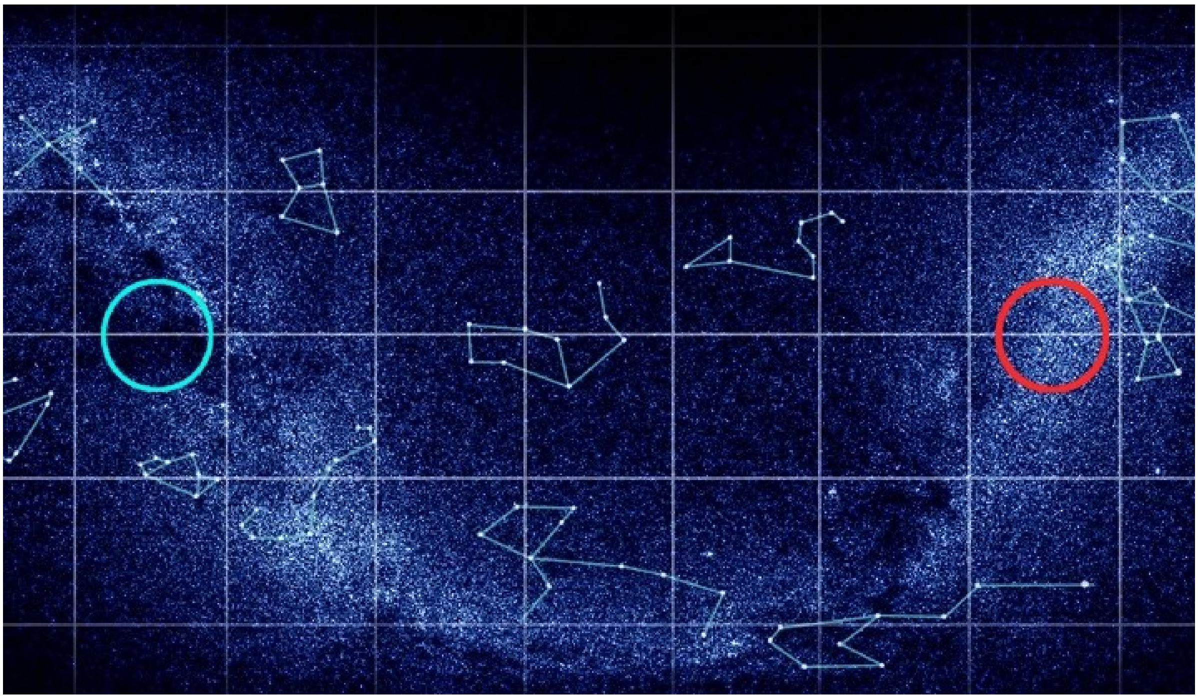
Introduction

The space mission COnvection ROtation & planetary Transits (CoRoT), successfully launched in 2006 December, was the first instrument to search for exoplanets from space. CoRoT is an instrument dedicated to wide-field ultra-high precision relative stellar photometry. It has been built in order to fulfil the two scientific objectives the mission : (1) the detection of small-size planets at short orbital periods, using the transit method; (2) the investigation of stellar interiors using asteroseismology. Each of these programs has a dedicated Field Of View (FOV). In addition, it has been identified very early in the mission preparation phase that a number of fields of research in stellar physics can benefit this extremely precise time-series photometry, especially in the exoplanets FOV. Complementary observations are then as essential to the science of CoRoT as the space-based ones. The Exodat database has been built in order to provide as much as possible of the available stellar information in the FOV of the exoplanetary science program. It gathers an extended body of data various in origin and nature, and delivers it to the community through a user friendly information system.

Overview of the database

The observable zones of CoRoT are two circular regions of about 15º radius each, centred on the Galactic plane (i.e. in the direction perpendicular to the polar orbit of CoRoT), in opposite directions at 99.36º and 279.36º in right ascension (RA) and called the “CoRoT eyes” (see Fig. \ref{fig:corot_eyes}). While not close to the center of the Galaxy, these two directions of pointing are referred to as the anti-center and center directions. Those regions delimit the spatial extent of the database, and stars outside of this zones are not included in Exodat.



The so-called "CoRoT eyes". The two observable zones of CoRoT are highlighted by two circles in this map of the sky, the blue and red circles are in the so-called “center”' and “anti-center” directions, respectively. Credits: CNES

We give here a quick overview of the datasets, the detailed content of the database and the different datasets will be presented [here]. From the point of view of their contents, the datasets of Exodat can be classified in three subsets in hierarchical order:

- the total sample : a catalog of about 65 610 000 stars covering the whole CoRoT-eyes. This catalog relies mainly on the PPMXL catalog, used as a reference for the positions and photometry in r', B, J, H and K bands. It should be complete from the brightest stars to about 20th magnitude in V. There are some exceptional additions for stars observed by CoRoT but not included in PPMXL for some reason, most of the time because they are in the vicinity of a bright star. This catalog also provides cross-references to other public photometric catalogs (e. g. CMC14, 2MASS, UCAC2, ...). The photometric catalog obtained in the preparation phase of the mission is also available, and cross-referenced. All the stars in the database are uniquely referenced by an identifier called a corot_id, a 9-digit integer. This photometry has been used to obtain the colour temperature, flux contamination of low level L0, and the spectral type and luminosity class.
- the targets : a subset of the total sample corresponding to the stars that were actually observed by the satellite. In addition to the previous information, for those stars, we give also information about the specifics of each observation (run, CCD, positions on the CCD, etc). Each observed star has an identifier called a target-id defined for each observational run. Thus the same star observed twice can have two targets-id. The flux contamination of higher level L1 is computed for each target, using the actual orientation and mask used for observations. A estimation of the type of temporal variability is also given.

- the objects of interest : available to authorized users, it is a subset of the targets corresponding to the stars that were identified as potential planetary systems and were mostly followed-up with ground-based spectroscopy. We give for all of the them an estimation of the parameters related to the transits using a single analysis software, described [here].

Origin of the data

Positions

We used the PPMXL Catalog of Positions and Proper Motions on the ICRS (Cat. I/317) as our reference catalog. PPMXL gives the mean positions and proper motions on the ICRS system, determined by combining USNO-B1.0 (Cat. I/284) and 2MASS (Cat. II/246) astrometry. It aims to be completed from the brightest stars down to about V ≈ 20 all sky. The mean errors of positions at epoch 2000.0 are 80–120 mas, if 2MASS astrometry has been used, 150–300 mas else. Every star position in this catalog fitting in the CoRoT-eyes has been attributed a unique CoRoT identifier.

Photometry available for all the stars

We store in our base the value of B, V, R, I, J, H and K bands taken from PPMXL. PPMXL retains photometric information form USNO-B1(B, R, I), from PPMX (Cat I/312) (B, V, R) and from 2MASS (J, H, K). In Exodat, the J, H, K bands then always comes from 2MASS and are the near-infrared bands centred at 1.25 µm, 1.65 µm and 2.17 µm respectively. The V magnitude is always taken from the PPMX and is the Johnson V magnitude. The I band is always taken from USNO-B1 and is optical I band between 750 and 1000 nm. For the B and R magnitude, they are taken form PPMX when available (for the brightest stars), and are then the Johnson B magnitude and the calculated Ru (UCAC) magnitude. When PPMX magnitudes are not available, they are taken from The USNO-B1, which is a two-epoch catalog. There are discrepancies in the magnitude system from field to field and from early to late epoch. Magnitudes from USNO-B should be used with care, photometric calibration may be severely off for some plates. This the main reason why we give several others catalog references for each star, so that a more accurate photometry can be found when available. To average the epoch discrepancies, we give the mean magnitude value of the 2 epochs when available, and we give the dispersion as a rough estimation of the error. The way that the B and R magnitude are obtained is stored in the column labeled “mag_b_ori” and “mag_r_ori”. The explanation of the values of this fields are given in detail [here].

Photometry available for subsamples :

The OBSCAT catalog

During the preparation phase of the mission, a large program of multicolour broadband photometric observations was initiated to obtain reliable and uniform photometry down to the 20th magnitude in the CoRoT eyes. The observations started in June 2002 and were performed with the Wide Field

Camera (WFC) at the 2.5m Isaac Newton Telescope (INT) at Roque Muchachos Observatory on La Palma. However, the total surface covered by the eyes is larger than 600 deg^2, the observations had to be limited to preselected areas. The corot-ids of the stars observed during this campaign systematically begin by the number 1, and are constituting the OBSCAT catalog.

The filters used are Harris B and V filters,and Sloan-Gunn r' and i' ones. Photometry was also obtained with an RGO U filter, but over smaller areas only, due to long exposures being needed for comparable depth. A total of 6187 WFC images was obtained during 23 nights of observations over the course of the whole program. The primary data reduction and stellar photometry were performed using the CASU pipeline developed at Cambridge University [Irwin and Lewis, 2001]. All the individual images, once fully reduced, are archived in Exodat. They can be retrieved on demand (see the [Contacts] page).The completeness of the resultant catalog is about 18 in the r′ and V filters.

The CHFT catalog

An other observing campaign was lead latter on, in 2007, this time using the wide-field imager, MegaCam, on the 3.6-meter telescope of the Canada-France-Hawaii observatory on Mauna Kea. The MegaCam filters were used for the photometry in the u⋆, g′, r′, i′, z′ bands and the magnitudes are in the AB magnitude system. The stars that were observed during this campaign have been attributed a corot-id beginning with the number 3.

A note on cross-matching

Those catalogs, as well as others publicly available photometric catalogs, (namely: 2MASS, USNO-B1, Tycho2, CMC14, USNO-A2 and UCAC2) have been cross-matched with PPMXL using a cone of 3 arcsec radius. Not all the stars resulted in a single match. No complete auto-cross-match has been made with PPMXL, but it is estimated that about 10% of the stars are false doubles or multiples from USNO-B1.0. Also, it is clear that at least 1% of the OBSCAT stars are not found in PPMXL. PPMXL has not been the reference catalog throughout the course of the mission, other catalogs have been successively used as input catalogs. Thus,stars present in OBSCAT but missing from PPMXL have been observed, and it is also the case of stars taken from other catalogs and still missing in PPMXL. When those stars where actually observed with CoRoT, we added them to the database, using the position given in the original catalog where this star was first extracted. The actual performance of the cross-matching will be investigated in depth in the near future.

Exodat Products

Exodat has been used as the input catalog for the exoplanet channel of the CoRoT mission. To increase the probability of detection of a small-size planets around late-type dwarf stars, several stellar parameters needed to be computed on a very large sample, with method as automatized as possible. There were mainly 2 criteria initially considered for target selection: the spectral type and the luminosity class on one hand and the contamination factor on the other hand. The latter required the estimation of the colour temperature that we also make available.

Colour Temperature

The colour temperature T_c is obtained from the B-R colour index for stars with -0.5<B-R<3.5 by computing the value of the 6th order polynomial :

$\log(T_c)=c_0 + c_1.(B\text{-}R) + c_2.(B\text{-}R)^2 + c_3.(B\text{-}R)^3 + c_4.(B\text{-}R)^4 + c_5.(B\text{-}R)^5 + c_6.(B\text{-}R)^6$

with the following coefficients:

c_0 = 4.04926, c_1 = -0.543458, c_2 = 0.712282, c_3 = -0.730077, c_4 = 0.392534, c_5 = -0.100637, c_6 = 0.00972606.

The error σ_T on the colour temperature is then $\sigma_T = \varepsilon_0.(\log(T_c) - c_0).T_c$ where ε_0 = 0.1. For stars with B-R<-0.5 or B-R>3.5, the field is left empty.

L0 contamination

The idea behind the Level 0 (L0) contamination was to obtain an order of magnitude of the contamination factor before the actual observations with CoRoT in order to avoid the most contaminated targets. Since the prism placed in the optical path of the exoplanet channels introduces a strong spatial and chromatic asymmetry in the PSF, the flux contamination can only be precisely computed if we know the orientation of the image plane relatively to the sky. Moreover, the actual PSF of the instrument varies significantly with the position in the image plane. The L0 contamination is computed before the pointing of the instrument so this information is not yet known. Consequently the L0 contamination can not be anything but crude.

First we pave the CoRoT-eyes with rectangles corresponding to the CCD footprint, arbitrarily orientated along the directions of constant ra and dec. We simulate the image obtained on the CCD using an average PSF, selected in a library of templates that depends only on the colour temperature of the star. Then a mask is attributed to each star, using the same procedure as for real observations, and the total flux F_T of the simulated image that falls within the mask is computed. Then the PSF of the target star is removed from the simulated image and the flux of contaminants F_C within the mask is computed. The contamination factor C_0 is then: $C_0 = F_C/F_T$

Spectral Type and Luminosity Class

The spectral type and luminosity class is obtained using the SED analysis for stars in the range 11 ≤ R ≤16. This method is detailed in (Deleuil et al 2009), we will only give a summary here. It yields an estimate of the spectral type, luminosity class, and of the mean reddening E(B-V) by fitting models' atmosphere to the observed fluxes. The procedure mainly works in two steps:

1. Dwarfs and giant stars are separated in colours in colour-magnitude or colour-colour diagrams. The limits of main sequence and giant populations in these diagrams depend on the mean reddening of the fields (Ruphy et al. 1997) which is unknown. The reddening is one of the free parameters of the method and best guesses may be obtained

iteratively. The two populations are quite well separated at the brighter end of the CoRoT magnitude range.

2. The broadband magnitudes taken from a wide range of catalogs are compared with those derived from a spectral library of dwarfs and giants, taking into account the transmission function of each of the instrumental filters used for the observations. The stellar template library includes SED of 454 stellar single objects, with templates of brown dwarfs and white dwarfs. The best spectral type and luminosity class for each star is then determined by a Chi-square minimization with 6 degrees of freedom. The final parameters are the luminosity class, the spectral type and the colour excess $E(B - V)$ with the corresponding Chi-square value. The two best solutions are then archived in the database.

More scientific products are available for authorized users that will be documented [here].