Latest News about the Mission PLATO 2.0
(PLAnetary Transits and Oscillations of stars)

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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
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 ground

Techniques

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

- Photometric transit
- RV – follow-up
- Asteroseismology
- 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: $48.5^\circ \times 48.5^\circ$
- + 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
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 $\sim 0.1 \mu Hz$ 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**
  - P1: 20,000 stars
  - P2: 1,000 stars

- **step & stare**
  - P3: 3,000 stars
  - P4: 5,000 stars

- **mag**
  - V<16
  - V<15

- **Noise in central field**
  - 50s/600s

- **spectral type**
  - F5/K7

- **sampling rate** (phot./cent.)
  - 30s/30s

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Exoplanet characterization and asteroseismology

- M dwarf host star sample
  - P4: 5,000 stars V<16
  - P5*: 245,000 stars

Exoplanet statistics and stellar science

*: P5 for long AND step&stare phases. *1,000,000 lightcurves <13 mag.
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 compliant with the required stellar samples
- The final observing strategy will be fixed ~3 yrs (tbd) before launch.
Latest developments

• Previous design assumed downlink of data using X-band.
  → lightcurve photometry and centroids computed onboard,
  sampling $\geq 50$ sec
  → only $\sim 2000$ ($\sim 1\%$ 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 $\sim 4$.

• 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

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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)


- Feb/March 2016  - Spacecraft System Requirements Review (SSRR)

- May/June 2016  - Mission adoption & IPC approval
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 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

CoRoT

Kepler

K2

TESS

GAIA

CHEOPS

PLATO 2.0

HST

JWST

Now - 2015

2017

2020

H. Rauer, AAAS 2015 Annual Meeting, San Jose, CA, 13.02.2015