], G. Ramsay[24], H. Rauer[8,22], S. Udry[23]

(Affiliations can be found after the references)

Astronomy & Astrophysics manuscript no. output
September 19, 2021

Submitted

The PLATO field selection process

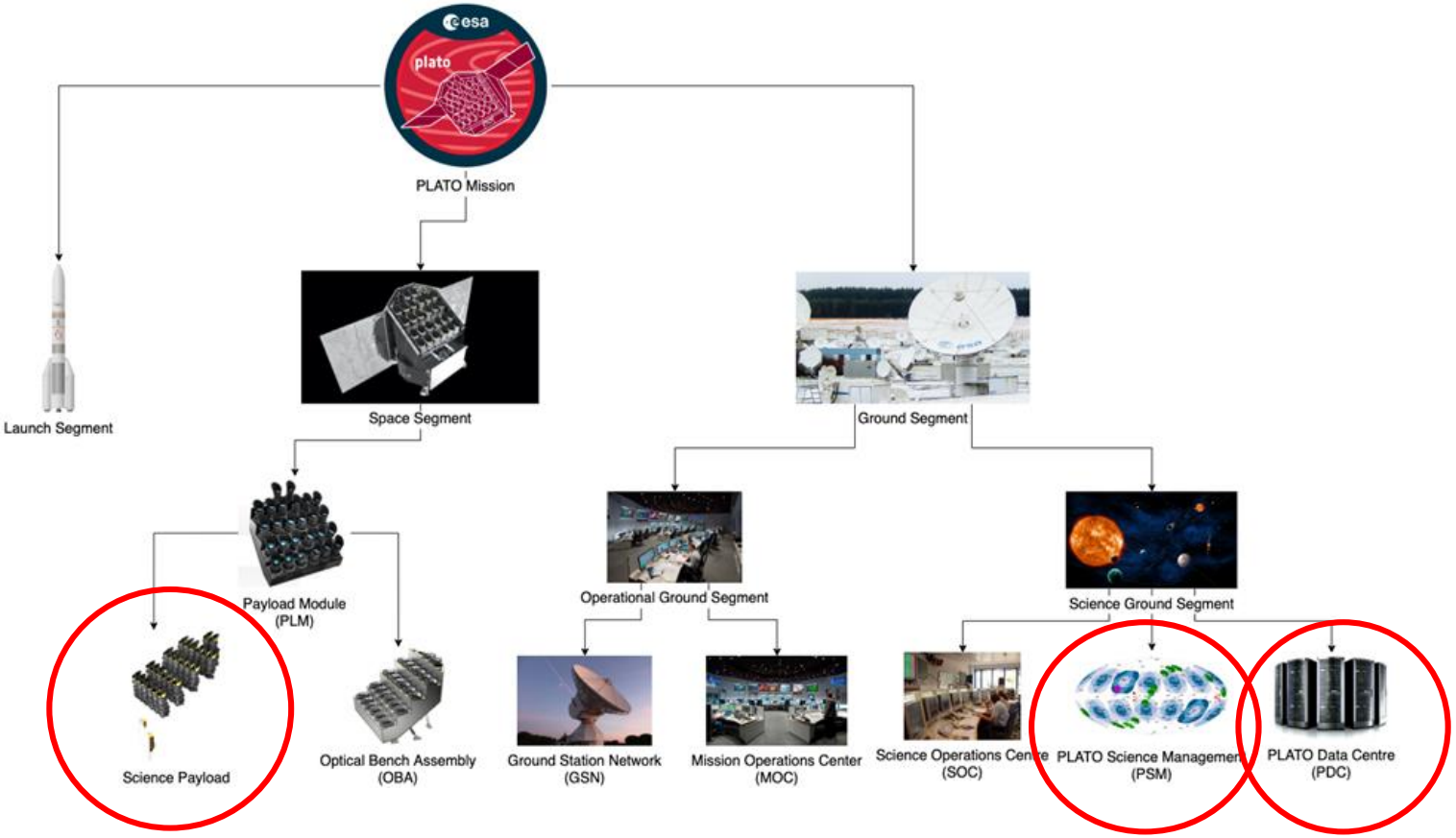
I. Identification and content of the long-pointing fields

V. Nascimbeni⋆[1,2], G. Piotto[2,1], A. Börner[3], M. Montalto[2,1], P. M. Marrese[4,5], J. Cabrera[6], S. Marinoni[4,5], C. Aerts[7,8,9], G. Altavilla[4,5], S. Benatti[10], R. Claudi[1], M. Deleuil[11], S. Desidera[1], M. Fabrizio[4,5], L. Gizon[12,13,14], M. J. Goupil[15], V. Granata[2,1], A. M. Heras[16], L. Malavolta[2,1], J. M. Mas-Hesse[17], S. Ortolani[2,1], I. Pagano[18], D. Pollacco[19,20], L. Prisinzano[11], R. Ragazzoni[2,1], G. Ramsay[21], H. Rauer[6,22,23], and S. Udry[24]

(Affiliations can be found after the references)

Compiled: September 19, 2021

PMC (PLATO Mission Consortium)



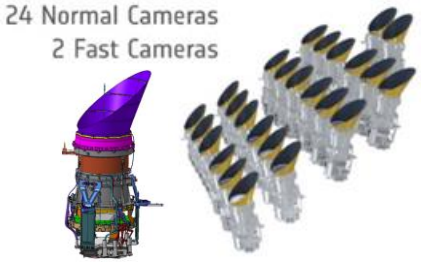
PLATO is a joint development by ESA and the PMC.

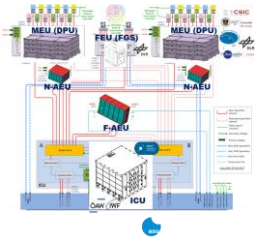
PMC contributions:

- **Science Payload**
- Ground segment:
  - **PLATO Science Management**
  - **PLATO Data Center**
- **Calibration & Operation**
- **Science Performance Monitoring**

PMC main activities

Payload





Onboard data processing system

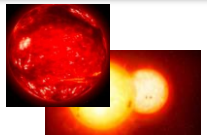
PSM

Exoplanet science

Stellar science

Target field selection (PIC)

Ground-based observations



Complementary science

PDC

Science data base (L2, L3, PIC)

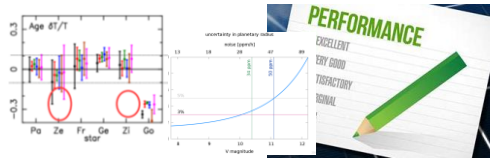
L2, L3 data product processing

- **Payload cameras** (with contributions from ESA)**, Onboard data processing units**
- **Science Ground Segment** including:
  - **PLATO Science** Management (PSM), e.g.:
    - Specification of PLATO Input Catalogue (PIC)
    - Exoplanet and stellar science
    - Specification of data processing algorithms
    - Coordination of ground-based observing program (GOP)
    - Coordination of complementary science
  - **PLATO Data Center** (PDC) L2, L3 data products
- **PLATO Calibration & Operation Team** (PCOT)
- **PLATO Performance Team** (PPT)

PCOT

Operational procedures, tests, user manual

PPT



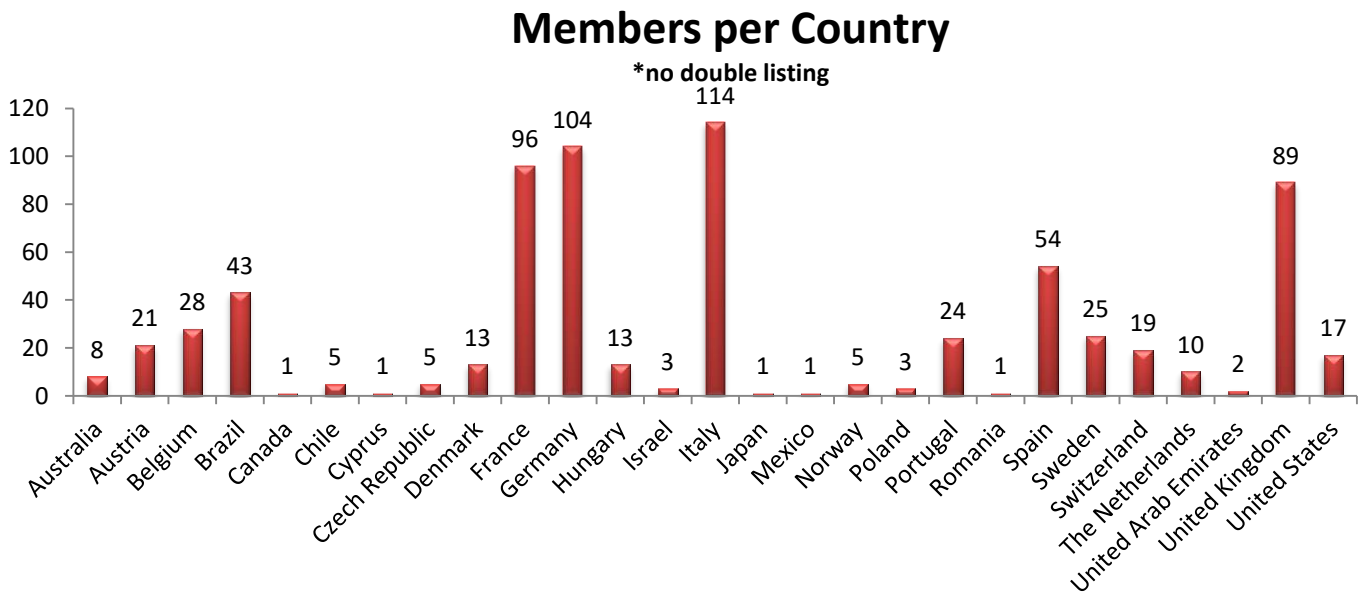
Science mission performance, instr. simulators

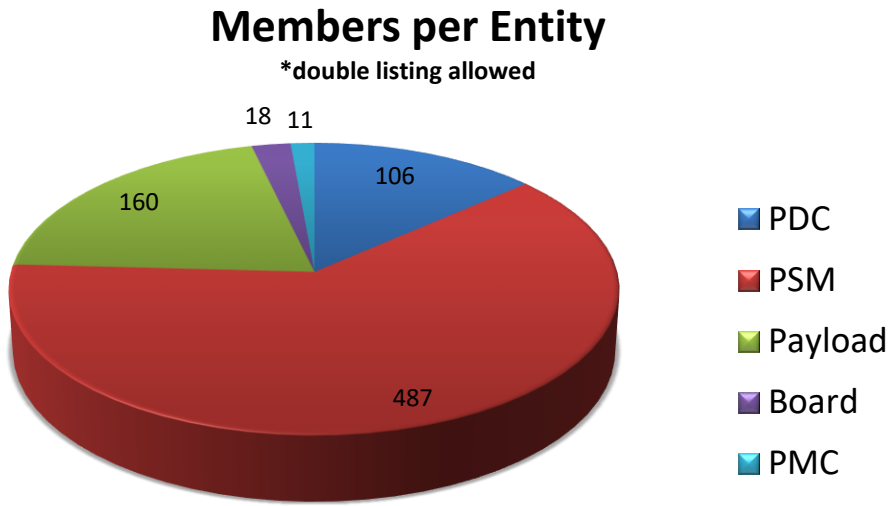
PMC contact points

position	person	
PI and Co-PI Office	Heike Rauer	DLR, D
	Isabella Pagano	INAF, I
	Miguel-Mas-Hesse	INTA, ES
PMC manager	Anders Erikson	DLR, D
PSM Coordinator	Don Pollacco	Univ. Warwick, UK
PSM manager	David Brown	Univ. Warwick, UK
PDC Coordinator	Laurent Gizon	MPS, D
PDC manager	Aaron Birch	MPS, D
PCOT manager	Cesar Martin Garcia	DLR, D
PPT manager	Juan Cabrera	DLR, D

PMC Membership status

- 706 PMC members come from 27 countries worldwide





October 5, 2021

PLATO community