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The PLATO mission

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Abstract

The PLATO mission (PLAnetary Transits and Oscillations of stars) is one of three M-class missions under definition study in the context of ESA's Cosmic Vision 2015-2025 program, applying for a launch in 2017/18. Its goal is to detect transiting exoplanets, including terrestrial planets in the habitable zone, and to characterize their fundamental parameters with unprecedented accuracy. The final M1/M2 mission selection process at ESA will take place in autumn 2011.

1. Introduction

More than 500 planets around other stars have been discovered and more than 1000 further good candidates are already known. However, extrasolar planets turned out to show much larger diversity than found among the in our Solar System. The possible variety of planets and planetary systems is by no means explored. In particular the diversity of small planets in the so-called "habitable zone" around stars is only poorly constraint and remains one of the essential future scientific goals for planet detection missions.

PLATO is the next generation planetary transit experiment [1,2]. Its objective is to characterize the prime parameters (radius, mass, age) of exoplanets and their host stars in the solar neighbourhood. PLATO follows the ongoing very successful space missions CoRoT and Kepler, which have demonstrated the wealth of information that can be gained from such missions in particular for terrestrial extrasolar planets e.g. like CoRoT-7b and Kepler-10b.

2. Science objectives

The major breakthrough to be achieved by PLATO will come from its strong focus on bright targets, typically with mV≤11. The PLATO targets will also include a large number of very bright and nearby stars, with mV≤8, as well as a large sample of cool M dwarfs down to mV=15-16.

The objective of PLATO is to detect and characterise a sufficiently large sample of extrasolar planets and with a photometric accuracy high enough that the data can be used to build a statistically significant sample of planets down to Earth-size orbiting main sequence F-, G-, K-type (Solar Type) and M-stars in their habitable zone. The radius and mass of both the parent star and the planet(s) orbiting it will be constrained up to a couple of %. In addition, the age of the system will be determined to about 10% via astroseismology. It will therefore be possible to derive an accurate planetary mass function extending from Brown Dwarfs down to planets smaller than the Earth.

Targets detected by PLATO will allow the selection of a sample of bright and nearby systems for further studies with ambitious facilities such as JWST, the ELT or future spectroscopy missions and provide reliable statistics for the occurrences of earth-like planets in the solar neighbourhood.

In addition to the seismic analysis of planet hosting stars, asteroseismology of the many other stars present in the field-of-view will be used to study stellar evolution. Light curves of stars of all masses and ages across the HR diagram, including members of several open clusters and old population II stars, will be collected for this purpose.

Besides the core programme, PLATO will allow a broad range of studies involving photometric variability to address many different questions, mainly (but not exclusively) in the area of stellar physics.

3. The basic instrument concept

The instrument concept of PLATO differs from traditional space observatories [1,2]. To observe a large number of target stars over a wide magnitude range, a multi-telescope approach was chosen. Observations of 32 refractive telescopes are combined. Each telescope has a pupil size of about 120 mm and operates in "white" light. The telescopes are complemented by two so-called "fast" telescopes with higher read-out cadence and fixed colour filters. These two telescopes are used to monitor the brightest targets, but also for satellite fine-pointing.

The 32 telescopes are combined into 4 groups of 8 telescopes each, pointing into the same viewing direction. The fields of the 4 groups overlap, thereby increasing the area covered in one pointing but keeping a central area where all 32 telescopes are combined. This setting is an optimization of the number of stars at a given noise level and the number of stars at a given magnitude range.

References

[1] Catala, C., 2009, Communications in Asteroseismology, 158, 330

[2] Rauer, H., Catala, C. and the PLATO Team, IAU Symp.