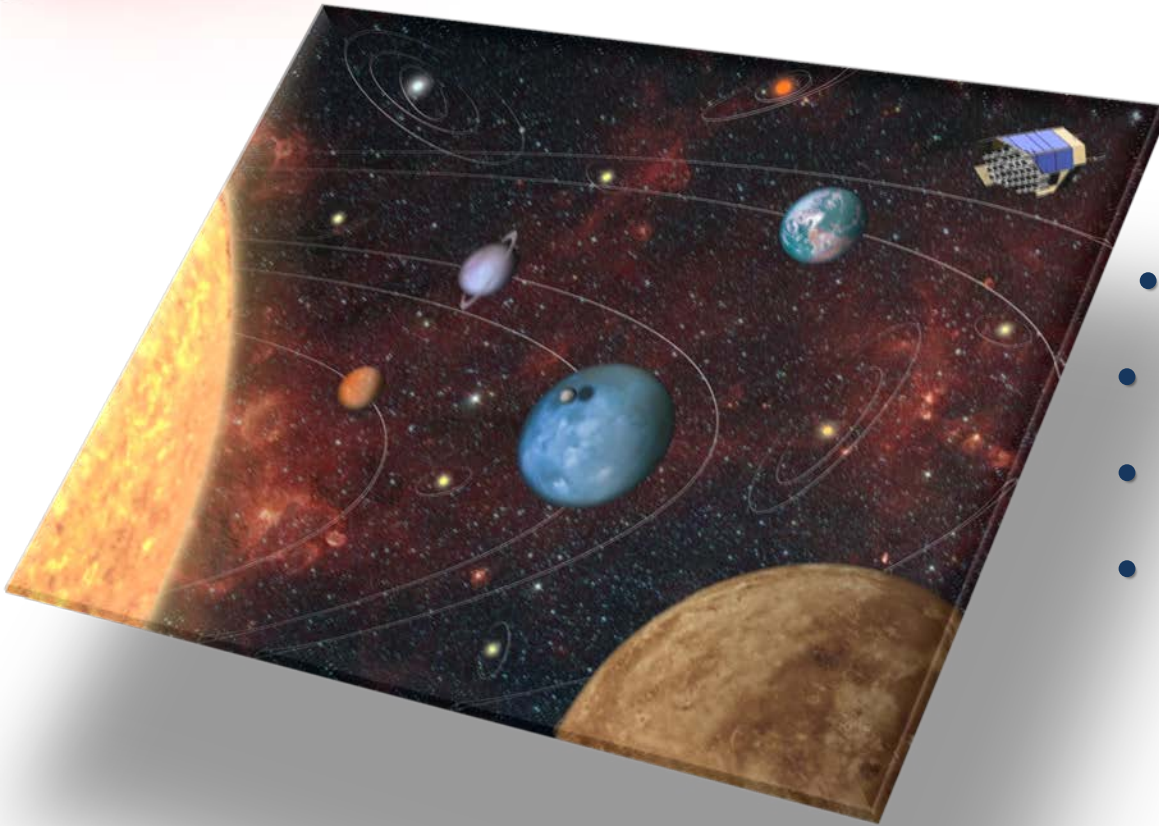


The Mission PLATO 2.0

(PLANetary Transits and Oscillations of stars)



- ESA selected M3 Mission
- Currently in Phase B1
- Mission adoption in 2016
- Launch in 2024

Heike Rauer
Institute for Planetary Research, DLR, Berlin
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 Methods

Characterize bulk planet parameters

Accuracy around solar-like stars for PLATO 2.0:

- Radius (~2%)
- Mass (~10%)
- Age (~10%)

For bright stars (4 – 11(13) mag)

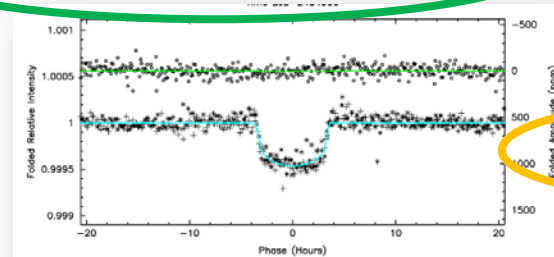
The PLATO mission has two elements:

- Photometry from space
- Spectroscopy from ground

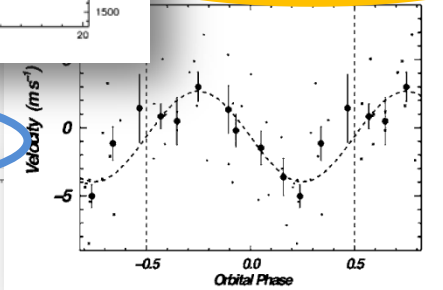
Techniques

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

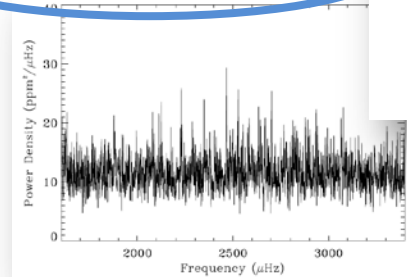
Photometric transit



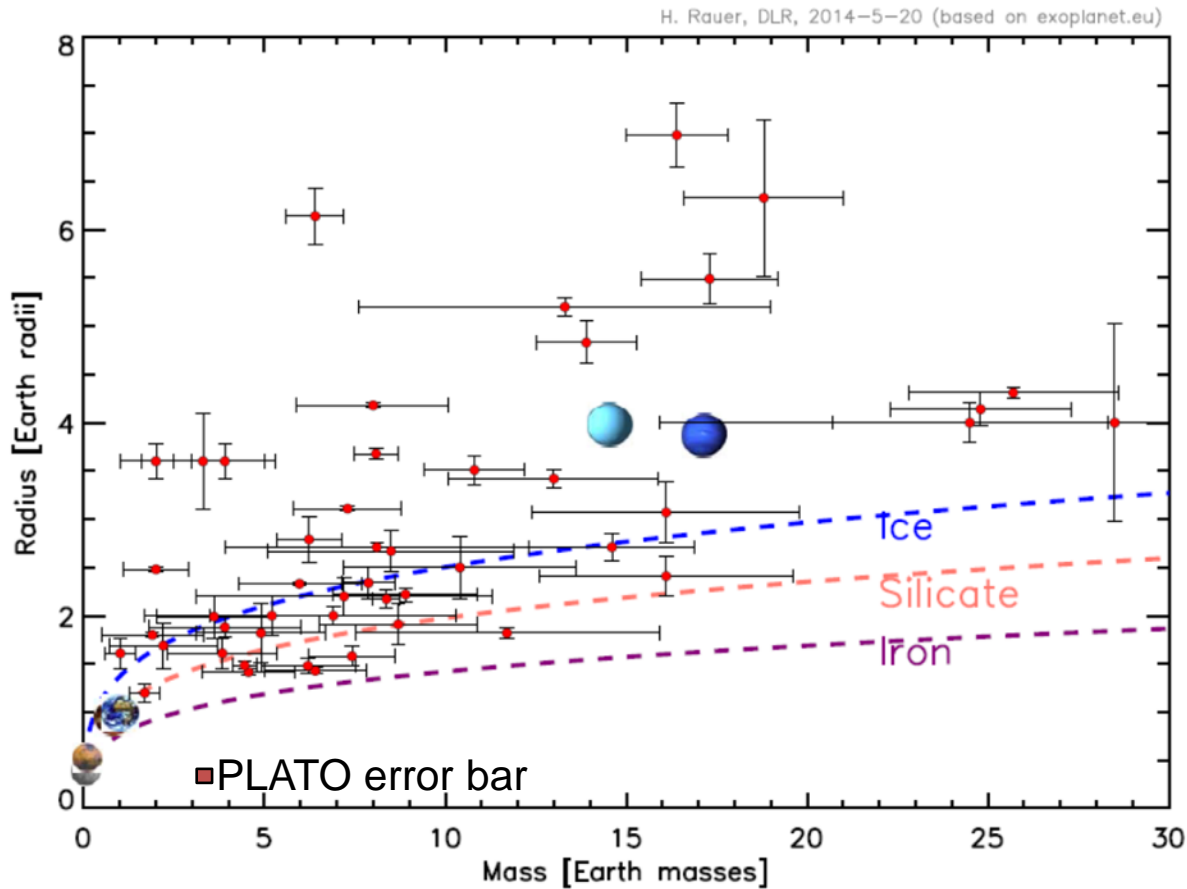
RV – follow-up



Asteroseismology



Diversity of „super-Earths“



Status:

- Large diversity in masses and radii
- Individual planets have large error bars

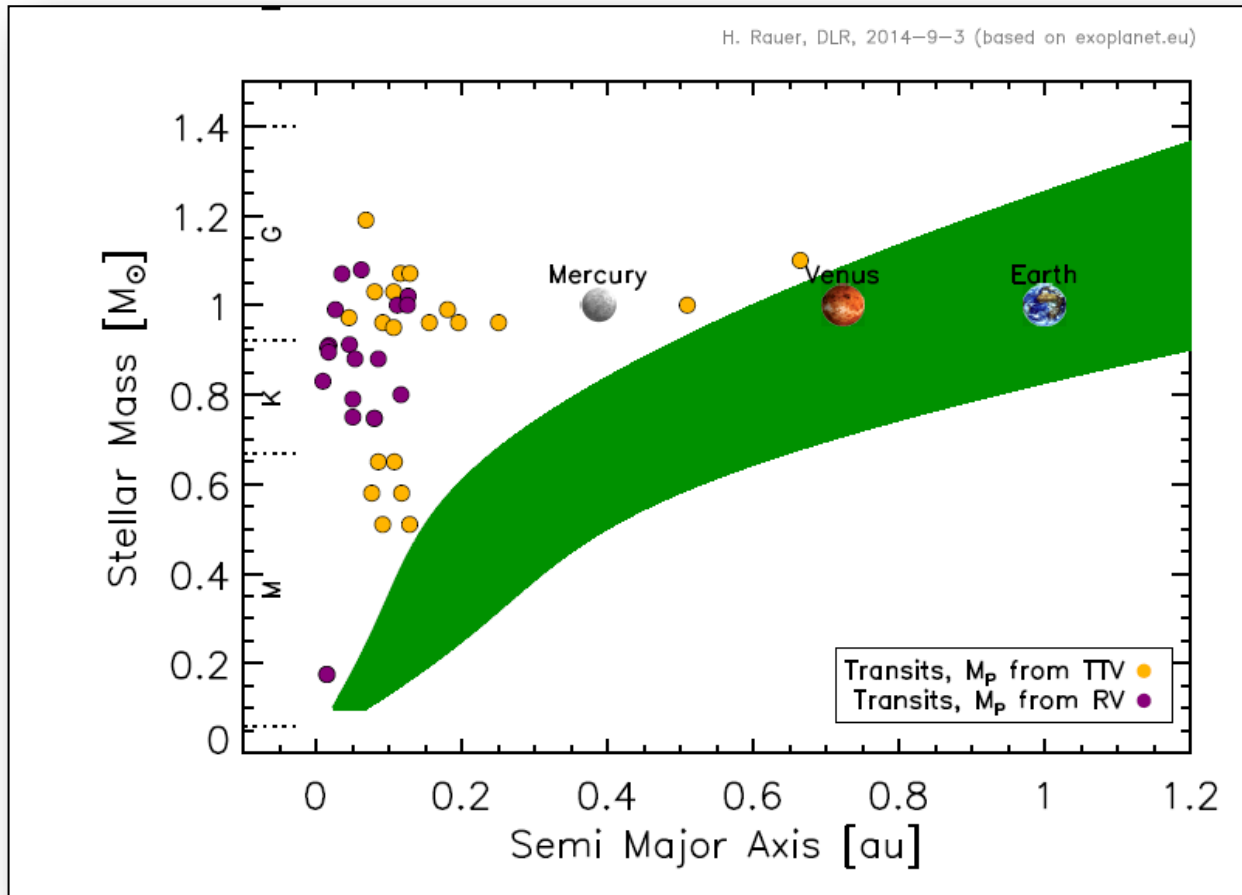
→ **PLATO goal:**

Masses: 10%

Radii: 2%

Prospects: Characterized „super-Earths“ in their habitable zone

„Super-Earths“ with characterized radius and mass

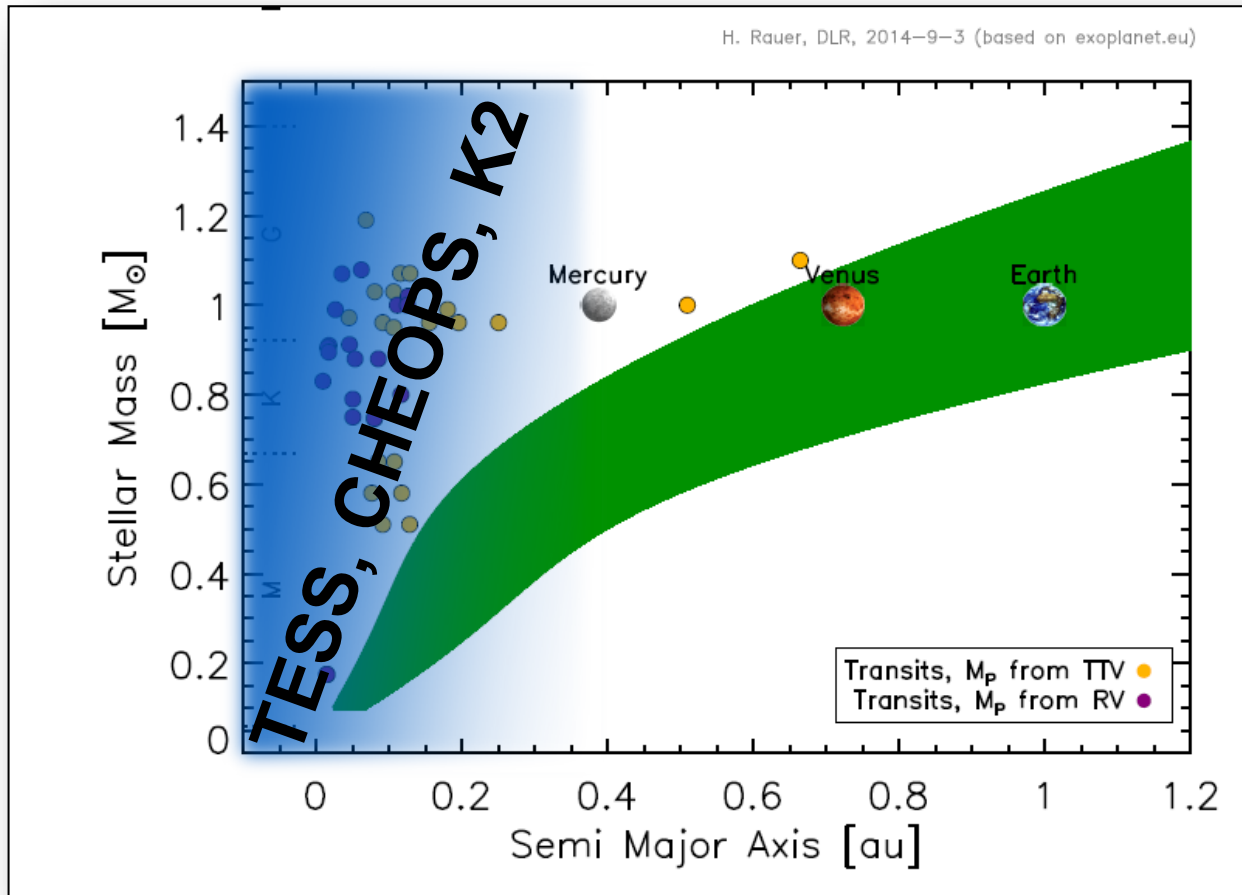


- TESS, CHEOPS, K2 will mainly cover orbital periods up to ~80 days

TESS ecliptic poles

Prospects: Characterized „super-Earths“ in their habitable zone

„Super-Earths“ with characterized
radius and mass

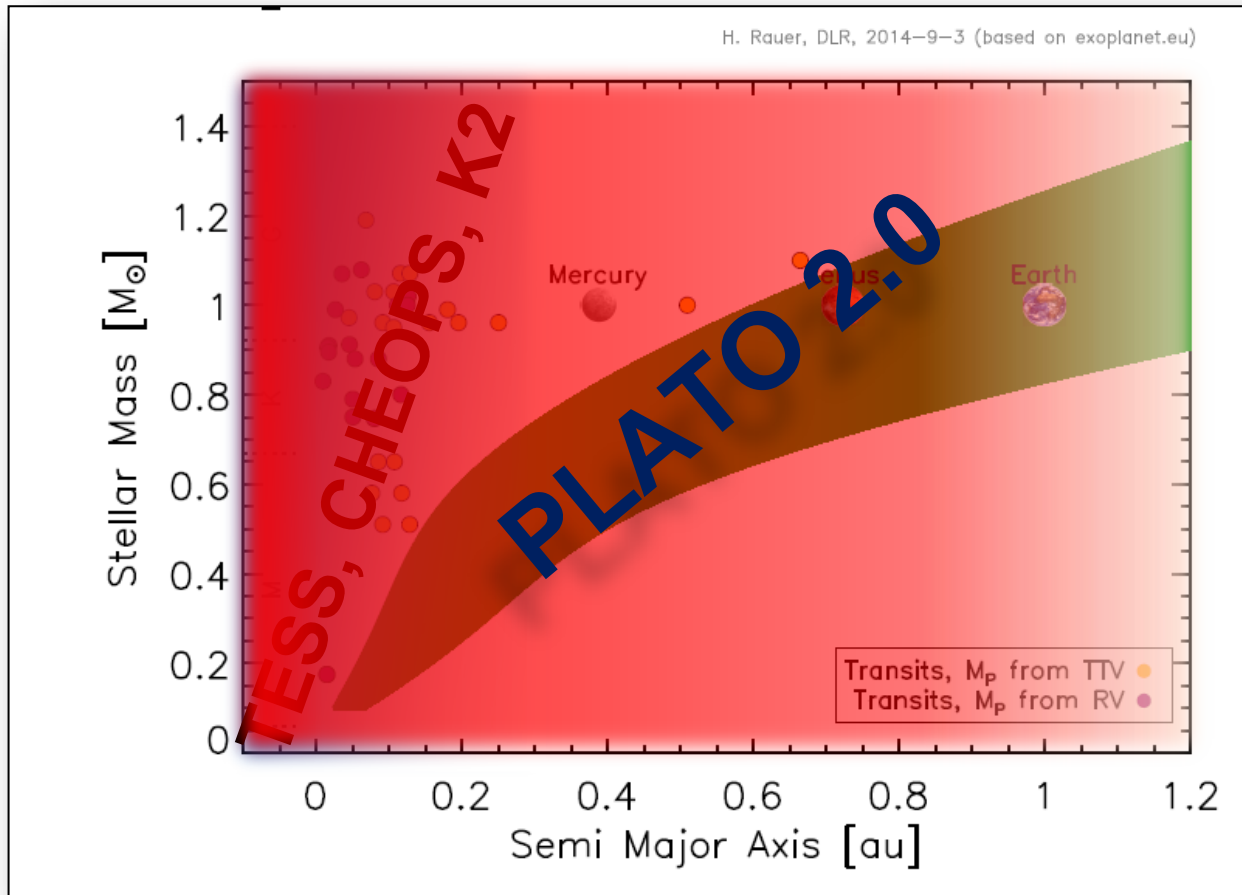


- TESS, CHEOPS, K2 will mainly cover orbital periods up to ~80 days

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Prospects: Characterized „super-Earths“ in their habitable zone

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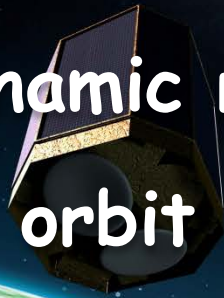


- PLATO 2.0 goal: Detect and characterize planets up to the habitable zone of solar-like stars.

TESS ecliptic poles

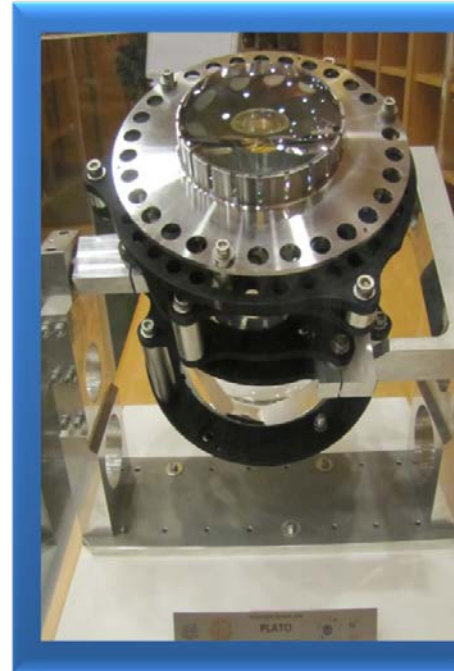
The PLATO 2.0 instrument

- A multi-telescope instrument (34 telescopes)
- Wide field-of-view combined with large dynamic range
- L2 orbit



The „normal“ cameras

- 32 „normal“ cameras
- 12cm aperture telescopes
- Operate in “white light”
(500 – 1000 nm)
- Dynamical range: $\sim 8 \leq m_V \leq 13$
- Total Field-of-View: $\sim 49^\circ \times 49^\circ$

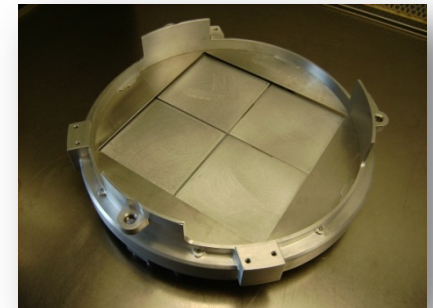


BreadBoard of one
PLATO 2.0
Telescope

- Aspheric feasibility demonstrated
- CaF lenses demonstrated
- Alignment in warm demonstrated

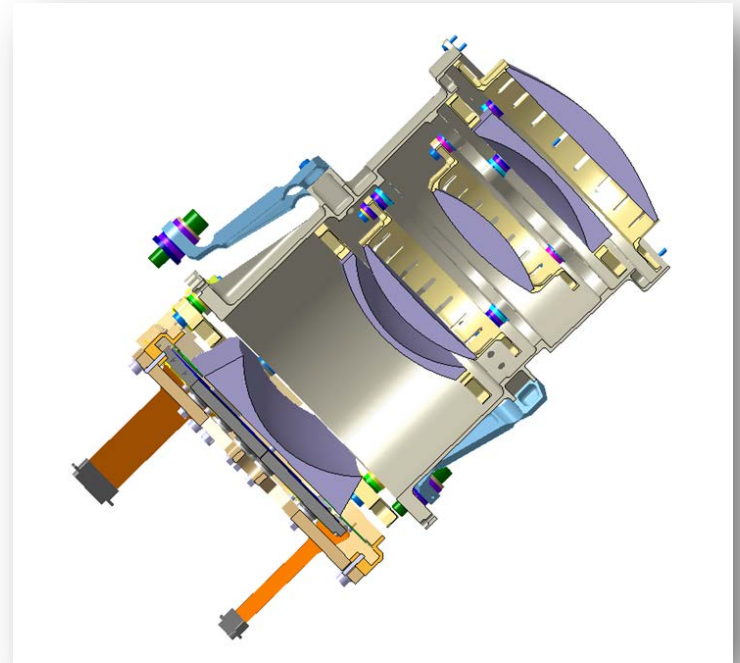
R. Ragazzoni

- CCD: 4510x4510px (x4)
- Pixels size: 18 μm square, 15 arcsec/px
- Read-out cadence: 25 sec



The „fast“ cameras

- 2 „fast“ cameras
- Each telescope has one broadband filter: one „red“ and one „blue“ telescope; exact filter bandpasses are tbd.
- Otherwise identical to normal cameras
- Read-out cadence: 2.5 sec in frame transfer mode
- Purpose:
 - **Fine guiding**
 - Photometry of the brightest stars ($< \sim 8$ mag)

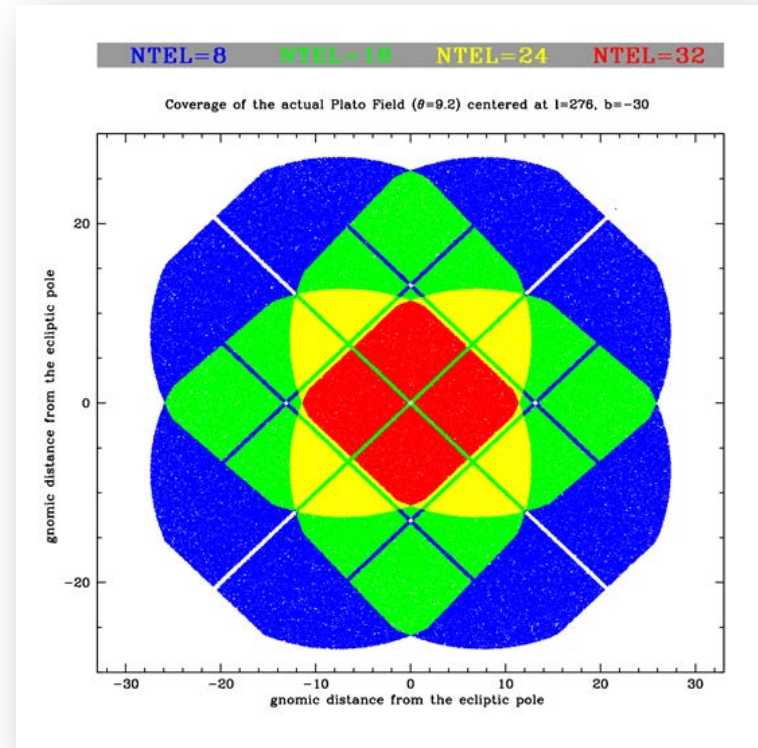
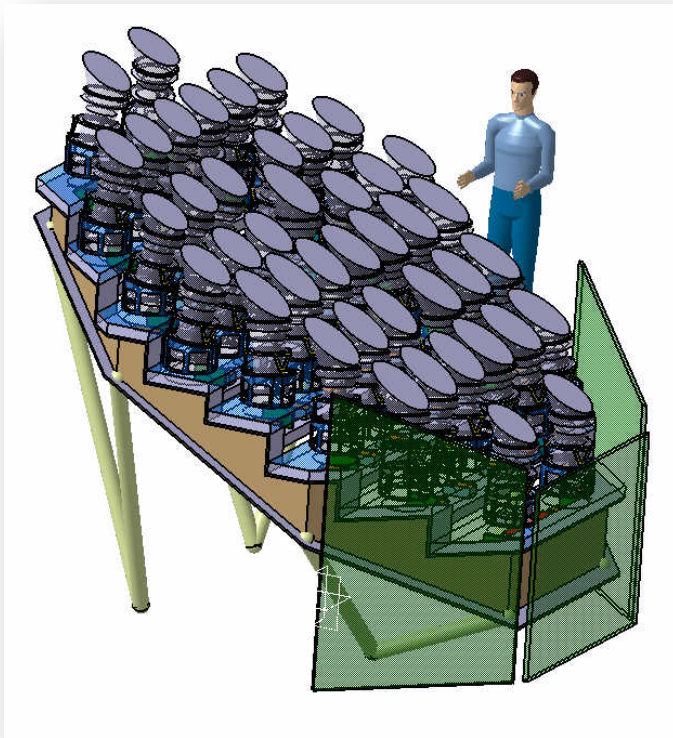


R. Ragazzoni

PLATO 2.0 Instrument

Mounting on optical bench,
Design study (final tbd):

Field-of-view:



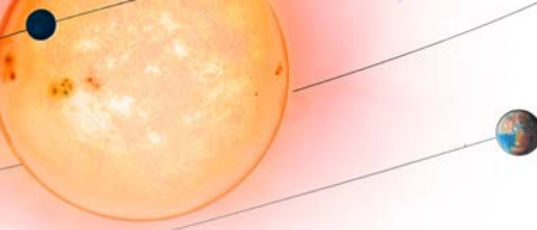
Telemetry using K band: 436 Gbit/day

Total Stellar Samples requirements

long pointings	step & stare	mag	Noise in central field	spectral type
P1: 20 000 stars	P1: 66000 stars	V<11	34 ppm	F5/K7
P2: 1 000 stars	P3: 3 000 stars	V<8	34 ppm	F5/K7
P4: 5 000 stars V<16	5000 stars V<15	V<15 V<16	800 ppm	M
P5*: 245 000 stars	P1: 881000 stars	V<13		F5/K7

 No requirements; adding these leads to ~1,000,000 lightcurves total

Total Stellar Samples requirements



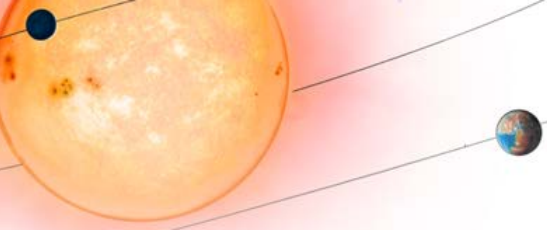
long pointings	step & stare	mag	Noise in central field	spectral type
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P1: 20 000 stars
P2: 1 000 stars

Exoplanet characterization and asteroseismology

P4: 5 000 stars V<16	5000 stars V<15	V<15 V<16	800 ppm	M
P5*: 245 000 stars	P1: 881000 stars	V<13		F5/K7

 No requirements; adding these leads to ~1,000,000 lightcurves total



Total Stellar Samples requirements

long pointings step & stare mag Noise in central field spectral type

P1: 20 000 stars
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Exoplanet characterization and asteroseismology

P4: 5 000 stars
V<16

M dwarf host star sample

P5*: 245 000 stars

P1: 881000 stars

V<13

F5/K7

No requirements; adding these leads to ~1,000,000 lightcurves total

Total Stellar Samples requirements

long
pointings

step &
stare

mag

Noise
in central
field

spectral
type

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

No requirements, adding these leads to ~1,000,000 lightcurves total

Planets, planetary systems and their host stars evolve

→ Need to derive accurate planetary system age

Formation in proto-planetary disk, migration

Loss of primary, atmosphere

Stellar radiation, wind and magnetic field

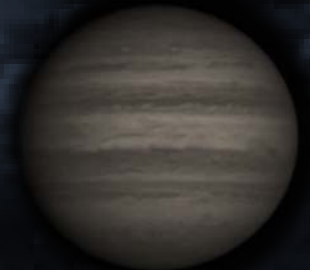
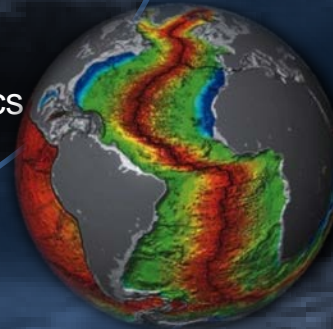
Cooling, differentiation

Cooling, differentiation

life

Secondary atmosphere

(plate)-tectonics



Exoplanet Space Missions and Space Observatories

