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The PLATO mission

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Abstract

PLATO is the next generation space-based survey for transiting extrasolar planets and is proposed to ESA as a candidate for the M3 slot within the ESA Cosmic Vision 2015-2025 program. Its main objectives are the detection of Earth Analogue systems around bright stars, and to reveal the interior structure of planets and their host stars. We will present here the expected scientific impact of the PLATO mission.

1. Introduction

One of the main scientific drivers for extrasolar planet research is the search for terrestrial planets in the habitable zone and subsequently the detection of biosignatures indicating the presence of life as well as understanding the processes of planetary system formation. The detection of extrasolar planets is a challenging task since planets orbit stars which are several orders of magnitude brighter than the planet itself. Characterization of planets found requires high signal-to-noise ratios. Targets for further spectroscopic atmosphere studies have to orbit bright stars. Therefore, PLATO, the next generation transit survey, will search for a large sample of planets around bright stars. For V<11 the host star can be characterized by asteroseismology and ground-based radial velocity follow-up allows deriving accurate masses even for small planets. By covering a large fraction of the sky, a large sample of well characterized rocky planets can be found and their bulk interior composition constraint.

2. Science goals

A selection of major science goals of the PLATO mission includes:

- Detect Earth-sized planets in the habitable zone with known radii and masses, including planets orbiting solar-like stars.
- Obtain statistical significant numbers of characterized small planets at different orbits, stars, … (expand the mass function to small planets).
- Study planet interior composition and structure including terrestrial objects.
- Study planetary systems.
- Determine accurate ages of planetary systems.
- Provide a large sample of small terrestrial planets around bright stars as targets for atmosphere studies via transmission spectroscopy.

PLATO will therefore provide a huge sample of characterized planets with known mass, radius and age, including terrestrial planets in the HZ of solar-like stars as well as planets surrounding stars bright enough for detailed follow-up. Due to the wide sky coverage and large sample the data set will pioneer true comparative planetology and taxonomy of planetary systems.

In addition, the mission will allow for a huge complementary science program:

- 1,000,000 of high-precision photometric stellar lightcurves
- 85,000 of these stars will allow for asteroseismic characterization
- in synergy with Gaia: mass, age, rotation, distance, luminosity, radius

The complementary program will provide a breakthrough in stellar physics, in addition to deeply characterizing the host stars of planetary systems.

3. Instrument and observations

The PLATO mission has a novel telescope concept to cover at the same time a wide fraction of the sky in one pointing and allow for a large dynamical range of the observations, covering a wide magnitude range.

The instrument consists of 32 telescopes with a pupil diameter of 120 mm, read out at a cadence of 25 sec. In addition, two telescopes operate for fine pointing and high-cadence asteroseismology (2.5 sec readout cadence). The 32 main telescopes form four groups with partially overlapping lines-of-sight to increase the overall instrument field-of-view. The observing sequences will consist of so-called step-and-stare phases pointing at interesting regions on the sky and covering a large part of the total sky to characterise planets in different environments. Two long pointing complement the wide sky coverage to search for planets at large orbital distances.