PLATO

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l'Observatoire de Paris — LESIA

Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

cnrs dépasser les frontières — UPMC Sorbonne Universités — Université Paris Diderot Paris 7 — PSL Research University

PLATO (Planetary Transits and Oscillation of Stars)

Key dates :

- PLATO selected as ESA M3 mission (Feb. 2014)
- PLATO adopted by ESA in June 2017
- Currently in phase B2 (consolidated definition phase)
- Phase C (consolidated design and implementation) : Q4 2019-Q4 2023
- Launch is expected in 2026

Soyuz launch from Kourou (Credit: ESA)

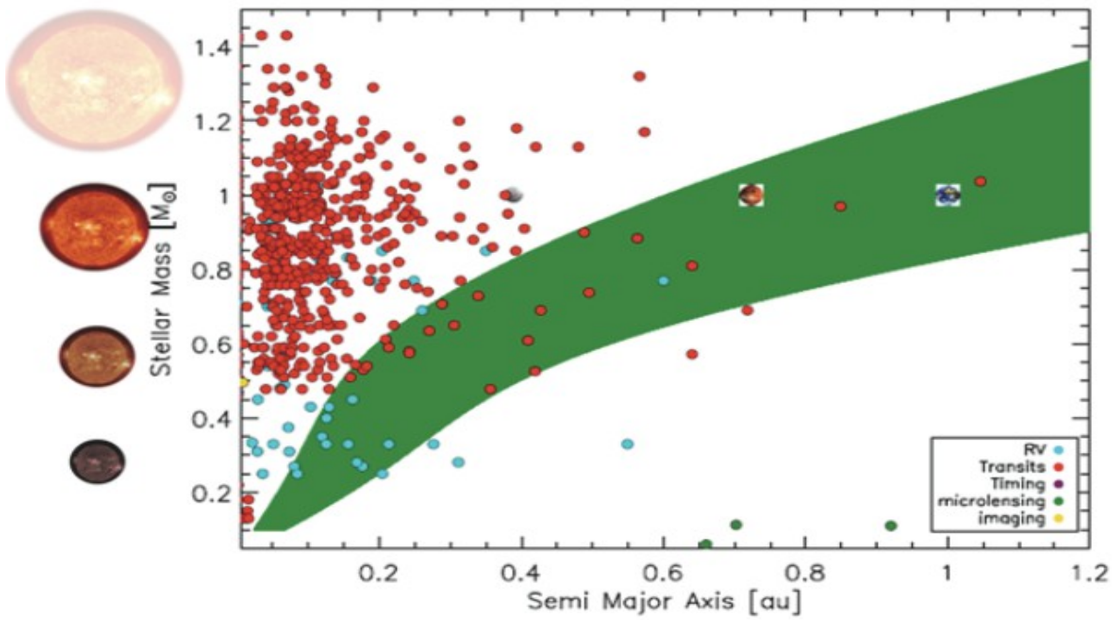
PI : *H. Rauer (DLR)*
Science coordinator :
D. Pollacco (Warwick Univ.)

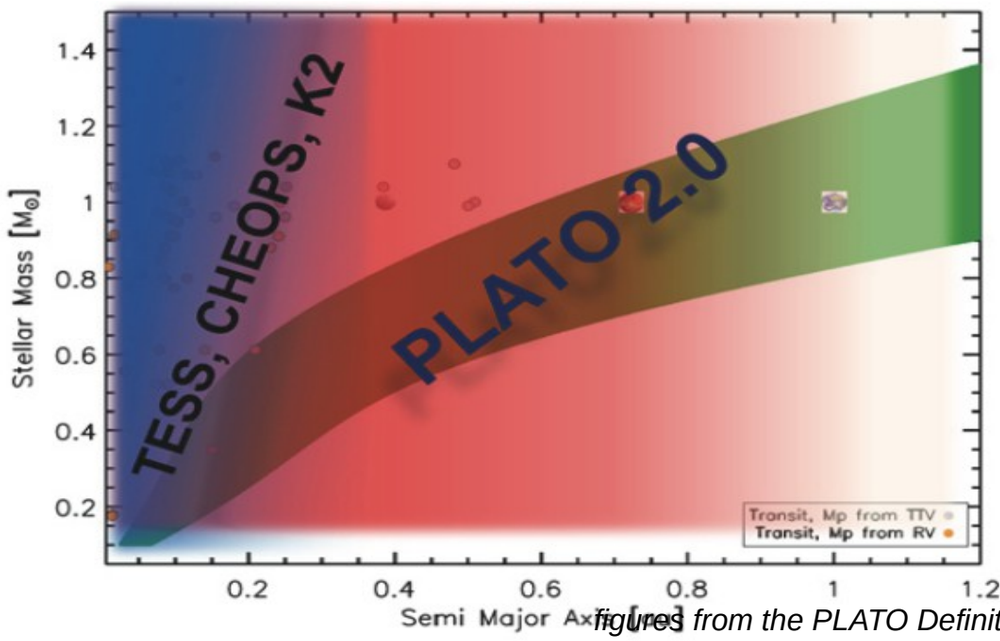
Launch by Soyuz-Fregat2-1b from Kourou in 2026 (compliant with a Ariane 6 launch)

PLATO main objectives

Characterize planets to:

- explore planet diversity
- detect and characterize terrestrial planets in the habitable zone
- constrain planet formation and evolution processes





figures from the PLATO Definition Study Report

*Determine the bulk properties (mass, **radius**, mean density) of planets in a wide range of systems, including terrestrial planets in the habitable zone of solar-like stars.*

Specificité of PLATO : to derive accurate planetary system age

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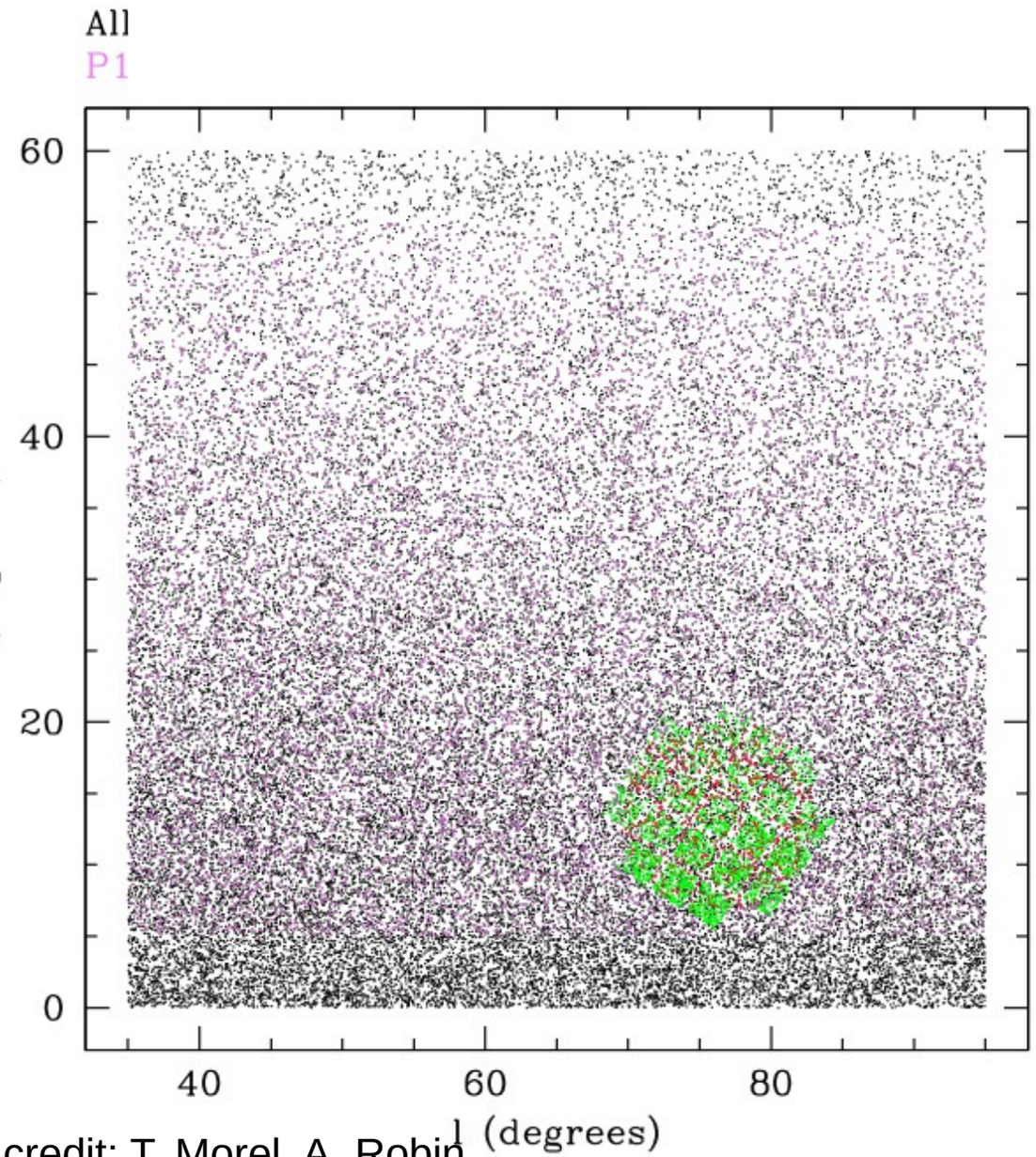
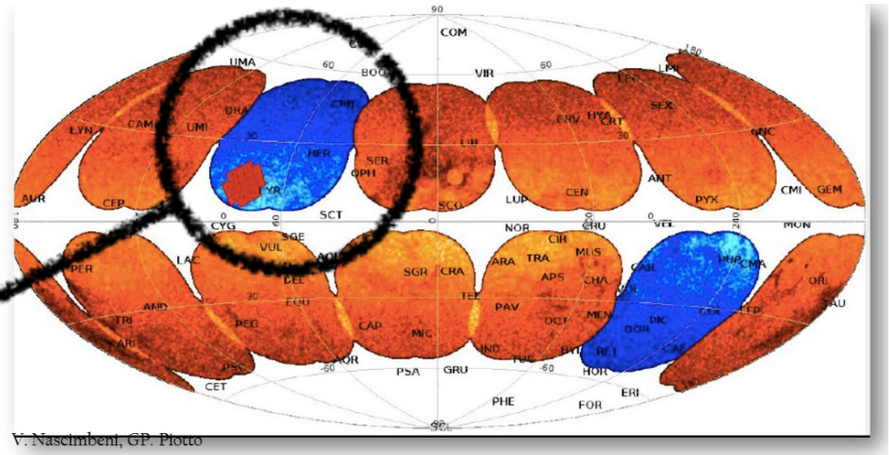
The PLATO expected performances

- ✓ Stellar population computed with the Besançon Model (A. Robin 2017) adapted for a PLATO 2yr long run



credit: T. Morel, A. Robin



V. Nascimbeni, GP. Piotto

- All stars simulated
- P1 stars
- *Kepler* field
- P1 stars in *Kepler* field

source :

PLATO main objectives

Characterize planets to:

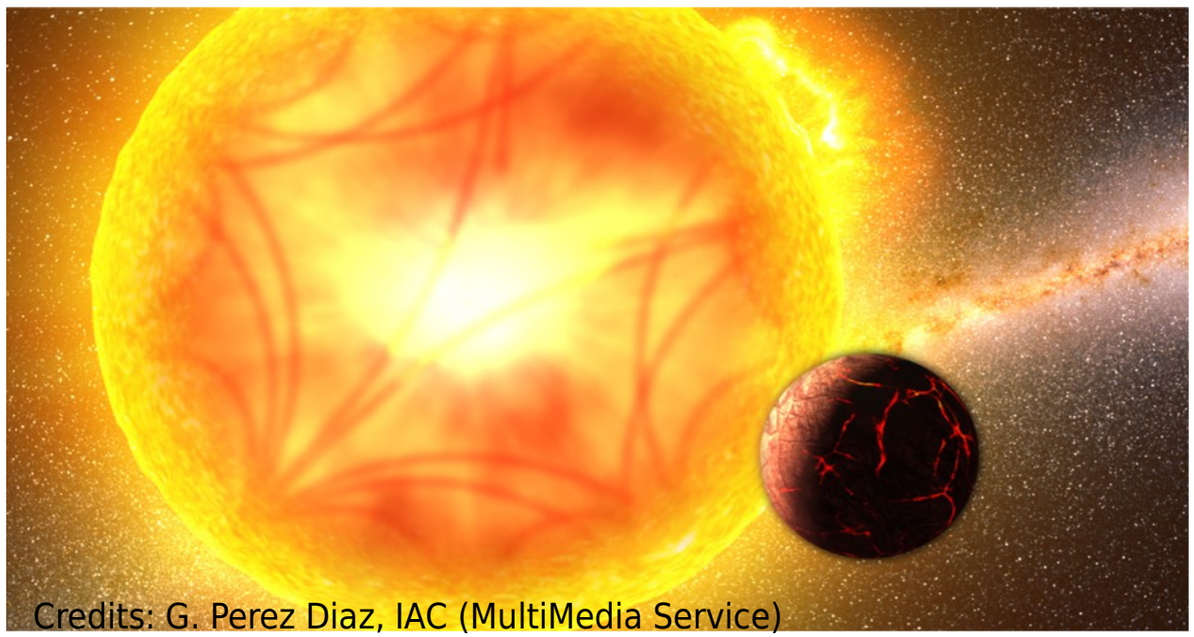
- explore planet diversity
- detect and characterize terrestrial planets
- constrain planet formation and evolution processes

Stellar science and asteroseismology:

- precise and accurate characterization of stars hosting planets :
  stellar mass, **radius** and age

This requires

- to improve our knowledge of the internal structure and evolution of low-mass stars



Credits: G. Perez Diaz, IAC (MultiMedia Service)

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PLATO main objectives

Characterize planets to:

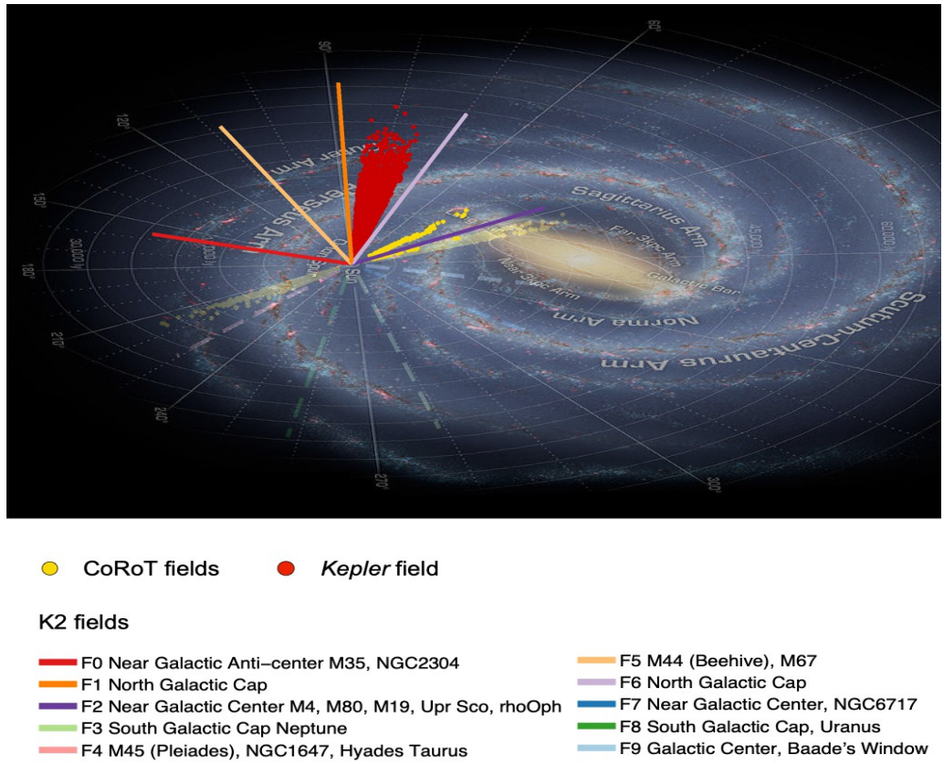
- explore planet diversity
- detect and characterize terrestrial planets
- constrain planet formation and evolution processes

Stellar science and asteroseismology:

- precise and accurate characterization of stars hosting planets (in particular ages)
- Improve our knowledge of the internal structure of low-mass stars

Complementary science:

- Seismology of massive stars
- Galactic population studies
- and much more…



source : http://www.octave.ph.bham.ac.uk/Outreach.html#three

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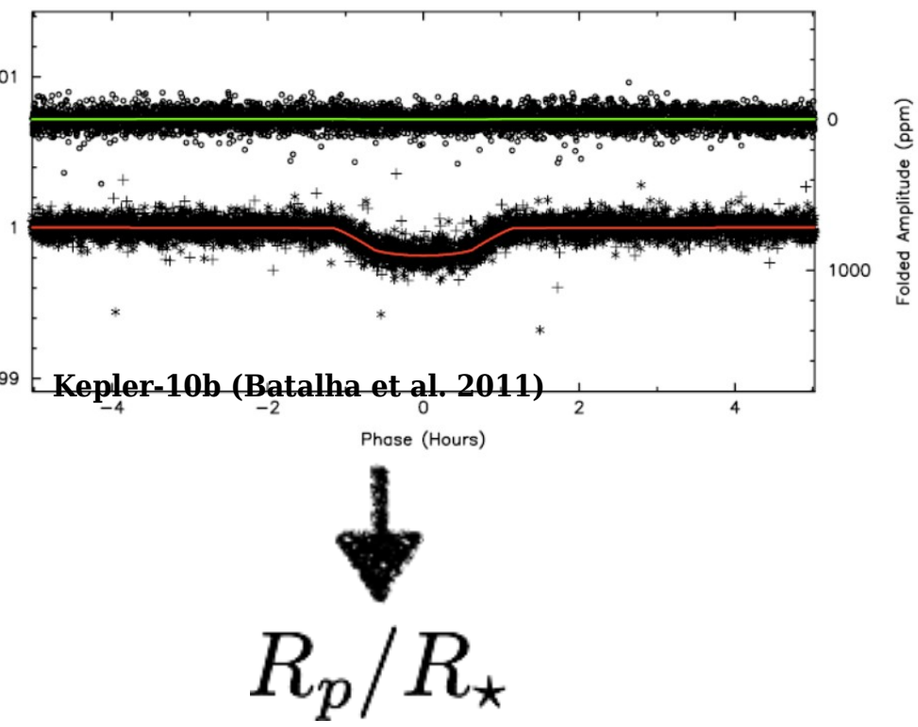
How to reach the scientific objectives?

- Transits



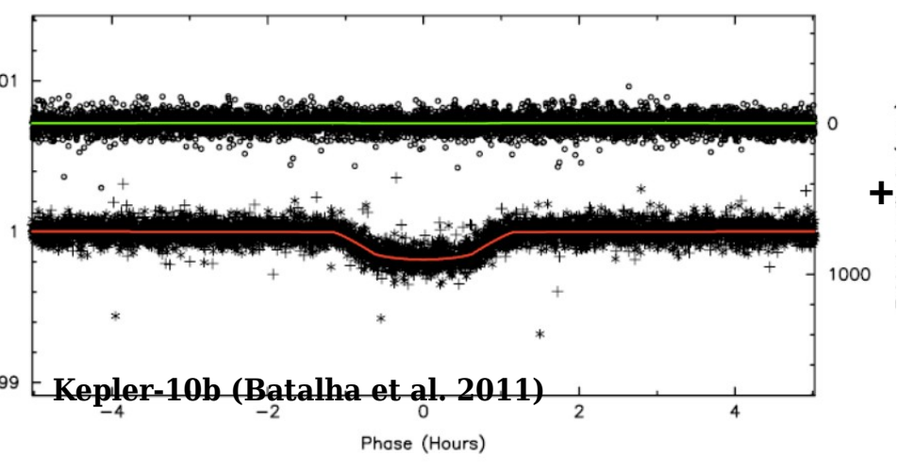
Kepler-10b (Batalha et al. 2011)

$$R_p/R_\star$$

source :

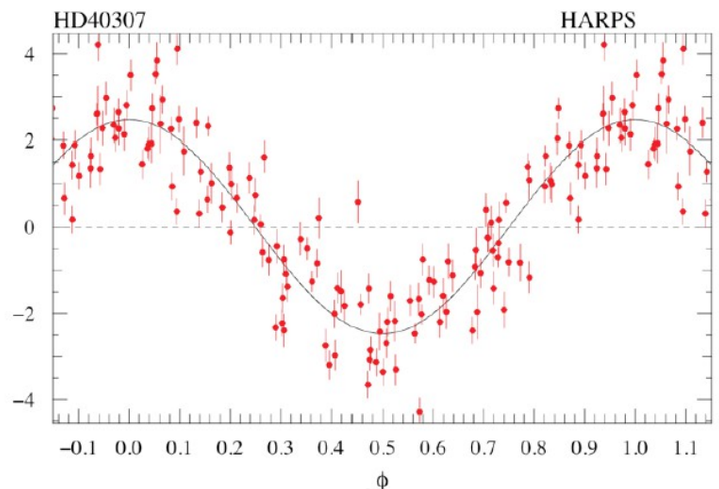
How to reach the scientific objectives?

- Transits



$R_p/R_\star$

- Radial velocities

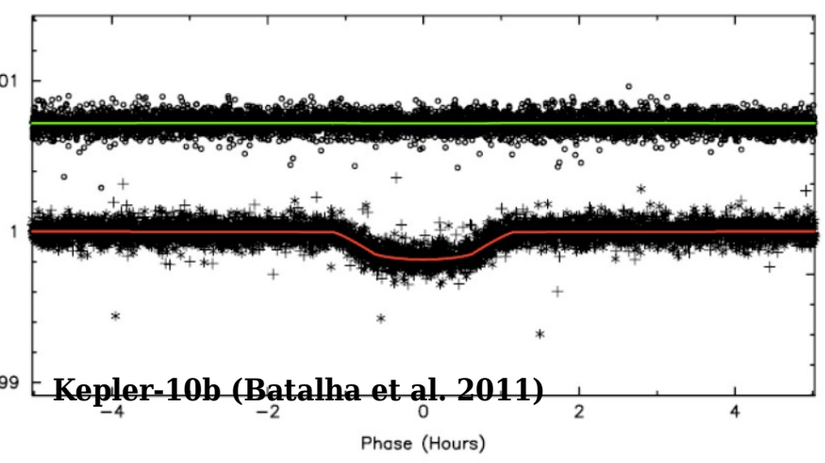


$M_p/M_\star$

source :

How to reach the scientific objectives?

- Transits

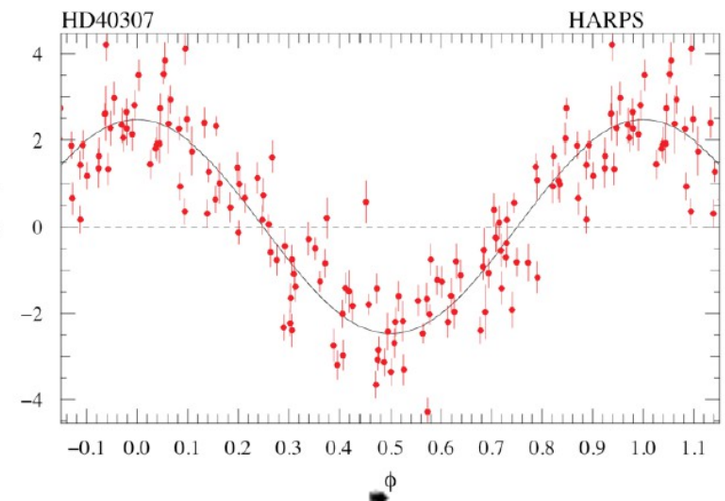


Kepler-10b (Batalha et al. 2011)

$R_p/R_\star$

+

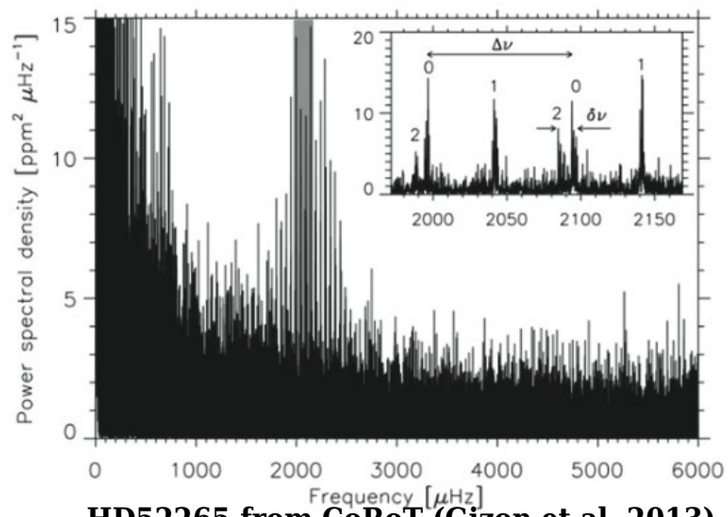
- Radial velocities



$M_p/M_\star$

+

- Asteroseismology



HD52265 from CoRoT (Gizon et al. 2013)

$R_\star, M_\star, \mathrm{Age}, \ldots$

+

gaia

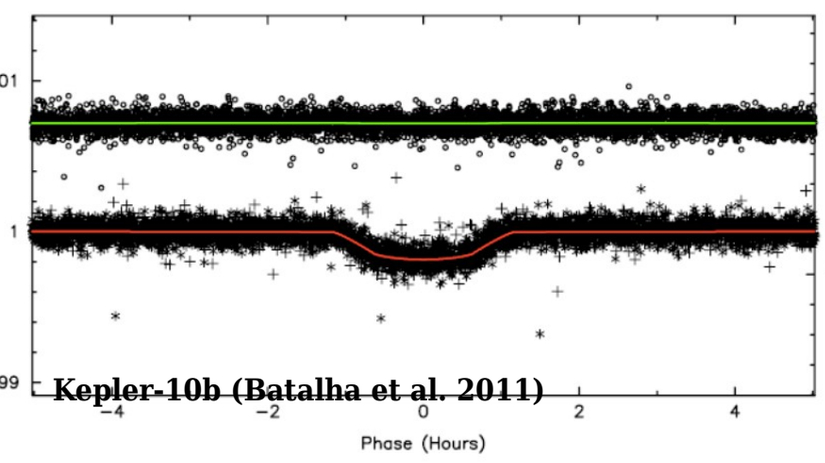
$L_\star, \ldots$

- **Simultaneous** *transit and asteroseismic measurements*
- **Synergies** between photometric, spectroscopic, and astrometric observations

→ *Precise and accurate characterized planetary systems*

How to reach the scientific objectives?

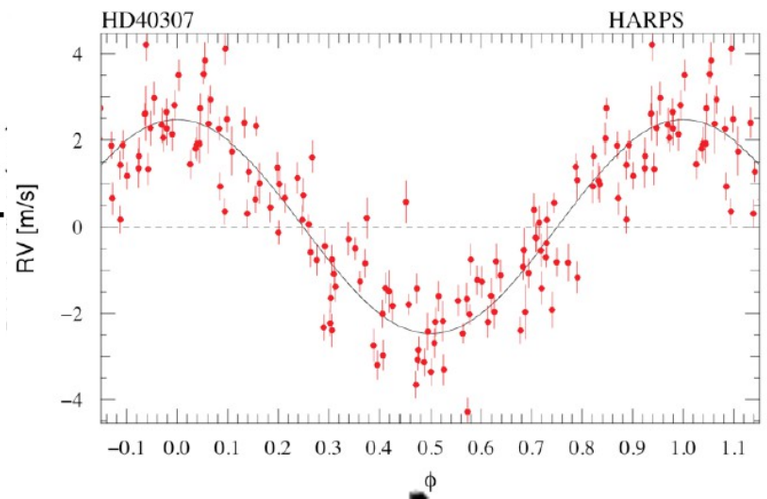
- Transits



Kepler-10b (Batalha et al. 2011)

+

- Radial velocities



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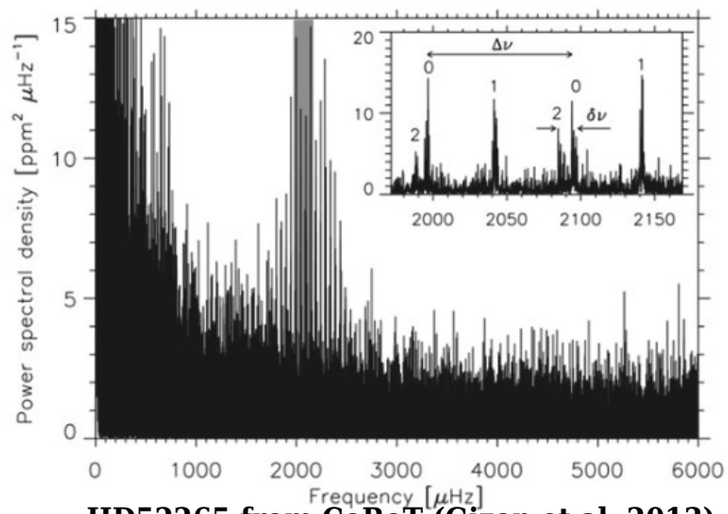
- Asteroseismology



HD52265 from CoRoT (Gizon et al. 2013)

$R_p/R_\star$ $M_p/M_\star$ $R_\star, M_\star, \mathrm{Age}, \ldots$

Needs precise accurate **limb darkening** **(**for transit fitting and interferometric radii)

source :

PLATO instrument

- 24 normal 12cm cameras, cadence 25 s, white light
- 2 fast 12cm cameras, cadence 2.5 s, 2 colors
- Dynamical range: $4 \leq mv \leq 16$
- Field-of-View: ~ 2232 deg², with 4 groups of cameras respectively looking on 301 deg², 247 deg², 735 deg², and 949 deg².

Prime contractor : OHB

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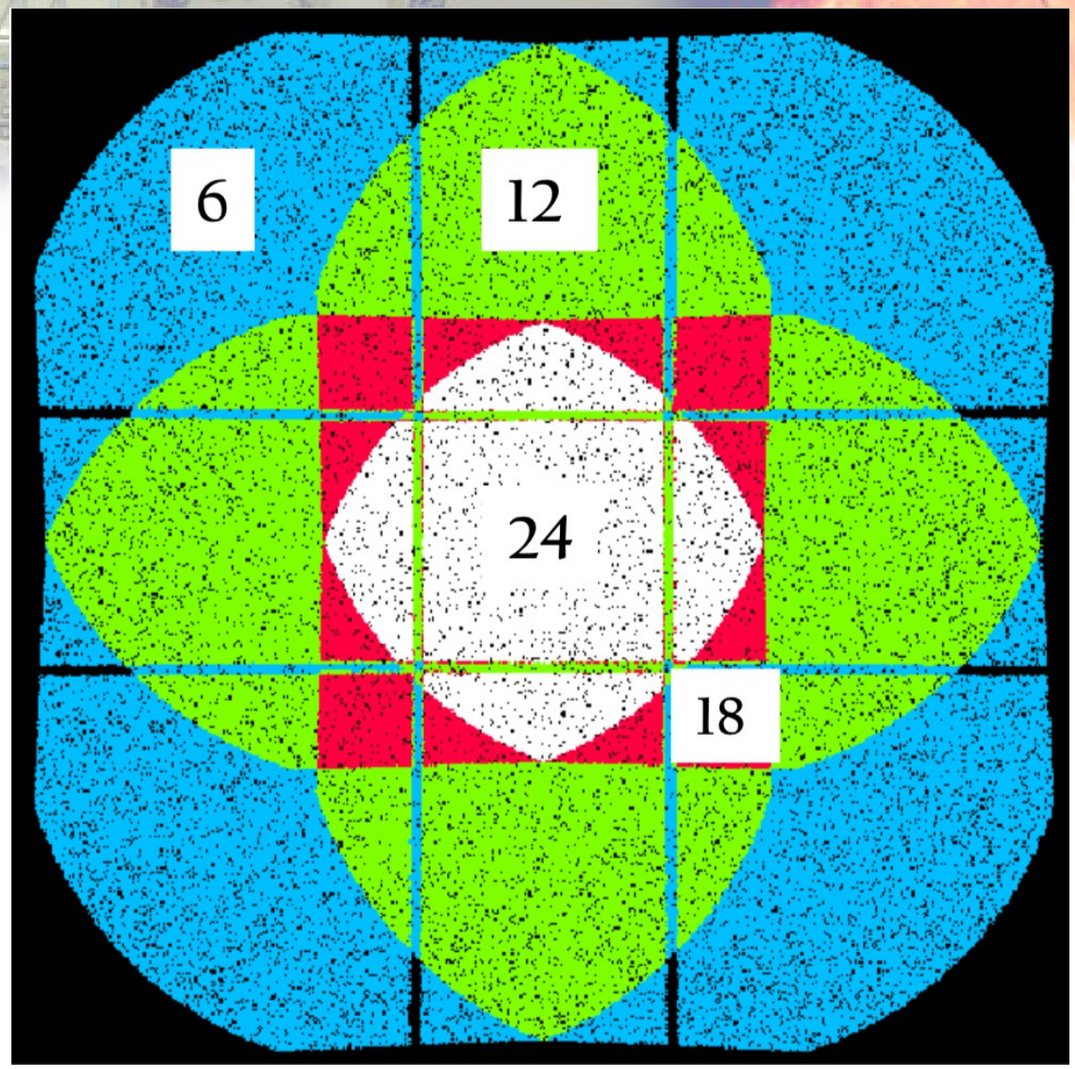
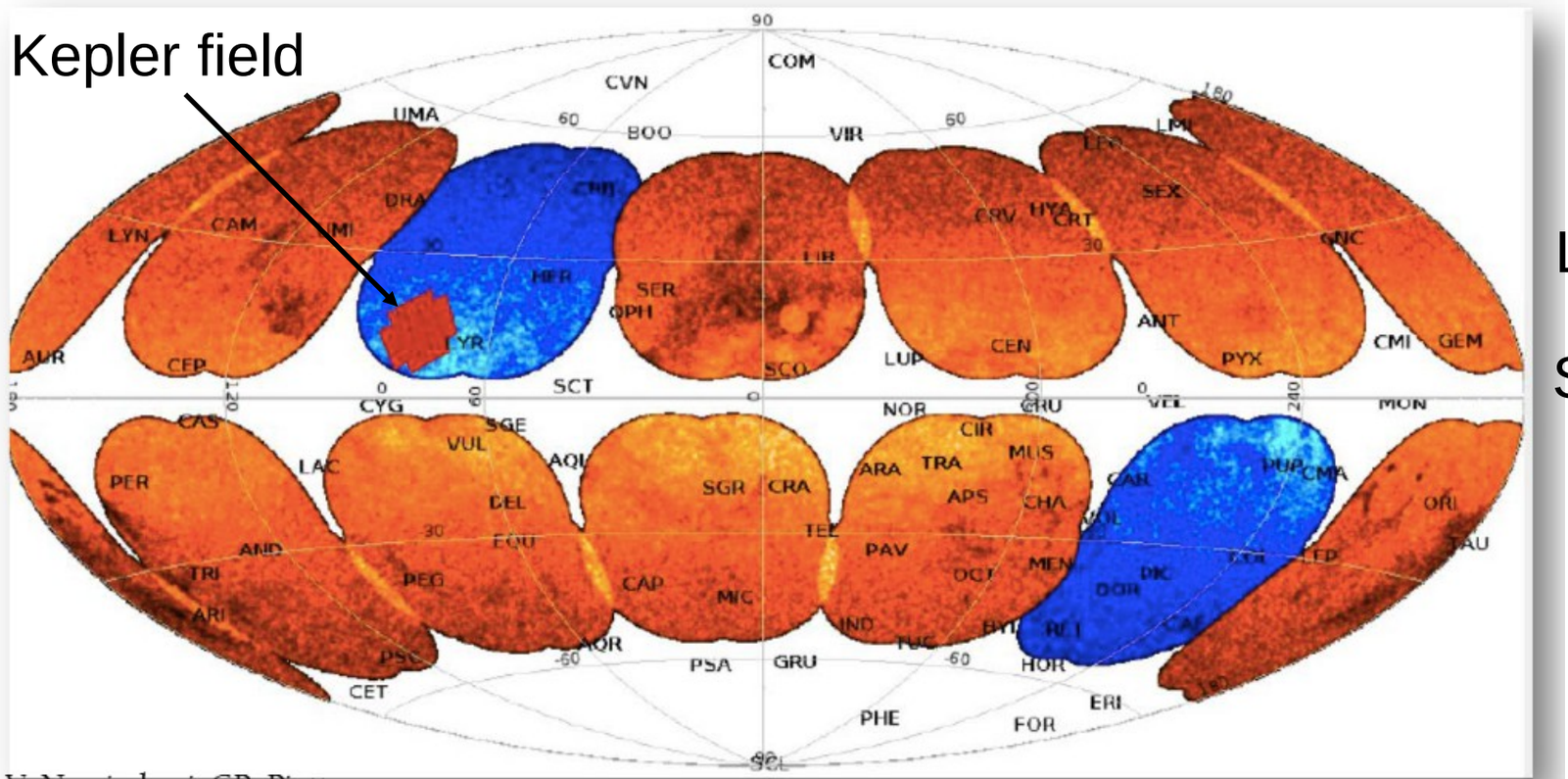
PLATO Observing strategy

- 4 groups of cameras
- Baseline observing strategy: 4 yrs nominal

  - 2 long pointing (LP) of 2 years
  - Optionally 3 years LP and 1 year “step-and-stare” phase.

- The final observing strategy will be fixed ~2 yrs before launch.
- the payload is designed for 8 years so extension can be expected…





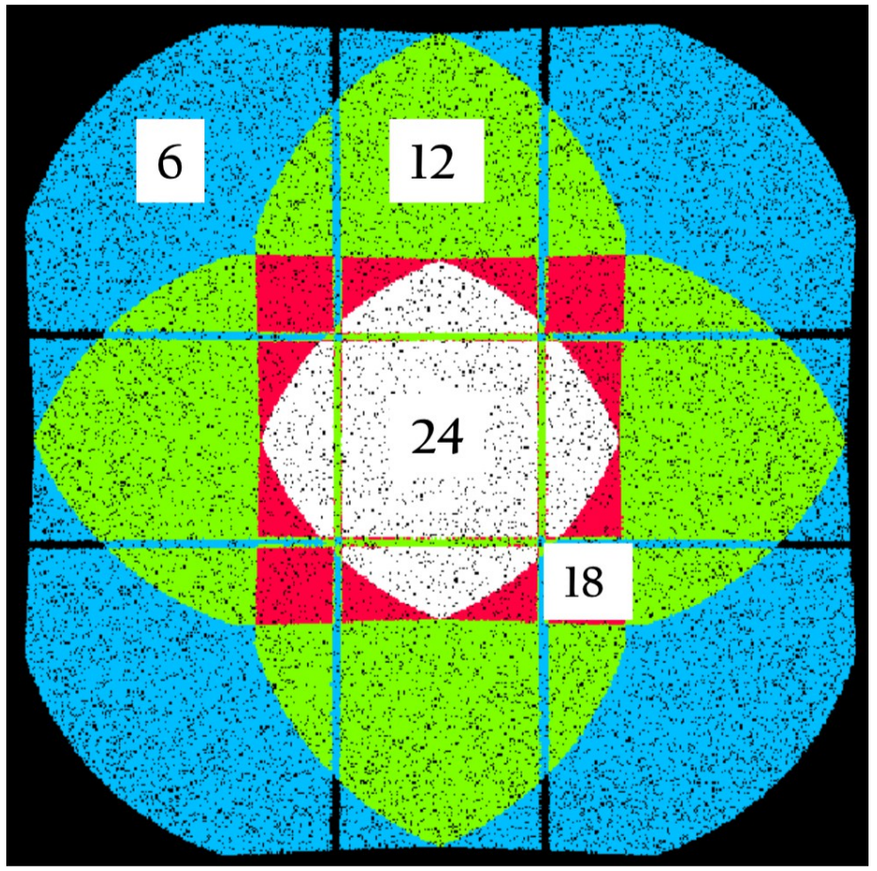
V. Nascimbeni, GP. Piotto

Long Observing Pointing (LOP)

Short Observing Pointing (SOP)

The PLATO samples

✓ Samples of stars will be observed with different numbers of telescopes corresponding to different noise levels



✓ Samples of target stars with the current baseline observing strategy :

- P1 ≥ 15 000 (goal 20 000) dwarfs and subgiants, spectral type F5-K7, 8 ≤ *mag* ≤ 11, noise ≤ 34 ppm.√h, time sampling 25s

⟶ using 24 cameras

- P2 ≥ 1 000 dwarfs and subgiants, spectral type F5-K7, *V* ≤ 8.2, noise ≤ 34 ppm.√h, (300 stars with 2 colours)

- P4 ≥ 5 000 M dwarfs *V* ≤ 16, time sampling 25s.

- P5 ≥ 245 000 dwarfs and subgiants, spectral type F5-K7, *V* ≤ 13, time sampling 600s and 25s for 9000 stars.

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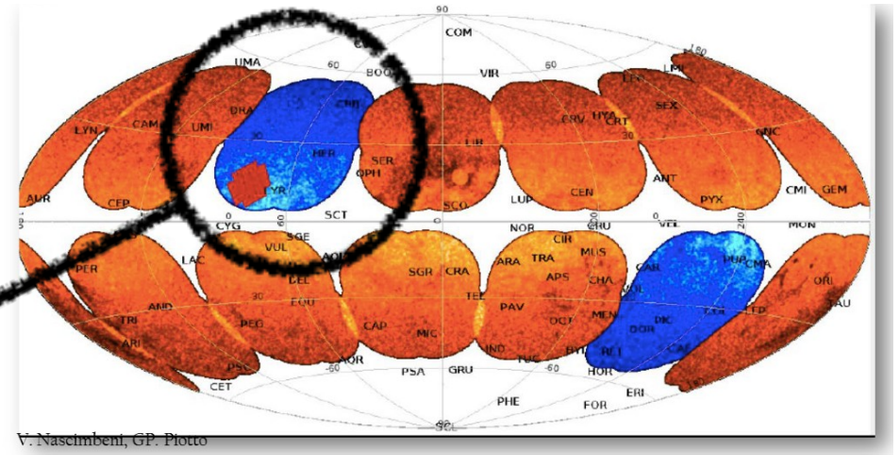
The PLATO expected performances

- ✓Stellar population computed with the Besançon Model (A. Robin 2017) adapted for a PLATO 2yr long run



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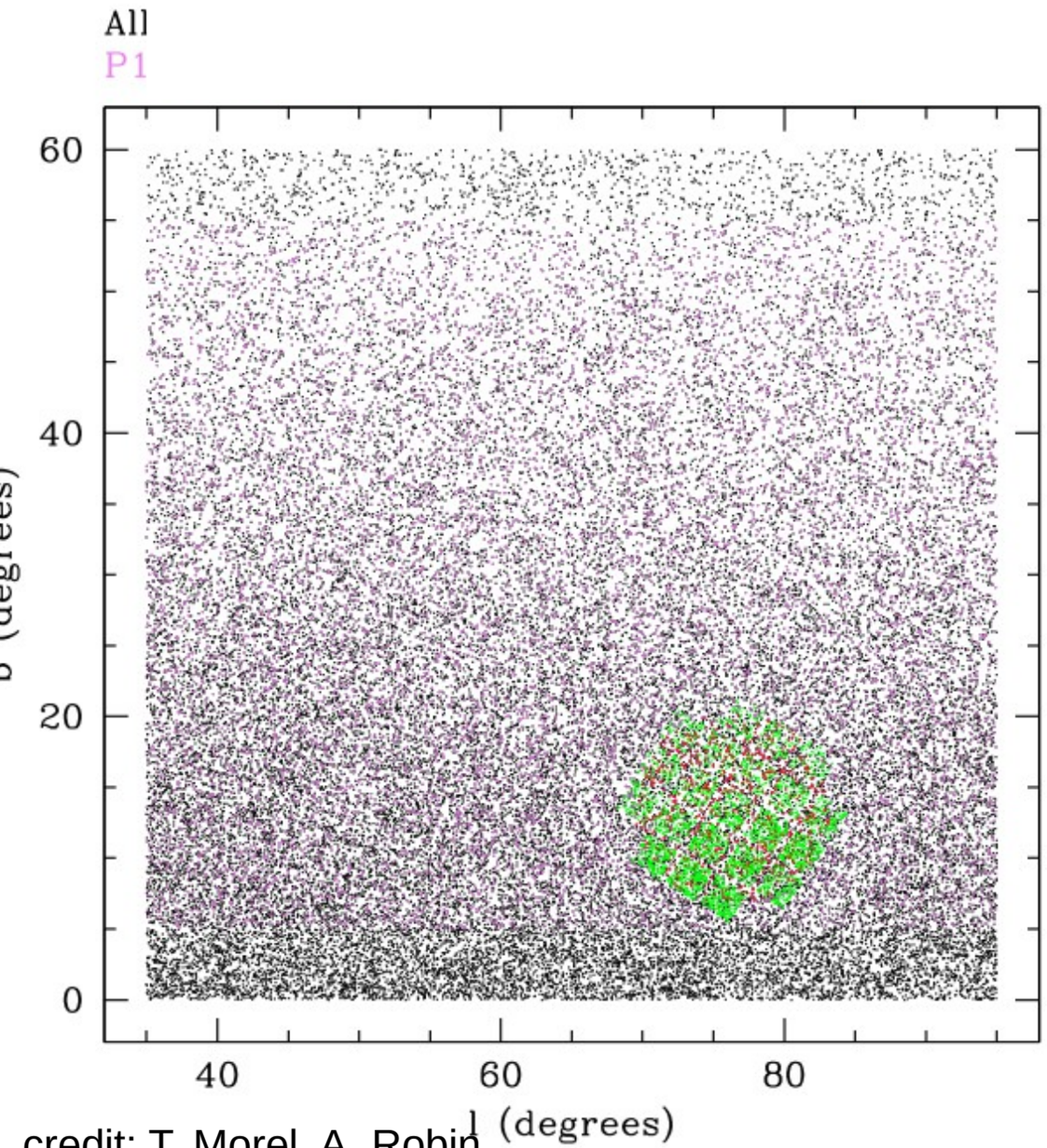

credit: T. Morel, A. Robin

- All stars simulated
- P1 stars
- *Kepler* field
- P1 stars in *Kepler* field

source :

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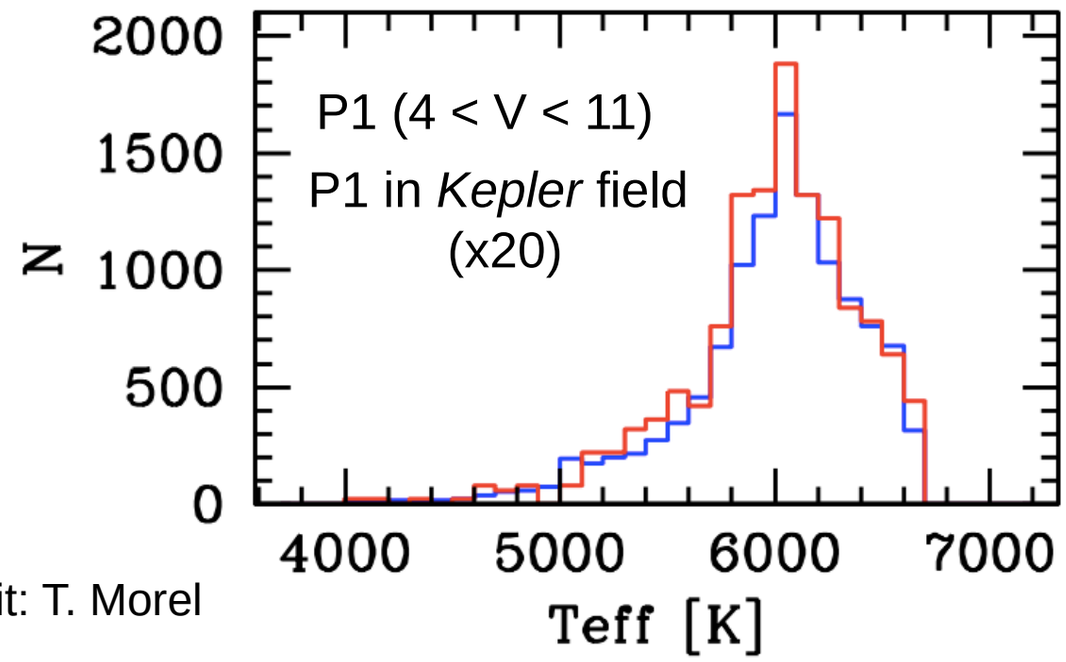
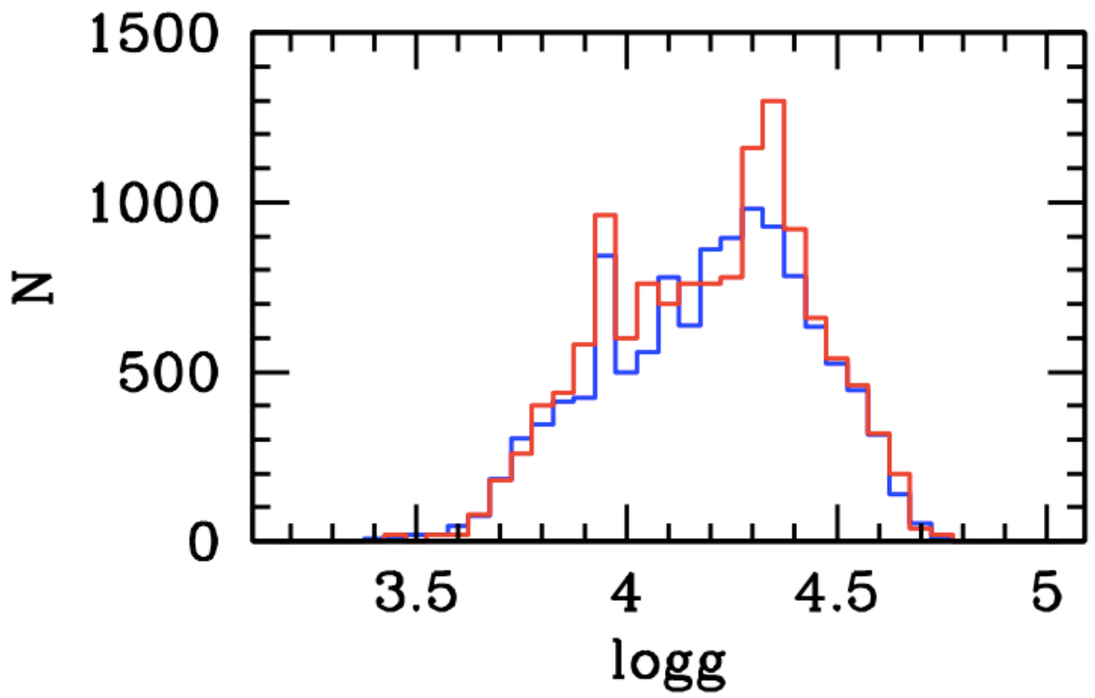
The PLATO noise

✓Stellar population computed with the Besançon Model (A. Robin 2017) adapted for a PLATO 2yr long run

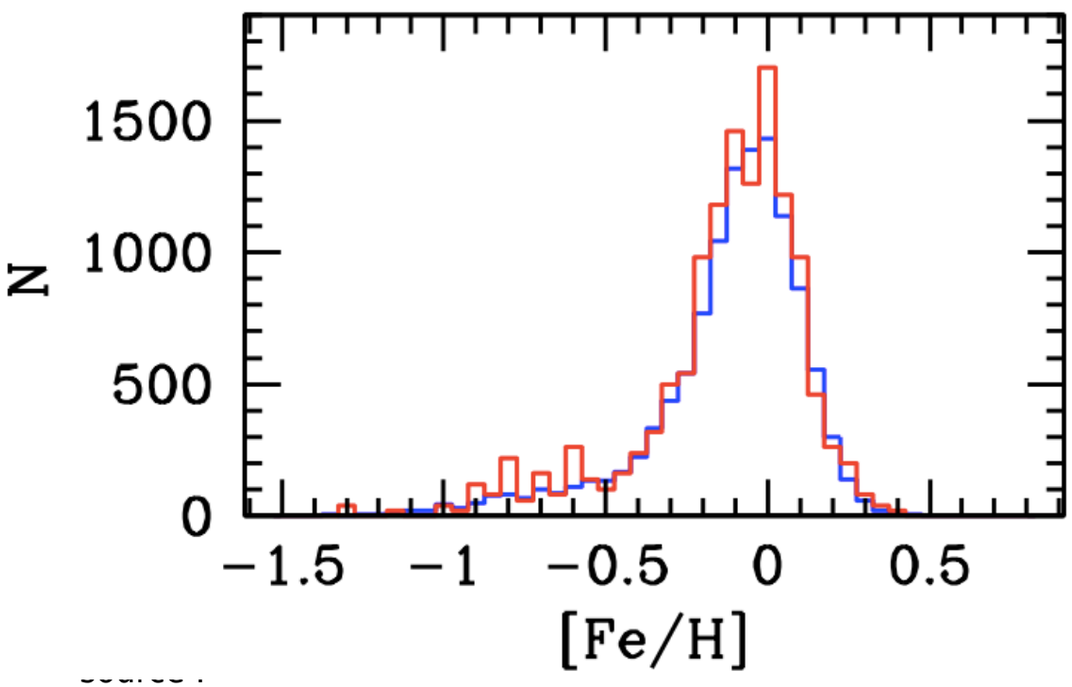


credit: T. Morel



Star distributions from the simulated catalogue:
P1 & P2 samples only

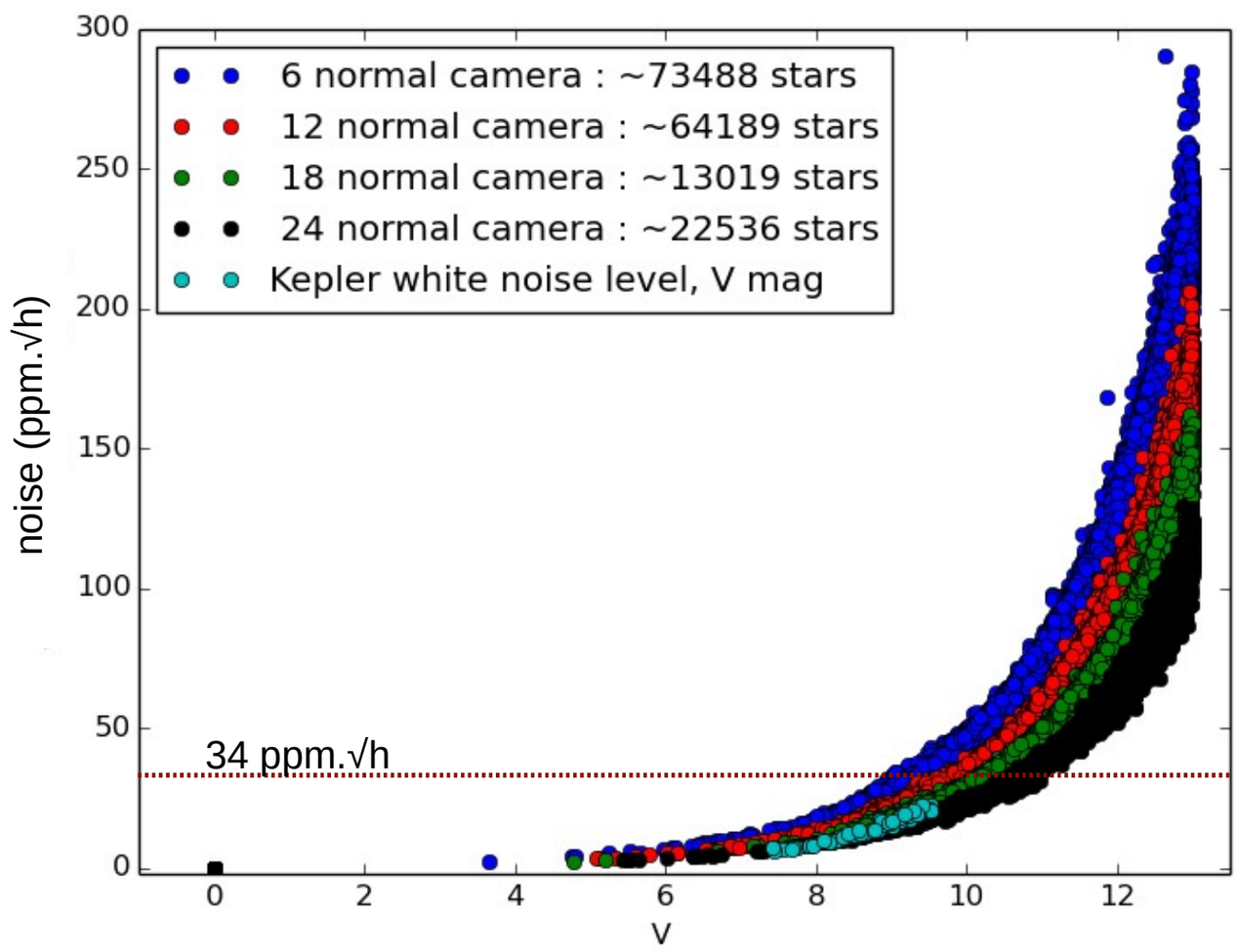
the properties of the Kepler field stars are similar to the properties of the PLATO P1 sample stars



The PLATO noise

✓ Plato noise including :

- Target photon noise
- Random noise from the instrument
- Residual noise after correction from systematics



Kepler white noise as derived by M. Lund provided by V. Silva Aguirre

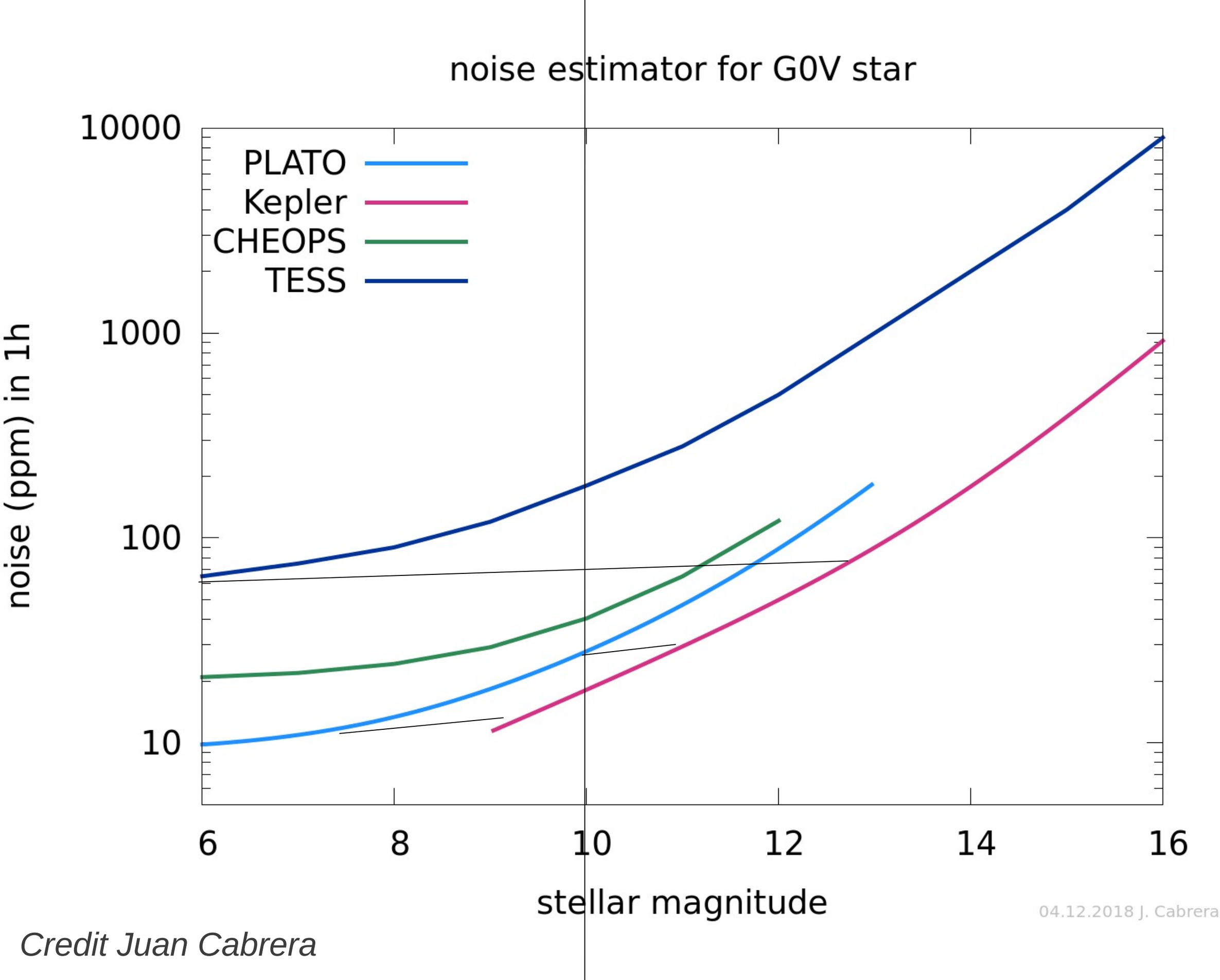
credit: M.J. Goupil, J. Cabrera

✓ the noise level for a target depends on the number of cameras

✓ for 24 cameras, the noise level is comparable to the Kepler Legacy sample

↓

Kepler Legacy sample is an excellent benchmark for PLATO



Credit Juan Cabrera

The PLATO data products

- L0 products: raw light-curves
- L1 products: calibrated light-curves and centroids
- L2 products: Science results
- L3 product: Final catalogue of confirmed planetary systems

Validated imagettes, light curves and centroid curves	DP0	L0
Calibrated imagettes, light curves and centroid curves	DP1	L1
Planetary candidate transits and their parameters	DP2	L2
Asteroseismic mode parameters	DP3	L2
Stellar rotation and activity	DP4	L2
Stellar radii, masses, and ages	DP5	L2
Living catalogue of confirmed planetary systems and their characteristics using light curves and transit time variations	DP6	L2
Follow-up ground-based observations		Lg
Living catalogue of confirmed planetary systems and their characteristics using new ground-based follow-up observations (Lg)	DP6+Lg	L3

Stellar science and asteroseismology → must provide data products DP3 to DP5

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The PLATO data products

Other data products:

- **PDP (Preparatory Data Products):** product used by the stellar pipeline. These data are computed before operations, stored in the data base and not modified during the run of the pipeline.
- **ADP (Additional Data Products):** delivered by the stellar part of the pipeline L1--> L2
- **IDP (Intermediate Data Products):** products produced at L2 level by the pipeline that are required to be stored, but that are not formal outputs of the L2 pipeline (DP3-DP5).
- **Benchmark stars** as tests and validation of the results of the stellar pipeline before, during and after opera

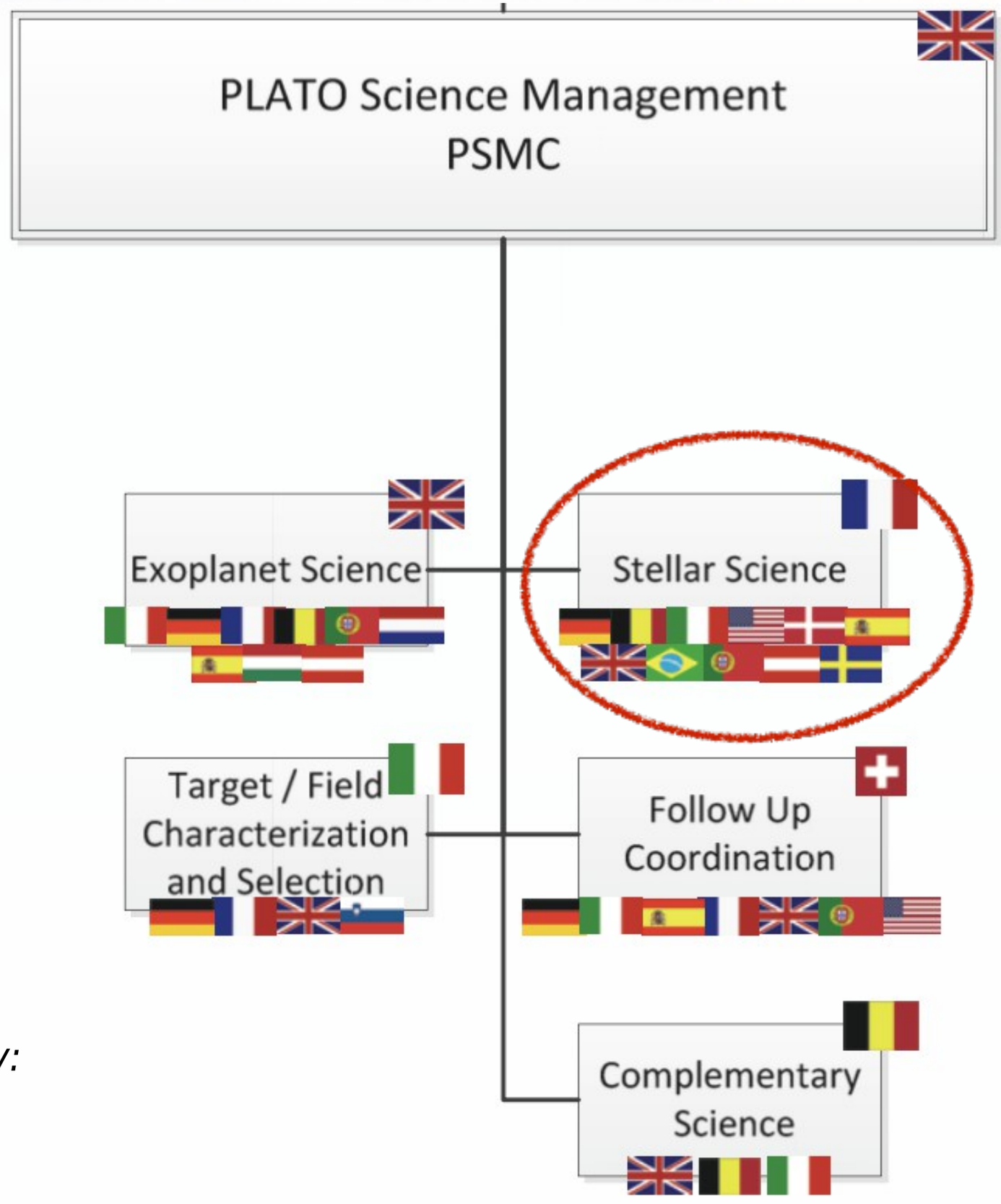
PLATO Science Management (PSM): Stellar Science

- PSM stellar science must provide the specifications and algorithms to the PDC for deriving DP3 to DP5 with associated error-bars

↓

Still a lot of preparatory work to do before launch !

Especially to assess both the precision and accuracy of the data products



If you want to join or for any other inquiry:
plato.wp120-office@obspm.fr

END

Website for stellar science: https://plato-stesci.lesia.obspm.fr/

Search...

Advanced search

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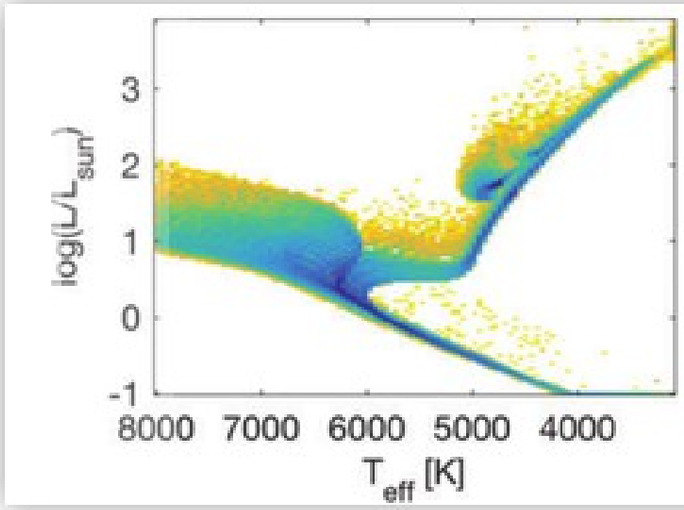
PLATO WP 120
Stellar Science

PLATO 2.0
Planetary Transits and Oscillation of Stars

- Home
- Organisation
- Events
- Timeline
- Documents
- News & Outreach
- Get involved!
- Wiki (consortium only)



News

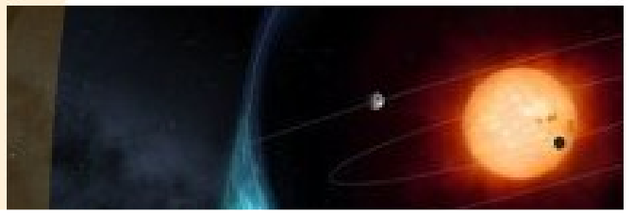
PLATO as it is: A legacy mission for Galactic archaeology

Future Events

PLATO week #5, Porto 23-27 Oct 2017

News

Green light for the PLATO mission



The PLATO mission

PLAnetary Transits and Oscillations of stars (PLATO) is the third medium-class mission in ESA's Cosmic Vision

If you want to join or for any other inquiry: plato.wp120-office@obspm.fr

PLATO main objectives

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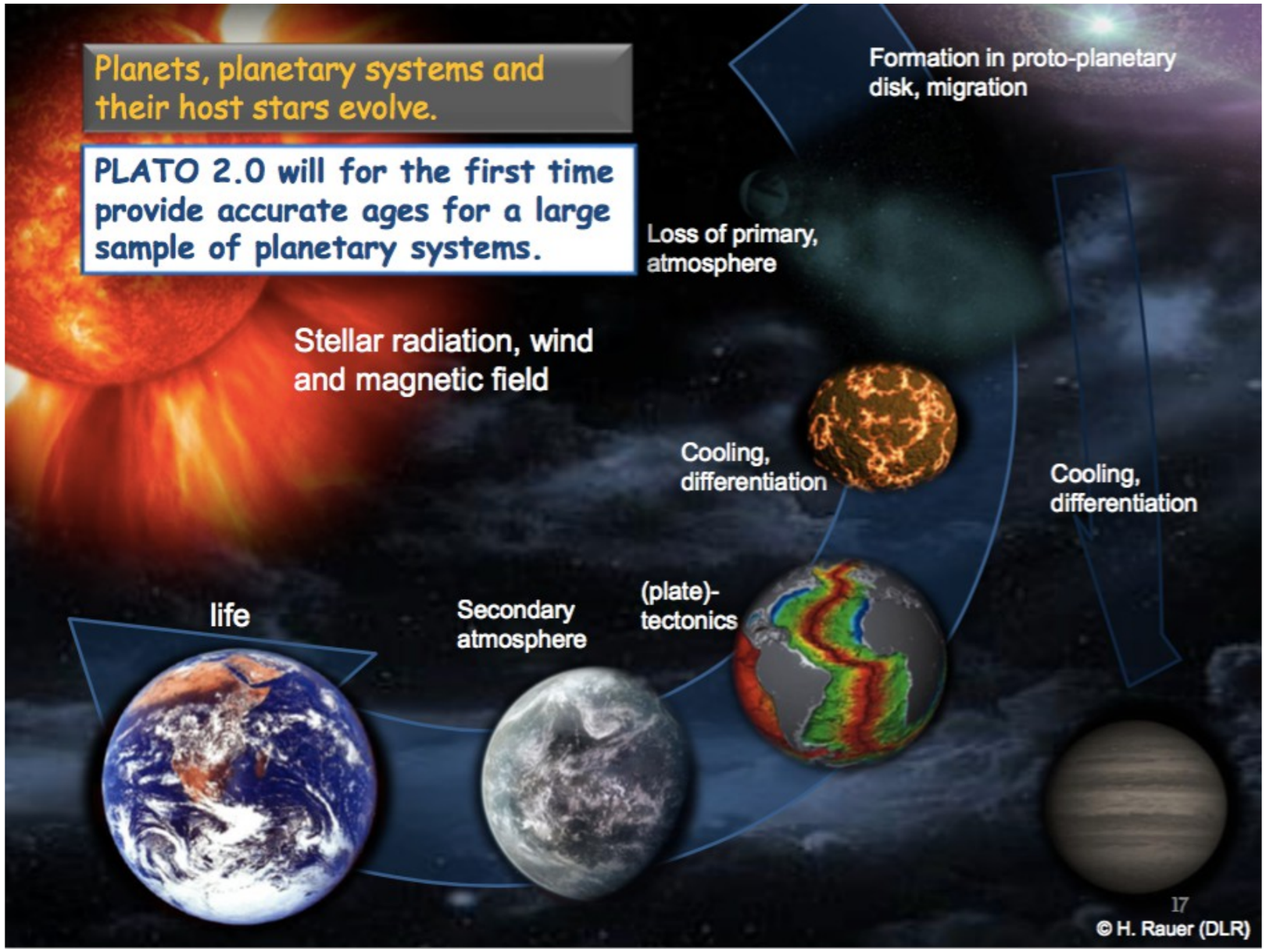
- detect and characterize terrestrial planets



Need to derive accurate planetary system age

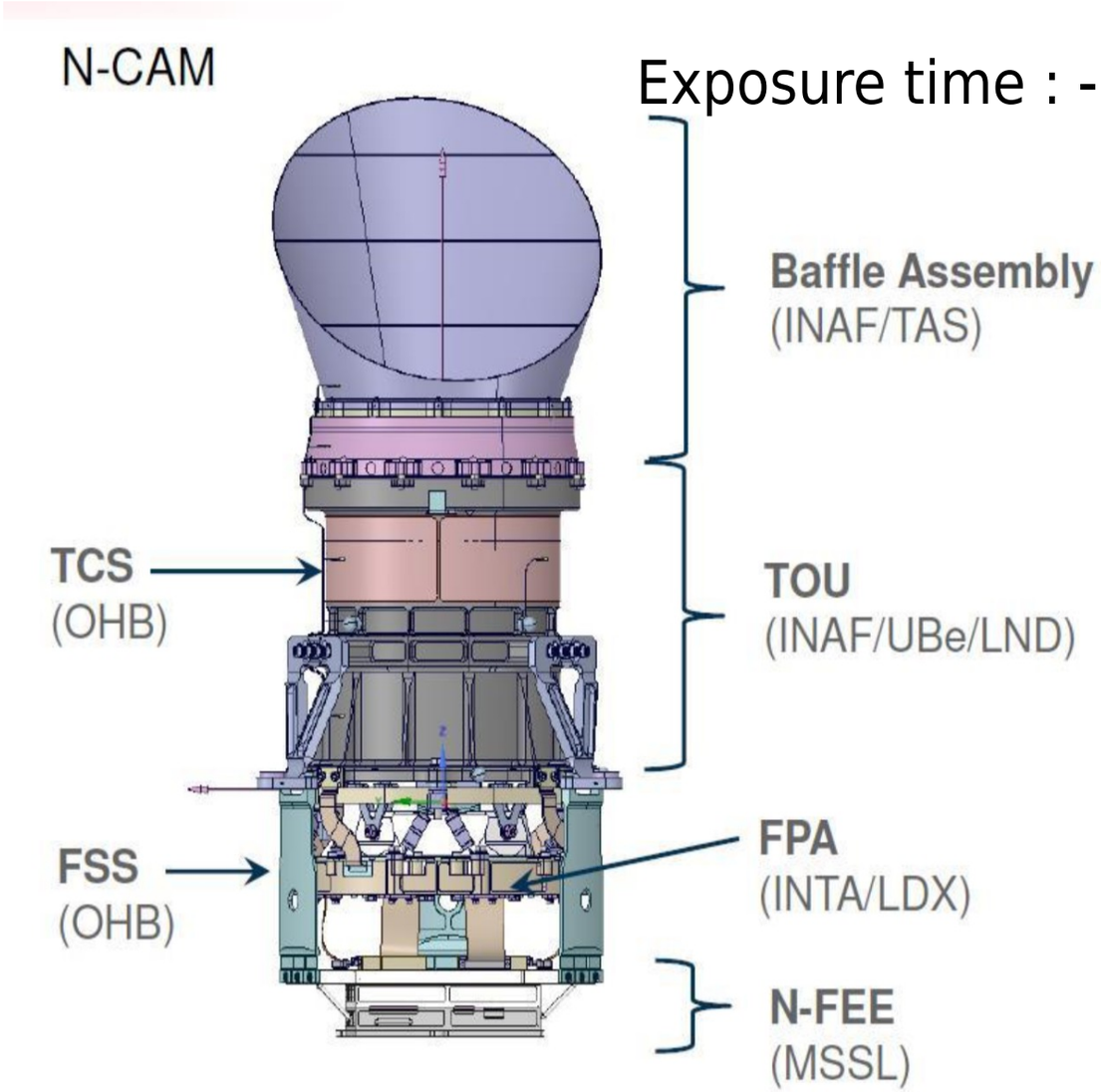
PLATO instrument

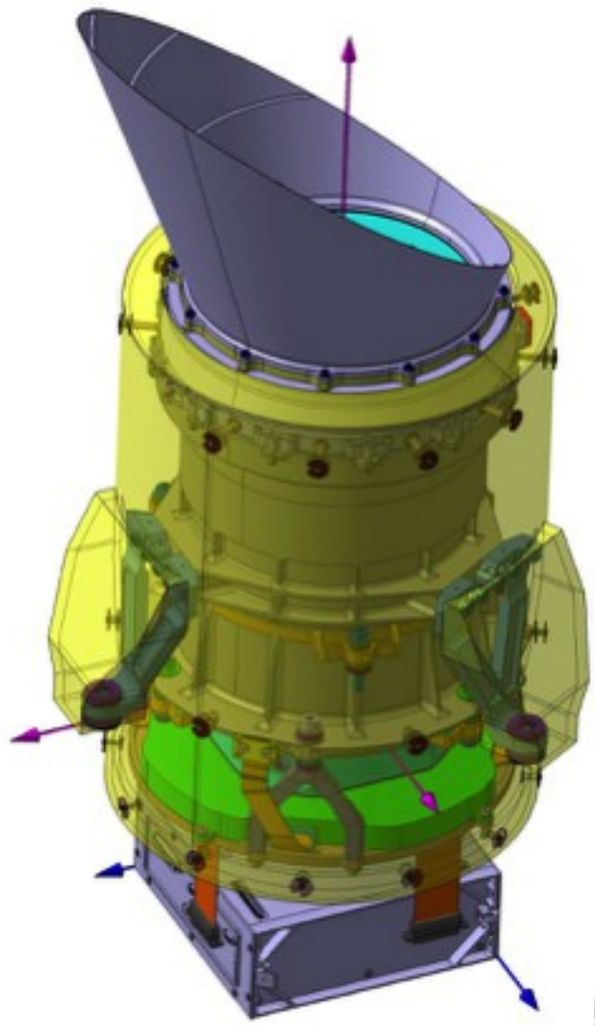
~ 80cm height

PLATO Camera: ~ 30cm diameter ~ 20kg

4 CCD per Camera → ~40° FoV

Exposure time : - 25s (N-CAM) - 2.5s (F-CAM)





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PLATO Mission Consortium