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The CoRoT Exoplanet Program for the next 3 years

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Abstract

The CoRoT mission is a space telescope devoted to the search and characterization of extrasolar planets and the study of stellar interiors via asteroseismology. The nominal mission lifetime of 3 years was extended in October 2010 until March 2013. Recently, the CoRoT Scientific Comitee has submitted a proposal for a 3 year prolongation. We describe here the main goals of the exoplanet program for the proposed CoRoT extension period 2013-2015.

1 Introduction

The asteroseismology of stellar interiors and the discovery of small rocky transiting planets requires extremely precise photometric observations only feasible from space. These complementary programs constitute the core science of the CoRoT mission.

CoRoT is an afocal telescope with a pupil aperture of 27 cm orbiting in a polar low Earth orbit at 900 km altitude. Since its launch in December 2006, CoRoT has observed around 180 000 stars in 24 fields and produced many relevant results both in the stellar and in the exoplanet domains (see, for example, the reviews by [8], [1] and [9]).

The proposal submitted by the CoRoT Scientific Committee for a 3 year extension takes into account the specificities of the mission, the experience acquired in the past, and how these can be optimally used to make the most relevant contributions to exoplanet science and stellar variability monitoring.

2 Mission characteristics

One of the biggest challenges for the CoRoT science program is the competition with the space telescope Kepler [4]. Kepler is a larger telescope which is continuously observing the same region of the sky in the direction of the constellation Cygnus. Its bigger diameter yields a photometric precision ten times higher than CoRoT and it is devoted to the search of small, rocky planets in long orbits, with preference on those in the habitable zone.

The observational strategy of CoRoT is determined by the choice of its orbit and therefore only two regions of the sky, called the CoRoT Eyes [5], are within reach. These regions are located towards the constellations of Monoceros (winter observations) and Aquila (summer observations) and each one has a diameter of approximately 15 degrees. A second limitation of the orbit is the maximum duration of a continuous pointing, which is of 150 days.

Therefore, CoRoT cannot observe as long as Kepler the same field and it cannot reach the same photometric precision as Kepler for stars of the same magnitude. However, the pointing of CoRoT is much more flexible, within the allowed regions, and it is possible to go back one year later to a previous field and perform new observations if required. On the other hand, short observing runs of 30 days long are adequate to characterize bright stars hosting planets via asteroseismology (see the case of HD 46375 [7]) and to discover and characterize transiting planets (see the case of CoRoT-20b [6]).

The discovery of new planets has proven to be a passionate field, but we are entering now the era of the interpretation of the discoveries. For this interpretation, it is fundamental to have a precise characterization of the planet and its host star. In the case of small planets, this characterization is only possible for bright stars.

3 The exoplanet program

The exoplanet program for the CoRoT extension will concentrate in two aspects:

3.1 focus on bright stars

The exoplanet channel will concentrate in the search for new planets around stars brighter than 15 magnitude. Around these targets, CoRoT can detect and characterize planets down to sub-Saturn regime (see the case of CoRoT-8b [3]). This optimized strategy on a reduced number of targets will deliver more imagettes than was previously affordable, potentially further increasing the photometric precision reached at a given magnitude. The calculation of the centroid of the light curves, a useful tool to reject false alarms, is under consideration.

3.2 focus on known systems

On the one hand, re-observations of interesting CoRoT targets will increase our knowledge of the internal structure, formation and evolution of "Rosetta Stone" planets, such as CoRoT-2b or CoRoT-20b, which is intriguing because of the amount of heavy elements on its central core [6]. New observations of known CoRoT systems will also contribute to a better understanding of the influence of planets in the activity pattern of stars, such as the cases of CoRoT-2b, CoRoT-4b, CoRoT-6b and the impact of stellar activity in the mass determination of small rocky planets, such as the recent observing campaing of CoRoT-7b.

But on the other hand, we aim also at the discovery of small rocky planets around very bright stars in the seismology field. CoRoT has already shown the interest of characterizing via asteroseismology stars hosting planets (see the case of HD 52265 [2]). For stars of magnitude 6 or 7, CoRoT achieves the same photometric precision as Kepler for stars of magnitude 11 or 12, making accessible the discovery and characterization with ground based facilities of small rocky planets. Bright stars known to host giant Jupiter-sized planets from radial velocity surveys are of special interest, because of the potential of CoRoT to accurately characterize the stellar parameters via asteroseismology and because of the potential to discover new additional small planets in the system.

4 Summary

CoRoT is in optimal conditions to continue an interesting program in exoplanet science taking the advantage of its specific characteristics. The CoRoT Scientific Committee has presented a science plan for a 3 year extension focusing, in the exoplanet domain, in the detection and characterization of planets around bright stars. In parallel, the same Committee has presented a complementary plan for the asteroseismology program focusing on solar analogs, hot and massive stars, young clusters, pulsating binaries, and the characterization of the galactic structure via the analysis of red giants. With an extension up to 2016 we will have a time span of 8.5 years for some targets and we will be exploring planet and stellar populations for different regions of the Galaxy.

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