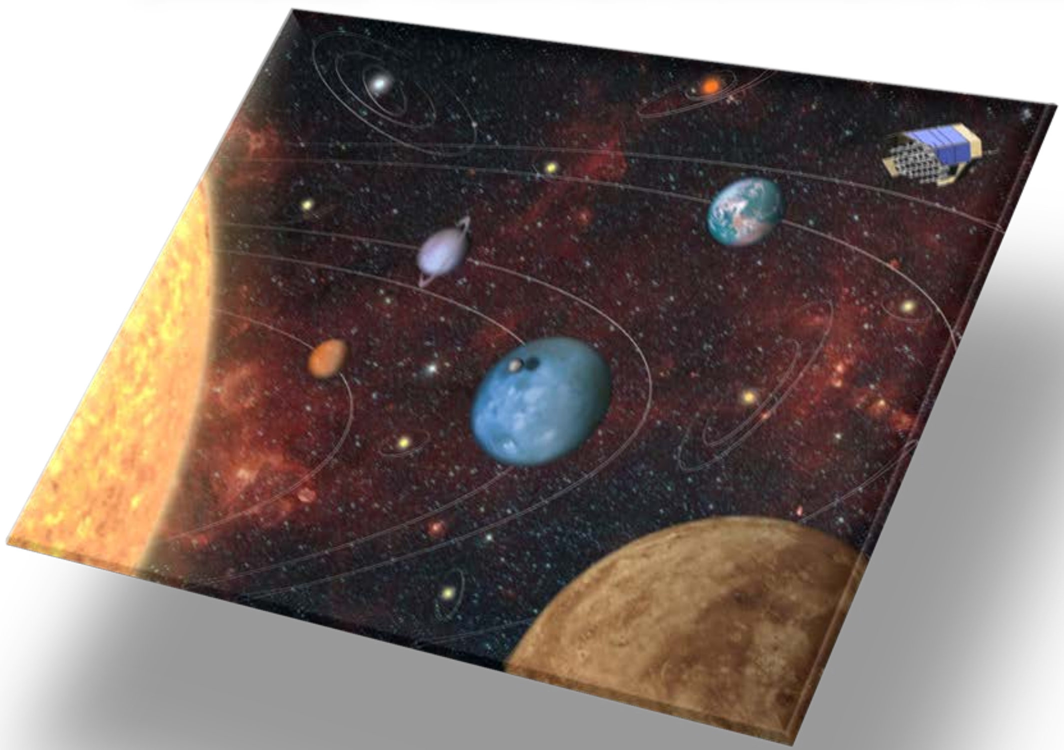
Latest News about the Mission PLATO 2.0

(PLAnetary Transits and Oscillations of stars)



Heike Rauer

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and the PLATO 2.0 Team

PLATO 2.0 Scientific Motivation

PLATO Objectives:

- Characterize planets for their density and age to:
  - Explore planet diversity and
    - detect and characterize terrestrial planets in the habitable zone
    - constrain planet formation and evolution processes
- Stellar science
- Complementary science

The Method

Characterize bulk planet parameters

Accuracy around solar-like stars for PLATO 2.0:

- **radius**
- **mass**
- **age**

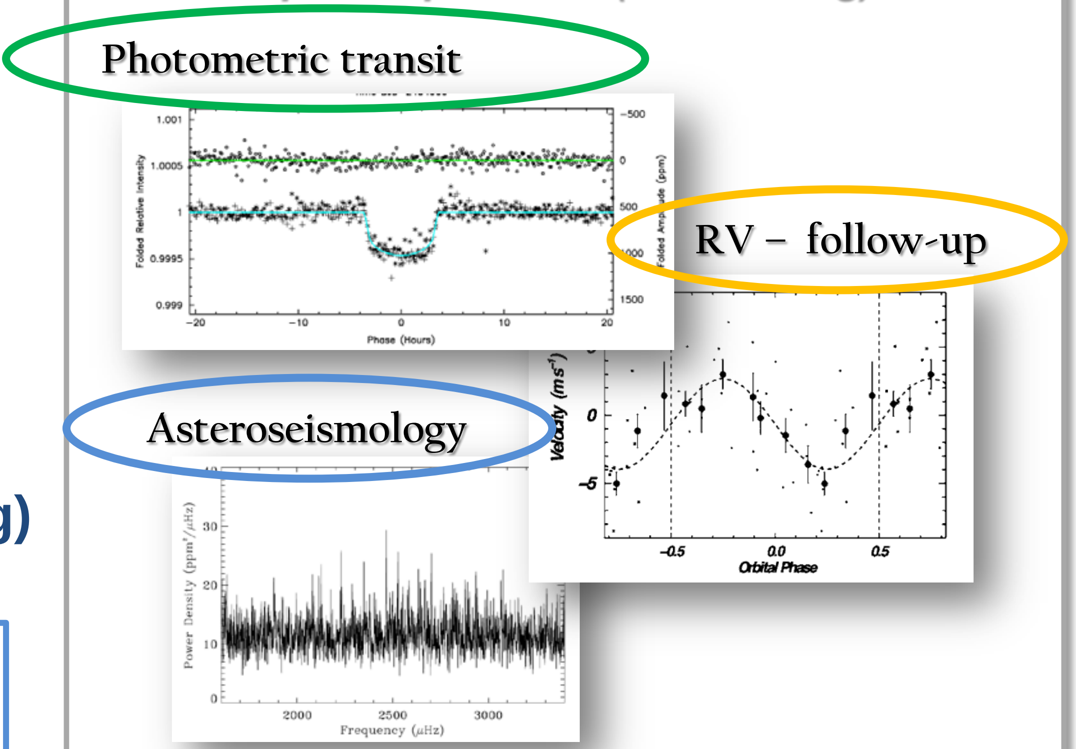
For bright stars (4 – 11(13) mag)

The PLATO mission has two elements:

- Photometry from space
- Spectroscopy from gound

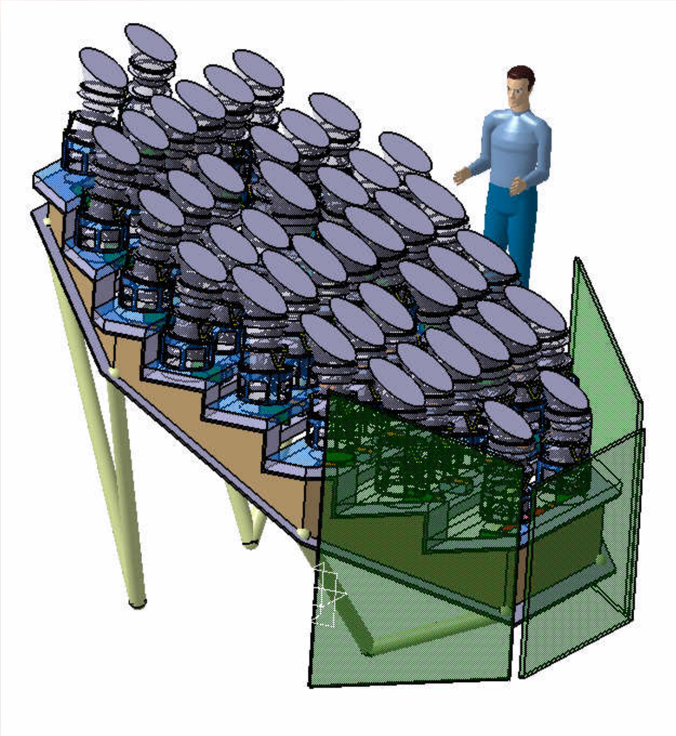
Techniques

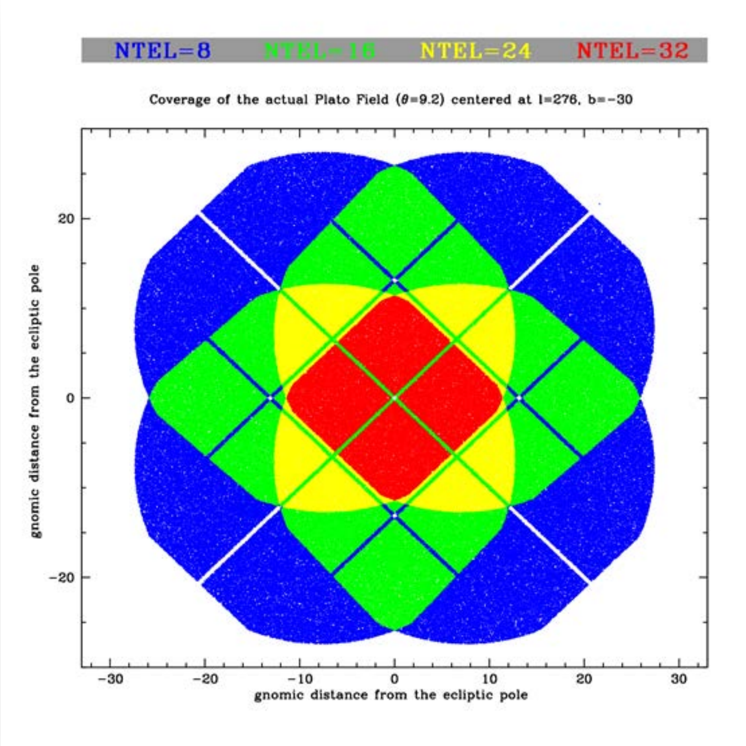
Example: Kepler-10 b (V=11.5 mag)



PLATO 2.0 Instrument

Design study:





- 32 « normal» 12cm telescopes, white light (500 – 1000 nm)
- cadence 25 s, lightcurve sampling: 50 sec and 600 sec
- dynamical range: $8 \leq m_V \leq 13$ (16)
- Field-of-View: 48.5° x 48.5°
- + 2 “fast” telescopes

The fast telescopes

- PLATO includes two „fast“ telescopes
- Optics identical to „normal“ cameras, except:
  - Each telescope has one broadband filter: one „red“and one „blue“ telescope; exact filter bandpasses are tbd.
- Purpose:
  - **Fine guiding**
  - Photometry of the brightest stars (<8 mag)
- Read-out cadence: 2.5 sec in frame transfer mode
- Lightcurve sampling: 50 sec
- Provide a sample of ~400 stars

Requirements

PLATO parameter accuracy requirements (from Science Requirement Document):

- radius of a planet of the same size as the Earth and orbiting a G0V star of m_V=10 (goal m_V=11) with an accuracy better than 3%.

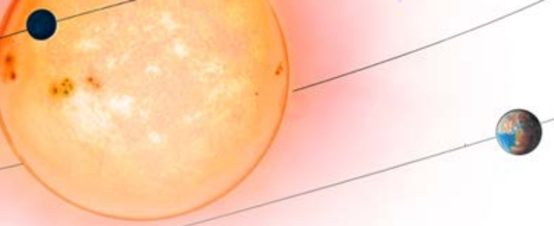
- ratio of planetary-to-stellar radius with an accuracy of 2%, for a planet of the same size as the Earth orbiting a G0V star of m_V=10 (goal m_V=11).

- **radius of a G0V star of m_V=10 (goal m_V=11) with a precision of 1-2%.**

- **frequencies of normal oscillation modes in main sequence stars with precisions ~ 0.1 μHz for several mode frequencies below and above the frequency of the mode with maximum amplitude.**

- **the age of a G0V star of m_V=10 (m_V=goal 11) with an accuracy of 10%.**

- Mass of a planet of the same mass as the Earth and orbiting a G0V star with an accuracy of 10% or better.



Stellar Samples

long pointings	step & stare	mag	Noise in central field	spectral type	sampling rate (phot./cent.)

P1: 20 000 stars

P2: 1 000 stars

Exoplanet characterization and asteroseismology

P4: 5 000 stars
V<16

M dwarf host star sample

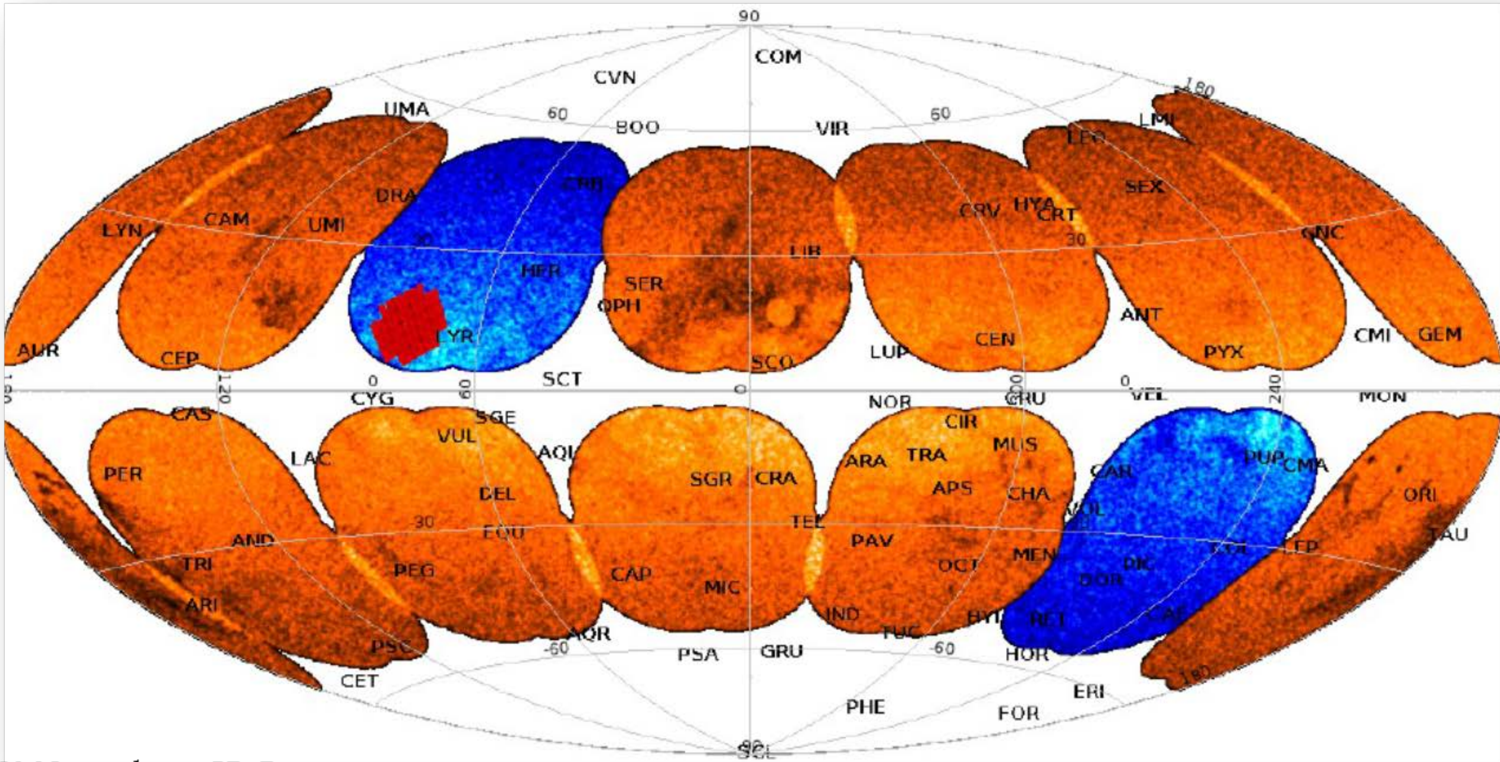
P5*: 245 000 stars

Exoplanet statistics and stellar science

*: P5 for long AND

PLATO 2.0 Sky

- A baseline observing strategy has been defined for mission design:
  - 6 years nominal science operation:
    - 2 long pointings of 2-3 years
    - step-and-stare phase (2-5 months per pointing)
- The baseline scenario is compllliant with the required stellar samples
- The final observing strategy will be fixed ~3 yrs (tbd) before launch.



V. Nascimbeni, GP. Piotto

Latest developments

- Previous design assumed downlink of data using X-band.

  → lightcurve photometry and centroids computed onboard, sampling ≥50 sec

  → only ~2000 (~1% of lightcurves) imagette per camera (with 25 sec sampling)

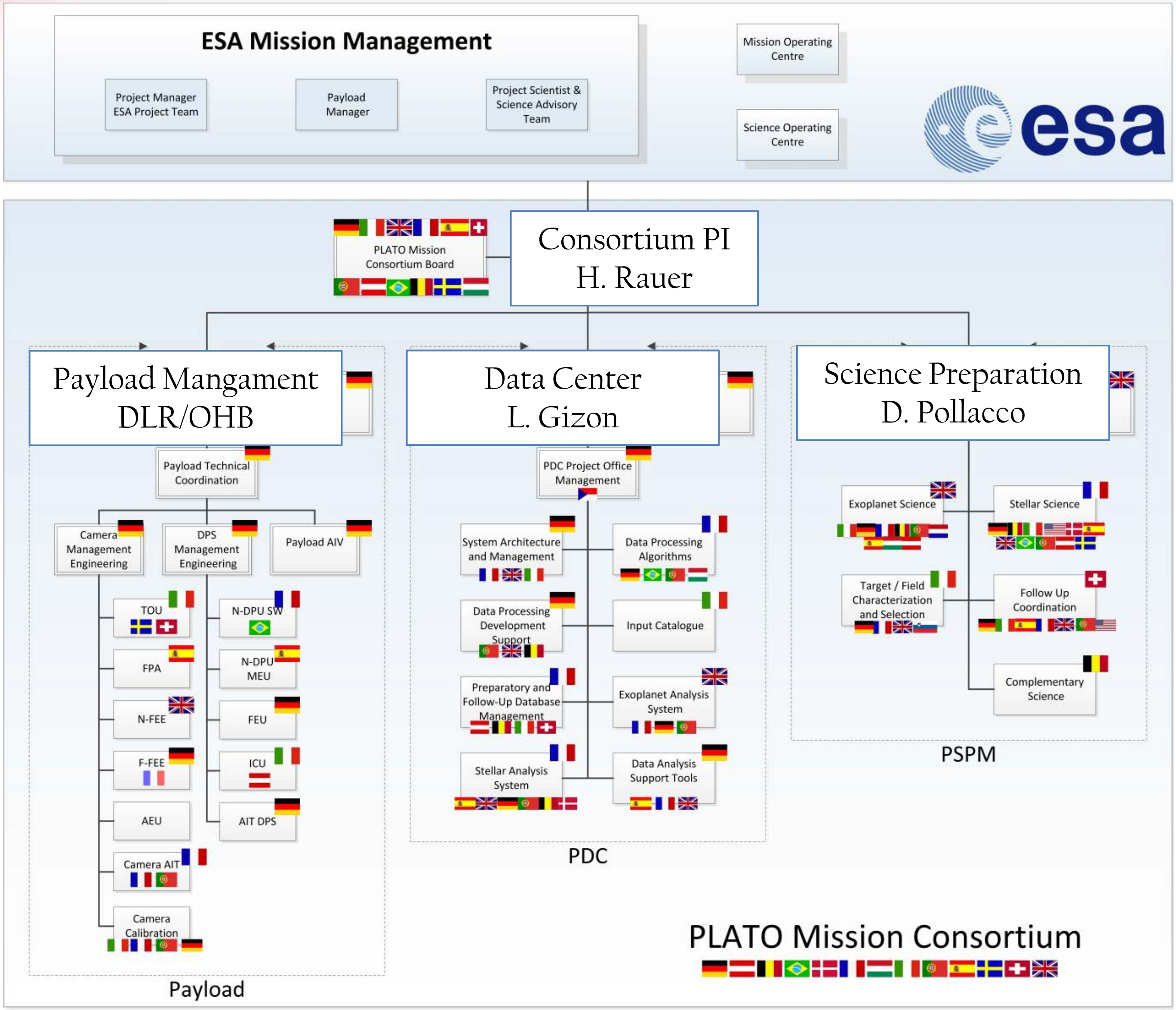
- In March 2015 ESA decided that K band should be used, based on a recommendation by the PLATO Science Team (PSAT).
- This results in an increase of transmitted data volume by factor ~4.
- How to use the increased downlink rates is under study, e.g. download imagette for the whole P1 sample, increase the sample of fast telescopes,..
- Imagette allow to re-process data with pipeline updates and provide a higher time resolution.

Data products

- L0 products: raw lightcurves from 34 telescopes, centroids, house keeping
- L1 products: calibrated lightcurves and centroids
- L2 products: Science results

Calibrated light curves and centroid curves	DP1	L1
Planetary candidate transits & their parameters	DP2	L2
Asteroseismic mode parameters	DP3	L2
Stellar rotation and activity	DP4	L2
Stellar radii, masses and ages	DP5	L2
Confirmed planetary systems and their characteristics	DP6	L2

The PLATO 2.0 Mission Consortium



Definition Phase: B1

- Feb 2014 - Mission selection by ESA
- July 2014 - PMC kick-off
- Oct 2014 - ESA started three parallel industrial studies for the satellite
- Mar/April 2015 - Payload Development Consolidation Review (PDCR), investigating design, management plans, procurement, etc.
  - parallel PDCR for the Ground Segment (including PDC and PSPM)
- Oct/Nov 2015 - Instrument System Requirment Review (ISRR) (incl. Ground segment)
- Feb/March 2016 - Spacecraft System Requirments Review (SSRR)
- May/June 2016 - Mission adoption & IPC approval

PLATO Performance Team

- To address the performance of the PLATO mission, the PLATO Performance Team (PPT) has been established.

- It includes members from all elements of the PLATO mission (payload, PDC, PSPM)

- Tasks:
  - Study instrument performance, e.g. instrument noise sources, operation scenarios,…

  - Study science performance, e.g. stellar counts, planet detection yield, parameter accuracy (planet and star), …

  - Support the PMC and the PLATO Science Advisory Team of ESA

Studies on performance

Studies on science performance have been made the PPT, e.g. on:

- stellar samples
- accuracy on planet radii, stellar radii, stellar age
- baseline observing and in-flight calibration strategy
- noise budgets, „breathing“ effects, PSF sampling, jitter corrections,…
- filter bandpasses for fast telescopes
- …

→ So far performances are compliant with requirements.

→ Studies assume simplified scenarios with margins

→ next: add more complex scenarios and demonstrates that margins are met.

Exoplanet Space Missions and Space Observatories