The PLATO spacecraft

OHB System AG is the PLATO spacecraft prime contractor and coordinates an industrial organization which includes, as Core Team partners, Thales Alenia Space (France and UK) and RUAG Space Switzerland.

The PLATO spacecraft is composed of two main elements: a Service Module (SVM) and a Payload Module (PLM), which are interfaced through a quasi-isostatic mounting structure. This allows high decoupling between the two modules and provides a very robust solution for the optimal accommodation of the instrument. A sunshield, on which the solar cells are mounted, surrounds both the modules, so to provide protection of the instrument from sun illumination.

Most important for the PLATO mission is the achievement of the pointing requirements, in terms of accuracy and stability, in order to guarantee the quality of the scientific observations. The modularity of the architecture implements high degree of decoupling between Payload and Service modules, suppressing undesired interferences, thus allowing the payload cameras to operate in a stable environment, with minimization of thermos-elastic distortions (TED).

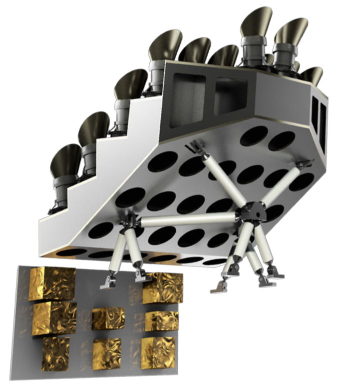
The optical bench, on which the 26 high precision cameras are mounted, is a key element of the spacecraft. The design relies on a robust CFRP optical bench, which is fully developed in the Core Team, combining OHB design with RUAG technology.

A state of the art, highly performant, avionic architecture, including on-board handling of data, spacecraft positioning and orbit control as well as on board software, is designed and developed by Thales Alenia Space. The avionics implements the on board operational aspects, covering the collection and storage of the science date, the safe handling of the instrument and the necessary level of autonomy, failure detection and recovery.

Mass at launch	2150 kg	
Power	2100 W (Capability EoL)	
Delta-V	100 m/s	
Launcher	Compatible with Soyuz ST 2-1B Fregat and Ariane 6.2	
Propulsion	Monopropellant, blow-down system	
	Thrusters	20 x 20 N in total
	Tank	2 x 96 l (PTD-96)
COMMS	X-Band: TMTC and ranging	
	K-Band: high rate science at 72Mbps	
	Daily data Volume: 1425 Gbit	
	X band downlink data rate: 26 kbps	
	X band uplink data rate: 16 kbps	
Antenna	2 fixed X-Band Low Gain	
	1 steerable K-Band High Gain	
	1 steerable X-Band Low Gain	
AOCS	3 axis stabilized with 4 Reaction Wheels	
	Science Pointing Mode with P/L cameras	
CDMS	On Board Computer with LEON-2 processor Mass Memory storage > 2 TB EoL	
Solar Array	3 body mounted and 2 deployable panels	

PLATO spacecraft key features

The installation and precise alignment of the cameras provided by PMC will be carried out by the OHB experts at the "OHB-Space Center Optics & Science" in Oberpfaffenhofen, nearby Munich, in a special ISO Class 5 clean room.



Payload Module (PLM)

Service Module (SVM)

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Über OHB System AG

Die OHB System AG ist eines der drei führenden Raumfahrtunternehmen Europas. Der Systemanbieter gehört zum börsennotierten Hochtechnologiekonzern OHB SE, in dem rund 2.500 Fachkräfte und Systemingenieure an zentralen europäischen Raumfahrtprogrammen arbeiten.
Mit zwei starken Standorten in Bremen und Oberpfaffenhofen bei München und mehr als 35 Jahren Erfahrung ist die OHB System AG spezialisiert auf High-Tech-Lösungen für die Raumfahrt. Dazu zählen kleine und mittelgroße Satelliten für Erdbeobachtung, Navigation, Telekommunikation, Wissenschaft und Exploration des Weltraums ebenso wie Systeme für die astronautische Raumfahrt, Luftaufklärung und Prozessleittechnik.

About OHB System AG

OHB System AG is one of the three leading space companies in Europe. It belongs to the listed high-tech group OHB SE, where around 2,500 specialists and system engineers work on key European space programs. With two strong sites in Bremen and Oberpfaffenhofen near Munich and more than 35 years of experience, OHB System AG specializes in high-tech solutions for space. These include small and medium-sized satellites for Earth observation, navigation, telecommunications, science and space exploration as well as systems for human space flight, aerial reconnaissance and process control systems.

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SPACE SYSTEMS

PLATO

PLAnetary Transits and Oscillations of stars

PLATO
THE MISSION

PLAnetary Transits and Oscillations of stars (PLATO) is the name of the third M(edium) class science mission of ESA's Cosmic Vision program. The mission main objective is the observation of planets orbiting in other solar systems (exoplanets), far away from our Sun.PLATO mission is realized by a spacecraft to be launched in outer space. OHB System AG has been selected by ESA as industrial prime contractor for the design and development of the PLATO spacecraft.

The PLATO mission

The primary goal of PLATO (PLAnetary Transits and Oscillations of stars) is to open a new way in exoplanetary science by detecting terrestrial exoplanets and characterizing their bulk properties, in particular focusing on planets orbiting in the habitable zone of Sun-like stars. PLATO will provide the key information (planet radii, mean densities, stellar irradiation, and architecture of planetary systems) needed to determine the habitability of these unexpectedly diverse new worlds.

PLATO will answer the profound and captivating question: how common are worlds like ours and are they suitable for the development of life?

Understanding planet habitability is a true multi-disciplinary endeavor. It requires knowledge of the composition and the atmospheric properties of the planets, in order to distinguish terrestrial planets from non-habitable gaseous mini-Neptunes,. PLATO will be achieving the science objectives by combining:

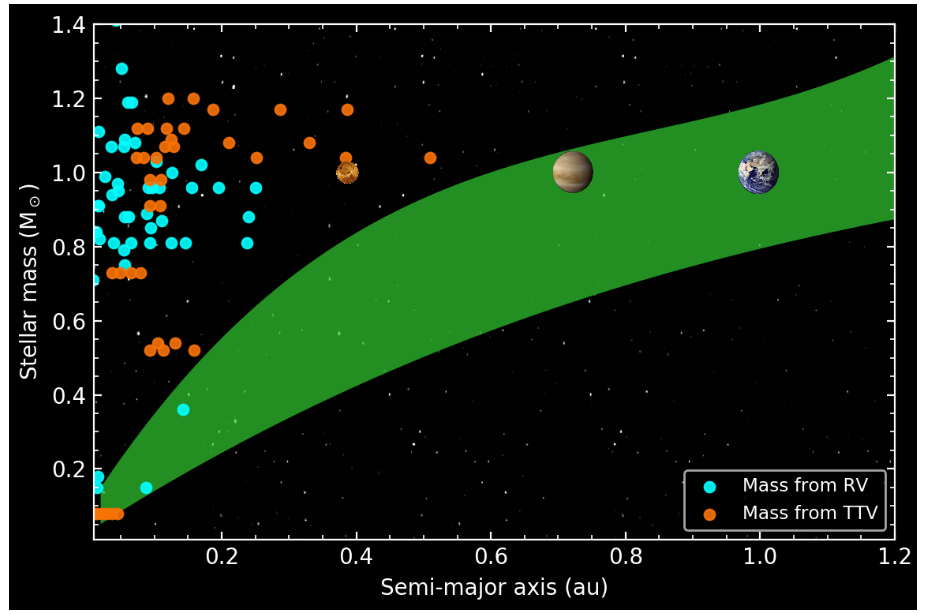
- Planet detection and radii determination from photometric transits of planets in orbit around bright stars ($m_V < 11$)
- Determination of planet masses from ground-based radial velocity follow-up
- Determination of accurate stellar masses, radii, and ages from asteroseismology
- Identification of bright targets for atmospheric spectroscopy.

The mission will characterize hundreds of rocky (including Earth twins), icy or giant planets by providing exquisite measurements of their radii (3 per cent precision), masses (better than 10 per cent precision) and ages (10 per cent precision). This will revolutionize our understanding of planet formation and the evolution of planetary systems.

PLATO will assemble the first catalogue of confirmed and characterized planets with known mean densities, compositions, and evolutionary ages/stages, including planets in the habitable zone of their host stars.

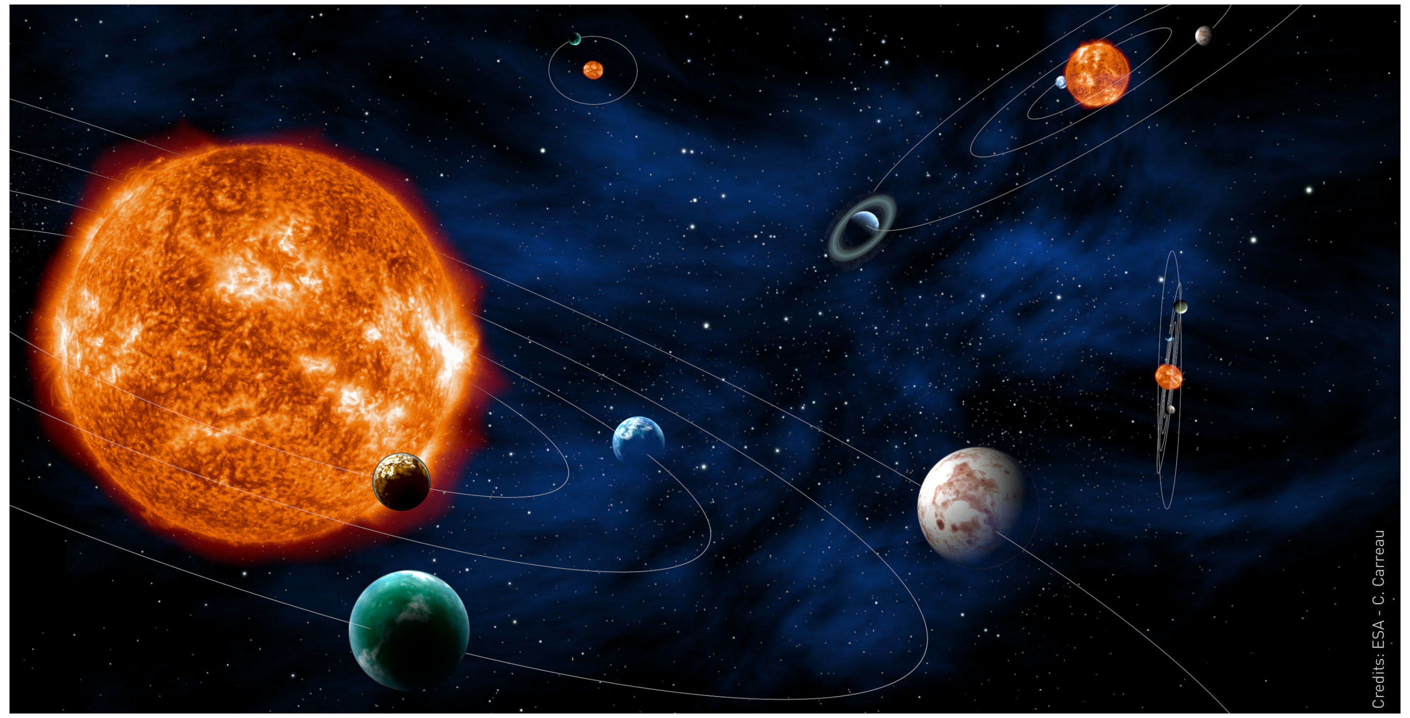
Thanks to PLATO, the density and composition of exoplanets will be obtained from the measured mass and the radius. In addition, important properties of host stars, such as chemical composition and stellar activity will be measured by PLATO and the associated ground-based follow-up for a large sample of systems. Extending the bulk characterization towards cool terrestrial Earth-sized planets on Earth-like orbits will be unique.
PLATO mission is designed to address fundamental science questions:

- How do planetary systems form and evolve?
- What makes a planet habitable?
- Is the Earth unique or has life also developed elsewhere?



Super-Earth exoplanets with known radius and mass ($1 < M_{planet} \leqslant 10\ M_{Earth}$ or $R_{planet} \leqslant 2\ R_{Earth}$) for different host star masses, and with respect to the position of the habitable zone shown in green (Rauer et al. 2014). Earth, Venus and Mercury are shown for reference. The habitable zone, defined as the area around a star where water may be in liquid form on the surface of an orbiting planet, is empty except for planets around very cool stars. The main objective of PLATO is to populate this diagram by determining the bulk properties and ages of small planets up to the habitable zone of Sun-like stars.
Credit: ESA and PLATO Mission Consortium

PLATO
THE MEASUREMENT CONCEPT

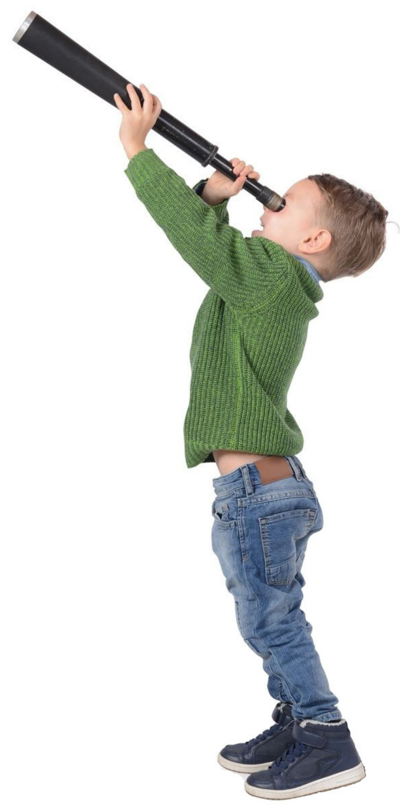


The Measurement concept

The measurement principle of PLATO is to carry out high precision, long (months to years), uninterrupted photometric monitoring in the visible band of very large samples of bright ($m_V \leqslant 11$–13) stars. The resulting light curves will be used for the detection of planetary transits, from which the planetary radii will be determined, and for the asteroseismology analysis to derive accurate stellar parameters and ages. Since the PLATO targets are bright, the masses of the detected planets can be determined from radial velocity observations at ground-based observatories.

The key scientific requirement to detect and characterize a large number of terrestrial planets around bright stars determined the design of the PLATO instrument. The instrument provides a wide field-of-view (FoV) to maximise the number of the sparsely distributed bright stars in the sky with one pointing, and allows the satellite to cover a large part of the sky. In addition, it provides the required photometric accuracy to detect Earth-sized planets and a high photometric dynamic range, allowing astronomers to observe bright stars ($m_V < 11$) as well as fainter stars down to V-magnitude of 16.

This performance is achieved by a multi-telescope instrument concept, which is novel for a space telescope.



PLATO
THE INSTRUMENT

The PLATO Mission Consortium (PMC)

As in other ESA science missions, the payload, that is a complex scientific instrument, is designed and developed in parallel to the spacecraft and it will be supplied by the PLATO Mission Consortium (PMC). The PMC is a consortium of European research centers and institutes led by the Institute for Planetary Research (PF), Berlin, of the German Aerospace Center (DLR). DLR PF has contracted OHB System AG for payload management and engineering support, so OHB involvement in PLATO covers both the spacecraft and the payload.

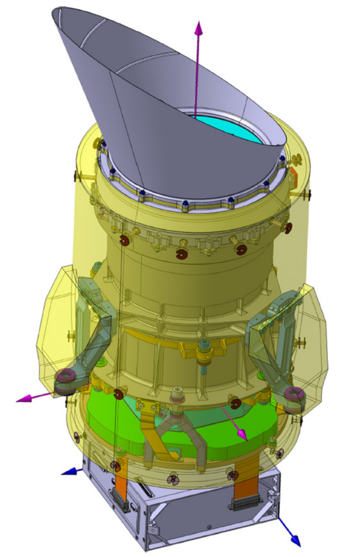
The PLATO instrument

The payload consists of a set of 26 optical cameras working in parallel in the visible range, complemented by several electronic units, which perform on board pre-processing of the science data.

Twenty four cameras, named ‚normal cameras" will be read out with a cadence of 25 s and will monitor stars with $m_V > 8$. Two special cameras, named ‚fast cameras" operates with higher read-out cadence (2.5 s) and are used for stars with m_V ~4–8.

The ‚normal' cameras are arranged in four groups of six. Each group has the same field-of-view but is offset by a 9.2° angle from the payload module +Z axis, allowing astronomers to survey a total field of about 2250 deg2 per pointing, but with different sensitivities over the field.

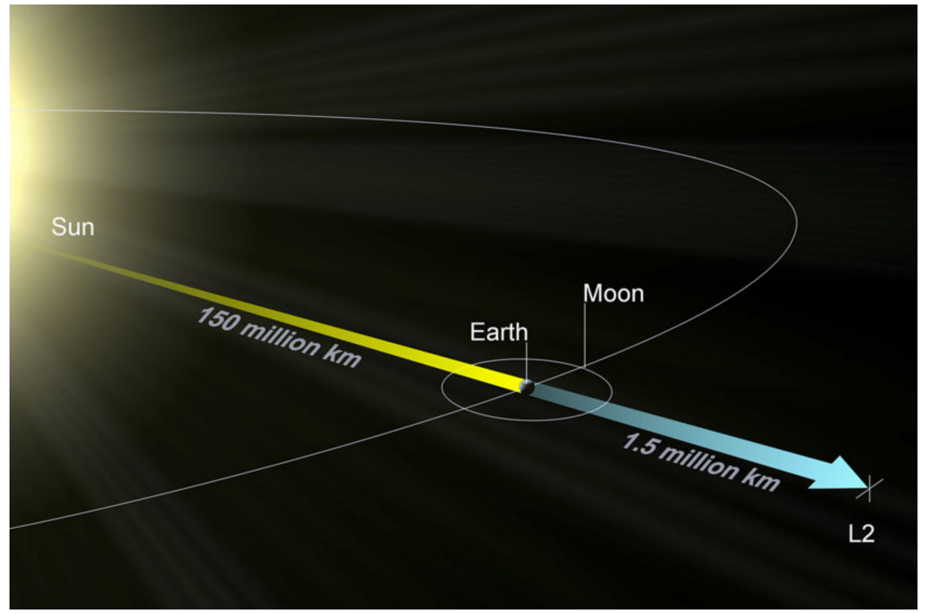
All cameras have CCD-based focal planes and identical telescope optical unit, implementing a fully dioptric design with 6 lenses. Each camera has an 1100 deg2 field-of-view and a pupil diameter of 120 mm and is equipped with a focal plane array of 4 CCDs, each with 4510x4510 pixels of 18 µm size, working in full frame mode for the ‚normal camera" and in frame transfer mode for the ‚fast camera".



Schematic figure of one of the cameras of the PLATO spacecraft
Credit: PLATO Mission Consortium

The current baseline observing plan for the 4-year nominal science operations consists of long-duration observations of two sky fields lasting two years each. An alternative scenario is for operations split into a long-duration pointing lasting three years and a one-year step-and-stare phase with several pointings.

In view of the exceptionally fast development of exoplanet science, the final observing strategy will be investigated throughout the mission development and decided two years before launch. Depending on the selected strategy, the mission will be able to cover between 10 per cent and 50 per cent of the sky during the nominal observing time.



PLATO will be launched with a medium-size rocket for injection into a Lissajous orbit around the L2 Lagrangian point. To protect the instrument from solar light, it has to rotate by 90° around the line-of-sight (LoS) every 3 months. The PLATO satellite will be built and verified for an in-orbit lifetime of 6.5 years, accomodating consumables for 8 years, which offers the possibility of mission operation extensions.

L2 Lagrangian point. Credit: ESA