EPSC Abstracts
Vol. 9, EPSC2014-753, 2014
European Planetary Science Congress 2014

Photometric follow-up for current and upcoming space-based exoplanet searches

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Abstract

An overview over the ground-based photometric follow-up of current and upcoming space missions related to Exoplanet searches will be given. The motivation for this type of follow-up will be introduced. Its application to the CoRoT and Kepler/K2 will be shown and its potential for the upcoming TESS and PLATO missions be discussed.

1. Introduction

The need for a ground-based photometric follow-up of results from space-based transits searches was recognized during discussions prior to the launch of CoRoT in 2006. This led to the formation of a dedicated working group, whose motivation and methods together with some intermediate results were presented in [1]. This work was primarily dedicated to the identification of false positives among planet candidates found in data from the CoRoT mission. A second major application for ground follow-up comes from the need to perform timings of candidate and planet transits beyond the coverage given by the space mission.

1.1 Photometric identification of false positives

In transiting planet candidates identified in some lightcurves, a target star's light might be contaminated by the light from a nearby eclipsing binary. In CoRoT, this type of contamination was of rather strong concern, due to the large photometric aperture that was employed. Its ground-based follow-up reobserved transits of susceptible CoRoT candidates with a much higher spacial resolution as 'seen' by the satellite and was thereby able to identify most cases of contamination eclipsing binaries. Of the about 300 candidates that were surveyed from ground, about 35% of them had to be rejected due to this type of contamination.

1.2 Transit timing and characterization beyond mission coverage

A second motivation for ground-follow-up comes from the limited temporal coverage given by the space missions, and from the wider selection of instrumentation available from ground. For one, a verification of planets or a rejection of candidates might be based on the observation of 'transit timing variations' or variations in periodicity, which indicate the mass of the observed candidate. For another, the re-observation of verified planets may be warranted to refine their ephemeris and/or to survey them for period variations that could be indicative of other orbiting bodies in a multi-planet system. For CoRoT, the ephemeris of many of its planets have relative large errors due the mission's short target coverage, and a program to refine their ephemeris is currently under way; some results will be shown. For the ground follow-up of Kepler candidates, as well as for future ones from the K2 mission, the KOINet observing network has recently started its surveying on a selected sample of transit candidates, with the principal aim being the detection of orbital periodicity variations.; some results might be available at the time of the conference. Furthermore, re-observation of transiting CoRoT or Kepler planets in different filters and/or higher temporal resolution may also lead to improved characterizations of the planet's physical or orbital parameters.

2. Photometric follow-up of results from upcoming space missions

Two space mission dedicated to the detection of transiting planets are currently approved for their respective launches: TESS, a NASA explorer mission

providing a relatively shallow all-sky transit survey for the year 2017 [3], and PLATO, an ESA mid-sized mission for a wide-field survey in search of earth-sized planets for 2024 [3]. In the case of TESS, very most of its survey area has a coverage lasting about 2 months, from which numerous candidates requiring longer lasting surveying of their transits can be anticipated. The PLATO mission will have long 'stare' phases on likely two selected fields and shorter coverages on more extended sky sections. Different follow-up needs for these two observing modes can therefore be expected. Both of these missions are currently in the process to define their requirements for ground-based follow-up, which will likely result in many opportunities to participate in their ground-based follow-up.

Acknowledgements

HD acknowledges support by grant AYA2012-39346-C02-02 of the Spanish Ministerio de Economi\'a y Competividad, for work related to the CoRoT and PLATO missions.

References

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